Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1	6	0	0	0	0	Overall a very nice job in summaring the Carbon and Biogeochemical Cycles!! [Stefan Gerber, USA]	Noted
6-2	6	0				May be it's just the style of writing and/or the word limit but I have found a lot of sentences that are too long with lots of info being condensed and the result is that these sentences are hard to follow even for a science person like me, let alone the general audience for whom the report is being written. I have tried to pick up on a lot of these sentences in my comments below. [Vivek Arora, Canada]	Editorial - copyedit to be completed prior to publication.
6-3	6	0				Comments on figures [Vivek Arora, Canada]	Noted
6-4	6	0				I believe chapter 6 does a good job at summarizing the carbon cycle as well as cycling of CH4 and N2O. I particularly like how the chapter was organized to give a perspective on the cycles at different points in history (glacial-interglacial, Holocene, Last millennium, and since 1750). My biggest concern with chapter six is that deforestation/afforestation seems to be the main focus when considering the effects of landuse change on carbon cycling. There is a wealth of recent literature that documents the depletion of soil organic carbon stores that occur with wetland drainage yet this receives very little attention in the chapter. Where wetlands are discussed the focus is almost entirely on northern peatlands and very little attention is given to temperate freshwater mineral wetlands, which are probably the most threatened wetlands as they are found in the agricultural regions of the world. Furthermore, there is growing evidence that indicates that temperate freshwater mineral soil wetlands are more important carbon sinks than was previously thought. There is also evidence that demonstrate that small agricultural impoundments store tremendous amounts of carbon. Inland freshwater aquatic ecosystems play a huge role in the global carbon cycle. In particular the many millions of small wetlands that remain are of particular importance. Please see Armentano and Menges (1986), Anderson-Teixeira and DeLucia (2011), Battin et al., (2009), Downing et al., (2008), Badiou et al., (2011), Gleason et al., (2006). Chapter 1 in the Biogeochemistry of Submerged Soils by Kirk (2004) gives a particularly good summary of wetland carbon stores both mineral and peat. [Pascal Badiou, Canada]	Taken into account - peat and agricultural management are mentioned in section 6.3
6-5	6	0				This chapter is very well written, easy to understand and well organised. The main results and messages are highlighted. Some typos and mistakes are left in the text. [CATHERINE BELTRAN, France]	Noted. Editorial - copyedit to be completed prior to publication.
6-6	6	0				A good chapter but some rebalancing in length might be necessary (eg, 9 pages on CDR but only 1 page on permafrost, half a page on methane hydrates, and only a few paragraphs on CO2 fertilisation although clearly a very important yet uncertain process). [Olivier Boucher, France]	We have clarified and highlighed the CO2 fertilization text. We did not feel it was appropriate to expand the permafrost and hydrate text given the limited literature. As for reducing CDR, we have taken this into account
6-7	6	0				Please have a single spelling for fertilisation/fertilization. [Olivier Boucher, France]	Accepted Editorial - changed to fertilization everywhere
6-8	6	0				I would say some of the terminology regarding ocean circulation is frequently if not consistently vague and simplistic. The processes by which the deep ocean is ventilated and anthropogenic carbon stored there are usually referred to as “mixing”, which is physically inaccurate and reflects representations used in a much earlier generation of models than those now in use. Go through the text searching on “mix”. I would say most of the occurrences that relate to ocean mixing do not make sense to me (e.g. 3/15, 30/36+37, 39/29+31, 51/36, 70/35; 52/10 and 70/11 are exceptions) On p. 30 we “A more vigorous circulation generally results in more uptake of anthropogenic carbon, compensated by an outgassing of natural carbon”, which at least does not conflate circulation and mixing, but I find this passage quite vague. What is a more vigorous circulation? Does it refer to North Atlantic overturning? Southern Ocean upwelling? Or the shallow of overturning cells of the tropics? And do these all have similar effects on CO2 fluxes (see e.g. Watson 1995 in CP Summerhayes et al eds, “Upwelling in the Ocean: Modern processes and Ancient Records”)? When we move water between two boxes of different tracer concentrations, the tracer concentrations in each box change almost exactly as they would with mixing at the interface between the two boxes. Fickian diffusion is actually a good mathematical representation of this process, whether the mechanism is advection or stirring by mesoscale currents, although in the latter case the exchange coefficient (“eddy diffusion”) is not well	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						defined. But physically it is NOT a mixing process. A good ref for this is Danabasoglu et al 1994 (Science 264: 1123). It is mainly about stirring by eddies along isopycnals vs z levels (i.e. the Gent-McWilliams parameterization used in most climate models), but I find it a very lucid introduction to the physics of tracer stirring vs mixing. The discussion of mixing and ocean models on p. 40 is unconvincing. It may be true that small-scale mixing is a key process that models must necessarily parameterize, but it is not clear that this is the most important missing process. Some might argue that in the current generation of models mesoscale eddy processes are at least as important a constraint on the models' realism as small-scale mixing. And it isn't clear that in the subsequent discussion the authors are not conflating mesoscale stirring and small-scale mixing. I think they are both important, but it is important to be clear when we are talking about which. I think the statement that "physical mixing in the Southern Ocean is thought to have caused most of the 80–100 ppm changes in atmospheric CO2 during glaciations (Sigman et al., 2010)" misrepresents the contents of the Sigman paper. This is a good exercise: go through Sigman et al using your "Search" function and read every passage where "mix" occurs. All of these make physical sense to me, and they do not support the summary/paraphrase quoted above. Yes they do state that there may have been increased stratification (which is certainly a barrier to mixing) in the SO, but when they invoke this as a control on atmospheric CO2 they are talking primarily about advective mechanisms (i.e., ventilation of the deep ocean by high-latitude deep water formation). The only place they invoke mixing as a physical control is when they postulate increased stratification between the abyssal ocean (which in their hypothesis would be primarily filled with water from a SH source in the glacial climate) and the intermediate ocean which they hypothesize to be filled with water of a North Atlantic source that penetrates to the abyss in the interglacial climate). This would have the result of both slowing the loss of DIC from this DIC-rich abyssal water (they are clearly talking about diapycnal mixing here but do not address how important diapycnal mixing is relative to other ventilation mechanisms) and slowing the overturning circulation as per Munk and Wunsch (1998, their ref 62). If the key point here is to point out there are potentially important dynamical processes that models represent poorly, if at all, the fact that diapycnal mixing is actually localized along boundaries to a much larger extent than in models is stated by Munk and Wunsch (see also Wunsch and Ferrari 2004 ARFM 36: 281). Of course, this probably contradicts the hypothesis of Sigman et al who are using a conceptual model closer to Munk and Wunsch 1966 than Munk and Wunsch 1998. It remains a possibility that models are tuned to get about the right amount of deep water formation but that the underlying mechanisms are completely wrong, because the 'background' level of diapycnal mixing in the main thermocline is almost certainly much smaller than it is in models. This is also discussed in Chapter 9 ("Evaluation of climate models"). Anderson et al 2009 (Science 323: 1443) also discuss the role of deep ocean ventilation via the SO in glacial-interglacial changes in atmospheric CO2, and explicitly cite advection, not mixing, as the key process. Denton et al 2010 (Science 328: 1652) explicitly identify SO upwelling as a source of the postglacial rise in atmospheric CO2. Another important consideration is that Sigman et al is simply an "ideas" paper: all of the scenarios they sketch are simply hypotheses, and even quite speculative ones. Sigman et al are quite clear about this, and papers of this type should not be cited in a synthesis report as sources of specific facts. [James Christian, Canada]	
6-9	6	0				I thought that in WG I the rule is no grey literature citations. Lackner 2010 strikes me as especially problematic in this regard. I can't interpret AMAP 2009 or Report 2009 (reference manger software is a wonderful thing but it needs post-editing by a human). I have not gone through the reference list systematically looking for other examples. [James Christian, Canada]	Section 6.5. - check Lackner (2010) to be non-grey literature.
6-10	6	0				"GtC" appears quite a lot. Should use SI units. In Table 6.2 it says PgC in the caption and GtC in the headers. [James Christian, Canada]	Accepted - Changed to Pg C everywhere
6-11	6	0				Congratulations for a very informative chapter. I hope that my comments are helpful. Eric Davidson [Eric Davidson, USA]	Noted
6-12	6	0				General: It would be useful if Impulse Response Functions for CO2 are presented and discussed somewhere	Accepted - is dealt now in Box 6.2

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						in this chapter. They are important for calculations of Global Warming Potentials (GWP), Global Temperature change Potentials (GTP) and other metrics. They are also used in some simplified climate models. The IRF has a potentially significant effect on the GWP and GTP values and thereby also on the calculated effects of emissions and emissions reductions in policy making. In AR4 the adopted IRF was given little attention in terms of robustness etc (see footnote a to table 2.14 on page 212 in AR4) in spite of its important role for the GWPs calculated there. A brief assessment of IRFs for CO2 would be useful as a basis for the application in chapter 8 (and for other applications outside IPCC). A coordinated effort is ongoing (see: www.climate.unibe.ch/~joos/IRF_Intercomparison/index.html) which hopefully can be useful for this chapter. [Jan Fuglestvedt, NORWAY]	
6-13	6	0				CO2 concentration is presented as 389.8 ppm, could be rounded to 390. [Marcelo Galdos, Brazil]	Noted - rounded to 390.7 ppm in January 2011 (updated from http://www.esrl.noaa.gov/gmd/ccgg/trends/global.html)
6-14	6	0				CO2 concentration in January 2011 is presented as 390, but elsewhere as 389.8 in 2010. One figure and period should be selected for consistence [Marcelo Galdos, Brazil]	Changed - see reply to 6-13 above
6-15	6	0				Comment on whole chapter: I think the chapter has some potential to be shortened to be made more concise. I suggest to rethink a bit the current structure of having relatively detailed introductory sections/paragraphs followed by the actual assessments. This leads to a certain level of redundancy which can be avoided in my opinion. A good example is the anthropogenic carbon budget, which is introduced in the introduction, then introduced again in section 6.3, and then finally supported by the actual assessment text. [Nicolas Gruber, Switzerland]	The introduction has better cross referencing to section 6.3 and reduncencies removed
6-16	6	0				Figure 6.1: I recommend to more clearly separate the natural from the anthropogenic fluxes. At the moment only the emission fluxes are shown as red. But there are also perturbation fluxes into the land and ocean that are worth highlighting. [Nicolas Gruber, Switzerland]	V Brovkin - we agreed that this figure needs to be redone, with small arrows for small fractions of the perturbations in the long MRT pools, and better (same color ; better connection) between emissions and fate of anthropogenic C - agree but M.Heimann takes care about this figure
6-17	6	0				Figure Box 6.1, Fig 2: This is very much focused on the ant. Perturbation fluxes of the global N cycle. What is missing is the natural component that also connects with the global C cycle. [Nicolas Gruber, Switzerland]	Accepted - waiting for revised figure.
6-18	6	0				Figure 6.4: The denitrification fluxes are missing on this figure. I recommend to add them. [Nicolas Gruber, Switzerland]	Accepted - figure legend to provide information
6-19	6	0				Figure 6.5: on what basis was the expert judgment obtained? Please explain [Nicolas Gruber, Switzerland]	Accepted - the caption will be revised to explain better how the confidence level for each of the processes is obtained. We basically follow the IPCC guidelines on treatment of uncertainties and use two criteria (number of evidence, aggreement between eivdence).
6-20	6	0				Figure 6.8: see comment 44 above about the inconsistency [Nicolas Gruber, Switzerland]	Accepted - Non anthropogenic fluxes will be included in figure 1.
6-21	6	0				Figure 6.12: combine with Figure 6.12 [Nicolas Gruber, Switzerland]	Figure comment
6-22	6	0				Figure 6.16: The ocean fluxes are not well constrained by the atm. Inversion and largely reflect the ocean priors. I therefore would suggest to replace the ocean part of this Figure with ocean-based estimates such as the Takahashi fluxes and the ocean inversion based fluxes. [Nicolas Gruber, Switzerland]	Taken into account - Takahashi fluxes were added to the figure
6-23	6	0				Figure 6.19: I suggest to delete it. There are already many figures in this chapter [Nicolas Gruber, Switzerland]	Accepted - delete it
6-24	6	0				Figure 6.24: I would suggest to coarsen this figure, particularly over the ocean. I don't have much confidence in the average of 3 models. [Nicolas Gruber, Switzerland]	taken into account - figure will include as many CMIP5 models as available
6-25	6	0				Figure 6.44: I would be careful here. This result strongly depends on what assumptions have been made with	Accepted - Text revised for caption. Also, the

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						regard to the re-release. This needs to be discussed in detail in the caption. [Nicolas Gruber, Switzerland]	"idealized" nature of experiments is stated
6-26	6	0				The above general comments for chapter 03 is also true for chapter 6. [Masao Ishii, Japan]	noted
6-27	6	0				In general, chapter 6 is impressive and comprehensive. However, there is one aspect that I find in not very well considered, namely the importance of forest management for the carbon stock increases mainly in the forest living biomass, in particular for managed forests in Europe. The impacts of nitrogen deposition and CO2 concentration increases are considered to some extent. However, the most important aspect, namely that forest harvest rates are kept well below forest growth rates is not highlighted. This is most unfortunate since the fact that harests are kept below growth rates is not a given fact, but the result of responsible forest practice in these countries. Forestry in these countries is driven by the demand for timber and other biomass from the forest sector industry in combination with decisions made by the forest owners. I think that it would have been most valuable if the forest sector would have received some credit from IPCC for their responsible forest practice in this respect. That would motivate this sector to continue their responsible forest practice and the sector in return maybe could use this in the marketing of forest industry products. It is likely that the role of forest management will increase in the future also for tropical forests, since the demand for biomass from forests will increase dramatically in the future. It is therefore important to emphasize that also for plantation forestry in the tropics it will be very important to maintain a forest ecosystem carbon balance that is optimized in the respects of carbon release and removal from the atmosphere. Hence, it the description of anthropogenic influence on the carbon cycles, it is very important to recognize the importance of forest management practice. In addition, it should be recognized that this aspect is not taken into account very well in the different Global Geochemical Models. [Per Erik Karlsson, Sweden]	Accepted - we have now specifically named forest management and reduced havest rates with references
6-28	6	0				Compared with the geoengineering discussion in Chapter 7 (SRM, Chapter 7.5) here the topics are discussed in less detail. A more detailed consideration especially of risks and possible side effects could be helpful. [Birgit Nabbefeld, Germany]	Noted - Text revised with more discussion but text length reduced as mandated. Mandated to address only the side effects relatedto scientific aspects - physical climate system and carbon cycle .
6-29	6	0				This chapter (much like AR4) does not do a good job of distinguishing between the total ocean carbon sink, which I would define as the accumulation of ocean carbon including the lateral transport of ~0.8 PgC from land to ocean by rivers (discussed on page 6.29 and shown in Figure 6.1) and the direct atmosphere-ocean flux which does not include a riverine contribution. Atmospheric inverse modeling estimates give the direct atmosphere-ocean flux, while I would expect methods that measure changes to C or CO2 of ocean water to give the total ocean carbon accumulation including riverine carbon. Figure 6.1 shows 0.8 PgC from rivers as a flux separate from the land-atmosphere or the ocean-atmosphere fluxes (as in the equivalent figure in AR4). The figure implies that the ocean accumulates 2.3+0.8 PgC/yr, while the land would accumulate 2.3–0.8 PgC/yr. Do the 1750-2010 cumulative 124 PgC for land and 154 PgC for ocean (page 6-4 and 6-26) include this lateral riverine transport in their calculations of cumulative carbon storage or just the direct atmosphere-ocean and atmosphere-land fluxes? In Figure 6.8, or LeQuere et al. (2009, Nature GeoScience, 17, 1-6), the riverine contribution is not mentioned explicitly, so it is not clear if it is included as part of the ocean carbon sink. If not, then the figure is only giving the direct atmosphere-ocean flux and not the total accumulation of carbon in the ocean, which is how I would define “ocean sink.” [Ray Nassar, Canada]	Taken into account - Figure 6.1 will include a natural outgas of 0.6 from the ocean to the atmosphere resulting from river fluxes. The caption of figure 6.1 has been modified to clarify the natural and anthropogenic cycles. Figure caption of 6.8 has been clarified to explain that river fluxes are not included. The notes of Table 6.1 now explains that river fluxes are not included in the numbers.
6-30	6	0				This chapter (and to my knowledge the entire report) makes no mention of satellite observations of CO2. Satellite observations of CH4 and NO2 (page 6-33, 6-38 and extensively in chapter 2) are mentioned, which indicates that similar observations of large scale atmospheric composition are relevant to the chapter. Satellite observations of CO2 are growing in importance with improved retrievals of CO2 from many older instruments, the arrival of GOSAT, and future missions such as OCO-2 (NASA), TanSat (China), GOSAT-2 (Japan) and many others to follow. Although at present, the contribution to the scientific understanding of CO2 that they have delivered is limited, this is changing with a great deal of present research focused on this area. By AR6 or sooner, their contribution could be quite significant and I believe that it would appear short-sighted if there	noted - but more of a cross-chapter issue with chapter 2

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						was no mention of this emerging research in AR5. I suggest the following text to be included in Chapter 6, but if it is deemed more appropriate for Chapter 2 (Observations: Atmosphere and Surface), with an abbreviated mention in Chapter 6, that would be reasonable. “Although satellite observations of CO2 do not match the high precision of in situ or flask measurements, the greatly increased data coverage provided by satellites has the potential to improve CO2 flux estimates using an inverse modeling approach. CO2 has been retrieved from spectra recorded by multiple satellite instruments including TOVS (Chédin et al., 2003), AIRS (Chahine et al., 2008), TES (Kulawik et al., 2010) and IASI (Crevoisier et al., 2009), which measure CO2 using thermal/mid-infrared emission of the atmosphere over land and oceans. A few inverse modeling studies have tried to estimate CO2 surface fluxes using these mid/upper tropospheric CO2 observations (Chevallier et al. 2005;2009; Nassar et al., 2011), with varying degrees of success due to the limited direct information they contain about the surface, but the studies suggest complementarity between these observations and ground-based measurements. SCIAMACHY (Buchwitz et al., 2007; Scheising et al., 2011) measures CO2 using near-infrared reflected sunlight from the land surface. The dedicated greenhouse gas mission GOSAT (Yoshida et al., 2011; Butz et al., 2011; Crisp et al., 2012) launched in 2009, uses a similar approach, although has the capability to measure over both land and low latitude oceans. The carbon cycle science community is now beginning to work with these observation data sets, which are expected to lead to improvements in our understanding of carbon cycle processes. The joint assimilation of observations from multiple satellite instruments with different vertical sensitivities and coverage, along with in situ data has been suggested to be the most promising method for constraining CO2 fluxes by inverse modeling in the near future (Pak and Prather, 2001; Chevallier et al., 2009; Hungershoefer et al., 2010; Nassar et al., 2011). The quantity and quality of CO2 observations from space is expected to increase rapidly with the launch of the OCO-2 satellite (Crisp et al., 2012) in 2014, TanSat around 2015 and other CO2 missions later in the decade.” References: Buchwitz, M., Schneising, O., Burrows, J. P., Bovensmann, H., Reuter, M., and Notholt, J.: First direct observation of the atmospheric CO2 year-to-year increase from space, Atmos. Chem. Phys., 7, 4249–4256, doi:10.5194/acp-7-4249-2007, 2007. Butz, A., et al. (2011), Toward accurate CO2 and CH4 observations from GOSAT, Geophys. Res. Lett., 38, L14812, doi:10.1029/2011GL047888. Chahine, M. T., Chen, L., Dimotakis, P., Jiang, X., Li, Q. B., Olsen, E. T., Pagano, T., Randerson, J., and Yung, Y. L. (2008), Satellite remote sounding of mid-tropospheric CO2, Geophys. Res. Lett., 35(17), L17807, doi:10.1029/2008GL035022. Chédin, A., Serrar, S., Scott, N. A., Cr´evoisier, C., and Armante, R.: First global measurement of midtropospheric CO2 from NOAA polar satellites (2003), Tropical zone, J. Geophys. Res., 108(D2), 4581, doi:10.1029/2003JD003439, 2003. Chevallier, F., Fisher, M., Peylin, P., Serrar, S., Bousquet, P., Bréon, F.-M., Chédin, A., and Ciais, P.: Inferring CO2 sources and sinks from satellite observations: Method and application to TOVS data (2005), J. Geophys. Res., 110, D24309, doi:10.1029/2005JD006390. Chevallier, F., Engelen, R. J., Carouge, C., Conway, T. J., Peylin, P., Pickett-Heaps, C., Ramonet, M., Rayner, P. J., and Xueref-Remy, I (2009), AIRS-based versus flask-based estimation of carbon surface fluxes, J. Geophys. Res., 114, D20303, doi:10.1029/2009JD012311. Crévoisier, C., Chédin, A., Matsueda, H., Machida, T., Armante, R., and Scott, N. A (2009), First year of upper tropospheric integrated content of CO2 from IASI hyperspectral infrared observations, Atmos. Chem. Phys., 9, 4797–4810, doi:10.5194/acp-9-4797-2009.	

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Crisp, et al. (2012), The ACOS XCO2 retrieval algorithm, Part 2: Global XCO2 data characterization, Atmos. Meas. Tech. Discuss., 5, 1–60, 2012, doi:10.5194/amtd-5-1-2012 Hungershoefer, K., Breon, F.-M., Peylin, P., Chevallier, F., Rayner, P., Klonecki, A., Houweling, S., and Marshall, J. (2010), Evaluation of various observing systems for the global monitoring of CO2 surface fluxes, Atmos. Chem. Phys., 10, 10503–10520, doi:10.5194/acp-10-10503-2010, 2010. Kulawik, S. S., Jones, D. B. A., Nassar, R., Irion, F. W., Worden, J. R., Bowman, K. W., Machida, T., Matsueda, H., Sawa, Y., Biraud, S. C., Fischer, M. L., and Jacobson, A. R. (2010), Characterization of Tropospheric Emission Spectrometer (TES) CO2 for carbon cycle science, Atmos. Chem. Phys., 10, 5601–5623, doi:10.5194/acp-10-5601-2010. Nassar, R., D. B. A. Jones, S. S. Kulawik, J. R. Worden, K. W. Bowman, R. J. Andres, P. Suntharalingam, J. M. Chen, C. A. M. Brenninkmeijer, T. J. Schuck, T. J. Conway, and D. E.Worthy (2011), Inverse modeling of CO2 sources and sinks using satellite observations of CO2 from TES and surface flask measurements, Atmos. Chem. Phys., 11, 6029–6047, 2011, doi:10.5194/acp-11-6029-2011. Pak, B. C. and Prather, M. J. (2001), CO2 source inversion using satellite observations in the upper troposphere, Geophys. Res. Lett., 28(24) 4571–4574, 2001. Schneising, O., M. Buchwitz, M. Reuter, J. Heymann, H. Bovensmann, and J. P. Burrows (2011), Long-term analysis of carbon dioxide and methane column-averaged mole fractions retrieved from SCIAMACHY, Atmos. Chem. Phys., 11, 2863–2880, doi:10.5194/acp-11-2863-2011. Y. Yoshida, Y. Ota, N. Eguchi, N. Kikuchi, K. Nobuta, H. Tran, I. Morino, and T. Yokota (2011), Retrieval algorithm for CO2 and CH4 column abundances from short-wavelength infrared spectral observations by the Greenhouse gases observing satellite, Atmos. Meas. Tech., 4, 717–734, doi:10.5194/amt-4-717-2011. [Ray Nassar, Canada]	
6-31	6	0				A fascinating synthesis. After fixing the grammar, it will be a very well-written piece of work. [David Pearson, United Kingdom]	Noted. Editorial - copyedit to be completed prior to publication.
6-32	6	0				In many cases results are shown for the decade 2000-2009, though 2010 and sometimes 2011 data are available (e.g., Peters et al 2012, Nature Climate Change). Is there are particularly reason to stop at 2009 (consistency in decades), or another reason. In any case, I think there were some cases where 2010 or 2011 data could have been used, but they were not. [Glen Peters, Norway]	Accepted - All quantites will be up to date to 2011 in the final ms. but we'll keep each decade and its quantities separate, plus the addional years to 2011.
6-33	6	0				It may be worth mentioning (and leaving a place holder) for an IRF intercomparison that is underway, with the results primarily for application for emission metrics (Chapter 8), but will also serve many more useful applications. See http://www.climate.unibe.ch/~joos/IRF_Intercomparison/ [Glen Peters, Norway]	Accepted - yes we are aware of the intercomparison and will coordinate with chapter 8
6-34	6	0				Overall, this chapter is in very good shape relative to the equivalent stage in AR4. Congratulations to the drafting team. [Michael Raupach, Australia]	Noted
6-35	6	0				In general I find this report stronger on summary and weaker on synthesis than I would have expected. Perhaps this is a response to the IPCC guidelines but it does not always seem clear whether the various lines of evidence adduced are consistent with each other. I believe the authors could state this without prejudicing any of the evidence. [Peter Rayner, Australia]	we made sure that each section summary was more synthesis oriented. We made sure that section summaries use appropriate IPCC confidence language to clarify amount of evidence for conclusions.
6-36	6	0				The authors are to be congratulated on a very well written first draft - it covers all the key areas well and provides a significant update from AR4. The FOD has numerous typos that will obviously need correcting - a thorough read through and check by all authors of all sections will help a great deal. The inclusion of Geoengineering is an interesting decision - at times the coverage in this chapter seemed to belong better in WGIII. One could argue that geoengineering actually gets much more space than it deserves here, given the low likelihood of any of the strategies proposed being adopted in the near (decade or more) future. If the	complement noted; CDR section mandated by IPCC guidance; length of CDR considered in overall balance based on all comments. Decided to keep table because it is felt that it was a useful summary.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						authors wish to reduce the overall length of the chapter, or to increase depth of coverage on some aspects (e.g. interactions of projected land use change with GHG fluxes) then I would recommend that the Geoengineering section is reduced in size. Much of the CDR text repeats that already provided in the Royal Society (2009) report, and my feeling is that items such as Table 6.16 could be dispensed with and a briefer summary of CDR and SRM impacts on GHG fluxes. Some of the figures need reproducing to improve their clarity and, for me, the global C cycle figure from AR4 should be reused but with updated figures, as this figure remains one of the most accessible and useful of its type. Other comments listed below. [Dave Reay, UK]	
6-37	6	0				This is a very instructive and comprehensive chapter. However, I missed a more detailed discussion of drought-CO2 feedbacks. On page 41 (line 20), the authors note that "carbon release in response to future drying is one of the dominant contributors to the positive carbon cycle-climate feedbacks found in previous coupled models", however, the assessed literature on this topic is very limited in the present version of the chapter. For instance, the recent IPCC SREX report (chapter 3; Seneviratne, Nicholls, et al. 2012) provides an assessment of the projected drought risk in the Amazon region (see Table 3.3 of that report), which concludes at low confidence in these projections. It would be useful if the authors could evaluate the contribution of this uncertainty compared to that associated with other components affecting the carbon cycle. [Sonia Seneviratne, Switzerland]	The topic is very important along with other drivers. The fact that drought in the future has such a low uncertianty, particulalry regional, makes it that much more difficult to assess its consequences in the C cycle. We have added a box that deals with the greening and browing which will address the issue to some extend.
6-38	6	0				The executive summary of this chapter does not provide likelihood and confidence assessments using the calibrated IPCC language. This makes it difficult for the reader to assess the reliability of the provided assessments. [Sonia Seneviratne, Switzerland]	Accepted - likelyhood and confidence using IPCC calibrated language was added to each section of the executive summary, like for instance in the SREX report
6-39	6	0				placeholder [Reiner Steinfeldt, Germany]	Noted - comment unclear
6-40	6	0				Include list of acronyms in the text following the chapter outline. [Christina Tonitto, USA]	Accepted - list was added for the entire AR5 report
6-41	6	0				There are a number of small grammatical errors and typos throughout the chapter. I only highlighted a few, per the reviewer instructions indicating that the document will undergo a professional editing [Christina Tonitto, USA]	Noted. Editorial - copyedit to be completed prior to publication.
6-42	6	0				For the lay reader, make sure the implication of the sign of CO2 flux as reported by the atmospheric sciences community versus the sign of C uptake reported by the terrestrial and ocean science community is understood. [Christina Tonitto, USA]	Noted - sign conventions are noted where there might be confusion
6-43	6	0				There are some mistake in typing for superscript and subscript such as page 13 line 26, page 15 line 41. Some references in the text can not be found in the reference. In the reference, the year of the same author should be in order. [Soydoa Vinitnantharat, Thailand]	Noted. Editorial - copyedit to be completed prior to publication.
6-44	6	0				Executive Summary: Overall reduction in length is required including a focusing on the assessed results. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - Exec summary length was reduced
6-45	6	0				Despite the length, the Executive Summary currently lacks sufficient detail about the current carbon budget. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - more details on current budget was added
6-46	6	0				Table 6.7: Needs reorganizing to avoid confusion. We suggest indicating the references as numbers, listed below the table in full as notes. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - table revised
6-47	6	0				RCPs are only briefly referred to in chapter 1, but their full introduction comes in Chapter 12. Therefore, please refer to Chapter 12 and make sure the coverage in 12 is sufficient for the purposes you require in Chapter 6. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - reference added to Chapter 12 when refering to RCP ; coordination with Chapter 12 occured
6-48	6	0				Consider using clear synthesizing paragraphs at the end of each main section. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account, we made an effort to strengthen summary paragraphs.
6-49	6	0				Section 6.3.5: There is no explicit connection made between the 'new observations' and the evaluation of climate models. We suggest model evaluation is treated explicitly in a separate sub-section. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - new observations section has now being removed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-50	6	0				When speaking of RCPs and "model projected CO2 concentrations" it is unclear where these come from. MAGICC? What CO2 is used to force the models? [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - RCPs will be presented in Ch.1
6-51	6	1	1	1		Carbon and Other Biogeochemical Cycles [Medani Bhandari, Nepal]	Accepted - text revised
6-52	6	1	1	55	6	General comment on figures and figure captions: Please verify that all carbon units are in Pg C. It is very mixed (as in the text too), and one may find Pg C, or Gt C. [Leticia Cotrim da Cunha, Germany]	Taken into account - all units in Pg C
6-53	6	1	1	55	6	I am a CLA on chapter 4, WGII (Terrestrial and Freshwater ecosystems) and I read this chapter largely to check for consistency and overlap with my chapter. Generally I find good consistency, and small overlap. Specific examples where we can collectively do better I will highlight below. It is better, for significant common issues, to decide where teh main treatment will be, and only have a pointer to that text and a conclusion with respect to the context in which it is called out in the other chapters. This is both efficient and prevents divergence. [Robert Scholes, South Africa]	Noted
6-54	6	1	1	55	6	Overall I found the chapter excellent for a FOD, but too long. There is a lot of wordiness - the same thing can often be said more concisely. In places there is a tendency to present a textbook (ie instructional/educational material) rather than assessment. Some parts are very hard for a non-specialist (even a carbon cycle person such as myself) to read due to the use of very technical language. The intended audience is educated but unspecialised policymakers. [Robert Scholes, South Africa]	Taken into account. Combined with other comments: 6-2, etc.
6-55	6	1	1	72	58	Given my area of expertise, I have focused my review on chapter 6 Carbon and Biogeochemical Cycles. As a general comment, the compilation of data in the chapter is excellent as far as I can see. However, a major shortcoming of the report in its current state is the lack of a synthesis or some sort of conclusion identifying the major gaps in our knowledge. Apart from mentioning uncertainties in the data, there is very little information on the reasons for the uncertainty, its consequences, and how to ensure that the uncertainty is reduced by future research. In particular, the spatial aspects of C and other biogeochemically relevant pools and fluxes are generally ignored because they "cannot be measured" (p. 27, line 18f). I find this approach difficult because it relies heavily on global scale models and remotely sensed data sets without understanding the underlying processes. This carries the risk of overgeneralising and missing non-linearities and synsergies in system reactions. More reference should therefore be given to local or regional studies on C and biogeochemical cycles and their relevance for the model results referred to in this chapter. [Nikolaus Josef Kuhn, Switzerland]	taken into account - have expanded process experiment section; did not cover aspects more appropriate to IPCC WGII.
6-56	6	1	1	156		For the global carbon cycle there is one important component missing and this is the role of freshwaters that play a substantial role as a global carbon sink as well as a carbon source. Several publications point this out, the most important ones being Cole et al. 1997 (Ecosystems), Tranvik et al. 2009 (Limnology and Oceanography), Battin et al. 2009 (Nature Geoscience) and Aufdenkampe et al. 2011 (Frontiers in Ecology and the Environment). For CO2 the role of freshwaters has been neglected throughout the text as well as in the figures (Fig. 6.1 and Fig. FAQ 6.2 Fig. 1) albeit the total C loss by freshwaters (outgassing + burial) corresponds to as much as 2 Pg C yr-1 (Tranvik et al. 2009). For CH4, freshwaters have sometimes been considered and they have been included in Fig. 6.2 although the emission number from freshwaters should be renewed to 103 Tg CH4 yr-1 (Bastviken et al. 2011, Science). All these studies clearly show that soils are not as efficient as C sinks as outlined in the chapter. The lateral carbon export from soils needs to be considered and has recently been quantified (Weyhenmeyer et al. 2012, Global Change Biology). [Gesa Weyhenmeyer, Sweden]	taken into account - text discussing this added to introduction; figure revised?
6-57	6	1	11	1	31	I presume contributing author country affiliations will be added (as per other Chapters)? [Peter Burt, UK]	Noted
6-58	6	1	20	1	20	pre-industrial would be better. Pre human is about 300K ago, and there were lots of differences then that are not relevant here [Robert Scholes, South Africa]	Taken into account - Changed to 'pre-agricultural'
6-59	6	1	26	12	27	I believe Wouter Peters's current address is The Netherlands. [James Butler, United States of America]	Noted - to be confirmed for SOD.
6-60	6	1	26			R Law should be Australia [Peter Rayner, Australia]	Noted - to be confirmed for SOD.
6-61	6	1	27	1	27	Stephen Sitch's name appears 2x: line 18 and line 27 [Leticia Cotrim da Cunha, Germany]	Taken into account. A list of Contributing Authors has been revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-62	6	1	27	1	27	Stephen Sitch's name appears twice in author list [Dave Reay, UK]	Taken into accound. Combined with comment 6-61.
6-63	6	1	33	1	33	The dominant processes are the industrial manufacture of NH3, primarily for use in fertilisers, and the biological nitrogen fixatin by large areas of leguminous crops. [Robert Scholes, South Africa]	Accepted, change made.
6-64	6	1	41	1	41	The comment applies here, but also throughout the chapter. I think you should standardise on your time-period descriptions, and my preference wouuld be to use plain language (the past million years) rather than technical terms (Holocene, or glacial-interglacial). It would also be helpful if you used the same periods throughout: post 1750, 100 to 1750, 11000 to 1000, 1 million to 11000 etc [Robert Scholes, South Africa]	noted - we tried to keep common reference where possible, but had to consider overall structure and limitations on text.
6-65	6	1		20		this needs quite some checking for the English: IPCC Team advise me not to list details here [David Newbery, CH]	Editorial - copyedit to be completed prior to publication. Combined with other comments: 6-31, etc.
6-66	6	1		72		I am wondering who the audience for the Chapter is. It seems to me that it is far too detailed and complex for any other than those in the field to spend time reading. I feel that there is a need for a Chapter that will be read by a much wider audience but which is more comprehensive than an Executive Summary. [Roger Gifford, Australia]	rejected- in conflict with mandate; see executive summary for simplified discussion.
6-67	6	1		72		Please be consistent in reference styles. For example, in page 7, line 46, usually the citation should be 350-550 PgC, Prentice et al. (2001). At the beginnig of a sentence, the citation should be Name et al. (year) rather than (Name et al., year). [Zongbo Shi, United Kingdom]	Technical issues. Work on citations/references to be completed by the Second Order Draft.
6-68	6	1		72		It is better to maintain consistency in using the word, particularly the carbon dioxide/CO2; carbon/C. There is no harm to use both. But I find there is no reason to see carbon doioxide here but CO2 there. [Zongbo Shi, United Kingdom]	Accepted - harmonized in the text of Chapter 6
6-69	6	1		156		The chapter is generally comprehensive and within my area of expertise I see no major problems. [Göran Ågren, Sweden]	Noted
6-70	6	1		156		My comments will, therefore, mostly be of an editorial character aimed at improving the readability of the chapter. [Göran Ågren, Sweden]	Noted. Editorial - copyedit to be completed prior to publication.
6-71	6	1		156		However, the entire chapter needs a thorough linguistic revision as the text does not run smoothly everywhere; it seems that the there has been some haste in completing the text. [Göran Ågren, Sweden]	Taken into account. Combined with other comments: 6-31, 6-65, etc. Editorial - copyedit to be completed prior to publication.
6-72	6	1		156		I would suggest a consistent use of units; now both Pg and Gt are used. This may require coordination with other chapters. [Göran Ågren, Sweden]	Taken into account - all units in Pg C
6-73	6	1		156		Abbreviations should be defined the first time they are used in this chapter, even if they have defined in previous chapters. The entire report will probably in most cases not be read from the beginning to end but by single chapters. [Göran Ågren, Sweden]	Accepted - abbreviations are defined the first time they are used in the chapter.
6-74	6	1				General comment: Overall well done, my findings are mostly on editing, or where aspects aren't clear. One thing - there is a lot or repetition - not only with the more detailed sections later but even within the introductory section. Quite a bit of information is given repeatedly in different paragraphs. Is the introductory section really necessary (=formally asked for by IPCC)? To me would seem more logical to have the Executive summary, and then start with the detailed chapter, with only a very brief introduction (and maybe have the intro. section focussing more clearly on what is new since AR4) [Almut Arneth, Germany]	taken into account - removed as much repetition as possible
6-75	6	1				SUBSTANTIVE COMMENTS [Richard Bourbonniere, Canada]	Noted
6-76	6	1				COMMENTS ON WORDING, SPELLING, MISSING PARTS, TYPOS ETC. [Richard Bourbonniere, Canada]	Taken into account - combined with other comments: 6-5, 6-31, 6-65, 6-71, etc.
6-77	6	1				My kudos to the authors for a fine article. As this is a first draft, I understand that refinements will be made. Here are some comments that the authors may be able to use. [Mohammad Aslam Khan Khalil, USA]	Noted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-78	6	1				some of written expression may need more refined and more mechanism formulas may help the refining [Bing Qiao, China]	REJECTED - comment Not understood
6-79	6	1				It would be useful to include, as was done in AR4, statements regarding "current concentrations are the largest in at least the past X thousand years" (maybe even a small table). (possibly Chapter 8 if not here) [Marcus Sarofim, USA]	noted - this is covered on pages ??
6-80	6	2	3	2	3	There are some white characters which is not easy to see in Figure 6.1. I think it better to change color. [Takashi Maki, Japan]	Noted, revised figure has better layout
6-81	6	2	3			Figure 6.1 Why are reserves of non-conventional oil - already exploited(for example in Alberta) not indicated? [Andrew Glikson, Australia]	Accepted - new figure redrawn
6-82	6	2	5	2	6	Figure 1,shows the unbelievable static flat earth model which is so untypical of real climate [VINCENT GRAY, NEW ZEALAND]	REJECTED. We do not cite Beck or else cite Keelings and Meijer's rebuttal.
6-83	6	2	24	2	26	The main sink of atmospheric CH4 is reaction with OH radicals in the troposphere. Smaller sinks of CH4 include bacterial oxidation in soils, reaction with chlorine and/or oxygen (O(1D)) atoms in the stratosphere, and oxidation with chlorine atoms in the marine boundary layer. Although small relative to the OH sink, the stratospheric removal by Cl/O1D is comparable in magnitude to the soil sink. I suggest that you specifically mention the stratospheric sink and perhaps distinguish between the tropospheric and stratospheric sinks. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Taken into account - stratosphere and troposphere sink mentionned
6-84	6	2		2		Figure 6.1. Revise the figure by inclding storgae and emissions from freshwaters. Battin et al. (2009, Nature Geoscience) shows how to do it. [Gesa Weyhenmeyer, Sweden]	Noted, revised figure includes freshwaters
6-85	6	2				Figure 6-1: Weathering part: The C that is liberated from the lithosphere into terrestrial surface waters by carbonate chemical weathering is missing. This amounts to about 0.1 Pg C a-1 (Hartmann et al. 2009). Reference: Hartmann, J., Jansen, N., Dürr, H.H., Kempe, S. and Köhler, P., 2009. Global CO2-consumption by chemical weathering: What is the contribution of highly active weathering regions? Global and Planetary Change 69 (4), 185-194. [Nils Moosdorf, Germany]	Noted - revised figure has weathering
6-86	6	2				By the time AR5 is released, CO2 emissions from fossil fuels and cement manufacture could exceed 10 PgC/yr, significantly higher than the 2000-2009 mean of 7.7 PgC/yr. Although correct, the figure does not accurately represent how large the anthropogenic perturbation to the carbon cycle is at present. Perhaps, clarification in the caption can accomplish this by reminding the reader that the fossil fuel (and cement) value shown is a decadal mean value ranging from 6.75 to 8.75 PgC/yr over the decade, with recent years exceeding even those values. [Ray Nassar, Canada]	Accepted -reference to the budget table where the decadal quantities are provided.
6-87	6	2				Fig 6.1. I quite prefer Fig 7.3 of AR4 which distinguishes the anthro perturbation from the natural preindustrial red vs black; uses typography to distinguish flux italic and stock upright . Suggest retain that figure but modify it to update amounts and understanding. The current figure, while glitzier, with cows and the like, is much less clear, much less informative, for example lacks the stocks for reference to assess the annual fraction of a stock that a given flux represents. The 795 for the atmosphere is such a number; but the anthro perturbation to that is equally if not more impt. The 4 ± 0.2 is of course not a flux; it is a residual. But we don't see (at least I don't) the comparable residuals in land and ocean. I think these could be shown with creative use of color or typography. [Stephen E Schwartz, USA]	Tend to agree ; we need to add anth and natural if we could. Taken into account - Figure revised.
6-88	6	3	1	6	1	This part of the manuscript reads very much as if the author is not a native writer in the English language. There are numerous minor writing style issues throughout. I will provide corrections for the most prominent style errors but it would be of great aid to have a style editor review the entire chapter. [Nathaniel Ostrom, United States of America]	Taken into account - combined with other editorial comments.
6-89	6	3	1	6	26	As a summary, it seems too long. [Rongshuo Cai, China]	Taken into account - length of summary was reduced
6-90	6	3	1	6	26	The executive summary as well as the chapter in general should address the different kind of ocean sinks including "blue carbon". [Øyvind Christophersen, Norway]	Noted - Under team discussion.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-91	6	3	1	6	26	The structure of the executive summary of the Chapter 6 is different from other chanpter, it arranged by topics instead of major findings as in other chanpters, and not outlined as bullets. [Xuemei Wang, China]	Accepted - summary organized as bullets with IPCC calibrated language
6-92	6	3	1	6	26	Another consideration is that in other chapters, the assessement is done by putting the confidence level in each finding, to show the current knowledge on the issues. I think this is very good and could also be used in this chapter, especiaaly for the issues addressing feedback between climate change and biogeochemical cycles. [Xuemei Wang, China]	Accepted - see reply to 6-89
6-93	6	3	1	6	28	Not all parts from the chapter seem to be reflected in the summary in a proportional extension. Recommend that this will be chequed and if necessary corrected. Reading and understanding of the summary could be improved by putting together text and numbers in ways easier to perceive, eg line 47-56 on page 4, see specific comment. Further the wording could also be made simpler to make the summary easier to read. [Øyvind Christophersen, Norway]	taken into account - Summary revise - but not in proportional extension to each part of the Chapter
6-94	6	3	1	6	28	In the chapter is information about the direct and indirect effect of reactiv N on climate, the latter via the effects on CO2, CH4 and O3, showing some of the interaction between the C and N-cycles. Could this be mentioned in the sumary? [Øyvind Christophersen, Norway]	Rejected - given limited space of ES.
6-95	6	3	1	6	28	Carbon dioxide removal is mentioned in the summary, but without any numbers giving an idea of the potential. Such numbers are available in the chapter, 6.5 . It would be an advantage to present a few of these numbers in comparison to eg the amount of C in the atmosphere, now, the anual emissions, the increase since preindustrial time, and the content in teh atmosphere consistant with some stabilisation scenarios, eg 2 degrees. [Øyvind Christophersen, Norway]	Accepted - We provide a number of 100 PgC in this Century for any individual scheme.
6-96	6	3	1			Executive Summary: The Summary is unbalanced. There is no or very little mention of N2O in the entire summary. There is a heading for Future of natural CH4 sources, but not one for Future of anthropogenic CH4 sources. Shouldn't all headings for the historical discussion of LLGHGs include all three GHGs? For example, Glacial-interglacial changes in CO2, CH4, and N2O, instead of just Glacial-interglacial changes in CO2. Why is it currently only for CO2? If there is little known about the other gases during these times, this would be important for the reader to know rather than ignoring them altogether. [Christopher Butenhoff, USA]	Taken into account - text revised to mention CH4 and N2O wherever reflecting parts of the chapter
6-97	6	3	1			Executive Summary: It is important to have symmetry in the headings. One heading for CO2 reads The global budget of anthropogenic CO2 over the past decade (2000-2009), while a similar heading for CH4 reads The global budget of CH4 over the past decade: emission and sinks, shouldn't it be The global budget of CH4 over the past decade (2000-2009) to be consistent with the CO2 section? And likewise for other headings in the Summary. [Christopher Butenhoff, USA]	Taken into account - text revised to give the summary into bullets
6-98	6	3	1			Executive summary comes across as choppy; clarity and transitions could be strengthened [Jennifer Johnson, United States of America]	Taken into account. Summary rewritten to provide better clarity
6-99	6	3	1			It would be good to include a paragraph about N2O in the Executive Summary, perhaps emphasizing that the future evolution of N2O emissions will be closely tied to food production and mentioning the tradeoffs between CO2 and N2O associated with biofuel production and other carbon mitigation activities. [Cynthia Nevison, USA]	Taken into account - N2O mentionned but radiative forcing tradeoffs issue was not in part of the chapter (related to WG3 on scenarios) and was not added
6-100	6	3	3	3	4	The radiative properties of the atmosphere is also strongly influenced by water vapor change in the atmophere. Water vapor increases too and affects the radiative properties, although it seems have nothing to do with the chapter title (carbon etc.). [Rongshuo Cai, China]	Rejected - this chapter is about the long lived greenhouse gases; water vapor is discussed elsewhere in the report
6-101	6	3	3	3	4	This statement is idiculous. These are the minor greenhouse gases. Water vapour is by far the most important [VINCENT GRAY, NEW ZEALAND]	Rejected - this chapter is about the long lived greenhouse gases; water vapor is discussed elsewhere in the report
6-102	6	3	3	3	8	This opening statement is not really strong enough, especially for an executive summary. These are the three most influential of all greenhouse gases, amounting to over 80% of total radiative forcing from long-lived greenhouse gases and about 95% of their annual increase in radiative forcing over the past decade. AR4 noted that the global increase in temperature since the 1950's was very likely caused by increasing GHGs, most notably CO2. Adding the other two makes it even more important. [James Butler, United States of	Taken into account - opening statement rewritten

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						America]	
6-103	6	3	3	3	8	The most important and most abundant greenhouse gas is water vapour. It is just as "long-lived" as carbpn dioxide in that both are constantly recycled. Methane and nitrous oxide are not particularly "long-lived". None of them is particularly "well-mixed". You have no figures for 1750 and the large number of measurements made between 1815 and 1958 have been suppressed and ignored (see Beck, E-G, 2007. 150 Years of Atmospheric Gas Analysis by Chemical Methods, Energy and Environment 18 259-281) [VINCENT GRAY, NEW ZEALAND]	The water vapor comment is rejected; the rest of the comment was taken into account and the executive summary modified.
6-104	6	3	3	5	2	There is confusion nhroughout these pages between emissions and atmospheric concentrations (abundances) and no attempt to explain how they are related numerically [VINCENT GRAY, NEW ZEALAND]	rejected - we do not agree that there is confusion.
6-105	6	3	3	6	26	The executive summary needs much work. It has several redundancies and needs to be better connected to the rest of the chapter 6. Furthermore, uncertainties are not well treated here. I suggest to bring related topics together and start the rewriting from there. [Nicolas Gruber, Switzerland]	taken into account - executive summary rewritten as shorter paragraphs with key first sentence in bold letters
6-106	6	3	4	3	8	You have no reliable measurements from 1750 and all the more than 90,000 measurements from 1812, published by reputable scientists in peer reviewed journals have been suppressed by the IPCC. The details have been recorded by Beck at Beck, E-G, 2007. 150 Years of Atmospheric Gas Analysis by Chemical Methods, Energy and Environment 18 259-281.The current measurements are predominantly from unrepresentative ocean sites, and concentrations over land are almost non existent. Carbon dioxide increases may involve human emissions but the exact relationship is unknown. Methane is emitted from many natuiral sources, with wetlands the most prominent, which are highhly variable, so are not well known from purely ocean-based measurements. [VINCENT GRAY, NEW ZEALAND]	REJECTED. We do not cite Beck or else cite Keelings and Meijer's rebuttal.
6-107	6	3	5			"Concentration". The term is perhaps appropriate when referring qualitatively to abundance, but becomes increasingly inappropriate when referring quantitatively to mixing ratio (more specifically molar mixing ratio in dry air). Concentration is amount per volume. Mixing ratio is independent of changes associated with volume changes with altitude or temperature. I am confident that the authors know this, but I question whether this concept has to be dumbed down for the reader. I applaud the use of the unit ppm (not, erroneously ppmv, as is common). I suggest the unit be rathre precisely defined at first use (seems to be page 3, line 42), mole fraction in dry air, expressed as parts per million, ppm. I think that the reader, rather than being put off by this technicality, will be favorably impressed by the precision of language that complements the precision of the measurements. If not in the text, at least in a footnote. Or a box. Likewise PgC might be defined, identified with billion tonne. Box might also compare to tonne CO2 (factor of 44/12) sometimes used. Box might also motivate and explain conversion between PgC and ppm with reference to the mass of the atmosphere. [Stephen E Schwartz, USA]	accepted - we created a new box to address this issue
6-108	6	3	5			"Industrial Revolution"; 1750. I think this is misleading; I would define the onset of industrial revolution with the onset of use of fossil fuel which really doesnt kick in till about 1850. Does it matter? Yes in the sense that the emissions between 1750 and 1850 are almost entirely land use change, which is misleading to call industrial revolution; See Keeling et al AGU monograph 1989, chapter 1 Figure 41. Likewise "preindustrial"; throughout the chapter. [Stephen E Schwartz, USA]	taken into account - we are folloiwng the WGI convention of starting at 1750, but we have removed references to "fossil fuel era" to clarify.
6-109	6	3	7		8	Superimposed on the concetration increases caused by human actions are modulations... [Almut Arneth, Germany]	Accepted - text revised
6-110	6	3	10	3	10	"Humans" may be a better choice than "Human activities" [James Butler, United States of America]	Accepted - text revised
6-111	6	3	10	3	13	The figures are approximate and you should say so [VINCENT GRAY, NEW ZEALAND]	accepted - modified text to include uncertaity
6-112	6	3	10	3	18	It should be explained that the relationship between emissions and concentrations is not clear, so that the effects of public efforts to reduce emissions cannot at present be predicted. [VINCENT GRAY, NEW ZEALAND]	accepted - modified text to explain relationship
6-113	6	3	10	3	18	It is unclear to me what the purpose of this paragraph is. It tries to establish a first indication of a budget, but then it does so without consideration of uncertainties, and without consideration of all aspects. I suggest to	Taken into account - paragraph rewritten

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						delete it or to rephrase it entirely [Nicolas Gruber, Switzerland]	
6-114	6	3	11	3	11	Is the 9.1 PgC in 2011 intended to exclude cement manufacture or is this actually the value for 2010 including cement? Peters et al. (2012), “Rapid growth in CO2 emissions after the 2008-2009 global financial crisis” stated 9.1 PgC for 2010 and estimate 9.4 PgC for 2011, which both include ~0.4 PgC due to cement manufacture (standard in the CDIAC values). The number and date should be verified and the inclusion/exclusion of cement should be clarified, since the ~0.4 PgC from it is not negligible in relation to 1.0 PgC from land use change. [Ray Nassar, Canada]	Accepted - all quantities will be updated to 2011 and will include the cement production. Peters et al. only provided a prediction for 2011, not an actual estimate based on energy use.
6-115	6	3	11	3	13	please provide error bars for fossil emissions and land use emissions [philippe bousquet, France]	Accepted - error bars were added
6-116	6	3	11			To tie the statement to the 2°C target this sentence should be expanded with; ", this implies temperature change will reach the 2°C target in another 50–70 years. Modeling studies indicate that emissions should decline starting 2020 in order to stabilize CO2 at 450 ppm and CO2 emissions should be negative if stabilization is required below 400 ppm (Mathews, 2010)." Copied from section 6.5.1.1 Why CDR Methods? p6-62 l13-17. [Øyvind Christophersen, Norway]	accepted - executive summary revised to discuss emissions compatable with targets
6-117	6	3	11			1% only? [Francois DANIS, France]	Noted - 1% is correct value
6-118	6	3	11			Anthropogenic emissions are one factor. What remains in the atmosphere after natural exchange with the biosphere and dissolution into the oceans is another one. Yearly anthropogenic emissions : over 1 % of atmospheric CO2 content. CO2 increase (average 2010-2012) measured at Mauna Loa : 0.46 %. Anthropogenic increase measured from C13/C12 ratio (see comment about Chapter 2 Page 44) confirmed by lowest recent values of d(CO2)/dt : ~ 0.1 %. This means that cutting the CO2 emissions by a factor of x is expected to have an impact on the composition of the atmosphere of x/10. I recommend that this remark should be made clear and also mentioned in the future summary for policymakers because they have to be conscious that any effort will have an impact divided by 10. [François GERVAIS, France]	REJECTED - 13C/12C ratio changes are not that straightforwardly converted to anthropogenic net CO2 increases. This does not belong into the summary
6-119	6	3	12			…to the atmosphere contributing each year about an additional.. [Almut Arneth, Germany]	Accepted - text revised
6-120	6	3	13	3	13	human caused → human-caused (OR, better, anthropogenic) [Peter Burt, UK]	accepted - text revised
6-121	6	3	13	3	13	in recent years? How many years? [Rongshuo Cai, China]	Taken into account - period added to the text
6-122	6	3	13	3	13	Say "additional 1 PgC per year in recent years" [Michael Raupach, Australia]	Accepted - text revised (see reply to 6-119)
6-123	6	3	13			be more specific on time period re: 'recent years' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-124	6	3	14	3	14	Add sediments, i.e. where it can be stored in the vegetation, soils and sediments [Gesa Weyhenmeyer, Sweden]	Taken into accout, sediments added but smaller storage mentioned
6-125	6	3	14	3	18	"while it gets slowly mixed into the deep waters". Unclear what "it" refers to. Rephrase. [Nicolas Gruber, Switzerland]	Accepted - text revised
6-126	6	3	14			change 'can' to 'is' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-127	6	3	16			I would explain in a bit more detail the relevance of dissolving carbonate sediments - at the moment it is bad that we will loose carbonate sediments! [Paul Halloran, UK]	Accepted - Sentence added
6-128	6	3	16			'it' is not CO2, but carbonic acid - clarify [Jeffrey Obbard, Singapore]	Accepted - Sentence rewritten
6-129	6	3	17			change to 'will release further amounts of CO2' [Jeffrey Obbard, Singapore]	Rejected - rock weathering removes additional (fossil fuel CO2) from the atmosphere. Sentence rewritten to clarify that CO2 is removed from the atmosphere, not the ocean
6-130	6	3	20	3	20	edit to reomve bad English '..carbon cycle, but CH4..' [Peter Burt, UK]	Accepted - Sentence rewritten

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-131	6	3	20	3	20	"small loop" What is meant with this? [Nicolas Gruber, Switzerland]	Taken into account Sentence rewritten (small was used for the small number of moles of C involved in CH4 fluxes compared to CO2 fluxes) "small" was removed for the executive summary
6-132	6	3	20	3	20	"loop" is not a very definitive term; perhaps substitute with "component". [Nathaniel Ostrom, United States of America]	Taken into account - Sentence rewritten
6-133	6	3	20	3	25	The paragraph on methane has to be rewritten. Suggested phrasing : The global cycle of atmospheric methane (CH4) is a short loop of the global carbon cycle, as methane lifetime is less than 9 years in the atmosphere. But CH4 is a much more -potent greenhouse gas than CO2, and plays an important role in the oxidizing capacity of the troposphere, and in tropospheric ozone production. Among .... rice paddies). The range of the global source of methane is estimated by atmospheric inversions to be [518-550] Tg/yr for 2000-2009 decade, with a domination of anthropogenic emissions. The main sink of CH4 is the chemical reaction with OH radicals in the atmosphere, which removes the equivalent of more than 90% of the emitted methane each year. Atmospheric methane can also be oxydised in soils and possibly removed by reactive chlorine in the marine boundary layer. The atmospheric accumulation of methane results from the small imbalance between the large global source and the large global sink. Atmospheric methane has experienced a stabilization period between 1999 and 2006, followed by an increase since 2007. Reasons for such variations are stilml debated today. [philippe bousquet, France]	Taken into account - paragraph rewritten
6-134	6	3	20	3	26	It would make sense to give numbers for emissions, as is done above for CO2 [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - numbers for emissions are added
6-135	6	3	20			"Loop of the global c cycle sounds" strange. Revise: In view of the total amount of carbon, the global cycle of atmospheric methane (CH4) is small. [Almut Arneth, Germany]	Taken into account Sentence rewritten
6-136	6	3	21	3	21	more-potent → more potent [Peter Burt, UK]	Editorial - corrected in text.
6-137	6	3	21	3	21	"interacts with tropospheric chemistry" gives little information suggest deleting [Stefan Gerber, USA]	Taken into account Sentence rewritten
6-138	6	3	21	3	21	redundant hyphen: '-potent' [Dave Reay, UK]	Editorial - corrected in text.
6-139	6	3	21			instead of much more, you should be more precise [Christoph Mueller, Germany]	Taken into account Sentence rewritten
6-140	6	3	24	3	24	delete comma after 'landfills' [Peter Burt, UK]	Editorial - corrected in text.
6-141	6	3	24	3	24	Add reservoirs as anthropogenic source [Gesa Weyhenmeyer, Sweden]	Rejected - reservoirs not mentioned in Summary
6-142	6	3	24	3	26	There is also stratospheric destruction of methane by chlorine and O1D [William Collins, United Kingdom of Great Britain & Northern Ireland]	Noted - but this level of precision not kept in revised summary
6-143	6	3	25	3	32	Suddenly you change from atmospheric concentrations to emissions. The "budget" is entirely concerned with emissions, and so are the projections. How can these be related to atmospheric concentrations? [VINCENT GRAY, NEW ZEALAND]	Noted - a box was added to explain how emissions translate into concentration changes
6-144	6	3	28	3	28	"pre-human world" is not the best way to say this. Try something like "in the absence of humans" or something like that. [James Butler, United States of America]	Taken into account - Changed accordingly - see reply to 6-58
6-145	6	3	28	3	28	I would not call N2O "reactive" nitrogen, for the same reason we don't refer to the long-lived CFCs as reactive. In that light, this parenthetic statement is not correct. [James Butler, United States of America]	Rejected - Nr is explicitly defined in the text.
6-146	6	3	28	3	28	To be most accurate, this statement should probably not start with the "pre-human" world but "pre-industrial. Certainly, this sentence would also apply to the human occupied world prior to 1750 and perhaps even prior to the early 1900's when the Haber-Bosch process was invented. [Nathaniel Ostrom, United States of America]	Taken into account - Changed accordingly - see reply to 6-58
6-147	6	3	28	3	29	delete "atmospheric" (both occurrences). The vast majority of N2 is in the atmosphere but everything here applies equally to N2 dissolved in water. (see also Fig 6.4 caption) [James Christian, Canada]	Accepted and changed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-148	6	3	28	3	29	I don't find the definition of "reactive nitrogen" provided in parentheses to be very accurate. It might be better to state that reactive nitrogen is comprised of all inorganic nitrogen species excepting atmospheric N2. [Nathaniel Ostrom, United States of America]	Rejected, Nr is explicitly defined in the text.
6-149	6	3	28	3	30	There is a need to be consistent in the use of an abbreviation for "nitrogen". In the first sentence "nitrogen" is used but on line 30 "N" is used. One or the other should be used throughout the manuscript. [Nathaniel Ostrom, United States of America]	Accepted - we will use 'nitrogen' and 'carbon'.
6-150	6	3	28	3	39	Same comment, give N2O emissions estimates, as for CO2 [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account - text revised to mention N2O emissions
6-151	6	3	28		39	Based on the defination of reactive nitrogen, N in fossil fuels is also reactive. Therefore, the release of N from fossil fuels by consumption would not increase Nr. Is it correct? [Zucong Cai, China]	Agreed, text will be added to reflect the sequestered Nr in fossil fuels.
6-152	6	3	28			"Pre-human" sounds stragen (are you really thinking more than 2 Mio years ago?) - you really mean "pre Haber-Bosch process" I guess, revise. [Almut Arneth, Germany]	Accepted text revised - see reply to 6-58
6-153	6	3	28			"pre human world"; do you really mean prior to 500 000 years ago pre homo sapiens?; also at page 6-10, line 31. [Stephen E Schwartz, USA]	Accepted -text revised - see reply to 6-58
6-154	6	3	30	3	31	This sentence is not clear. At equilibrium nothing can accumulate [William Collins, United Kingdom of Great Britain & Northern Ireland]	Taken into account - text revised
6-155	6	3	30			Note that N2O and NH3 emissions are also natural processes - there production os exacerbated by human activities. [Jeffrey Obbard, Singapore]	Noted.
6-156	6	3	32	3	32	It may be worth adding rice paddies in the list of N2O sources from denitrification. It is probably a small source, with substantial data although not quite enough to provide a solid estimate. [Mohammad Aslam Khan Khalil, USA]	Accepted, change made.
6-157	6	3	34	3	35	I think this is misleading because the mechanisms by which biofuels and fossil fuels put Nr into the environment are completely different. [James Christian, Canada]	Accepted & changed
6-158	6	3	34	3	35	The way you write here (see also p. 6-10, lines 15-16) might give a less informed reader that N is indeed a major component of the fossil fuels; while the NO and NO2 produced is mainly the result of oxidation of N2 during combustions using oxygen in air as oxidant. In the case of many biofuels, however, the N content is a problem. [Peter Högberg, Sweden]	Accepted & changed
6-159	6	3	34	3	35	Sentence is unclear. Is the goal to emphasize reactive N increase from biofuel production, largely resulting from fertilizer creation and losses from over application? Or is the goal to emphasize that biofuels have a higher N content, so combustion of biofuels releases more Nr relative to combustion of fossil fuels? [Christina Tonitto, USA]	Accepted & changed
6-160	6	3	34	3	35	Possible rewording: Fossil fuel combustion is another source of Nr to the atmosphere. Due to the higher N content of biofuels, increasing the biofuel component of our energy supply can result in a higher Nr release per unit of energy used relative to fossil fuel energy [Christina Tonitto, USA]	Accepted & changed
6-161	6	3	34	3	36	Somewhere in here it would be good to include a statement that there may be tradeoffs between N2O release and CO2 uptake or emission offsets associated with, e.g., N deposition, biofuel production, and ocean fertilization. [Cynthia Nevison, USA]	Accepted & change to be made
6-162	6	3	35	3	35	"exacerbate" is a value judgment. Replace with "further increased" [Iain Colin Prentice, Australia]	Accepted - text revised
6-163	6	3	36	3	38	True that denitrification occurs under low oxygen conditions, but N2O is favored at 60-70% WFPS. In totally anoxic environments complete denitrification to N2 is more likely. It is because croplands are not completely anoxic that N2O production can be abundant. Given that most crops require an aerated rooting zone, it is hard to manage the agricultural landscape to prevent N2O production, though N management to reduce surplus soil inorganic N can reduce N2O loss. In agricultural systems N2O loss from manure piles is significant. Given the concentrated nature of confined animal operations, manure management is feasible and a better target for	Accepted & change to be made

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						reducing N2O loss from agricultural practices. [Christina Tonitto, USA]	
6-164	6	3	36	3	39	there are other processes that contribute to N2O production, e.g. Codenitrification, or heterotrophic processes other than denitrification, please include [Christoph Mueller, Germany]	Noted
6-165	6	3	37	3	37	Maybe I'm being picky, but nitrification takes place in low oxygen environments. I don't think much happens under high oxygen. Denitrification requires virtually anoxic conditions. [James Butler, United States of America]	Noted
6-166	6	3	37		38	sounds as if oxygen is scarce in soils… [Almut Arneth, Germany]	Accepted & change will be made.
6-167	6	3	41	3	45	Comparing the text with fig 6.5 and p.12 line 39 to p.14 line 25 is confusing; the 90 ppm lower CO2 conc in the atmosphere during the LGM is explained by a number of mechanisms. In fig 6.5 the mechanisms leading to more C in the sea and less in the atmosphere are together 75 ppm, but these are counteracted by the opposite effects of lower sealevel/higher salinity (15 ppm) and less CO2 fertilization on land(25 ppm). Doesn't seem consistent with the 90 ppm lower value. From the text on p. 12-14 it is sometimes unclear in which direction the mechanisms work. [Øyvind Christophersen, Norway]	Accepted - text revised and now clearly states that no precise scenario accounting for the porposed mechanisms can fully explain the 90ppm changes.
6-168	6	3	41	3	50	The point is not easy to understand as written. It should be rethought and simplified. [Mohammad Aslam Khan Khalil, USA]	Taken into account - text revised and simplified
6-169	6	3	42	3	42	replace "were" with "was" [James Butler, United States of America]	Editorial - copyedit to be completed prior to publication.
6-170	6	3	42	3	42	"The 90 ppm increase in atmospheric CO2 between glacial and interglacial conditions". According to Hansen and Sato 2011 figure 3a peak values of the glacial-interglacial cycles reached just under 300 ppm and and low values near 170 ppm CO2, rendering the range near ~130 ppm. [Andrew Glikson, Australia]	Accepted - text will be modified to include a range of values.
6-171	6	3	42	3	44	"were mainly caused by" Where does this degree of confidence come from? I suggest to follow IPCC's terminology and say something like "likely" [Nicolas Gruber, Switzerland]	Accepted - rewritten using IPCC calibrated language
6-172	6	3	42	3	44	You make it sounds like we understand glacial-interglacial CO2 change! Unless I've missed some very important paper, surely we do not, and although it is likely that circulation change was important, I've not seen any convincing evidence that biological Fe fertilisation provided a 'significant contribution'... and what does 'significant contributions from.... carbonate chemistry' mean? In my opinion, suggesting that we understand glacial-interglacial CO2 in the executive summary is very misleading. [Paul Halloran, UK]	Accepted - text is modified and reflects better the content of section 6.2
6-173	6	3	42			instead of a fixes 90 ppm value it would be more realistic to quote a range [Christoph Mueller, Germany]	Accepted - text will be modeified to include a range of values.
6-174	6	3	43	3	45	The text makes it clear that the increase in atmospheric CO2 from glacial to interglacial is mainly caused by ocean outgassing of CO2 (a positive contribution to CO2 in the atmosphere with significant contributions from from changes in biological fertilisation by iron deposition and carbonate chemistry. The expression "in parallel, carbon storage on land increased....." , could suggest that also this contributed to more CO2 in the atmosphere which is not the case (fig. 6.5). We suggest the following wording; In parallel, carbon storage on land increased from glacial to inter-glacial reducing CO2 in the atmosphere, [Øyvind Christophersen, Norway]	Rejected - fig 6.5 shows that less carbon is stored on land at LGM, thus partly counterbalancing the effects of ocean storage. Fig 6.5 has been modified to be less confusing.
6-175	6	3	44		45	bit ambiguous - at the beginning of the paragraph you speak of the increase in CO2, but now suddenly swith to stating that land C increased (which would take CO2 up). Maybe use "By contrast" rather than "In parallel"? [Almut Arneth, Germany]	Accepted - text revised.
6-176	6	3	45	3	45	Insert "the" before "magnitude" [James Butler, United States of America]	Editorial - copyedit to be completed prior to publication.
6-177	6	3	45	3	46	Insert "the" between "can" and "magnitude" so that the line reads "Models of reduced complexity can simulate…". Also, consider using "timing" instead of "phasing". [Nathaniel Ostrom, United States of America]	Editorial - copyedit to be completed prior to publication. Combined with comment 6-176.
6-178	6	3	45	3	47	Would it be possible to express the content in a way that is easier to understand? [Øyvind Christophersen, Norway]	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-179	6	3	45	3	47	Does this mean that simpler models are better than complex models for glaciations? It seems slightly counterintuitive. [William Collins, United Kingdom of Great Britain & Northern Ireland]	Noted - text modified in Section 6.2 to account for that comment. Simpler models are miuch more parameterized wich offers the possibility to better tune them to match G-IG changes. "Better" is not the right word.
6-180	6	3	45	3	47	Can models of reduced complexity really capture the phase of glacial-interglacial CO2 changes? Then, you say ESMs can not capture the magnitude but I would have thought you should also say phase, otherwise this sentence reads like they can. [Paul Halloran, UK]	Accepted - text revised.
6-181	6	3	45	3	48	It seems counter-intuitive that simple models can simuate the changes while comprehensive models cannot. Is it because the EMICS do not realy represent the processes behind the change? You might want to explain a bit more. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Noted - text modified in Section 6.2 to account for that comment. Simpler models are miuch more parameterized wich offers the possibility to better tune them to match G-IG changes. "Better" is not the right word.
6-182	6	3	46	3	46	"Phasing" presumably refers to the ~700 year lag between temperature and CO2 in the long (850 ky) record, with temperature leading CO2. This has been a subject of contention in the skeptic community, via the spurious argument that the lag demonstrates that temperature changes cause CO2 changes, not the other way around. Therefore it is desirable (1) to be explicit about the meaning of "phasing" here, and (2) to offer more detailed evidence later (see comment on P6-12, section 6.2.2.1.1). [Michael Raupach, Australia]	Noted - Phasing is removed here. Details on leads and lags are gien in Chap5.
6-183	6	3	47	3	47	"cannot account for" This is vague regarding inadequate representation of mechanisms vs computational limitations. If EMICS have the relevant processes, dynamical ESMs do too, regardless of whether it is computationally possible to do the experiment. [James Christian, Canada]	Noted - text modified in Section 6.2 to account for that comment. Simpler models are miuch more parameterized wich offers the possibility to better tune them to match G-IG changes. "Better" is not the right word.
6-184	6	3	48	3	50	The statement on the lack of understanding the low glacial CO2 concentrations in the atmosphere is noted. However, what is much more relevant in the context of the AR5 is the questions of possible implications of this poor understanding for the policy relevant question of attribution. It is suggested that such and other similar issues are addressed in the executive summary of chapter 10 (detection and attribution). [Klaus Radunsky, Austria]	Noted - Section 6.2 has been modified to account for this comment..
6-185	6	3	49	3	49	Change "prevent an unambiguous intrepreation.." to "prevent a clear explanation .." [Richard G Williams, UK]	Accepted - text revised.
6-186	6	3	50			change to 'lowered' [Jeffrey Obbard, Singapore]	Editorial - copyedit to be completed prior to publication.
6-187	6	3	50			add 'concentrations' after 'CO2' [Jeffrey Obbard, Singapore]	Editorial - copyedit to be completed prior to publication.
6-188	6	3	52	3	52	Recall for the non-spcialist the dates of the holocene period in a foot-note [Michel Petit, France]	Accepted - footnote added
6-189	6	3	53	3	54	"with an additional contribution from late Holocene agricultural activity". The ages for CO2 and CH4 rise recorded in Greenland ice cores, i.e. ~6000 years and ~4000 years, respectively, are nearer to mid-Holocene. [Andrew Glikson, Australia]	Noted - the studies suggest that noticeble contributions from agricultural activities are during the last several thousand years, which is the late Holocene
6-190	6	3	53	3	54	The first sentence of this paragraph should start with the value of the reconstructed Holocene CO2 change (20ppm), then follow with the attribution. Remove the reference to 20-ppm reconstructed change from the third sentence of the paragraph. [Beverly Law, USA]	Accepted - Sentence rewritten as suggested in the comment 6-191
6-191	6	3	53	3	55	This introductory sentence reads poorly as written. Perhaps rewrite as "Studies suggest that the magnitude and timing of reconstructed CO2 changes in the Holocene atmosphere are the result of a combination of natural marine and terrestrial processes as well as a contribution from late Holocene agricultural activity." [Nathaniel Ostrom, United States of America]	Accepted - Sentence rewritten as suggested

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-192	6	3	55	3	55	State that "reconstructed" means "inferred from multiple observations, primarily ice cores" [Michael Raupach, Australia]	Accepted - Sentence rewritten
6-193	6	3	55	3	57	Poorly written sentence. Rewrite as "The contribution of CO2 from early anthropogenic land use and land cover change is not sufficient to explain the timing and magnitude of the reconstructed 20 ppm CO2 increase." [Nathaniel Ostrom, United States of America]	Accepted - Sentence rewritten
6-194	6	3	56	3	56	"reconstructed 20 ppm". Specify "reconstructed" on which basis or from what data? [Andrew Glikson, Australia]	Accepted - Sentence rewritten as suggested in the comment 6-193
6-195	6	3	56		57	Needs to be clearer which time you are considering - 20 ppm increase until when? Last 4000 years - is that pre-indsutrial, or pre the last millennium (since the next sub-section specifically deals with LM) [Almut Arneth, Germany]	Accepted - the timing of the CO2 increase is provided
6-196	6	3	57	3	57	Rewrite as "However, the reconstructions can explain the CH4 increase during the last 4,000 years." [Nathaniel Ostrom, United States of America]	Noted - the sentence is rewritten, also in reponse to the comment 6-197
6-197	6	3	57	3	57	"could explain" gives too much credence to an unnecessary hypothesis [Iain Colin Prentice, Australia]	Accepted - Sentence rewritten
6-198	6	3				From the point of view of a wider audience clarity and simplicity is essential. Something that might cause confusion is the technical way of writing. For example, a process that has a negative impact on atmospheric C is actually in the technical way you view and present things (which I as a fellow scientist agree on), a process that withdraws carbon dioxide from the atmosphere. This problem is heigthened in Table 6.1 (see below). Maybe this is clarified at some (early) stage in the AR, but is not fully clear here. [Peter Högberg, Sweden]	accepted - executive summary uses language for more general audience, but table 1 convention is kept (caption explains meaning of negative impact for those that need it).
6-199	6	4	1			y axis, left of the first figure: should O2 be "change in O2"??? Why minus? [Zongbo Shi, United Kingdom]	Rejected - misplaced comment
6-200	6	4	3	4	3	millenium instead of Millenium. [Leticia Cotrim da Cunha, Germany]	Accepted - Sentence rewritten
6-201	6	4	3	6	4	"CO2 drop by 5 to 8 ppm around year 1600, have not yet been identified." The distinct lull in sun spots recorded for the interval ~1610-1700AD (Solanki, 2002) and major volcanic events during this period provide likelyexplanation for enhanced sequestering of CO2 by the colder water. [Andrew Glikson, Australia]	Noted. Response of carbon cylce to reduced solar irradiance is one of causes, but unlikely the only one
6-202	6	4	4	4	4	A recent (2012?) paper (Nature? Nature Geo? Science?) attributed it to a sequence of identified volcanic eruptions. [James Butler, United States of America]	Noted. The reference is not specified clearly enough.
6-203	6	4	4	4	4	Causes have been "identified"! They have just not been "firmly established" [Iain Colin Prentice, Australia]	Accepted - text revised
6-204	6	4	6	4	6	change "world population" to "human population" (see also Box 6.1 Fig 1) [James Christian, Canada]	Accepted. Editorial - copyedit to be completed prior to publication.
6-205	6	4	10	4	20	Can the authors please clarify the statement that ' Terrestrial ecosystems have accumulated 124 ± 59 Pg of anthropogenic C during the same period, more than compensating the cumulative C losses from land use change (mainly deforestation) since 1750'? Earlier in this paragraph they state that LULUCF carbon losses since 1750 were 151 ± 51 PgC. As such the fomer would not appear to 'more than compensate' for the latter. [Dave Reay, UK]	Accepted - text revised
6-206	6	4	10	4	23	Carbon budget: Here and elsewhere in the chapter. I don't think that it is good practise to write numbers such as 151 ± 51 Pg C. This implies overconfidence to me. We teach our students to use one significant digit, which would imply here 150 ± 50 Pg C. [Nicolas Gruber, Switzerland]	Accepted
6-207	6	4	10	4	23	I suggest to add the basis for these numbers, e.g., models and in situ observations indicate that .... [Nicolas Gruber, Switzerland]	Rejected - this is a higher level summary section. In the corresponding section in 6.3 there is an accounting of how the various fluxes of the carbon budget are being estimated.
6-208	6	4	11	4	12	The amount of 365 +/- 22 Pg C between 1750 and 2010 is not completely consistent with p.9 line 5; 1750-2008, 340 Pg C and p.17 line 55-56; 1750-2011, 365 +/- 22 Pg C [Øyvind Christophersen, Norway]	Accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-209	6	4	11	4	23	The text is a bit uncler with respect to the numbers given here. Line 12 says land use release 151 PgC, line 18 says terrestrial ecosystems accumulated 124 PgC, MORE than compensating for the land use loss. Clearly 124 is less than 15, so the land LESS than compensating. Clarify please. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-210	6	4	11	4	23	Line 12 states that 151±51 PgC has resulted from land use change from 1750-2010. Line 18-19 state that terrestrial ecosystems have accumulated 124±59 Pg of anthropogenic C during the same period “more than compensating the cumulative C losses from land use change”; however to me the fact that the accumulated anthropogenic C in terrestrial ecosystems is less, suggests that it has not compensated. [Ray Nassar, Canada]	Accepted - text revised
6-211	6	4	11			"±"; need to define how it is used here. std error on best estimate? Beer (p 6-7, line 49) meant it to be one sigma. Need to define and use consistently through the chapter. [Stephen E Schwartz, USA]	Accepted - text revised
6-212	6	4	12	4	18	according to l.12, 151 PgC have been released due to landuse change according to l. 18, terrestrial ecosystems have accumulated 124 PgC, 'more than compensating the cumulative C losses from land use change' ; if the emissions due to landuse change are 151 PgC, the formulation 'more than compensating the cumulative C loss from land use change' is wrong, as 124 PgC is less than 151 PgC [Reiner Steinfeldt, Germany]	Accepted - text revised
6-213	6	4	12			"while"; do you really mean "at the same time"? Suggest avoid "while" for simple contrast; a semicolon will suffice. "While is confusing at best." [Stephen E Schwartz, USA]	Accepted - text revised
6-214	6	4	13	4	13	change "resulting into" to "resulting in". [Andrew Glikson, Australia]	Accepted. Editorial - copyedit to be completed prior to publication.
6-215	6	4	13			…’resulting in’ [Christina Tonitto, USA]	Editorial. Combined with other comment - 6-214.
6-216	6	4	14	4	14	These CO2 numbers are slightly different from Chapter 2 or chapter 8 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepted - coordiante with chapter 2
6-217	6	4	14	4	15	"at the end of 2010" why not use the annual mean? [James Christian, Canada]	Taken into account - Changed to value in January 2011
6-218	6	4	18	4	20	The phrasing of this sentence misrepresents the significant impact of deforestation on terrestrial C storage potential. An Executive Summary should not imply that deforestation is readily compensated for. A reader should understand that deforestation of an old-growth tropical wet forest or boreal forest, with a tremendous storage of vegetation and soil C, is a land use change that should be discouraged. The summary should not imply that all land use changes have equal outcomes. [Christina Tonitto, USA]	Accepted - text revised
6-219	6	4	18	4	20	In addition, this statement does not appear to be technically correct. In section 6.3.1 land use change is reported to lose 151 Pg C-CO2, while the terrestrial sink is reported as 124 PgC-CO2. The terrestrial sink approximately compensates for land use change CO2 emissions, but it does not exceed CO2 emission estimates. [Christina Tonitto, USA]	Accepted - text revised
6-220	6	4	19	4	19	Mathematically, this is not more than compensating for losses from land-use change since 1750. Earlier in the paragraph, it says 151 ± 13 51 PgC was released from deforestation and other land use change, and here it says terrestrial ecosystems accumulated 124 ± 59 Pg of anthropogenic C. Change the wording 'more than compensating' to almost compensating. [Beverly Law, USA]	Accepted - text revised
6-221	6	4	19	4	19	I get emissions of 151 versus accumulation of 124 - which only partly compensates [Robert Scholes, South Africa]	Taken into account - combined with other comments: 6-209(210), 6-212, 6-219(220) - text revised.
6-222	6	4	19			"more than compensating"; not on face. 124 Pg vs 151, although the uncertainties overlap. [Stephen E Schwartz, USA]	Taken into account - combined with other comments: 6-209(210), 6-212, 6-219(220, 221) - text revised.
6-223	6	4	20	4	23	add improved forest management tothe factors explaining the gain of carbon uptake to terrestrial ecosystems [Per Erik Karlsson, Sweden]	Accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-224	6	4	21	4	22	In several places (e.g., p. 6-4, lines 18-23; p. 6-19, lines 38-42; p. 6-27, section 6.3.2.5.1), you describe the major causes of the increasing land C sink as the result of enhanced photosynthesis at higher [CO2], and to effects of N deposition, longer growing seasons at high latitudes and an expansion and thickening of forests. Management is not mentioned explicitly, but is a major cause of the thickening of forests. As described by Vitousek and others, the human appropriation of products of photosynthesis has increased tremendously, and this involves management of forests and arable lands. The major objective of both farmers and foresters is to increase the productivity, and that these influences could be large should be discussed. For example, in Sweden, which has had a detailed National Forest Survey since the 1920´s, forest productivity has increased by around 70%, with large increases also in areas with low N deposition, and which cannot be attributed to higher [CO2] alone. Hence, management of these forest has most likely played a major role. Along with this increase in forest productivity and average standing stock of wood, there has been a large increase in soil C (on average 25 g C m-2 yr-1), despite the short-term increased release of CO2 from soil organic matter after clear-felling. The same probably applies to many other northerly countries, in which most forests are managed. In Europe a positive long-term trend in forest growth was reported by Kauppi et al. 1992 (Science), Spiecker et al. 1996 (book). In less intensively managed forests, disturbances like forest fires and insect outbreaks play important roles. These issues are discussed in more detail in section 6.3.5.3.2, but the effect of management is not handled other than a reference to the importance of forest age. This is problematic because forest C sequestration rate does not increase linearly with age, but has a more complex relationship. [Peter Högberg, Sweden]	Accepted - text revised
6-225	6	4	23	4	23	Geneal comment at the end of paragraph. Why is the role of bushfires and wildfires not mentioned? According to Bowman et al. 2009 (Fire in the Earth system; Science 324, 481; DOI: 10.1126/science.1163886) "Currently, all sources of fire (landscape and biomass) cause CO2 emissions equal to 50% of those stemming from fossil-fuel combustion (2 to 4 Pg C year−1 versus 7.2 Pg C year−1). [Andrew Glikson, Australia]	Rejected - the paragraph deals with possible mechanisms that lead to gains in C uptake, not losses which are dealt elsewhere. Also, fires associated with land use change are already included in the LUC emission term. Fires which are part of the background such as fires in savannas are not necessarily leading to a net emission or gain.
6-226	6	4	30	4	30	PgC/yr is not a measure of concentration, so the word “concentration” here should simply be removed. [Ray Nassar, Canada]	Taken into account - sentence rewritten
6-227	6	4	30	4	30	I think "this decade" refers to 2000-2009, but this is not clear. [Cynthia Nevison, USA]	Taken into account - sentence rewritten
6-228	6	4	30	4	30	To be most accurate, delete reference to "concentration" because the units provided are not a concentration but a rate. It would be more accurate to state that the "Abundance of CO2 in the atmosphere increased by a rate of 4.0…" [Nathaniel Ostrom, United States of America]	Taken into account - see reply to 6-226
6-229	6	4	30	4	31	The sentence "Atmospheric CO2 concentrations grew by 4.0 PgC yr-1 in the 2000s" should be reworded - as written it is misleading and wrong. A possible wording could be: The amount of CO2 included in the atmosphere grew by ….. [Klaus Radunsky, Austria]	Taken into account - see reply to 6-226
6-230	6	4	31	4	31	Similar to my comment above (p 4, line 30) rewrite this sented as "The estimated mean ocean and land CO2 sinks accumulated carbon at rates of 2.3…" [Nathaniel Ostrom, United States of America]	Taken into account - sentence rewritten
6-231	6	4	35	4	35	These CH4 numbers are slightly different from chapter 2 or chapter 8 [William Collins, United Kingdom of Great Britain & Northern Ireland]	To be done - harmonization with chapters 2 and 8
6-232	6	4	38	4	39	plausible explanantions would be betetr than lines ofevidence [Robert Scholes, South Africa]	Accepted - text rewritten
6-233	6	4	40	4	40	Soviet Union instead of soviet union. [Leticia Cotrim da Cunha, Germany]	Accepted
6-234	6	4	40	4	41	The reduced global fossil fuel emission hypothesis seems in contradiction with the fossi fuel emission numbers given in the previous paragraph (line 26-27). The next hypothesis : increasing anthropogenic emissions, is in contradiction with the previous one. Can we give to contradicting hypothesis as equally possible ? This long list is a bit frustrating, you almost cite every possible cause here... [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Rejected : see 6-236. Fossil fuel emissions for CO2 and CH4 do not necessarily refer to the same processes. In addition, the time periods in the two paragraphs cited here are not exactly the same.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-235	6	4	40	4	42	Decreasing wetland emissions, reduced emissions from rice paddies and changes in OH concentrations are indicated as causes of a near stable level of methane in the atmosphere from 1999 - 2006. But what is the explanation of these phenomena? [Øyvind Christophersen, Norway]	Accetped - text revised
6-236	6	4	40			statement on global fossil fuel related emissions - appears unreasonalbe given the increase in global consumption of fossil fuels over the 2000-2009 period. [Jeffrey Obbard, Singapore]	Rejected : fossil fuel CO2 emissions and fossil CH4 emissions can have opposite trends. Fossil fuel-CO2 emissions reflect energy production ; Fossil CH4 emissions reflect natural gas extraction and distribution (pipelines) ; coal and oil industry, where technology improvements can reduce emissions
6-237	6	4	42	4	43	Suggest; "positive trends in emissions from wetlands mainly in the tropics but also at northern high latitudes" to make it more clear. [Øyvind Christophersen, Norway]	Accepted - text revised
6-238	6	4	42			change 'is' to 'has begun' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-239	6	4	42			change 'relies o n' to may be linked to' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-240	6	4	43	4	43	of → from [Peter Burt, UK]	Accepted. Editorial - copyedit to be completed prior to publication.
6-241	6	4	43	4	44	Rewrite as "...with some contribution of from northern high latitudes in 2007, due to anomalies of in precipitation and temperature in these regions." [Nathaniel Ostrom, United States of America]	Rejected - this is a concise summary. Full explanations of drivers are in the methane section in 6.3.3.
6-242	6	4	46	4	46	Change the phrasing of the paragraph : The global budget of CH4 over the past decade (2000–2009) [philippe bousquet, France]	Accepted.
6-243	6	4	46	4	46	Add "(2000-2009) after "decade" to make it more clear and to be consistent with line 25. [Øyvind Christophersen, Norway]	Accepted. Combined with comment 6-242.
6-244	6	4	46	4	55	Add emissions from hydroelectric reservoirs . According to Barros et al. 2011 (Nature Geoscience) hydroelectric reservoirs emit 48Tg C as CO2 and 3 Tg C as CH4 per year. [Gesa Weyhenmeyer, Sweden]	Accepted - text revised in section 6.3.3
6-245	6	4	47	4	47	"Regional CH4 sources at the surface the globe are" ma be replaced by "CH4 sources at the surface the globe can be" [philippe bousquet, France]	Accepted - text revised
6-246	6	4	47	4	47	The line beginning "Regional CH4 sources at the surface the globe" seems very awkward as well as being gramatically incorrect. In particular, use of the terms "regional" and "globe" together isn't appropriate as the budgets being referred to are global estimates. How about "Global surface sources of CH4 are …" or "Surface sources of CH4 are ...". [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-247	6	4	47	4	47	Rewrite as "Regional CH4 sources at the surface of the globe are…" [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-248	6	4	47	4	48	"Regional CH4 sources at the surface the globe are biogenic (64–76%; wetlands, ruminants, landfills, waste, 48 termites)," What is the role of methane emmitted from animals (cattle, sheep, horses, pigs, dogs, cats etc.) in this regard and why is it not mentioned? [Andrew Glikson, Australia]	Already taken into account under livestock, but not cats, dogs, pigs which are not rumniant and don't produce methane
6-249	6	4	47	4	55	Here are many numbers that are useful, but the readability could have been better. Consider simplifications and consistency. [Øyvind Christophersen, Norway]	Accepted - text revised
6-250	6	4	47	5	2	This paragraph suffers from poor writing style (see comment #11). [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-251	6	4	47			I believe you talk about the global, not the regional budget? [Almut Arneth, Germany]	Noted - it is the global budget
6-252	6	4	47			at the surface the globe? [Almut Arneth, Germany]	Accepted - text revised. Combined with similar comments - 6-245(246, 247), etc.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-253	6	4	49		50	The single most dominant source with respect to annual magnitude and interannual variation is CH4 emissions.. [Almut Arneth, Germany]	Accepted - text revised
6-254	6	4	50	4	50	Confusing writing here as sources do not cause "variations"; processes cause variations or variations are driven by changes in source and sink terms. It is probably best here to simply state that the greatest source for the 200-2009 time period is wetlands. [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-255	6	4	50	4	51	"from natural wetlands, from the tropics and high northern latitudes" Methane release from permafrost and methane clathrates should be specified here. [Andrew Glikson, Australia]	Rejected - No evidence of significant permafrost and chlatrate emissions in the contemporary methane budget
6-256	6	4	51	72	53	General comments: (1) Why do the CO2 quantities appear as Pg C (or Pg C yr-1, corresponding to Pg C-CO2 yr-1), and the CH4 ones appear as Tg CH4 (or Tg CH4 yr-1)? Is it meant to be Tg C-CH4 yr-1? It would be useful to clarify this at the very beginning of the text; (2) Throughout the text, the reference formatting should be reviewed. In many cases the reference is inside parentheses when it shouldn't be (e.g.: page 26, lines14-15). Listing all the cases in this review would make it very long, so this will appear as a general comment; and (3) CO2 appears many times as "CO2" in the text, and the same is valid for N2O and CH4.. [Leticia Cotrim da Cunha, Germany]	taken into account - a box added to explain
6-257	6	4	52	4	52	Change "from an ensemble of process-based models" to "an ensemble of process-based models indicate that anthropogenic..." [Nathaniel Ostrom, United States of America]	Accepted - text revised.
6-258	6	4	55	4	55	Consider another term then "destroyed" eg. "broken down". [Øyvind Christophersen, Norway]	Accepted - text revised
6-259	6	4	55	4	56	The meaning of the sentence seem unclear; Is the 5 % an increase or a decrease or within +- 2.5%? Please be more specific, and try to explain how this influences the development for CH4. [Øyvind Christophersen, Norway]	Accepted - text revised
6-260	6	4	55	4	56	Does this statement on the stability of OH mean that the "changes in OH" should be removed from the previous paragraph? [William Collins, United Kingdom of Great Britain & Northern Ireland]	Taken into accpunt - text was revised for more clarity
6-261	6	4	55	4	56	Poorly written sentence. Tell the reader what the "different approaches" are. I assume the authors are referring to "different models". The statement "...OH changes remained within 5% in the period 2000–2009." is confusing. Do the authors mean that the concentration of OH stayed with 5% of the pre-2000 value? Or do they mean that the rate of reaction of CH4 with OH radicals stayed within 5% of the pre-2000 values? [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-262	6	4	56	4	56	"OH changes remained within 5%" Not clear what this means. Does this refer to changes in the CH4 sink via this process? If so this needs to be made more explicit. [James Christian, Canada]	Accepted - text revised
6-263	6	4	56	4	56	Isn't the fact that OH remain relatively constant in contradiction with OH changes as a possible cause for reduced CH4 groth rate as mentioned in the previous paragraph ? [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-264	6	4	56	5	2	One get the impression that a topdown approach (atmospheric based estimates) gives an estimate of 518-550 Tg CH4(2000-2009??) with a antropgenic domination, whilst the approach in line 50-55 (bottoms-up??) estimates anthropogenic sources to 235-338 Tg and natural sources 244-368 Tg , together 479-706 Tg. Is there an explanation for the difference? Is it necessary to give so many numbers? If so could they be presented in an easier and consistent way? Use units for all emmisions "(518-550)" and check "20000s" [Øyvind Christophersen, Norway]	Accepted - text revised in section 6.3.3; there is no room in the executive summary to go into details
6-265	6	4	56			remove 'now, [Jeffrey Obbard, Singapore]	Accepted. Editorial comment - copyedit to be completed prior to publication.
6-266	6	4	57	4	57	Replace "using" with "based on". [Nathaniel Ostrom, United States of America]	Accepted - text revised.
6-267	6	4				Figure 6.3: With regard to the top, the trend of O2 might indicate the changes from that in the base year. Please describe the details in the legend (otherwise it indicates the O2 concentration in the atmosphere).	Noted - revised figure caption describes this correctly

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						[Shigehiro Ishizuka, Japan]	
6-268	6	4				Several paragraphs discuss changes of CO2 and CH4 over very long time scales. Then we come suddenly to since 1750. Why are these longer time scales important to this document? Does this discussion belong in the Executive Summary? It is distracting because of the inherent uncertainties in the past records. That has little to do with the present situation where the authors already say that the changes are known to be driven by human activities [Mohammad Aslam Khan Khalil, USA]	rejected - following mandate given to chapter
6-269	6	4				Numbers here and elsewhere... Please.... Some attention should be paid to significant digits. Can we really say that land use change has produced 151 pgC? Can it be 150? How about 130? Similarly we see 516+ -56 pgC. How about 500 +-60? What are the +- anyway? This is not stated. [Mohammad Aslam Khan Khalil, USA]	Taken into account - numbers were not rounded but uncertainty +- meaning is precisely explained
6-270	6	4				In listing the causes of changes in methane trends, I would ask that speculations and actual calculations be separated. I believe that change of emissions from the former USSR are speculation, while changes in rice field emissions are matters of observations in the field and by agricultural records. [Mohammad Aslam Khan Khalil, USA]	rejected - emission reductions from FF are based on energy statistics, probably more robust yet with uncertianties, that those for natural emissions such as wetlands.
6-271	6	4				Fig 4. Suggest show oxygen on same scale and same locations so slope and fluctuations can be directly compared. And of course oxygen is not mixing ratio, but anomaly; date should be specified. [Stephen E Schwartz, USA]	Noted - oxygen is plotted on same scale, but as anomaly - figure caption has been revised
6-272	6	5	1	5	1	years 20000s should be replaced by years 2000s [philippe bousquet, France]	Accepted - text revised.
6-273	6	5	1	5	1	"global sinks for the years 20000s" The number (magnitude) is missing here (in addition to the typographical error). [James Christian, Canada]	Accepted - text revised.
6-274	6	5	1	5	1	Units for global emissions? Years 2000s instead of 20000s- [Leticia Cotrim da Cunha, Germany]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278), etc.
6-275	6	5	1	5	1	years 2000s not 20000s [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278), etc.
6-276	6	5	1	5	1	""years 20000s" should be "years 2000s" [Andrew Glikson, Australia]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278), etc.
6-277	6	5	1	5	1	"for the years 20000s" Do you mean 2000-2009? [Beverly Law, USA]	Accepted - text revised.
6-278	6	5	1	5	1	Replace 20000s with 2000s [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278), etc.
6-279	6	5	1	5	1	Include units for CH4 emissions i.e. 518–550 Tg CH4/year [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - sentence revised
6-280	6	5	1	5	1	Delete the extra zero in "20000s". The writing would improve by refering to post-1999 rather than "years 2000s". [Nathaniel Ostrom, United States of America]	Accepted - sentence revised.
6-281	6	5	1	5	1	Please correct 'global emissions (518–550) and global sinks for the years 20000s' to provide units and time period [Dave Reay, UK]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278), 279, etc.
6-282	6	5	1	5	7	Box 6.1, figure 1 - y-axis: Better "population, 10E9 inhabitants" [Leticia Cotrim da Cunha, Germany]	Accepted. Figure will be revised.
6-283	6	5	1			(518-550), add units [Almut Arneth, Germany]	Accepted. Combined with similar comments: 6-274, 6-279, 6-281, etc.
6-284	6	5	1			You add only rates for the sources, but not for the sinks - what are their estimates? [Almut Arneth, Germany]	The Executive summary has been substantially modified.
6-285	6	5	1			There´s an extra 0 in "the years 20000s" [Marcelo Galdos, Brazil]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278, 279, 281), etc.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-286	6	5	1			change to '2000s' [Jeffrey Obbard, Singapore]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278, 279, 281), etc.
6-287	6	5	1			typo 2000s [Christina Tonitto, USA]	Accepted. Combined with similar comments: 6-272, 6-275(276, 277, 278, 279, 281), etc.
6-288	6	5	2			change 'ones' to 'sources' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-289	6	5	4	5	13	Might need one sentence to introduce what this is about. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account - sentence added and text revised
6-290	6	5	4	5	20	With the inclusion of N-cycle, making carbon cycle models more complete, there are now some studies which result in climate feedbacks that can be of either sign (e.g. Socolov et al. 2008). In previous assessments, statements were included that all models give a positive feedback; at this time this is not true. Suggest reversing the order of paragraphs in this section. The first paragraph should mention that some models with N-cycle have a weak or even negative climate-carbon feedback. The second paragraph focusing on CMIP5 should recognize that CMIP5 does not span that range of models. If the coupled N-C-cycle models are plausible, then CMIP5 would not sample those types of results and could be underestimating the range of climate-carbon feedback spanned by N-C-cycle models and give an underestimate of that aspect of uncertainty in projections. [Haroon Kheshgi, United States of America]	taken into account - text revised as suggest
6-291	6	5	5	5	7	Note that C4 models were not "officially' part of CMIP3, although C4MIP results were discussed in the AR4 report. Also wouldn't it make more sense here to say that BOTH sets of models "consistently estimate a positive feedback"? [James Christian, Canada]	accepted - text revised
6-292	6	5	5	5	7	Consider the readability and the grammar of the whole sentence. And, it is not clear if "carbon cycle - climate feedback" is meant as a term or something else. [Øyvind Christophersen, Norway]	taken into account - reworded for clarity
6-293	6	5	5			Insert "simulated" before the word "carbon" [Roger Gifford, Australia]	Accepted - text revised
6-294	6	5	5			insert "of" before "frozen" [Roger Gifford, Australia]	Accepted - text revised
6-295	6	5	7	5	8	This sentence needs to clarify whether the CMIP5 models being compared all inlcude the contnuing CO2 fertilising effect on generating a continuing terrestrial C sink as it probably has been doing to date. So far there is no hint that global warming to date has reduced the rate of increase in the absolute global terrestrial C sink which has been keeping up with the increasing anthropogenic emissions. This needs to be clearly acknowledged when commenting on the adequacy of the models. [Roger Gifford, Australia]	first statement is taken into account - text clarifies CO2 fertilization in models; second point is rejected
6-296	6	5	9	5	13	I couldn't see where in the chapter is said that land use is a significant source of uncertainty for future climate. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted - text clarified in section 6.4
6-297	6	5	9	5	13	A rather long and less than clear sentence. I suggest rewrite. [Andrew Glikson, Australia]	taken into account - reworded for clarity
6-298	6	5	9	5	13	This statement exemplifies, again for my area of research, the problem of not elaborating on the Carbon and Biogeochemical cycles in more detail. The quantitative role of land use and management is recognised, but not really explained throughout the report. While I recognise that this might be part of WG 2 or WG 3, a better conceptual understanding of the effect of land use and land management on the C and biogeochem cycles should be added here. In the light of several high profile publications and a somewhat controversial debate in the past four years on the role of human intervention on the soil C pool and fluxes, especially erosion, more information would be helpful to put the quantitative information in this chapter into perspective to the processes associated with the fluxes of C and nutrients. Relevant references for the field of soil erosion are cited below. I am fully aware that this would seem like pushing my own work, but these references are merely listed to illustrate the point that for all fluxes discussed in this chapter more information and reference to the controlling processes and their interaction is required. 1. Stallard. R.F. 1998. Terrestrial sedimentation and the carbon cycling: coupling weathering and erosion to carbon burial. Global Biogeochemical Cycles, 12, 231-257; 2. Van Oost, K., Quine,T. A. Govers, G. De Gryze, S., Six, J. Harden, J.W., Ritchie, J.C., McCarty, G.W., Heckrath, G. Kosmas, C., Giraldez, J. V., Marques da Silva, J.R. Merckx, R. 2007. The Impact of Agricultural	accepted - land use comment - figure added to section 6.3; river comment - text added in introduction to address (see also comment 6-56)

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Soil Erosion on the Global Carbon Cycle. Science 318, 626-629., also correspondence by Lal on this paper; 3. Kuhn, N. J., Hoffmann, T., Schwanghart, W., Dotterweich, M. (2009): Agricultural Soil Erosion and Global Carbon Cycle: Controversy over?. Earth Surface Processes and Landforms, 34, 1033-138; 4. Quinton, J.N., Govers, G., Van Oost, K., Bardgett, R. D., 2010. The impact of agricultural soil erosion on biogeochemical cycling. Nature Geoscience. 3, 311-314. 5. Kuhn, N.J. 2011. Connecting the cycles. Applied Geochemistry 26 (2011). [Nikolaus Josef Kuhn, Switzerland]	
6-299	6	5	12			insert 'thereby' after ',' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-300	6	5	13	5	13	End of paragraph. As in the comment above (6-4-23) why is the role of fire not mentioned? [Andrew Glikson, Australia]	taken into account - fire is covered in section 6.3 and 6.4
6-301	6	5	15	5	20	Does this mean that according to the CMIP5 models nitrogen is a limiting factor for sequestration of C, so that nitrogen deposition and increased N-availability due to warming will reduce this limitation, and still predict a smaller land sink for C than in the earlier CMIP4 models not comprising N? [Øyvind Christophersen, Norway]	taken into account - some models include N and some don't - this will be covered explicitly in sec 6.4
6-302	6	5	15	5	20	Add a statement of confidence [Nicolas Gruber, Switzerland]	Accepted - confidence statement added
6-303	6	5	16	5	17	expanation required why this is like that [Christoph Mueller, Germany]	Taken into account - explanation was added
6-304	6	5	19			tropospheric ozone could be added [Per Erik Karlsson, Sweden]	rejected - too much for executive summary, explained in section 6.4
6-305	6	5	22	5	28	Any reduction in ocean alkaliity has considerable variability. Your models seem to assume it is uniform and constant which iis wrong. [VINCENT GRAY, NEW ZEALAND]	Taken into account - the reduction in pH referred to here are well above the natural variability. Models fully include the regional and temporal variations in alkalinity and carbonate system. This has been clarified lines 26-30 on p. 50
6-306	6	5	22		28	I would find it more logical (regarding overall flow of the text) to move the section on oean deoxygenation before the section on Future projections (what is now starting at lines 4) [Almut Arneth, Germany]	accepted
6-307	6	5	23	5	23	Mult-model → Multi-model [Peter Burt, UK]	Accepted - typo corrected. Combined with similar comments - 6-308 (309), etc.
6-308	6	5	23	5	23	Replace "Mult" with "Multi". [Nathaniel Ostrom, United States of America]	Accepted - typo corrected. Combined with similar comments - 6-307, 6-309, etc.
6-309	6	5	23	5	23	Mult-model should run Multi-model [Gesa Weyhenmeyer, Sweden]	Accepted - typo corrected. Combined with similar comments - 6-307, 6-308, etc.
6-310	6	5	23	60	16	There is inconsistency with the convention used for 20th or 21st Century: 20th, 20th, century, Century. Chapter 1, and the other Chapters which I have looked at, generally use 20th Century or 21st Century. I suggest the terminology in this Chapter is standardised to that form (number as a number, exponential 'th', 'st' and Century with a capital 'C'). [Peter Burt, UK]	"20th century", and "21st century" are conventional for the IPCC Reports - to be checked throughout the Chapter.
6-311	6	5	23			Multi-model [Almut Arneth, Germany]	Accepted - typo corrected. Combined with similar comments - 6-307, 6-308, etc.
6-312	6	5	23			an error, should be "Multi" [Per Erik Karlsson, Sweden]	Accepted - typo corrected. Combined with similar comments - 6-307, 6-308, etc.
6-313	6	5	23			change 'Mult' to 'multi' [Jeffrey Obbard, Singapore]	Accepted - typo corrected. Combined with similar comments - 6-307, 6-308, etc.
6-314	6	5	23			Typo should be: Multi model [Edward Schuur, USA]	Accepted - typo corrected. Combined with similar comments - 6-307, 6-308, etc.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-315	6	5	24	5	26	Change the present form "is" to "will be", "occur" to "will occur" and "is" to "will become" since it will take place in the future. [Øyvind Christophersen, Norway]	The Executive summary has been substantially modified - wording corrected.
6-316	6	5	24			change to 'world's' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-317	6	5	24			change to 'emission' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-318	6	5	25			Is Aragonite undersaturation a widely understood term, and does the reader know how this effects ocean C cycling ? (I, at least, had to resort to Wikipedia) [Almut Arneth, Germany]	Accepted - aragonite undersaturation defined in text
6-319	6	5	26			How much do we believe these studies? Surely global ESMs can not be trusted to make such a strong statement about the Arctic? [Paul Halloran, UK]	Noted - uncertainties are discussed in the relecant sub-section.
6-320	6	5	27	5	27	Could "greatly influence" be replaced with "to a large extent limit". It will give more information if it is said wheter the influence is positive or negative. [Øyvind Christophersen, Norway]	Accepted - text revised.
6-321	6	5	27	5	27	consider "limiting the" replacing with "levels of" [Stefan Gerber, USA]	Editorial - wording corrected
6-322	6	5	27			should this read "… that limiting atmospheric CO2 concentration increase will greatly reduce the rate of ocean acidifiation ." to convey the intended meaning? [Roger Gifford, Australia]	Accepted - text revised.
6-323	6	5	27			change 'influence' to 'mitigate' [Jeffrey Obbard, Singapore]	accepted - sentence modified (influenced changed to limit)
6-324	6	5	28			change 'will be experienced' to 'that will manifest' [Jeffrey Obbard, Singapore]	accepted - sentence modified to 'also limit the future level of ocean acidification'
6-325	6	5	30	5	43	These 3 paragraphs would benefit from a) being more qunatitative, giving the model ranges for the different RCPs, and b) being more balanced. Most of what is written here might not apply for the low RCP2.6 (ex. ocean acidification continues inexorably in the future, large areas of permarost will experience thawing,...) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted
6-326	6	5	32			change 'evolution' to ' developmet' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-327	6	5	37	5	38	Ocean acidification will continue inexorably in the future' Really? From the previous sentence it sounds like you're considering stabalisation scenarios - in which case surface ocean acidification will surely stabalise quite quickly. [Paul Halloran, UK]	Taken into account - text modified to be consistent with range of possible future scenerios.
6-328	6	5	37	5	40	"Ocean acidification will continue inexorably in the future, with surface waters becoming corrosive to aragonite shells even before the end of the 21st century." This is actually not true, at least in models. Surface ocean saturation state stabilizes remarkably quickly in "strong mitigation" scenarios like RCP2.6. It probably will happen, but it is scenario-dependent. This likely applies to the subsequent statement regarding land ecosystems as well (I would change "induced changes" to "climate-induced changes" here). [James Christian, Canada]	Taken into account - text modified to be consistent with range of possible future scenerios.
6-329	6	5	38	5	38	Inexorably is a bit strong. You can delete it without changing the meaning of the sentence. [Robert Scholes, South Africa]	Taken into account - text modified to be consistent with range of possible future scenerios.
6-330	6	5	38	5	39	"with surface waters becoming corrosive to" : As written this statement is not tenable. First of all, this depends on the scenario, and second, this is projected to occur "only" in certain oceanic regions, such as the Arctic, the Southern Ocean, and a few other "hot spots" such as Eastern Boundary Upwelling Regions. [Nicolas Gruber, Switzerland]	Taken into account - text modified to be consistent with range of possible future scenerios.
6-331	6	5	38			insert 'more' after 'becoming' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-332	6	5	40	5	41	This statement is inconsistent with Ch.4, page 4, lines 6-9? [Henning Rodhe, Sweden]	Noted - harmonized with Chapter 4
6-333	6	5	40	5	42	This sentence appears to be incomplete. [Peter Högberg, Sweden]	Taken into account - Sentence revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-334	6	5	40	5	42	This sentence doesn't make clear sense. It seems like a full stop might be missing, eg: "magnitude. Frozen" [Daniel Metcalfe, Sweden]	noted - editorial
6-335	6	5	40	5	42	Permafrost are nowhere included in the emission guidlines, perhaps a note would be important that this is potentially important [Christoph Mueller, Germany]	taken into account - the role of permafrost is discussed in section 6.4
6-336	6	5	40	5	43	Does this mean that the expected thawing of permafrost will result in increased CO2 and CH4 emissions to the atmosphere, but with uncertain magnitude. Is this positive feedback not included in the current (CMIP5) models? In that case we have to assume a faster growth of CO2 and CH4 and temperature than shown in the modelled scenarios? If these assumptions are correct, could it be said more clearly? [Øyvind Christophersen, Norway]	rejected - this is already explicitly stated here
6-337	6	5	41	5	41	"magnitude frozen" should be "magnitude of frozen" [Andrew Glikson, Australia]	Editorial - wording corrected
6-338	6	5	41	5	42	Please clarify the sentence '...but uncertainty over the magnitude frozen carbon losses through CO2 or CH4 emissions to the atmosphere are large.' [Dave Reay, UK]	Editorial - wording corrected. Combined with comment 6-337.
6-339	6	5	41	5	42	carbon in frozen soils [Robert Scholes, South Africa]	Editorial - wording corrected. Combined with comment 6-337, 6-338.
6-340	6	5	41			possible to quantify 'medium confidence'? [Jeffrey Obbard, Singapore]	Medium confidence corresponds to par 9 of "Guidance for Lead Autthors on consistent treatment of uncertainties" available at http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf
6-341	6	5	43			insert 'radiative forcing' after 'poisitive' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-342	6	5	47	5	50	"Models and ecosystem warming experiments show agreement that wetland emissions will increase per unit area in a warmer climate, but wetland areal extent may increase or decrease depending on regional changes in temperature and precipitation affecting wetland hydrology."… In numerous experimental studies it has been shown that wetland hydrology e.g. water table level is an important driver for CH4 emissions from wetlands. Besides modelling those experimental studies might highlight the role of wetlands in CH4 emissions in future climate. [Pirkko Kortelainen, Finland]	taken into account - the role of wetlands and water table is presented in section 6.4.7
6-343	6	5	47	5	50	Given that regional wetland emissions may increase or decrease depending on regional changes in temperature and precipitation, it is inconsistent to say that "Models and ecosystem warming experiments show agreement that wetland emissions will increase per unit area in a warmer climate". I suggest that this is re-worded as follows: "Models and ecosystem warming experiments show agreement that global wetland emissions will increase in a warmer climate". It is also worth noting that climate models tend to have quite simplified schemes for methane wetland emissions. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	taken into account - reworded for clarity
6-344	6	5	51	5	52	The statement "However, the global release of CH4 from hydrates to the atmosphere is likely to be low due to … " is inconsistent with the preceding statement that emissions from gas hydrates in response to seafloor warming could be significant. This should probably read "However, the timescale for global release of CH4 from hydrates to the atmosphere is likely to be long due to ...". [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	taken into account - reworded for clarity
6-345	6	5	51			change 'constrained' to 'understood' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-346	6	5	52	5	52	"undersaturated". Better specify "understaurated in methane" [Andrew Glikson, Australia]	Accepted - text revised.
6-347	6	5	52			add 'its' after 'ocean,' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-348	6	5	53			remove of the ocean' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-349	6	5	53			add 'the ocean depths to' before 'seafloor' [Jeffrey Obbard, Singapore]	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-350	6	5	55	6		CO2 removal. I question whether this section is within the mandate of the WG. The material in this section, plus other approaches to geoengineering might better be in a special report rather than in the AR5. Even considering geoengineering might be taken as an endorsement and might redound negatively on IPCC as taking a position rather than assessing scientific understanding of climate change [Stephen E Schwartz, USA]	rejected - mandated for chapter
6-351	6	5	57			change 'to moderate' to 'designed to mitigate' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-352	6	5				I thought that the executive summary should be more about findings. What is new since AR4? As it is, the summary is more about lists of what affects CO2 and CH4 cycles, or oceans and how much uncertainty there is. I didn't come away with an understanding of scientific progress. [Mohammad Aslam Khan Khalil, USA]	Taken into account - the executive summary will be substantially modified for the SOD.
6-353	6	5				Box 6.1, Figure 1. Not clear why population on the figure; Text doesnt speak to it. Seems gratuitous; population is not WGI issue. Might be taken by some as an advocacy of population control. What point is being made? and why in this context? Suggest strike. Word "nitrogen" missing from caption. [Stephen E Schwartz, USA]	Accepted & change to be made
6-354	6	6	1	6	1	biomass energy will not result in carbon dioxide removal, after accounting for reductions in the land carbon sink, losses in use, energy efficiencies, emissions from transport, displacement of fossil fuel emissions (well to tank), and substitution. This should be removed from this section, as research has shown this (e.g. Searchinger et al. 2010) [Beverly Law, USA]	accepted - wording changed in sentence. "biomass energy and carbon capture and storage (BECCS)" is one method.
6-355	6	6	1	6	2	Carbon capture and storage of CO2 from fossil sources should not be regarded as CDR. The carbon already stems from the geological reservoirs, and are never released to the atmosphere. It is therefore widely accepted that CCS from fossile fuels are not regarded as geoengineering/CDR. Furthermore it are in many fora not agreement about whether traditional mitigation options like reforestation/afforestation and bioenergy should be regarded as geoengineering/CDR. Hence it will be important how geoengineering is defined in this report, and description of the ongoing discussion might be included. Eg. it is a big difference between these mitigation options and for instance ocean fertilization and accelerated weathering. [Øyvind Christophersen, Norway]	accepted - text modified (see response to comment 6-354)
6-356	6	6	1	6	4	New processes such as biochar application need to be mentioned explicity because it is currently one of the most propagated/discusse mititigation option [Christoph Mueller, Germany]	accepted - added to the text
6-357	6	6	2	6	3	"direct air capture". Direct air capture is a CDR only when combined with a particular storage method. This needs to be explicitily mentioned here. [Nicolas Gruber, Switzerland]	Taken into account- text revised
6-358	6	6	4	6	4	replace "should" with "would need to". The word "should" opens up the possibility of this being viable based upon what we know now, which I'm not so certain is the message you're trying to send. [James Butler, United States of America]	Editorial - Sentence removed in revision
6-359	6	6	4	6	5	Where is this qnatified in the chapter. What is a "discernable" climate effect ? If quantified in the chapter could you be a bit more quantitative. "several PgC/yr over several decades is a bit vague. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted- Sentence removed in revision
6-360	6	6	5	6	5	Petagrams → petagrams [Peter Burt, UK]	Editorial - Sentence removed in revision
6-361	6	6	6			What "red" and "blue" arrows refer to? Where is the source (reference) of this figure? [Zongbo Shi, United Kingdom]	Noted - revised figure and figure caption take care of this
6-362	6	6	7	6	17	It would be policy relevant to highlight the status of any of those CDR methods described in the literature in terms of maturity of the technology and any change in maturity e.g. since the SR of the IPCC on CCS. [Klaus Radunsky, Austria]	Rejected - not relevant for WG1 report
6-363	6	6	9	6	11	"When carbon is stored in a reservoir, the concentration gradient between the atmosphere and carbon reservoirs is reduced and thereby the subsequent rate of removal of CO2 from the atmosphere." This is not always true. If CO2 is stored in the deep ocean it may not affect surface ocean pCO2 for a long time. If C is stored as organic matter or black carbon in soils, it doesn't necessarily effect the rate of uptake via	accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						photosynthesis. (see also 63/24-26) [James Christian, Canada]	
6-364	6	6	10	6	10	"reservoir" is a bit ambiguous and "gradient" is confusing in this context. If the reservoir is in contact with the atmosphere (e.g., soils), what happens to the gradient? Also, what if the stored carbon is organic, e.g., in cellulose of a tree? How then do you compute "gradient"? [James Butler, United States of America]	accepted - see response to 6-363
6-365	6	6	10	6	10	The concept of "concentration gradient" does really hold for the land-atmosphere exchange. Soiul respiration is not driven by a delta pCO2. It sort of does hold on a more theoretical level if you assume that the global carbon pool is in equilibrium with an 20-30 years old atmospheric CO2. Not sure this is what you mean. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted - see response to 6-363, text revised
6-366	6	6	10	6	10	Say "gradient between the atmosphere and other land and ocean carbon reservoirs" [Michael Raupach, Australia]	accepted - see response to 6-363
6-367	6	6	10	6	11	This sentence doesn't make clear sense. It is not explicitly stated what the "subsequent rate of removal" will do, i assume it will be reduced like the "concentration gradient"? If so, i suggest a change to something like "thereby so is the subsequent rate". [Daniel Metcalfe, Sweden]	accepted - see response to 6-363
6-368	6	6	10			“reservoir”. In that part you are talking about storage... “natural reservoir” would make the sentence clearer. [Francois DANIS, France]	accepted - see response to 6-363
6-369	6	6	11			after 'atmosphere' [Jeffrey Obbard, Singapore]	Taken into account- text revised
6-370	6	6	12	6	12	Seems to make more sense as "of the long time". [Daniel Metcalfe, Sweden]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-371	6	6	12	6	14	It obviously constitutes an option of some kind, i assume you mean it doesn't present a very good option? How about something like "present a viable option for". Physical potentials for what, please clarify. Suggest you change to "achievable in the real world". [Daniel Metcalfe, Sweden]	Taken into account - text revised
6-372	6	6	12			insert 'to sequester carbon' after 'processes' [Jeffrey Obbard, Singapore]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-373	6	6	13	6	13	"during the next century". The reasons for specification of "next century" is not clear. [Andrew Glikson, Australia]	Taken into account - text revised
6-374	6	6	14			add 'the' before 'real' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-375	6	6	16	6	17	This is an exampe of a statement that uncertainties are very large, but no reasons are given. In my opinion, it is essential to be more specific about the uncertainties to understand their relevance and guide both climate as well as research policy. [Nikolaus Josef Kuhn, Switzerland]	Accepted - text revised
6-376	6	6	16	6	17	Can't use "upon" here, i suggest you substitute with "about". What is meant by "which CDR methods can be evaluated"? I'm not sure that this is the desired word here. Whether or not the methods can be evaluated doesn't seem to be too important in comparison to whether they can be practically implemented or effective in rapidly mitigating climate change [Daniel Metcalfe, Sweden]	Taken into account - word changed, This chapter is mandated to evalute only the scientic issues. Practical implementation issues would be evaluated by WG2 and WG3
6-377	6	6	19	6	26	The potential impacts on biodiversity and regional differences should be described. [Øyvind Christophersen, Norway]	rejected- not part of WG1
6-378	6	6	19	6	26	This paragraph contains some grammatical errors e.g. '...a temporary acceleration in global water cycle…' and '...could acidify the deep ocean, and lead to expand regions with low oxygen concentration..' [Dave Reay, UK]	Editorial - Paragraph rewritten
6-379	6	6	20	6	20	removal of carbon by afforestation would lead to an increase in transpiration. [what exactly does an acelleration of the water cycle mean, and why would it be temporary?] [Robert Scholes, South Africa]	Accepted - Discussed in section 6.5. This hydrological response is independent of the CDR method. Reference is provided in section 6.5
6-380	6	6	20	6	21	the authors should explain more : "removal of atmospheric CO2 would lead to a temporary acceleration in global water cycle" [CATHERINE BELTRAN, France]	Accepted - see response 379

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-381	6	6	20	6	21	Temporary acceleration of H2O cycle as a result of CDR: isn't this just an outcome of the way CDR is simulated? See comment 6. [Jennifer Johnson, United States of America]	Accepted - see response 379
6-382	6	6	20	6	26	This paragraph includes a number of hypotheticals lacking in more detailed explanation. [Andrew Glikson, Australia]	rejected - Not enough space to expand executive summary.
6-383	6	6	21	6	21	Insert "the". (Note -- this chapter could use some proof-reading to catch these minor slips, which I've seen several of in just a few pages. I won't be catching them all.) [James Butler, United States of America]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-384	6	6	21	6	21	Insert "the" before "global". [James Butler, United States of America]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-385	6	6	21	6	21	Change to "acceleration in the global". [Daniel Metcalfe, Sweden]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-386	6	6	21			..in the global water cycle (or: of the global water cycle?) [Almut Arneth, Germany]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-387	6	6	21			add 'the' before 'global [Jeffrey Obbard, Singapore]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-388	6	6	21			How does CO@ accelerate the global water cycle specifically? [Jeffrey Obbard, Singapore]	Accepted - see response to 379. "accelerate" changed to "intensify"
6-389	6	6	21			add 'positive or negative' after 'have' [Jeffrey Obbard, Singapore]	Taken into account - the suggested words added
6-390	6	6	22			Explain how changes in forest area will change surface energy budgets; not in detail but in directions. [Göran Ågren, Sweden]	reject- explination too complicated for executive summary. Discussed in section 6.5 and references cited there
6-391	6	6	22			change 'over' to 'In' [Jeffrey Obbard, Singapore]	Editorial - wording corrected. Copyedit to be completed prior to publication.
6-392	6	6	22			"by altering the surface energy budget": This should also lead to changes in trace gas emissions [Zongbo Shi, United Kingdom]	Accepted - text changed.
6-393	6	6	23	6	23	do you mean …increase the use of nitrogen and phosphorus [Robert Scholes, South Africa]	Accepted - text revised
6-394	6	6	24	6	24	So, the oceans are going to get acidified with increasing OR decreasing CO2? I'd be much more careful with or just remove this message . . . [James Butler, United States of America]	Accepted - "deep" ocean gets acidified by iron-fertilization. See section 6.5 and the literature cited there
6-395	6	6	24			explain how enhanced production increases acidification [Jeffrey Obbard, Singapore]	Accepted - see response to 394
6-396	6	6	25	6	25	This doesn't make clear sense, i suggest you change either to "lead to expanded regions" or "lead to expansions in the regions". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-397	6	6	25			change 'expand' to 'expanded' [Jeffrey Obbard, Singapore]	Accepted - text revised. Combined with other comments: 6-396, 6-398.
6-398	6	6	25			"Expand regions" should be "Expanded regions"??? [Zongbo Shi, United Kingdom]	Accepted - text revised. Combined with other comments: 6-396(397).
6-399	6	6	26	6	26	Change to "disturbance to the regional". [Daniel Metcalfe, Sweden]	Editorial - wording corrected
6-400	6	6	26			change to 'cycles' [Jeffrey Obbard, Singapore]	Editorial - wording corrected
6-401	6	6	32			Figure 6.3a: Make it clear that the Oxygen axis represents the CHANGE in atmospheric concentrations. The caption implies that the curves ARE the concentrations. [Richard Bourbonniere, Canada]	Noted - figure caption revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-402	6	6	48	6	49	Welp et al. (Nature 2011) used 18O and suggested the 120 Pg C uptake by terrestrial ecosystems may be too low, and gave a best guess of 150–175 petagrams of carbon per year better reflects the observed rapid cycling of CO2. Although several different approaches have converged on ~130 Pg C, and Welp et al. state their estimate is still tentative, the authors should consider this new estimate, perhaps by saying recent 18O isotope analysis suggests this estimate may be low. Welp, L.R., R.F. Keeling, H.A. J. Meijer, A.F. Bollenbacher, S.C. Piper, K. Yoshimura, R. J. Francey, C.E. Allison, M. Wahlen. 2011. Interannual variability in the oxygen isotopes of atmospheric CO2 driven by El Niño. 29 September 2011, Vol. 477, Nature 579, 579-582. doi:10.1038/nature10421 [Beverly Law, USA]	rejected - this is already addressed in section 6.3.5.1.5
6-403	6	6				Box 6.1, Figure 2 could possibly be omitted, as Figure 6.4 gives a more detailed and informative presentation of N cycle interactions. [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	taken into account - figure will be maintained but modified
6-404	6	7	3	7	6	The most important and most abundant greenhouse gas is water vapour. It is just as "long-lived" as carbpn dioxide in that both are constantly recycled. Methane and nitrous oxide are not particularly "long-lived". None of them is particularly "well-mixed". You have no figures for 1750 and the large number of measurements made between 1815 and 1958 have been suppressed and ignored (see Beck, E-G, 2007. 150 Years of Atmospheric Gas Analysis by Chemical Methods, Energy and Environment 18 259-281) [VINCENT GRAY, NEW ZEALAND]	see comment 6-103
6-405	6	7	6			Terminology ‘atmospheric branch of biogeochemical cycles’ is not familiar to me. Would ‘atmospheric phase’ be a possible substitution. [Christina Tonitto, USA]	Accepted - text revised
6-406	6	7	7			"natural"? suggest strike or make it clear that this anthro material is a perturbation on the natural cycle. [Stephen E Schwartz, USA]	Taken into account - Sentence revised
6-407	6	7	8	7	8	delete 'etc' (poor scientific writing style) [Peter Burt, UK]	Editorial - text revised
6-408	6	7	8	7	8	system → System [Peter Burt, UK]	Editorial - text revised
6-409	6	7	10	7	10	"changes in the latter can also modify …" The term "feedbacks" seems appropppriate in the context of this sentence. [Andrew Glikson, Australia]	Accepted - text revised
6-410	6	7	11			…glacial-interglacial cycles [Almut Arneth, Germany]	Accepted - text revised
6-411	6	7	11			remove 'as witnessed' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-412	6	7	11			"witnessed"; who was witnessing it; how about a simple "occurred"?; also line 32 [Stephen E Schwartz, USA]	Editorial - text revised
6-413	6	7	16	7	16	Add "atmospheric" to CO2 [Nicolas Gruber, Switzerland]	Accepted - text revised
6-414	6	7	16		29	In which domain is fossil fuel? Good oppty to make the point that combustion of fossil fuel has moved C from slow domain to fast domain; a major perturbation in C cycle. Almost getting there at line 26. [Stephen E Schwartz, USA]	Accepted - text revised
6-415	6	7	16			Terminology ‘atmospheric branch of biogeochemical cycles’ is not familiar to me. Would ‘atmospheric phase’ be a possible substitution. [Christina Tonitto, USA]	Accepted - text revised
6-416	6	7	17	7	17	system → System [Peter Burt, UK]	Editorial - combined with same comment 6-408
6-417	6	7	18	6	20	"A fast domain with large exchange fluxes and relatively rapid reservoir turnovers, which consists of carbon in the atmosphere, the ocean and on land in living vegetation and soils."...freshwater sediments might be mentioned here, too. …Downing et al. (2008) estimated organic carbon (OC) burial over the past century in 40 impoundments in one of the most intensively agricultural regions of the world. These analyses suggest that OC sequestration in moderate to large impoundments may be double the rate assumed in previous analyses. The OC buried in these lakes originates in both autochthonous and allochthonous production. Extrapolation suggests that they may bury 4 times as much carbon (C) as the world’s oceans. The world’s farm ponds alone may bury more OC than the oceans and 33% as much as the world’s rivers deliver to the sea. Downing, J.A., Cole, J.J., Middelburg J.J., Striegl, R.G., Duarte, C.M., Kortelainen, P., Prairie, Y.T. & Laube, K.A. 2008.	Accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Sediment organic carbon burial in agriculturally eutrophic impoundments over the last century. Global Biogeochemical Cycles 22, GB1018, doi:10.1029/2006GB002854. [Pirkko Kortelainen, Finland]	
6-418	6	7	18	7	18	: → . [Peter Burt, UK]	Editorial - text revised
6-419	6	7	18	7	18	"One can principally distinguish…" [Leticia Cotrim da Cunha, Germany]	Editorial - text revised
6-420	6	7	18	7	29	The use of time scales as a frame of reference for understanding the carbon cycle is an important concept, and the authors should be commended for beginning with this perspective. I hope it is not presumptous to suggest a more appropriate citation for this perspective: [Sundquist, E.T., 1986, Geologic analogs: their value and limitations in carbon dioxide research, in Trabalka, J.R., and Reichle, D.E., eds., The Changing Carbon Cycle: A Global Analysis: New York, Springer-Verlag, p. 371-402]. A copy of this paper can be provided on request. [Eric Sundquist, United States of America]	Reference included
6-421	6	7	20	7	20	Add and freshwaters including sediments, i.e. which consits of carbon in the atmosphere, the ocean and on land in living vegetation, soils and freshwaters including sediments. [Gesa Weyhenmeyer, Sweden]	Accepted - text revised
6-422	6	7	21	7	21	The portion ", to decades," seems superfluous and it's not clear to which portion it refers. I suggest you change to ", to decades - millennia for the various". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-423	6	7	21			I would say years as lower limit rather than decades for some plant and biotic soil components, but this is, of course, a matter of the resolution that you actually use in your models. [Peter Högberg, Sweden]	Wording changed
6-424	6	7	21			add ', and' after 'centuries' [Jeffrey Obbard, Singapore]	Editorial. Accepted.
6-425	6	7	22	7	25	I don't see what the strong radiative properties of CH4 makes it an independent biogeochemical cycle from CO2. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account - text revised
6-426	6	7	23	7	25	There is also a subset of ocean sediments that belongs to the "fast" domain. Not a huge amount of carbon but should be mentioned. [James Christian, Canada]	REJECTED: even if they contain relative fast turnover, these sediment layers are not affected significantly under the anthropogenic perturbation
6-427	6	7	26			"... slow domain can be assumed to be at steady state." Not with humans pumping crude oil. [Francois DANIS, France]	REJECTED: here we talk about the natural part of the CC which may respond to the perturbation, not the perturbation itself
6-428	6	7	27	7	28	What is meant by (se pages from geothermal vents and volcanoes) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	REJECTED: seepage is defined in Oxford dictionary and describes the process very clearly.
6-429	6	7	27	7	68	Style for quoting rates and quantities changes. Previously (in the Executive Summary) there was a space between the unit and the parameter (e.g. Pg C). Using the space is better style and easier to read. [Peter Burt, UK]	Editorial. Copyedit to be completed prior to publication.
6-430	6	7	28			add 'as' [Jeffrey Obbard, Singapore]	Editorial. Copyedit to be completed prior to publication.
6-431	6	7	31	7	31	..the Industrial Revolution the fast domain has also been...' [Peter Burt, UK]	Editorial. The text revised accordingly.
6-432	6	7	31	7	31	"…, the fast domain has also been…" [Leticia Cotrim da Cunha, Germany]	Editorial. Combined with same comment 6-431, 6-433.
6-433	6	7	31	7	31	Change to "revolution, the fast domain has also been" [Daniel Metcalfe, Sweden]	Editorial. Combined with same comment 6-431, 6-432.
6-434	6	7	31			Delete "also" [Zongbo Shi, United Kingdom]	Editorial. The text revised accordingly.
6-435	6	7	33	8	18	All of the values given here and in Figure 6.1 should be referenced to primary data sources and methods of calculation. The absence of primary source citations for carbon-cycle stocks and fluxes has been a recurrent problem in IPCC assessments. Because the assessments are so widely cited, improperly documented	accepted - figure caption modified to include primary references and stated uncertainties

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						estimates have been widely propagated even though they do not represent the current state of knowledge. For example, the best compilation of total DIC in the oceans is that of Key et al. 2004, who calculated a total of close 36000 PgC based on extensive oceanwide surveys. Allowing for an additional ~1000 PgC in DOC, the total carbon in the oceans is about 37000 PgC, not 38000 as indicated in the figure (incorrectly given as 3800 PgC in the text, p.7 line 55). This difference may seem small, but it is well outside any reasonable estimate of uncertainty based on the measurements used by Key; and in any case, one should always strive to use the best estimates available. Another example is the air-sea gas exchange fluxes, given in the figure as 90 and 92 PgC/yr. These values originated in estimates made years ago from calculations that indicated 70 PgC/yr natural background exchange (both ways) plus 20 and 22 PgC/yr due to anthropogenic carbon. Using the same approach, the anthopogenic fluxes should now be closer to 26 and 28 PgC/yr, and the total exchange fluxes should be 96 and 98 PgC/yr. Another problem is the values given in the figure for fossil fuels, which appear to be undocumented estimates of identified reserves. Given the chapter's emphasis on projections to the year 2100, the more appropriate estimates would be for identified resources (not reserves), which are substantially larger. (If the values in the figure are taken as real upper limits, there is no need to worry about RCP's 6.0 and 8.5, as they would require cumulative combustion totaling more than the indicated amounts.) Please check all values of carbon stocks and fluxes in the figure and text and provide citations for primary data sources and methods of calculation. Also please reconcile values in the text with values in the figure (e.g., the values for the atmosphere are different). To the extent possible, uncertainties should also be estimated, perhaps in a separate table. [Eric Sundquist, United States of America]	
6-436	6	7	37			It is difficult to see which numbers represent reservoirs and which represent fluxes. Use roman and italic characters to separate them? What do the values under Land-Atmosphere Flux and Ocean-Atmosphere Flux mean? [Göran Ågren, Sweden]	Wording changed
6-437	6	7	37			Figure 6.1 caption: "resp. carbon" something missing here [James Christian, Canada]	Wording changed
6-438	6	7	38	7	38	"resp. carbon"? What does it mean? [Leticia Cotrim da Cunha, Germany]	Wording changed
6-439	6	7	38	7	39	Describe blue vs. red arrows in caption (similar to Figure 6.3) [Christina Tonitto, USA]	Wording changed
6-440	6	7	39			"resp.": what does it mean? [Zongbo Shi, United Kingdom]	Wording changed
6-441	6	7	43	7	43	How can the mass of carbon in atmospheric CO and CH4 be the same if the mixing ratio of CH4 is ~1700 ppb and CO is ~ 100 ppb? [Christopher Butenhoff, USA]	Wording changed - correct numbers inserted
6-442	6	7	43	7	44	Change "hydrocarbons and other chemical compounds" to "hydrocarbons and other organic compounds" [James Christian, Canada]	Accepted. The text revised.
6-443	6	7	43			CO and CH4 are not ~ 2 PgC each. For one thing CO is a fraction of the carbon compared to CH4. [Mohammad Aslam Khan Khalil, USA]	Wording changed - correct numbers inserted
6-444	6	7	46	7	46	The TAR reported 466 to 654 PgC Table 3.2 TAR [Stefan Gerber, USA]	Numbers from TAR inserted
6-445	6	7	46	7	49	Referencing style wrong. Either there is one '(' too many or one ')' too few in each instance. [Peter Burt, UK]	Editorial. Copyedit to be completed prior to publication.
6-446	6	7	46	7	53	Add lake sediments (about 0.6 Pg C yr-1 according to Tranvik et al. 2009 in Limnology and Oceanography). In addition add that atmospheric CO2 ….subsequently released back into the atmosphere ….or transported to the oceans [Gesa Weyhenmeyer, Sweden]	Taken into account: the storage of 0.6 (Tranvik et al., 2009) is not mentioned here, but the natural flow of carbon from land via freshwater to the ocean is mentioned
6-447	6	7	46		49	Lots of ")" is missing. For example, (35-550 PgC, (Prentice et al., 2001) should be (350-550 PgC, (Prentice et al., 2001)) or (350-550 PgC, Prentice et al. (2001)) [Zongbo Shi, United Kingdom]	Editorial (combined with same coment 6-445). Copyedit to be completed prior to publication.
6-448	6	7	46		53	through photosynthesis' should be 'by photosyn..' [David Newbery, CH]	Wording changed
6-449	6	7	48			It is not quite correct to show Tarnocai separate from the Batjes number because there is some overlap. Also	Taken into account. Revised numbers from Schuur

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						the 2000 Jobbagy and Jackson is another good reference for total C storage. With that paper, you can subtract the amounts for arctic and boreal, THEN add Tarnocai total northern hemisphere pool to that. I can give you a best guess calculation if you'd like. [Edward Schuur, USA]	inserted into text
6-450	6	7	49			insert "gross" before "photosynthesis" [Roger Gifford, Australia]	Editorial - text revised.
6-451	6	7	50	7	50	Should the terms heterotrophic and autotrophic be defined here, or are they already defined somewhere else? [Daniel Metcalfe, Sweden]	Combined with comment 6-452. The terms are defined in sentence.
6-452	6	7	50			As introductory material I suggest that after "autotrpohic" it is worthwhile putting "plant" in parentheses, and after "heterotrophic" it is worth putting "soil microbial" in parentheses. [Roger Gifford, Australia]	Accepted. The text revised.
6-453	6	7	51		52	"Photosynthesis by the vegetation in the northern extra tropical hemisphere causes the characteristic seesaw seasonal pattern in atmospheric CO2"; photosynthesis together with decay during the non-growth seasons; photosynthesis alone won't make the seesaw pattern. Is it a "seesaw" pattern or a "zigzag pattern"? [Stephen E Schwartz, USA]	Wording changed
6-454	6	7	52	7	52	extra tropical → extratropical [Peter Burt, UK]	Editorial - text revised. Combined with comment 6-458.
6-455	6	7	52	7	52	The northern hemisphere contributes the most, but i guess the southern extra tropical land surface plays it's part too? [Daniel Metcalfe, Sweden]	Taken into account: the storage of 0.6 (Tranvik et al., 2009) is not mentioned here, but the natural flow of carbon from land via freshwater to the ocean is mentioned
6-456	6	7	52	7	52	sawtooth seasonal oscillation …. rather than seesaw pattern [Robert Scholes, South Africa]	Wording changed
6-457	6	7	52			About CO2 seasonal variation, what about burning more fuel during the winter? How much does it count compare to the photosynthesis effect? [Francois DANIS, France]	Rejected - fossil fuel emission seasonal cycle is very small compared to the sum of photosynthesis and respiration in the Northern Hemisphere
6-458	6	7	52			Should be "northern extratropical hemisphere"?? [Zongbo Shi, United Kingdom]	Editorial - text revised. Combined with comment 6-454.
6-459	6	7	53			Because Figure 6.3 appears later in the text, perhaps cite the section in addition to the figure? (see 6.1.2 Figure 6.3) [Christina Tonitto, USA]	Accepted - the text revised accordingly.
6-460	6	7	55	7	55	You mean 38000 PgC in the ocean. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Typo corrected (combined with other comments: 6-461 - 6-468).
6-461	6	7	55	7	55	Ocean reservoir is 38000 (typo one "0" is missing [Stefan Gerber, USA]	Taken into account - text revised.
6-462	6	7	55	7	55	First, this should read "38'000" instead of "3'800". Second, I think it is time to update the oceanic inventory of dissolved inorganic carbon. Based on GLODAP, the inventory is about 36'600 Pg C, but this does not include the marginal seas. Based on a rough estimate for the marginal seas, I come up "only" with an oceanic inventory of about 37'500 Pg C. Given more time, this could be much refined, instead of everybody in the community continuing to use an old number that was based on GEOSECS data from the 1970s. [Nicolas Gruber, Switzerland]	Typo changed. Updated numbers from Gruber solicited, but they are not published. To be discussed
6-463	6	7	55	7	55	"3800 PgC" should, I think, be "38000 PgC". [David Pearson, United Kingdom]	Typo corrected (combined with other comments: 6-461 - 6-468).
6-464	6	7	55	7	55	38000, not 3800 [Iain Colin Prentice, Australia]	Typo corrected (combined with other comments: 6-461 - 6-468).
6-465	6	7	55	7	55	The oceanic carbon reservoir (~3800 PgC)' the number 3800 PgC is wrong, it should presumably be 38000 PgC [Reiner Steinfeldt, Germany]	Typo corrected (combined with other comments: 6-461 - 6-468).
6-466	6	7	55			3800 should be 38000 [Göran Ågren, Sweden]	Typo corrected (combined with other comments: 6-

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							461 - 6-468).
6-467	6	7	55			Should it be ~38,000 PgC rather than ~3800? [Roger Gifford, Australia]	Typo corrected (combined with other comments: 6-461 - 6-468).
6-468	6	7	55			Should be 38,000Pg, right? [Edward Schuur, USA]	Typo corrected (combined with other comments: 6-461 - 6-468).
6-469	6	7	56	8	3	This does not mention DOC which is the vast majority of reduced carbon. Also change "primarily phyto-, zooplankton and other microorganisms" to "primarily phytoplankton and other microorganisms". Zooplankton are not microorganisms and it's probably safe to say that metazoan zooplankton account for a small fraction of the carbon in living biomass (see e.g. Christian and Karl 1994 JGR 99: 14269). [James Christian, Canada]	Wording changed - To be done - need revision of text on DOC
6-470	6	7				Figures, page 7. If I understand the top part of Figure 6.4, the yellow arrows represent input of anthropogenic plus natural nitrogen in Tg N/yr. The numbers in the figure for deposition to the ocean of NOy and NHx (20 and 17 TgN/yr respectively) are very close to the numbers of 23 and 24 TgN/yr respectively in Duce et al., Science, 320, 893 (2008). However, completely left out of Figure 6.4 is an estimate of the deposition of organic nitrogen species, which were found to be ~ 20 TgN/yr, or about 1/3 of the total input of atmospheric Nr to the ocean - and the majority of this organic N is apparently anthropogenic in origin. Organic nitrogen species are an important part of the input of water-soluble N to the ocean and should not be ignored. [Robert Duce, USA]	Agreed & change to be made.
6-471	6	7				Fig 6.1 This would be more informative to a) Put "Gross photosynthesis" alongside the blue down-arrow on the left hand side, and b) to have two blue up-arrows from the terrestrial zone, one labeled "plant respiration 60" and the other labelled decomposition 60". It would be advanatgeous to find a way to depict Net Primary Production (ie new biomass growth) which is the difference between Gross Photosynthesis and autotrophic respiration. (see comment for p64 lines 13-20). [Roger Gifford, Australia]	Noted - comment considered in revised Figure
6-472	6	7				All comments refer to Ch 6. alone [David Newbery, CH]	Noted - comment unclear
6-473	6	7				multitude' - suggest ' very wide set of' [David Newbery, CH]	Editorial - wording corrected.
6-474	6	7				note: photosynthesis is much less in southern hemisphere [David Newbery, CH]	Noted -
6-475	6	7				Fig 6.4 comprises typographical errors, e.g. "industrial proceses" and needs revision. In addition, the label "Rivers, estuaries, coasts" could be changed to "Rivers, estuaries, coastal waters" which would be more appropriate. In the top panel, check if it is correctly "Soil", as the image suggests it reads "Soii" now. In addition, for the labels in the upper panel, using commas to separate entries would be useful. E.g. "Agriculture Sewage" may be misleading and the reader could assume that it is agricultural waste water, not two different processes, agriculture and sewage treatment. Last, but not least, "Agriculture" is not specific, as other agricultural processes (e.g. BNF cultivation) are separate, so does the value for agriculture refer to animal excreta or what is the reference? [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	Noted - comment considered in revised Figure
6-476	6	8	1	8	1	Microbial carbon pump is suggested to be considered here, This is becasue microbes do not only respire DOC to CO2, but also produce RDOC. RDOC is the majority of DOC pool in the ocean. See: Jiao et al. 2010. Microbial production of recalcitrant dissolved organic matter: long-term carbon storage in the global ocean. [Rongshuo Cai, China]	See 6-469
6-477	6	8	2	8	2	edit to: '..which is subsequently transformed...' [Peter Burt, UK]	Editorial - wording corrected. Combined with comment 6-478
6-478	6	8	2			change to 'is subsequently' [Jeffrey Obbard, Singapore]	Editorial - wording corrected. Combined with comment 6-477
6-479	6	8	5	8	5	To better convey the importance of the biological pump, I suggest adding "that alllows the ocean to absorb substantially more CO2 from the atmosphere than it would in a perfectly mixed ocean." [Cynthia Nevison, USA]	To be done

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-480	6	8	6	8	6	"Upwelling deeper waters are therefore supersaturated with carbon and release this in the form of CO2 back to the atmosphere". It may help to mention the water warm at shallower depths which reduces CO2 solubility. [Andrew Glikson, Australia]	To be done
6-481	6	8	8	8	8	insert 'the' after 'termed' [Peter Burt, UK]	Editorial (combined with comments 6-483, from 6-485 to 6-488). Corrected.
6-482	6	8	8	8	9	Biological pump. I suggest to be more precise here. What is described here is what many of us call the "soft-tissue" or "organic carbon" pump. The biological pump is actually the sum of the soft-tissue and carbonate pumps. [Nicolas Gruber, Switzerland]	To be done
6-483	6	8	8			add 'the' after 'termed' [Jeffrey Obbard, Singapore]	Editorial (combined with comments 6-481, and from 6-485 to 6-488). Corrected.
6-484	6	8	11	8	11	"bicarbonate". It will help many readers if the chemical formulas of components such as bicarbonate, carbonic acid etc are specified in the text, in brackets. [Andrew Glikson, Australia]	To be done
6-485	6	8	12	8	12	insert 'to' after 'counter' [Peter Burt, UK]	Editorial (combined with comments 6-481, 6-483, and from 6-486 to 6-488). Corrected.
6-486	6	8	12	8	12	Should read 'counter to' in this sentence: '...this cycle operates counter the marine biological pump:…' [Dave Reay, UK]	Taken into account - text revised.
6-487	6	8	12	8	14	"cycle operates counter to": I have to admit that I am not a big fan of the expression "counterpump" because this gives the impression that carbon is actually flowing in opposite direction, which is clearly not the case. I therefore suggest to avoid this term alltogether and then be more explicit about what is meant here. It is the imprint of this "pump" on surface ocean pCO2, which is opposite of the imprint that the soft-tissue pump has. [Nicolas Gruber, Switzerland]	To be done
6-488	6	8	12			counter TO the [Richard Bourbonniere, Canada]	Editorial (combined with comments 6-481, 6-483, and from 6-485 to 6-487). Corrected.
6-489	6	8	14	8	15	Does not distinguish between deposition and burial: the quantity of carbon that "reaches the sea floor" is much greater than that which is "stored in sediments for millennia and longer". [James Christian, Canada]	To be done
6-490	6	8	16			. . . cycle exists due to higher solubility of CO2 in colder . . . [Richard Bourbonniere, Canada]	Editorial - wording corrected.
6-491	6	8	20	8	52	the content of §6.1.1.2 should be more consistent with the summary : "Sources of CH4 can be thermogenic, including (1) natural emissions from geological sources (marine seepages, geothermal vents, terrestrial microseepages, mud volcanoes) and (2) anthropogenic emissions from fossil fuel mining or incomplete burning of fossil fuels (Figure 6.2). A second category consists in pyrogenic sources, including natural fires and combustion of biomass and biofuels. A third category includes biogenic sources with (1) the natural emissions from wetlands, oceans and termites as well as (2) the anthropogenic sources from rice agriculture, livestock, landfills and waste treatment. In general, biogenic CH4 is produced from organic matter under anoxic conditions by fermentation processes of methanogenic microbes (Conrad, 1996), Thermogenic sources are due to the thermal breakdown of organic matter at great depth. Some geological sources can have a biogenic and/or a thermogenic origin (Etiope, 2008). [philippe bousquet, France]	Wording changed
6-492	6	8	22	8	23	the phrasing of the first sentence seems inapropriate. Suggested phrasing : The global cycle of atmospheric methane (CH4) is a short loop of the global carbon cycle, as methane lifetime is less than 10 years in the troposphere. [philippe bousquet, France]	Editorial - wording corrected.
6-493	6	8	22	8	23	"However, because ….CO2 (Chapter 8)" does not belong here. Since this is not part of the reason why it is loosely coupled to the global carbon cycle? [Stefan Gerber, USA]	Taken into account - text revised (see reply to 6-425)
6-494	6	8	22			Again, "loop" to me doesn't seem to be a good term to use. [Almut Arneth, Germany]	Accepted - text revised (see 6-494)
6-495	6	8	23	8	25	Certainly some properties of CH4 put it beside the CO2 part of the C cycle, but the microbial production of	REJECTED - not understood

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						CH4 [Richard Bourbonniere, Canada]	
6-496	6	8	25	8	25	"only loosely coupled to the carbon cycle." More correctly the methane cycle constitutes a subcycle of the carbon cycle. [Andrew Glikson, Australia]	Accepted - added to the text
6-497	6	8	25	8	25	the CH4 cycle is part of the C cycle, so how can it be loosly coupled? I think you mean that it is somewhat independent of the CO2 parts of the C cycle [Robert Scholes, South Africa]	Taken into account - text revised
6-498	6	8	27	8	27	seepages instead of see pages. [Leticia Cotrim da Cunha, Germany]	Editorial - the word corrected.
6-499	6	8	27	8	28	end line text does not make sense [Peter Burt, UK]	Corrected
6-500	6	8	27	8	28	"(see pages from geothermal vents and volcanoes)" . Which pages? [Andrew Glikson, Australia]	Corrected
6-501	6	8	27			delete "either" [Roger Gifford, Australia]	Editorial (combined with comment 6-502) - corrected.
6-502	6	8	27			Sources of CH3 are either non-biogenic…: Should "either" be deleted? [Zongbo Shi, United Kingdom]	Editorial (combined with comment 6-501) - corrected.
6-503	6	8	31	8	31	"liivestock". Why only livestock? - methane is released from creatures and animals in general, including hominids. [Andrew Glikson, Australia]	Changed to "ruminants"
6-504	6	8	31			after landfills add " man-made lakes and wetlands" [Roger Gifford, Australia]	Accepted - added to the text
6-505	6	8	32			"preindustrial"; seems inappropriate; give date instead. Or, as at page 6-17, line 49 refer to "fossil fuel era". [Stephen E Schwartz, USA]	Changed to "Fossil fuel era"
6-506	6	8	33			Please include more recent publications in addition to Conrad (1996) [Christoph Mueller, Germany]	To be done
6-507	6	8	34	8	34	replace "by the" with "through" [Stefan Gerber, USA]	Editorial - wording corrected.
6-508	6	8	34	8	35	Should say explictly that methane is removed in the stratosphere by reaction with chlorine radicals and oxygen radicals (O1D). [William Collins, United Kingdom of Great Britain & Northern Ireland]	Wording changed
6-509	6	8	34	8	35	"Atmospheric CH4 is also removed in the stratosphere by the ozone chemistry" is incorrect. It is removed in the stratosphere by reaction with chlorine and/or oxygen (O1D) atoms, at the surface by bacterial oxidation in dry soils, and by reaction with chlorine atoms in the marine boundary layer. These sinks are in addition to its main sink by reaction with OH. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Wording changed
6-510	6	8	34		35	needs a reference to support this claim [David Newbery, CH]	Wording changed
6-511	6	8	35	8	35	"…dry soils" : add "and possibly by reaction with chlorine in the marine boundary layer (Allan 2007)" [philippe bousquet, France]	Accepted - text revised.
6-512	6	8	35	8	35	'...and at the surface by oxidation in dry soils.' Suggest authors consider different wording here - 'dry soils' suggests very low % WFPS, but high affinity methane oxidation is actually limited by very low soil moisture contents. Maybe 'well-drained' or 'well-aerated' soils would be more appropriate? [Dave Reay, UK]	Wording changed
6-513	6	8	37			Figure 6.2: biomass burning is 100% anthropogenic? [James Christian, Canada]	accepted - this is clarified in figure
6-514	6	8	41	8	41	"pool (1500–7000 PgC,(Archer, 2007) of". Delete the coma after "PgC" [Andrew Glikson, Australia]	Editorial (similar comment 6-519) - reference style to be corrected before publication.
6-515	6	8	41	8	52	The space given to hydrates seems a bit large regarding the second order of this source. One should be careful not to give the impression that hydrates might become a large source in the next decades. Destabilization of hydrates, if occuring in the future, rely more to century scales than decadal scales. This paragraph should be re-written [philippe bousquet, France]	taken into account - this paragraph is shortened and details moved to section 6.4.7.2
6-516	6	8	41	8	52	Paragraph on Hydrates: In the executive summary there is a reference to thermal conductance of the ocean floor, however in the discussion on methane hydrates this is not mentioned. [Stefan Gerber, USA]	taken into account - executive summary written to be consistent with modified section 6.4.7.2

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-517	6	8	41			it is unclear to me how this value for the pool of hydrated CH4 relates to the corresponding value give on page 7 line 48 [Per Erik Karlsson, Sweden]	rejected- hydrate pool is not the same as permafrost pool
6-518	6	8	41			change to 'hydrate' [Jeffrey Obbard, Singapore]	Editorial - corrected.
6-519	6	8	41			should be (1500-7000 PgC, Archer, (2007)) [Zongbo Shi, United Kingdom]	Editorial (combined with similar comment 6-514) - reference style to be corrected before publication.
6-520	6	8	44	8	44	sea-level → sea level [Peter Burt, UK]	Editorial - corrected.
6-521	6	8	45	8	46	If you look closely at Shakova paper, they sort of imply that their methane flux is hydrates, but it does not say this in the paper anywhere, and there is no data distinguishing hydrates from the breakdown of organic C in permafrost. The shelf is inundated terrestrial yedoma, so the flux they observe could be from organic C NOT hydrates. They show no isotope data in that paper that could potenially help resolve this, if hydrates are from deep natural gas reservoirs [Edward Schuur, USA]	Wording changed
6-522	6	8	47	8	47	Is the estimate for hydrates (5-10 Tg) given for Arctic only or global scale ? This is unclear. [philippe bousquet, France]	Wording changed - number is for Eastern Siberian shelf only
6-523	6	8	49			change to 'affected' [Jeffrey Obbard, Singapore]	Editorial - wording corrected.
6-524	6	8	50	8	52	Hence CH4 emissions from this hydrate pool will manifest itself as chronic 51 seepages, potentially providing an amplifying effect similar to other terrestrial biogeochemical feedbacks 52 (Archer, 2007).' May be worth commenting that much of the CH4 likely to be released from hydrate sources will be oxidised before it reaches the atmosphere - so effectively a CO2 release rather than a CH4 release. [Dave Reay, UK]	Wording changed
6-525	6	8	52	8	52	The "end" of the sory of emission of methane by plants is missing there : "A source from plants under aerobic conditions has been suspected to contribute significantly to the global methane budget (Keppler et al., 2006) but several studies contradict such a large source in nature (e.g. Dueck et al., 2007; Nisbet et al., 2009) and explain Keppler's results by spontaneous breakdown of plant materia under UV stress conditions, which releases methane" [philippe bousquet, France]	Additional text inserted
6-526	6	8	54	9	53	is poorly written in English, many typos and grammar mistakes (leave to final editing team) [David Newbery, CH]	Noted.
6-527	6	8	54	12	10	Throughout this section "Anthropogenic Perturbation " the "perterbatioin" is of of atmospheric concnetrations but the "anthropogenic activity" is is by various emissions. The relationaship between these two diffeent concepts is never explained. [VINCENT GRAY, NEW ZEALAND]	Noted - relationship between emissions and concentration changes is described in details in sections 6.3 for historical and present, and in section 6.4 for future changes
6-528	6	8	56	8	56	Shouldn't this section be called CO2 cycle? [Leticia Cotrim da Cunha, Germany]	Rejected - the term carbon cycle part of the title of the paper
6-529	6	8				I think that the carbon reservoirs that constitute the pool of 1500 - 7000 PgC have to be discussed more precisely. First this is an incredibly wide range. Second, some of this is more vulnerable than the rest. The pool should be classified by vulnerability to release over the warming expected during the next century [Mohammad Aslam Khan Khalil, USA]	REJECTED here; this discussion comes in later sections.
6-530	6	8				Fig. 6.2: the units should be defined either in the caption or on the picture, e.g. "PgC" and "PgC/yr". [David Pearson, United Kingdom]	Accepted - units changed to Pg C everywhere
6-531	6	8				fig 6.6;suggest extend to present values of mixing ratios, 2010. Gives perspective to the changes shown in past. Same figure 6.7. I can see how this would affect the scale of the figure; maybe do it by an additional panel. [Stephen E Schwartz, USA]	Rejected - this will make the figure too complex. Small changes in the past will be invisible on the background of antropogeinc chages.
6-532	6	9	1	9	1	industrial revolution → Industrial Revolution [Peter Burt, UK]	Editorial - corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-533	6	9	1	9	2	The word "by" is strange here, i suggest "revolution, burning of fossil fuels by human activities". Change to "have released large". [Daniel Metcalfe, Sweden]	Editorial (combined with comments 6-534 to 6-536) - wording corrected.
6-534	6	9	1			add 'supported' after 'activities' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-535	6	9	2	9	2	release → released [Peter Burt, UK]	Editorial (the same comment 6-536) - corrected.
6-536	6	9	2			change to 'released' [Jeffrey Obbard, Singapore]	Editorial (the same comment 6-535) - corrected.
6-537	6	9	3	9	3	This sentence is constructed awkwardly, i suggest "estimated quite accurately (~5%) for recent decades from statistics of fossil fuel use. Estimates". [Daniel Metcalfe, Sweden]	Editorial (similar to comment 5-538) - wording corrected.
6-538	6	9	3			place 'quite accurately' after 'estimated' [Jeffrey Obbard, Singapore]	Editorial (similar to comment 6-537) - wording corrected.
6-539	6	9	4	9	4	delete 'time' (remove tautology) [Peter Burt, UK]	Editorial - corrected.
6-540	6	9	4	9	4	5% of What? Ambiguous. [Rongshuo Cai, China]	accepted - text was modified see comment 6-544
6-541	6	9	4	9	6	Executive Summary gives 365 up to 2010. Would be better to give the same numbers. Include uncertainty (as done in the exec summary) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted- text modified to 365
6-542	6	9	4	9	6	The ambiguous word “small” in relation to the contribution from cement manufacture should be replaced with something more quantitative. Calculating the cumulative total up to 2008 from the CDIAC website gives 8 PgC. The sentence could therefore be “This includes 8 PgC of CO2 caused by the anthropogenic production of cement.” [Ray Nassar, Canada]	Wording changed
6-543	6	9	4			Andres et al 2012, BGD has more on uncertainty. The uncertainty is also increasing as developing countries contribute more. [Glen Peters, Norway]	Wording changed including reference to Andres et al.
6-544	6	9	4			(~5%): is this an uncertainty? If it is, please state it clearly [Zongbo Shi, United Kingdom]	Wording changed
6-545	6	9	4			Could not see any dots in the figures, such as Law CO2? What does "dc" mean? [Zongbo Shi, United Kingdom]	Noted - comment considered in revised Figure
6-546	6	9	5	9	5	1750-2008 → (1750 - present) [Peter Burt, UK]	Wording changed
6-547	6	9	5	9	5	340 Pg C cited here differs from 365 Pg C cited in the Executive Summary and Table 6.1 [Cynthia Nevison, USA]	Wording changed - number from summary included
6-548	6	9	5	9	5	make sure all the numbers agree. Here it says 340. sewhere 365+-22 [Robert Scholes, South Africa]	see 6-548
6-549	6	9	5			Cement emissions are not really "small" and are an important source in some countries, like China. Using the word "small" puts less emphasis on it. Also, gas flaring should be mentioned. [Glen Peters, Norway]	changed, see 6-542
6-550	6	9	6	9	6	How much of CO2 is from the production of cement? [Rongshuo Cai, China]	changed, see 6-542
6-551	6	9	8	9	16	You conceal the fact that farming and forestry are the major anthropogenic activities which remove carbon dioxide from the atmosphere and convert it into useful products. You are obsessed with "emissions" [VINCENT GRAY, NEW ZEALAND]	REJECTED; here we talk about emissions.
6-552	6	9	8	9	16	This statment is very general and does not fully cover the implications of land cover change for the C and other biogeochem cycles. Especially the balance between current and past effects of land use and cover change on atmospheric greenhouse gas concentrations should be elaborated on to put the current rates of GHG increase through land use in perspective. [Nikolaus Josef Kuhn, Switzerland]	REJECTED; this is discussed later
6-553	6	9	10	9	10	I suggest you substitute "inevitably" for "usually" or even "almost always". Deforestation doesn't have to cause a net C loss to the atmosphere, though it usually does of course. [Daniel Metcalfe, Sweden]	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-554	6	9	12	9	12	Change to "area before and after the" [Daniel Metcalfe, Sweden]	Editorial - corrected.
6-555	6	9	14	9	14	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - corrected.
6-556	6	9	14	9	14	"massive" is not very informative, and a bit alarmist. Also, i don't think "Today" need to start with a capital. [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-557	6	9	15	9	16	Regarding the total CO2 emissions from land-use change, shown as 152 PgC since 1850: According to Houghton (2010), "From 1850 to 2000, land use and land-use change released an estimated 108–188 PgC to the atmosphere (Table 1), or about 28–40% of total anthropogenic emissions of carbon (274 PgC from fossil fuels)." And, …"gradually increasing trend in emissions, from ∼0.6 PgC yr−1 in 1850 to ∼1.3 PgC yr−1 in the period 1950–2005, with an annual range that varies between ±0.2 and ±0.4 PgC yr−1 of the mean." Houghton paper is also not listed in the citations. [Beverly Law, USA]	accepted - figures changed
6-558	6	9	16	9	16	Include uncertainty in Land use emission numbers (as done in the exec summary) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Wording changed
6-559	6	9	16			Table 6.2 doesn't appear to contain this information. [Roger Gifford, Australia]	To be done
6-560	6	9	18	9	18	Delete "clearly" (a word that in my view, and that of any sceptical reader, stands for a cover-up). The evidence is mentioned in the main text, so there is no probl;em just to state her that increasing anthropogenic emissions ARE the cause. [Iain Colin Prentice, Australia]	Editorial - corrected.
6-561	6	9	18	9	19	I suggest adding a sentence. "There are several reasons for this conclusion beyond the fact that the rate of CO2 emission from fossil fuel burning is about twice the rate of atmospheric CO2 increase." [Roger Gifford, Australia]	Wording changed and added bullets
6-562	6	9	18	9	30	You seem so confident that the emissions are related to the concentrations, but you give no information here to support this claim [VINCENT GRAY, NEW ZEALAND]	REJECTED, these arguments explicitly support this claim.
6-563	6	9	18	9	30	This is an example of a repetitious element. Similar arguments are made again on page 33, lines 49ff [Nicolas Gruber, Switzerland]	To be done - need to be harmonized
6-564	6	9	18	9	30	Another key argument has always been the actual numbers. The total accumulation in the atmosphere is much smaller than the total emissions. [Nicolas Gruber, Switzerland]	Comment included in text
6-565	6	9	18	9	30	I would break this para into three bullets, starting lines 19, 24 and 29 [Robert Scholes, South Africa]	Accepted - pp reformatted in bullets
6-566	6	9	18			"almost exponentially increasing emissions"; would be valuable to show figure; put land use on it as well. [Stephen E Schwartz, USA]	Wording changed
6-567	6	9	20	9	20	northern hemisphere → Northern Hemisphere [Peter Burt, UK]	Accepted
6-568	6	9	21	9	21	southern hemisphere → Southern Hemisphere [Peter Burt, UK]	Accepted
6-569	6	9	24	9	25	Rather than saying "depleted in the 13C/12C stable isotope ratio" I recommend saying "has a lower 13C/12C stable istoope ratio than atmospheric CO2". Ratios are not depleted though it is possible that a material is depleted in 13C. [Nathaniel Ostrom, United States of America]	Accepted - text revised.
6-570	6	9	24	9	26	This sentence is quite confusing. "Trend" in what, over time or between the two stations? "lower 13C/12C values in the northern hemisphere" compared to where? [Daniel Metcalfe, Sweden]	Wording changed
6-571	6	9	24			“CO2 from fossil fuel ... is depleted in the 13C/12C” I don't understand the verb. [Francois DANIS, France]	Taken into account - text revised (see 6-570)
6-572	6	9	26	9	26	on → an [Peter Burt, UK]	Editorial - corrected.
6-573	6	9	26			Omit the word concentration. [Peter Högberg, Sweden]	REJECTED for clarity
6-574	6	9	27			check 14C/C ratio term is correct [Jeffrey Obbard, Singapore]	REJECTED - the term is correct; reported 14C values

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							refer to the ratio of 14C versus total C atoms.
6-575	6	9	32			It should be “decrease in oxygen since ‘add year’” [Göran Ågren, Sweden]	Accepted - text revised ; year of O2 first measurement is in Fig 6.3 caption
6-576	6	9	32			Figure 6.3 caption: "Atmospheric concentration" not for oxygen; anomaly? [James Christian, Canada]	Noted - figure caption revised
6-577	6	9	33	9	33	legend to figure 6.3, and p.105, fig. 6.3: The legend is 'Atmospheric concentration of CO2, oxygen ...', but in the figure not the atmospheric oxygen concentration is shown, but presumably something like a 'concentration anomaly' (the numbers are negative, and concentrations cannot be negative) [Reiner Steinfeldt, Germany]	noted - figure caption revised
6-578	6	9	41	9	42	Do these values correspond to the Holocene before the Industrial Revolution? [Leticia Cotrim da Cunha, Germany]	Wording changed
6-579	6	9	44	9	44	references required! [Peter Burt, UK]	Added references
6-580	6	9	44	9	44	References need to be added. [Leticia Cotrim da Cunha, Germany]	Added references
6-581	6	9	44			[references] - presumably will be added? [Almut Arneth, Germany]	Added references
6-582	6	9	45	9	45	Change to "1800, CH4 levels rose almost exponentially, similar". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-583	6	9	45	9	45	Insert a comma: replace "rose almost exponentially similar to CO2, reaching..." with "rose almost exponentially, similar to CO2, reacing…" [Nathaniel Ostrom, United States of America]	Editorial - corrected.
6-584	6	9	45			delete 'similar to CO2' [Jeffrey Obbard, Singapore]	Wording changed
6-585	6	9	46		46	After 1800 CH4 should be "After 1800, CH4" [Zongbo Shi, United Kingdom]	Editorial - corrected.
6-586	6	9	46			Statements need refs to back-up [Almut Arneth, Germany]	Added reference to Dlugokencky
6-587	6	9	47	9	48	although it is not clear if this reflects a real trend or natural variability'. It should correctly read "reflects an anthropogenic trend of natural variability" [Andrew Glikson, Australia]	Wording changed
6-588	6	9	50			It is worth citing this evidence both for CO2 and CH4 [Peter Rayner, Australia]	Noted - to be done
6-589	6	9	51	9	51	details missing [Peter Burt, UK]	To be done
6-590	6	9	51	9	51	References need to be added. [Leticia Cotrim da Cunha, Germany]	To be done
6-591	6	9	51	9	51	Global cattle populations increased from 942 million in 1961 to 1.38 billion in 2009 according to UN FAOSTAT online database. Data prior to 1961 are less readily available. [Cynthia Nevison, USA]	To be done - perhaps in 6.3
6-592	6	9	53	9	58	Wy don't you give the fossil fuel contribution to CH4 increase, as it can be estimated. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	To be done from Kirschke et al. paper
6-593	6	9	56	9	58	I believe the North-South Gradient is not per se a indication of anthropogenic emissions, but also could stem more wetlands in the NH. What might be an indication of that is the temporal trend of the gradient. [Stefan Gerber, USA]	Noted - wording changed
6-594	6	9	58	9	58	northern hemisphere → Northern Hemisphere [Peter Burt, UK]	Editorial - corrected.
6-595	6	9	58			Confusing that Figure 6.10 is mentioned here. Firstly, I think you mean Figure 6.9 which shows anthropogenic CO2 contributions, but does not discuss CH4 emissions, which is the subject of the sentence. [Christina Tonitto, USA]	Wording changed
6-596	6	9	58			Rewording suggestion: “The dominance of anthropogenic GHG emissions in the northern hemisphere is evidenced by the observed north-south gradient in CH4 emissions (Figure 6.3) as well as the variation in CO2 flux (Figure 6.9). “ [Christina Tonitto, USA]	Accepted - wording corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-597	6	9				Fig. 6.3 (all) Reference is made to parts (a)-(d) of the figure, but they are not labelled thus. [David Pearson, United Kingdom]	Noted - figure caption revised
6-598	6	9				Fig. 6.3(a) O2 units are ppm. I think this is the change since some baseline date (possibly 1980), not an absolute amount. If I am right, this should be stated. [David Pearson, United Kingdom]	Noted - figure caption revised
6-599	6	9				Fig. 6.3, caption for part (b). I think the graph shows the quantity that is usually called d13C, (as at http://en.wikipedia.org/w/index.php?title=%CE%9413C&oldid=470512112), not the stated 13C/12C. If I am right, this should be stated. [David Pearson, United Kingdom]	Noted - figure caption revised
6-600	6	10	1	10	8	figure 6.7 - maybe use "time (year)" for the x-axis (like in figure 6.8), instead of "anno domini" [Leticia Cotrim da Cunha, Germany]	Accepted
6-601	6	10	1	11	50	Wouldn't it be better to replace Nr (for reactive nitrogen) by Nr? [Leticia Cotrim da Cunha, Germany]	Noted, but do not understand the comment
6-602	6	10	2	11	5	Section 6.1.3.1 on interactions with the nitrogen cycle, the sources cited omit a vital and recent publication, the European Nitrogen Assessment, which will underpin the points made in this section. Below, I have added a couple of citations at their respective locations, which I hope can be taken into account. [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	Noted & citations will be utilized.
6-603	6	10	2	11	10	I would have thought it would be important to mention the connections between the carbon cycle and the water cycle here. This is important not only for influences on climate (via evapotranspiration) but also for drought and water resources and, more speculatively, flooding, and as mentioned in section 6.5.4 is therefore an important consideration for solar radiation management. relevant references are already cited in this chapter: Betts et al. 2007; Cao et al. 2010; Gedney et al. 2006; Piao et al. 2007. [Richard Betts, United Kingdom of Great Britain & Northern Ireland]	rejected - topic covered in section 6.3 and in other chapters
6-604	6	10	6	10	6	"…species such as NH3 and Nox, except N2)" [Leticia Cotrim da Cunha, Germany]	Accepted & change made in response to Comment 6-606
6-605	6	10	6	11	50	In my opinion, this nitrogen section is written too much from the perspective of the anthropogenic perturbation of the N cycle. This is clearly important, but I think an opportunity is missed here to elaborate on the elements where the cycling of N and C interact with each other, and that involves to a significant degree also the natural cycle of N. This is what we tried to do in Gruber and Galloway, 2008. [Nicolas Gruber, Switzerland]	Agreed & change to be made.
6-606	6	10	6		7	"In most terrestrial and oceanic ecosystems, reactive nitrogen (Nr, comprising all nitrogen species other than molecular atmospheric N2, such as NH3 and NOx) constitutes a..." is a little bit difficult to understand, it is better to revise to "In most terrestrial and oceanic ecosystems, reactive nitrogen (Nr, comprising all nitrogen species other than molecular atmospheric N2), , such as NH3 and NOx, constitutes a...". [Zongbo Shi, United Kingdom]	Accepted & change made.
6-607	6	10	8			Add "plant" before "growth" [Roger Gifford, Australia]	Accepted - wording corrected.
6-608	6	10	11	10	12	Change to "environment at all". If they're increasing at all scales, then there is no need to individually mention the scales. [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-609	6	10	11			"equal": Is this word wrongly used? The processes could not be equal. They could only have equal effects [Zongbo Shi, United Kingdom]	Accepted & change made by adding text.
6-610	6	10	12	10	12	– → : [Peter Burt, UK]	Editorial - copyedit to be completed prior to publication.
6-611	6	10	12	10	12	I suggest to better differentiate between land and ocean, i.e. to add here "particularly on land, but increasingly so also in coastal and open ocean environment. [Nicolas Gruber, Switzerland]	Accepted & change made
6-612	6	10	13	10	17	Perhaps list Haber-Bosch first rather than third. Current order implies it's the least important process when in fact it's the most important. [Cynthia Nevison, USA]	Accepted & change made
6-613	6	10	14	10	17	The ordering chosen to list the main contributions to Nr is odd. Haber-Bosch is the dominant contributor, and	Accepted & change made

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						should appear first. Fossil fuel combustion is a minimal contribution and should appear last [Christina Tonitto, USA]	
6-614	6	10	14			It is not the cultivation of rice, which is the problem, but the widespread promotion of cynaobacterial N2-fixation, e.g., in association with Azolla, in rice fields. [Peter Högberg, Sweden]	Noted
6-615	6	10	14			rice is not an N2-fixer! [David Newbery, CH]	Rejected - the text does not say that rice is an N-fixer.
6-616	6	10	16	10	17	…converts N2 ro NH3 as a feedstock for industrial purposes, especially the manufacture of fertiliser [Robert Scholes, South Africa]	Accepted & change made
6-617	6	10	19	10	19	"ant.sources .. Are about equal". While the ant. Perturbation is undoubtedly very large, it is quite likely smaller than global (land and ocean) N fixation. In the ocean, the best current estimates converge at about 120 to 140 Tg N yr-1. The land number is at about 110 Tg N yr-1, giving a total of about 250 Tg N yr-1. [Nicolas Gruber, Switzerland]	Noted & numbers will be checked
6-618	6	10	19	10	19	"new" should be "anthropogenic" [Cynthia Nevison, USA]	Accepted & change made
6-619	6	10	19		24	a reference to phosphorus would be salient (there is more to plant biogeochemistry than N) [David Newbery, CH]	Taken into account - text revised
6-620	6	10	20	10	20	that → those [Peter Burt, UK]	Editorial - corrected.
6-621	6	10	20	10	20	BNF in natural terrestrial ecosystems and the oceans. [BNF in agroecosystems is one of the big anthropogenic sources) [Robert Scholes, South Africa]	Accepted & change made
6-622	6	10	20			The sentence: anthropogenic sources are about twice that of natural. Please consider the use of twice or double. [Soydoa Vinitnantharat, Thailand]	Accepted & change made
6-623	6	10	21			Reword for clarity: The emission of Nr in the form of NH3 and NOx is driven by agriculture and fossil fuel combustion, respectively. [Christina Tonitto, USA]	Accepted & change made
6-624	6	10	22	10	24	Seems odd to imply that air belongs to continent vs. ocean. Perhaps rewrite as "Much of Nr fixed on land by processes 1-3 above is deposited on the ocean. This transfer of Nr to the ocean via atmospheric deposition exceeds delivery of Nr from land to ocean through river transport." (Actually aren't the amounts fairly comparable? In fact, Figure 6.4 shows 37 TgN/yr deposited from the atmosphere vs. 45 transferred by rivers, implying river transport is slightly larger.) [Cynthia Nevison, USA]	Accepted & change made
6-625	6	10	23	10	23	Change to "in atmospheric N deposition". [Daniel Metcalfe, Sweden]	Accepted, change made in response to another comment.
6-626	6	10	24	11	50	The style and tone of this section differs markedly from other sections [Robert Scholes, South Africa]	Noted
6-627	6	10	24			Add a reference after "discharge" [Zongbo Shi, United Kingdom]	Accepted & reference to be added.
6-628	6	10	27	11	42	Language needs to be improved in general, see my also my detailed comment withing this box [Stefan Gerber, USA]	Noted
6-629	6	10	29	11	42	The box is too big and the statement is general. [Zucong Cai, China]	Rejected - the Box is supposed to be 'general'.
6-630	6	10	31	10	31	"In the pre-human world". This is not correct and should read "in the period preceding to human agriculture" [Andrew Glikson, Australia]	Accepted - wording corrected.
6-631	6	10	32	10	32	Reactive nitrogen has already been defined [Nathaniel Ostrom, United States of America]	Noted - useful to recall the definition of Nr again here
6-632	6	10	34		36	this is avery naive and incorrect statement: there is much more to this question than competition for N! [David Newbery, CH]	Accepted - text will be modified
6-633	6	10	35	10	35	– → , [Peter Burt, UK]	Editorial - corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-634	6	10	35	10	35	"most" should perhaps be "many" since tropical ecosystems generally aren't N limited. [Cynthia Nevison, USA]	Accepted & changed
6-635	6	10	35	10	36	reference needed to support this statement [Christoph Mueller, Germany]	Accepted & reference to be supplied.
6-636	6	10	36	10	36	delete 'last' [Peter Burt, UK]	Editorial - corrected.
6-637	6	10	36	10	36	th' as superscript [Peter Burt, UK]	Editorial - corrected.
6-638	6	10	36	10	38	Rewording suggestion: Human manipulation of the N cycle began following scientific discoveries of the 18th and 19th centuries including understanding N as an element, understanding the fundamental microbial processes which control transformation across various Nr species, (e.g. biological nitrogen fixation, nitrification, denitrification), and understanding the importance of Nr as a plant nutrient. [Christina Tonitto, USA]	Accepted & change made.
6-639	6	10	37	10	37	call them forms rather than species to avoid confusion with biological species [Robert Scholes, South Africa]	Accepted & change made.
6-640	6	10	37	10	38	Nr? [Rongshuo Cai, China]	Accepted & change made.
6-641	6	10	38	10	39	The prevailing view among historians is that Fritz Haber developed the method primarily to produce explosives (to enhance the German military capacity) rather than to promote its use as fertilizer. [Peter Högberg, Sweden]	Accepted & change made.
6-642	6	10	41	10	41	replace legume cultivation with agricultural biological nitrogen fixation [Robert Scholes, South Africa]	Accepted & change made.
6-643	6	10	42	10	42	biological nitrogen fixation in natural ecosystems [Robert Scholes, South Africa]	Accepted & change made.
6-644	6	10	43	10	43	earth → Earth [Peter Burt, UK]	Editorial - corrected.
6-645	6	10	45	10	48	The illustration of the anthropogenic influence on the N cycle is largely focused on change over time. While spatial patterns of Nr increase are acknowledged, the role of spatial patterns of Nr-Vegetation interaction should be at least mentioned, i.e. that N fertilisation has different effects on the C-cycle depending on where the fertilisation takes place. [Nikolaus Josef Kuhn, Switzerland]	Rejected - this comment is too detailed for this general treatment of the N cycle.
6-646	6	10	47	10	47	…accounts for three-quarters of Nr created by humans, with fossil fuel combustion and industial uses accounting equally for the remainder. [Robert Scholes, South Africa]	Accepted & change made.
6-647	6	10	47	10	48	Pedantically, these percentages add up to > 100 (75 + 13 +13 = 101) [Peter Burt, UK]	Noted
6-648	6	10	50			Box 6.1, Figure 1. I suggest adding a line for the long-term natural background N fixation. Explain also in legend the meaning of the black line. [Göran Ågren, Sweden]	Agreed & will make change pending availability of recognized natural background
6-649	6	10	50			Box 6.1 Figure 1 – Caption should state reactive NITROGEN concentration . . . [Richard Bourbonniere, Canada]	Reject: the caption is correct as written.
6-650	6	10	51	10	52	Box 6.1, Figure.1: Caption typo : '… and reactive N creation…' [Christina Tonitto, USA]	Editorial (combined with comments 6-651, 6-652) - corrected.
6-651	6	10	51			Reword: should be creation of Nr. [Peter Högberg, Sweden]	Editorial (combined with comments 6-650, 6-652) - corrected.
6-652	6	10	51			"…and reactive creation…"; should be "… and reactive nitrogen (or Nr) creaction…" [Zongbo Shi, United Kingdom]	Editorial (combined with comments 6-650, 6-651) - corrected.
6-653	6	10	54	10	55	Rewording suggestion: The three most relevant questions regarding anthropogenic perturbation of the N cycle with respect to global change are: 1) What is the fate of anthropogenic Nr? 2) What are the impacts of excess Nr on humans and ecosystems? 3) What are the direct and indirect effects of increased Nr on climate change? [Christina Tonitto, USA]	Accepted & change made.
6-654	6	10	54	10	56	These are relevant questions, but the key issue of spatial and temporal patterns of change (e.g. Where do soils change in the 21st century? How quickly do soils change in the 21st century?) should be mentioned here.	Rejected - this is beyond the scope of the assessment.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Some figures later in the text certainly highlight spatial differences, which should be acknowledged. The man issue of scarce knowledge of how quickly soils change in repsonse to land use, management and climate chnage should also be mentioned. [Nikolaus Josef Kuhn, Switzerland]	
6-655	6	10	54	10	56	Delete [Robert Scholes, South Africa]	Rejected, text is integral to Box 6.1.
6-656	6	10	54	11	25	Text needs improvement, all the pieces are there. Here's my suggestion: "Nr derived from the Haber-Bosch process is critical in food production. However, most of the Nr created today by humans also enters unmanaged environment, and it impact tropospheric ozone, tropospheric aerosol content, contributes to the acidification of the atmosphere, soils and fresh waters, lead to overfertilization of natural forests, grasslands, coastal waters and open ocean. A single Nr molecule can contribute to all these impacts as it cycles in sequence between atmospheric, terrestrial and hydrologic systems. Returning Nr to the atmosphere as N2 is thus critical to halt this "Nitrogen Cascade". [Stefan Gerber, USA]	Accepted & change made.
6-657	6	10		11		The paradox of what you are calling reactive nitrogen, of course, is that thermodynamicaly, N2, O2, H2O are unstable with respect to formation of HNO3. You might mention this. The broader question is what is the connection of the great increase in production of reactive nitrogen to climate change? Is it simply through N2O or is it broader. In principle someone might have said to Haber and Bosch, that if this process becomes widely adopted, it will have a major perturbation on this biogeochemical cycle. But it would seem that artificial fixation of nitrogen has been a boon to mankind. By analogy combustion of fossil fuel has been a boon to mankind, too, but in this case, a climate consequence has been identified and to some extent quantified. So again I ask the question why introduce the perturbation of the nitrogen cycle unless some consequence is at least identified. [Stephen E Schwartz, USA]	Rejected - reactive N is defined in the text.
6-658	6	10				Define "Law", "WAIS" etc.. Law did not appear in caption [Zongbo Shi, United Kingdom]	Noted but can not link to text.
6-659	6	10				General comments 6.1.3.1: The first paragraph and Box 6.1 have redundant information. On the other hand, details about the coupled nature of C and N cycles are not discussed in section 6.1.3. In particular, fast time-scale microbial drivers of the N cycle and the conditions that lead to N2 vs. N2O production are not discussed. In addition, the different fate of N source in agricultural systems is not discussed. 15N isotope studies show N source is important, with N from a legume-derived source having higher retention in the SOM for subsequent use in plant growth. While, N from an inorganic fertilizer source has lower retention, allowing for higher loss of Nr as NO3, N2O, or N2. Reference for 15N synthesis showing N source is retained differently. (Gardner and Drinkwater. 2009. The fate of nitrogen in grain cropping systems: a meta-analysis of 15N field experiments.) [Christina Tonitto, USA]	Accepted - redundent information has been diminshed and the coupled nature of the N&C cycles has been added, but the other information is too detailed given the space available.
6-660	6	11	1	11	1	delete 'this' [Peter Burt, UK]	Editorial. Copyedit to be completed prior to publication.
6-661	6	11	1	11	1	– → : [Peter Burt, UK]	Editorial. Copyedit to be completed prior to publication.
6-662	6	11	1	11	2	I don't understand this sentence [CATHERINE BELTRAN, France]	ALL (below): J Gallloway will reconstruct this sentence that has drawn a lot of attention!
6-663	6	11	1	11	2	This sentence is confusing and needs rewriting. [Leticia Cotrim da Cunha, Germany]	accepted - sentence rewritten to improve clarity
6-664	6	11	1	11	2	"With respect to its fate, of this Nr is released to the environment—combustion sources immediately, food production sources within about a year, and industrial sources immediately to years, depending on the use. Once released, the Nr is transported, transformed, and stored.". The construction of this setence is not correct. [Andrew Glikson, Australia]	taken into account - combined with comment 663
6-665	6	11	1	11	2	This sentence doesn't make clear sense, please clarify. [Daniel Metcalfe, Sweden]	taken into account - combined with comment 663
6-666	6	11	1	11	2	This is a very confusingly written sentence. The topic is the fate of Nr but the sentence addresses the time	taken into account - combined with comment 663

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						frame of the impact so the connection is not clear. I have no suggestion for rewriting but please make this more clear. [Nathaniel Ostrom, United States of America]	
6-667	6	11	1	11	2	With respect to its fate, of this Nr is released to the environment …' The meaning of this sentence is not clear to me [Reiner Steinfeldt, Germany]	taken into account - combined with comment 663
6-668	6	11	1	11	2	Rewording suggestion: The release of Nr to the environment is immediate at combustion sources, within an annual time-scale for agricultural Nr application, and varies from immediately to within years from industrial sources depending on the usage. [Christina Tonitto, USA]	taken into account - combined with comment 663
6-669	6	11	1		2	I could not understand this sentence. Also, the latter part of the sentence does not seem to be related to the fate of Nr [Zongbo Shi, United Kingdom]	taken into account - combined with comment 663
6-670	6	11	1			The meaning of this sentence is unclear. [Francois DANIS, France]	taken into account - combined with comment 663
6-671	6	11	1			It seems there is a word missing before "of this Nr", possibly "most"? [Marcelo Galdos, Brazil]	taken into account - combined with comment 663
6-672	6	11	1			This sentence needs some rewriting. [Peter Högberg, Sweden]	taken into account - combined with comment 663
6-673	6	11	4	11	4	"Figure 6.1.3" is referred to, but this is not consistent with the numbering of the figures. [David Pearson, United Kingdom]	Accepted - Figure number will be changed to Figure 6.4
6-674	6	11	4			Figure 6.1.3. - do you refer to Box 6.1, Figure 2? [Almut Arneth, Germany]	Accepted - Figure number will be changed to Figure 6.4
6-675	6	11	4			wrong figure number [Francois DANIS, France]	Accepted - Figure number will be changed to Figure 6.4
6-676	6	11	6			add to the end of the sentence "(see Erisman et al., 2011)" and to the references: "Erisman JW, van Grinsven H, Grizzetti B, Bouraoui F, Powlson D, Sutton MA, Bleeker A and Reis S (2011) The European nitrogen problem in a global perspective. In: The European Nitrogen Assessment, ed. MA Sutton, CM Howard., JW Erisman, et al ., Cambridge University Press." [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	Accepted & change made.
6-677	6	11	8	11	19	Main message could be clarified. This paragraph lists a lot of very different impacts of Nr without giving any details as to their significance, and without any references. [Christina Tonitto, USA]	Accepted, a reference has been added, as have additional impacts.
6-678	6	11	9			The Haber-Bosch process is quite energy intensive and will create additional CO2 emissions; this fact should be mentioned somewhere becuase it is important to develop sustainable fertilizer options [Christoph Mueller, Germany]	Noted
6-679	6	11	10	10	10	Remove "that" [Stefan Gerber, USA]	Editorial - corrected.
6-680	6	11	10	11	11	What is an "unmanaged environment"? [Leticia Cotrim da Cunha, Germany]	Accepted - will reword this sentence.
6-681	6	11	10	11	11	Change to something like "humans ultimately enters the unmanaged". [Daniel Metcalfe, Sweden]	accepted - text revised to clarify
6-682	6	11	10	11	11	The phrase "enters that unmanaged environment" is confusingly written. Change to "… that enters the envionrment unmanaged…". [Nathaniel Ostrom, United States of America]	taken into account - combined with comment 681
6-683	6	11	10	11	11	'that unmanaged environment': which kind of environment is meant here? [Reiner Steinfeldt, Germany]	taken into account - combined with comment 681
6-684	6	11	10	11		..enters that unmanaged… Sentence is unclear. [Almut Arneth, Germany]	taken into account - combined with comment 681
6-685	6	11	10			agricultural fields are hardly “unmanaged environments” [Richard Bourbonniere, Canada]	taken into account - combined with comment 681
6-686	6	11	10			"..that unmanaged environment…": I did not find what "that" refers to [Zongbo Shi, United Kingdom]	taken into account - combined with comment 681
6-687	6	11	10			Perhaps on page 6-11 L10 a reference regarding the importance of N source could be added. For example:	Rejected - comment is too broad for report.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						"One potential N mitigation strategy compatible with maintaining food production is diversifying N source in agricultural systems. Gardner and Drinkwater review field observations following the fate of N in cropping systems using 15N tracer methods Their results suggest that N source significantly impacts N retention, with legume-derived N having higher recovery in agricultural systems relative to Haber-Bosch derived N." (Gardner and Drinkwater. 2009. The fate of nitrogen in grain cropping systems: a meta-analysis of 15N field experiments.) [Christina Tonitto, USA]	
6-688	6	11	11	11	11	Replace "The critical … consequences?" with "It is critical to understand the consequences" [Stefan Gerber, USA]	Editorial. Accepted - wording corrected.
6-689	6	11	11	11	14	This list of impacts should specifically include reduction in biodiversity in terrestrial and aquatic ecosystems and effects of NOX, O3, , and PM2.5 on human respiratory health and nitrate in drinking water on human health. An updated review of health effects of excess N in the environment can be found at: Davidson, E.A., M. B. David, J. N. Galloway, C. L. Goodale, R. Haeuber, J. A. Harrison, R. W. Howarth, D. B. Jaynes, R. R. Lowrance, B. T. Nolan, J. L. Peel, R. W. Pinder, E. Porter, C. S. Snyder, A. R. Townsend, and M. H. Ward. 2012. Excess nitrogen in the U.S. environment: trends, risks, and solutions. Issues in Ecology, Report Number 15, Ecological Society of America. [Eric Davidson, USA]	Noted - under team discussion.
6-690	6	11	11	40	40	I think that is relevant to include a comment about possible new sources of nitrogen ignored until now. Recent investigation suggests that fixation by biological crust (Elbert et al. 2009; Biogeosciences Discuss., 6, 6983-7015) and N rich bedrock (Morford et al. 2011; Nature 477, 78–81) could be important source of Nr, although by the moment is insufficiently investigated to have useful estimates as input to the models. [Carlos Méndez, Venezuela]	Accepted & change wil be made
6-691	6	11	12	11	12	Change to "include an increase". [Daniel Metcalfe, Sweden]	Editorial (same comments: 6-692 to 6-695) - corrected.
6-692	6	11	12	11	12	Change "… and include and increase…" to "and include an increase…" [Nathaniel Ostrom, United States of America]	Editorial (same comments: 6-691, and 6-693 to 6-695) - corrected.
6-693	6	11	12			and include and increase? [Almut Arneth, Germany]	Editorial - same comments: 6-691(692), and 6-694(695). Corrected.
6-694	6	11	12			. . . include an increase. . . [Richard Bourbonniere, Canada]	Editorial - same comments: 6-691 to 6-693, and 6-695. Corrected.
6-695	6	11	12			".. And include and increase…" does not read right [Zongbo Shi, United Kingdom]	Editorial (same comments: 6-691 to 6-694) - corrected.
6-696	6	11	13	11	13	How do we judge if the unmanaged systems have been subject to " over fertilization", i suggest that "over" is removed. [Daniel Metcalfe, Sweden]	Accepted & change made.
6-697	6	11	14			modify the sentence "… indirect contributions to climate change (see Butterbach-Bahl et al., 2011)" and add to references "Butterbach-Bahl K , Gundersen P, Ambus P, Billen G, Boeckx P, Erisman JW, Garnier J, Upstill-Goddard R, Kreuzer M, Oenema O, Reis S, Schaap M, Simpson D, Sutton MA, de Vries W and Winiwarter W (2011) Nitrogen as a threat to the European greenhouse balance. In: The European Nitrogen Assessment, ed. MA Sutton, CM Howard., JW Erisman, et al ., Cambridge University Press." [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	Accepted & change made.
6-698	6	11	15	11	16	Sentence starting with "A unique.." is unclear, is this not also true for other elements? [Stefan Gerber, USA]	Accepted - wording corrected.
6-699	6	11	15	11	16	Needs rewording. The various forms of Nr comprise the N biogeochemical cycle. [Christina Tonitto, USA]	Accepted & change made in response to previous comment.
6-700	6	11	15	11	16	Rewording suggestion: The nitrogen cycle is unique due to its broad range of oxidation states. This results in complex transformations between Nr forms, mostly mediated by microbes. [Christina Tonitto, USA]	Accepted in spirit; sentence re-written due to a previous comment.
6-701	6	11	15	16		Sentence is ambiguous, why should that be so unique for N? Other impacts are also linked via biogeochemical cycles. [Almut Arneth, Germany]	Accepted in spirit; sentence re-written due to a previous comment.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-702	6	11	16	11	18	Sentence about nitrogen cascade, would it be better to move it to the paragraph above, where it is explained how Nr moves through biological systems? [Stefan Gerber, USA]	Accepted in spirit; sentence re-written due to a previous comment.
6-703	6	11	16	11	40	Lines 16-19 and 38-40 make a good point about the 'nitrogen cascade', but the two sections are redundant; one or the other should be deleted. [Jennifer Johnson, United States of America]	Accepted & change made.
6-704	6	11	16			Nitrogen-cascade' is mentioned in the publication but I don't agree that this is the best wording, N cycle N transformation dynamics is the more common and more exact wording [Christoph Mueller, Germany]	Rejected - N Cascade is a published concept.
6-705	6	11	18	11	19	One can argue that much of the cascading effect of N additions is slowed down to the extent that it is in reality terminated when N becomes bound into stable organic matter. [Peter Högberg, Sweden]	Noted
6-706	6	11	18			I think ". . .impacts noted in the above sequence . . " is what was meant not ".. noted above in sequence . . " [Richard Bourbonniere, Canada]	Accepted in spirit; sentence re-written due to a previous comment.
6-707	6	11	21	11	21	Box 6.1 Figure 2: I think this figure is of very poor quality overall. The underlying processes are described in exceedingly vague terms, and for the aquatic/ocean sphere, not at all. The caption gives little indication of what the point of this schematic is. [James Christian, Canada]	Noted; the figure will be redrawn to be more informative.
6-708	6	11	24	11	24	insert comma afer 'change' [Peter Burt, UK]	Editorial - corrected.
6-709	6	11	24	11	24	are → is [Peter Burt, UK]	Editorial - corrected.
6-710	6	11	24	11	24	summarize → summarised [Peter Burt, UK]	Editorial (combined with same comments: 6-711(712) and 6-716 to 6-718 - corrected.
6-711	6	11	24	11	24	Change to "are summarized here". [Daniel Metcalfe, Sweden]	Editorial (combined with same comments: 6-710, 6-712; 6-716 to 6-718) - corrected.
6-712	6	11	24	11	24	summarized [Michael Raupach, Australia]	Editorial (combined with same comments: 6-710(711) and 6-716 to 6-718 - corrected.
6-713	6	11	24	11	25	This sentence is confusing and needs rewriting. [Leticia Cotrim da Cunha, Germany]	Accepted & change made.
6-714	6	11	24	11	25	Delete Sentence [Stefan Gerber, USA]	Accepted & change made.
6-715	6	11	24	11	25	Delete [Robert Scholes, South Africa]	Accepted & change made.
6-716	6	11	24			"summarized" [Richard Bourbonniere, Canada]	Editorial (combined with same comments: 6-710 to 6-712; and 6-717 to 6-718) - corrected.
6-717	6	11	24			change to 'summarized' [Jeffrey Obbard, Singapore]	Editorial (combined with same comments: 6-710 to 6-712; and 6-716(718)) - corrected.
6-718	6	11	24			…summarize…" should be summarized [Zongbo Shi, United Kingdom]	Editorial (combined with same comments: 6-710 to 6-712; and 6-716(717)) - corrected.
6-719	6	11	25			"..other areas of the report…": please specify where [Zongbo Shi, United Kingdom]	Accepted - will be changed
6-720	6	11	27	11	27	"ground level" may be deleted since NOx affects both surface O3, tropospheric O3 and stratospheric O3. Production of O3 in the free troposphere is more important for climate than ground level O3. [Jan Fuglestvedt, NORWAY]	Accepted - word deleted
6-721	6	11	27	11	36	Please replace the "," between the list items by ";", and add an "and" before the item no. 6 (line 34). [Leticia Cotrim da Cunha, Germany]	Taken into account - text revised
6-722	6	11	27	11	36	Nitrate aersol formation could be mentioned. [Jan Fuglestvedt, NORWAY]	noted
6-723	6	11	27	40		Repeats to large degree what already has been stated in previous paragraph(s) [Almut Arneth, Germany]	Rejected - authors disagree that there is repetition

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-724	6	11	29	11	29	insert "anthropogenic" before "Nr", [Stefan Gerber, USA]	Accepted - wording corrected.
6-725	6	11	29			"…a warming or a cooling effect…": I am not particularly sure but why aerosols formed from Nr has a warming effect on the climate? Nitrate aerosols, to my knowledge, should have a cooling effect [Zongbo Shi, United Kingdom]	Noted - the reviewer is correct: aerosols have a direct and indirect cooling effect. However, after deposition it can increase the CO2 uptake from the atmosphere through growth stimulation. Future work has to distinguish these two effects better and relate the aerosol effect only to cooling and the deposition effect to C-sequestration.
6-726	6	11	30	11	31	Aren't 1) and 2) the same thing ? [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - the reviewer is correct. We will consider splitting the positive (extra C-sequestration) and negative (ecosystem damage to overfertilization, O3, etc).
6-727	6	11	30	11	33	Reword for clarity. Since you refer specifically to change in primary productivity in point 2), it seems that the biosphere pool referred to in point 1) would be changes in SOC storage resulting from a change in decomposition rate? [Christina Tonitto, USA]	Accepted - text will be altered.
6-728	6	11	30	11	33	Rewording suggestion: '… 1) alteration of organic C storage in soils in response to increased supply of Nr ' [Christina Tonitto, USA]	Accepted - text will be altered.
6-729	6	11	30	11	33	Points 1-3 and 5-6 outline how different biogeochemical cycles or ecosystem processes respond to increased Nr. Point 4) is mechanistically different than the other points. CH4 production from ruminants is driven by human management decisions regarding the magnitude of beef and dairy production versus other animal production. CH4 production from animals is not responding to increased Nr in the environment. The decision of how many cattle to raise directly influences Nr production due to fertilizer or legume usage to support animal feed production. Decisions regarding animal production ultimately also lead to increased Nr loss both at the grain farm and from manure generated at the animal farm. Point 4 should not be folded into this mechanistic list. Rather, animal agricultural should be discussed as a key driver in Nr production. [Christina Tonitto, USA]	Accepted - while there is no direct effect of Nr on CH4 production in ruminants, we will mention that because of the availability of Nr fertilizer more cattle are able to be grown.
6-730	6	11	30		31	The first and second indirect impacts are more or less the same. [Zucong Cai, China]	Noted - addressed in Comment 6-726
6-731	6	11	31	11	31	Delete "so" in this sentence. [Nathaniel Ostrom, United States of America]	Editorial - text revised.
6-732	6	11	33	11	33	"VOC emissions". The use of too many acronyms does not help readability. [Andrew Glikson, Australia]	Accepted - text revised.
6-733	6	11	33	11	33	Is the x in Nox subscript or not? [Daniel Metcalfe, Sweden]	Rejected, the 'x' is not a subscript.
6-734	6	11	33	11	34	Rewrite item 5) as "a reduction in CO2 uptake from the atmosphere by reducted plant productivity in response to ozone formation from NOx and VOC emissions". [Nathaniel Ostrom, United States of America]	Accepted - text revised.
6-735	6	11	33			state 'VOC' in full [Jeffrey Obbard, Singapore]	Accepted - text revised. (see 7-732)
6-736	6	11	34	11	35	It is not only O3 that affects OH but also the reaction NO + HO2 --> NO2 + OH; i.e. a more direct effect of Nr. A more relevant reference could be added regarding effect of OH on lifetime of CH4; e.g. Isaksen et al., 2009: Atmospheric composition change:Climate-Chemistry interactions, Atmos Environ, 43, 5138–5192, doi:10.1016/j.atmosenv.2009.08.003, 2009. [Jan Fuglestvedt, NORWAY]	Accepted - reference will be added.
6-737	6	11	35			. . . thus atmospheric lifetime of CH4. . . [Richard Bourbonniere, Canada]	Accepted & change made.
6-738	6	11	36			modify the bracket at the end of the sentence to "Erisman et al., 2011; Butterbach-Bahl et al., 2011)" and add to references "Butterbach-Bahl K , Gundersen P, Ambus P, Billen G, Boeckx P, Erisman JW, Garnier J, Upstill-Goddard R, Kreuzer M, Oenema O, Reis [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	Accepted & change made.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-739	6	11	38	11	38	delete comma after 'note' [Peter Burt, UK]	Editorial - corrected in text.
6-740	6	11	38			the content in this section has already been mentioned above [Per Erik Karlsson, Sweden]	Accepted & change made.
6-741	6	11	39	11	39	"has the potential to "affect"…"? Seems that a bit of text is missing. [Leticia Cotrim da Cunha, Germany]	Accepted & change made.
6-742	6	11	39	11	39	replace "climate change" with "affect climate" [Stefan Gerber, USA]	Editorial - corrected in text.
6-743	6	11	39	11	39	replace "climate change" with "affect climate" [Stefan Gerber, USA]	Duplicate of the comment 6-742
6-744	6	11	39	11	39	A word is missing here, change to something like "to affect climate change". [Daniel Metcalfe, Sweden]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-745	6	11	39	11	39	Change "has the potential to clmate change…" to "has the potential to impact climate change…" [Nathaniel Ostrom, United States of America]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-746	6	11	39	11	39	should be "potential to interact with climate change" [Michael Raupach, Australia]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-747	6	11	39			change climate (I presume?) [Almut Arneth, Germany]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-748	6	11	39			“change climate” not “climate change” [Richard Bourbonniere, Canada]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-749	6	11	39			insert 'impact' before 'climate' [Jeffrey Obbard, Singapore]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-750	6	11	39			"…potential to climate change….": this does not read right [Zongbo Shi, United Kingdom]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-751	6	11	39			typo: …has the potential to influence climate change, …. [Christina Tonitto, USA]	Editorial (combined with other comments: 6-742 down to 6-751) - corrected in text.
6-752	6	11	45			Figure 6.4. The bottom panel does not show a cycle because there are only one-way fluxes. Again removals of N2O are missing. [Göran Ågren, Sweden]	Accepted - Figure legend will be amended.
6-753	6	11	45			Figure 6.4 add N after "reactive"and change "creation" to "production" (both caption and graphic) [James Christian, Canada]	Noted, but text not found in Figure 6.4
6-754	6	11	45			Figure 6.4: Formatting is very odd. Perhaps this is an artifact of the software used to create the .pdf file. The bar of Atmospheric N2 conversion to various Nr forms appears below the top graph with arrows radiating into the top of figure 6.4. For instance, in the version I downloaded, there is an arrow of the magnitude of Haber-Bosch Nr protruding from the Atmospheric N2 pool through the ocean, through the soil, into the farm field. This visually makes no sense. The Atmospheric bar needs to be on the top of the diagram with the arrows pointing downward into the N cycle diagram. [Christina Tonitto, USA]	Accepted - Figure will be modified.
6-755	6	11	46			Nitrogen - lower case [Jeffrey Obbard, Singapore]	Editorial (same comment 6-756) - corrected in text.
6-756	6	11	46			"…Nitrogen species…": why "Nitrogen" not "nitrogen"? [Zongbo Shi, United Kingdom]	Editorial (same comment 6-755) - corrected in text.
6-757	6	11	54	11	54	"fast cycle" I suggest to rephrase this since oxygen is connected to the fast and slow cycling of carbon. [Nicolas Gruber, Switzerland]	Accepted - Mention of fast removed
6-758	6	11	54			Section 6.1.3.2. I think the argument can be sharpened here by being quantitative with regard to the connection between CO2 emissions and O2 decreases. For the period 1990-2010 the decrease in O2 of 80 ppm and the increase of 40 ppm in CO2 is consistent with an airborne fraction of 50% of emitted CO2. [Göran Ågren, Sweden]	REJECTED, this is discussed later in the budget section

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-759	6	11	55	11	55	replace "amounts" with "elemental ratios" [Stefan Gerber, USA]	Editorial - corrected in text.
6-760	6	11	55	11	55	replace "amount" with "ratio" [Stefan Gerber, USA]	Duplicate of the comment 6-759. Corrected.
6-761	6	11	56	11	56	It would probably be best to indicate that the decline is atmospheric O2 is quite small: write as "… O2 levels are decreasing by a small amount, which has…" [Nathaniel Ostrom, United States of America]	Wording changed
6-762	6	11	56	11	56	consequence of fossil fuel combustion... [Robert Scholes, South Africa]	Wording changed
6-763	6	11	58	11	58	Change "… that the rising CO2 is…" to "the rise in CO2 is…" [Nathaniel Ostrom, United States of America]	Editorial - corrected in text.
6-764	6	11				Also after section 6.3.4.4. A paragraph describing the process removing N2O is needed. Also a comment a comment on the consequences of the long lifetime of N2O in the atmosphere. [Göran Ågren, Sweden]	Accepted - paragraph will be added as first paragraph of 6.3.4
6-765	6	11				. I have not seen the usage of Nr. It is difficult to understand the discussion because Nr incorporates nitrogen with many different time scales of interaction with the environment. I hope that authors will consider an alternative means to present the impact of anthropogenic nitrogen on the environment [Mohammad Aslam Khan Khalil, USA]	Noted
6-766	6	11				What is the magnitude of the couplings between Nr and OH through O3? There are so many interactions, but many are small. Is this an important coupling? If so please show magnitudes, otherwise delete [Mohammad Aslam Khan Khalil, USA]	Noted - the response to Comment 6-738 already helps a bit in the response to this. There are interactions of N with CH4 production and consumption (in soils and in the atmosphere through O3), but the magnitude of these effects is small relative to the other impacts of Nr.
6-767	6	11				Fig 6.8. The variability in atmos growth rate is attrib entirely to variability in the terrrestrial sink; what is the evidence for that? [Stephen E Schwartz, USA]	Noted- this is explained in the text in section 6.3.2.5.3
6-768	6	12	1	12	3	I think the ratio itself is not an evidence by itself, since this could be caused by a natural pumping of O2, but the CHANGE of that ratio is a evidence of anthropogenic activity [Stefan Gerber, USA]	Not understood
6-769	6	12	1	12	3	"show the north-south concentration gradient " seems to imply O2/N2 is higher in NH like CO2. Perhaps rewrite as "show a south-to-north concentration gradient (higher in the south) ..." [Cynthia Nevison, USA]	Wording changed
6-770	6	12	6	12	6	"…the ocean, O2…" [Leticia Cotrim da Cunha, Germany]	Editorial- corrected in text.
6-771	6	12	6	12	8	Rewrite to more clearly capture essentials of O2/N2 vs. CO2 vector diagram method. In addition to the fact that about 98 % of the CO2 in the ocean-atmosphere system partitions into the ocean compared to only about 1% for O2, another important point is that the perturbation to CO2 is large compared to the total burden (e.g., 516 Pg released by FF and land use, which is on par with the total preindustrial CO2 burden) whereas the decrease in atmospheric O2 over the history of FF combustion is only about 0.1%. Fpr both the above reasons it's reasonable to assume the annual mean air-sea O2 flux is zero, although the complication of thermal outgassing of O2 probably needs to be mentioned. [Cynthia Nevison, USA]	Rejected. Size restrictions do not allow a longer description of the O2 method with the arrow diagram method, this was covered in the TAR.
6-772	6	12	7	11	8	sentence starting with "This is.." replace with "The oceanic CO2 content is much larger due to the carbonate chemistry" [Stefan Gerber, USA]	Editorial (combined with similar comments 6-773 to 6-777) - wording corrected.
6-773	6	12	7	12	7	Confusing writing: Change "This is which is different with CO2" to "This contrasts with CO2 which…" [Nathaniel Ostrom, United States of America]	Editorial (combined with similar comments 6-772 to 6-777) - wording corrected.
6-774	6	12	7	12	8	This sentence is confusing and needs rewriting. [Leticia Cotrim da Cunha, Germany]	Editorial (combined with similar comments 6-772 to 6-777) - wording corrected.
6-775	6	12	7	12	8	This sentence doesn't make sense. [Roger Gifford, Australia]	Editorial (combined with similar comments 6-772 to 6-777) - wording corrected.
6-776	6	12	7	12	8	This sentence doesn't make sense, change to something like "This is different to CO2", and "due to carbonate". The use of the word "inventory" in this context seems strange. [Daniel Metcalfe, Sweden]	Editorial (combined with similar comments 6-772 to 6-777) - wording corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-777	6	12	7	12	8	reword [Christina Tonitto, USA]	Editorial (combined with similar comments 6-772 to 6-776) - wording corrected.
6-778	6	12	9	12	9	Why suddenly "oceans" not "ocean". [Daniel Metcalfe, Sweden]	Editorial - corrected.
6-779	6	12	9	12	10	→ to assess independently [Peter Burt, UK]	Editorial - corrected.
6-780	6	12	9		10	"powerful method to independently assess the partitioning of the uptake of CO2 by land and oceans (Manning and Keeling, 2006)" ; Suggest specify what has been learned from this method. Constrains the fraction of incremental CO2 that has been introd into the atmos to between x and y %. Not simply state that it is a powerful method. [Stephen E Schwartz, USA]	TO BE DONE - not sure whether here or in budget section; there are also space restrictions.
6-781	6	12	10			Please add a paragraph summarizing the oxygen cycle in the oceans, to parallel the preceding paragraphs summarizing the oxygen cycle in the atmosphere and on land. This is especially needed because of the chapter's later discussion of potential ocean deoxygenation. [Eric Sundquist, United States of America]	Noted - changed text of ocean carbon (and oxygen) cycle description. Space constraints do not allow a full paragraph on this
6-782	6	12	11			delete 'is which' [Jeffrey Obbard, Singapore]	Editorial (combined with similar comments 6-772 to 6-776) - wording corrected.
6-783	6	12	12	12	25	The outline of the chapter seems out of place here, after the overview and anthropogenic disturbances have been discussed. Why not add a brief description of section 6.1 here, and place this outline at the very beginning of the chapter, after the executive summary? [Leticia Cotrim da Cunha, Germany]	accepted - section moved to beginning of introduction
6-784	6	12	12			Seems odd to have the outline of the chapter only now - why not before the introductory sections? [Almut Arneth, Germany]	accepted - section moved to beginning of introduction
6-785	6	12	12			Section 6.1.4. Why is this coming in so late, why not having this at the very beginning of 6.1 [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted - section moved to beginning of introduction
6-786	6	12	14	12	18	Punctuation here could be improved. I suggest change to "gases, CO2, CH4 and N2O, in the past emaphasizing" and "since 1750, addressing". [Daniel Metcalfe, Sweden]	Editorial - corrected.
6-787	6	12	14	12	25	Delete section [Robert Scholes, South Africa]	rejected - section is kept and moved to beginning of introduction
6-788	6	12	18			insert ',' after 'processes [Jeffrey Obbard, Singapore]	Accepted - text revised.
6-789	6	12	19	12	19	to evaluate critcally [Peter Burt, UK]	Editorial - corrected.
6-790	6	12	22	12	22	Change to "of the sign". Would it be clearer to subsitute "sign" with "direction"? [Daniel Metcalfe, Sweden]	Editorial - corrected.
6-791	6	12	23	12	23	Change to "future but". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-792	6	12	24	12	24	The final Section ..' → Finally, Section 6.5...' [Peter Burt, UK]	Editorial - corrected.
6-793	6	12	29	12	29	The subtitle-why... after introduction is necessary? [Rongshuo Cai, China]	Accepted - The subtitle is removed
6-794	6	12	29	12	29	No need for the word "introduction" here. Please explain greenhouse gases abbreviation (before was LLGHG), and avoid using it in a section title. [Leticia Cotrim da Cunha, Germany]	Accepted - The subtitle is removed
6-795	6	12	29	12	29	Delete 'Introduction' [Robert Scholes, South Africa]	Accepted - The subtitle is removed
6-796	6	12	31	12	33	GHG appears 3x in this short text. Maybe consider a bit of rewriting. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-797	6	12	31			What are the numerous mechanisms in common? For instance, the glacial - interglacial transitions for methane emissions are not the same as what we would expect in the future. [Mohammad Aslam Khan Khalil, USA]	Accepted - text revised.
6-798	6	12	32	12	32	→ '..changes therefore provide..' [Peter Burt, UK]	Editorial (combined with comment 6-799, 6-801) -

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							corrected in text.
6-799	6	12	32	12	32	"therefore" is misplaced. I suggest "changes therefore provide powerful". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-798, 6-801) - corrected in text.
6-800	6	12	32	12	33	Poorly constructed sentence. Hard to follow. [Roger Gifford, Australia]	Accepted - text revised.
6-801	6	12	32			change to 'therefore provide' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-798, 6-799) - corrected in text.
6-802	6	12	33	12	33	Change to "GHG concentrations in". [Daniel Metcalfe, Sweden]	Editorial - corrected.
6-803	6	12	35	15	13	is full of typos and writing mistakes: too many to list. [David Newbery, CH]	Accepted - text revised.
6-804	6	12	39			Section 6.2.2: this depends on knowledge of the reconstructed 850 ky records for temperature, CO2, CH4, N2O, sea level etc. Although it's a well known figure, it should be included here (with citations to primary sources) for completeness. [Michael Raupach, Australia]	Rejected - Figure 5.5 (Chap5) has some of the requested plots.
6-805	6	12	39			Section 6.2.2.1.1: Explicit comment is needed about the ~700 year lag between temperature and CO2 in the long (850 ky) record, with temperature leading CO2. See comment on P6-3 L46. [Michael Raupach, Australia]	Rejected - the chapter section is dealing with equilbirum state and not glacial-interglacial dynamics. Time scales are not considered here. Leads and lags during deglaciation are discussed in Chap 5.
6-806	6	12	42	12	42	Maybe here just cite when the Holocene started, for the non-expert reader. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-807	6	12	44			cite also Petit et al., 1999 [Hubertus Fischer, Switzerland]	Accepted - text revised
6-808	6	12	45	12	45	delete "subsequently" [Stefan Gerber, USA]	Accepted - text revised.
6-809	6	12	47	12	48	This is a confusing sentence , are "conceptual", "box" and "Intermediate Complexity (EMIC)" all separate models, or are the former words just descriptors of "Intermediate Complexity (EMIC)" models? Perhaps just say "as well as a range of models of varying complexity have been used". Also, what does the EM part of the EMIC models refer to? [Daniel Metcalfe, Sweden]	Accepted - text revised
6-810	6	12	48	12	48	move (ESM) to after 'Models' [Peter Burt, UK]	Editorial - corrected.
6-811	6	12	50	12	50	replace "their" with "its"? [Stefan Gerber, USA]	Editorial - corrected.
6-812	6	12	51	12	51	This doesn't quite make sense, i suggest "that this compartmentalization is potentially misleading, as many" [Daniel Metcalfe, Sweden]	Accepted - text revised
6-813	6	12	52	12	52	replace "sum" with "addition"? [Stefan Gerber, USA]	Accepted - text revised.
6-814	6	12	52	12	52	A linear sum isn't prevented, it is possible to sum the responses but they may not an accurate representation of the real-world outcome. [Daniel Metcalfe, Sweden]	Accepted - text removed
6-815	6	12	55	12	55	δ13C [Leticia Cotrim da Cunha, Germany]	Editorial (with same comments 6-816, 6-817) - corrected.
6-816	6	12	55	12	55	Substitute "d" with the proper greek delta symbol. "13" should be superscript. [Daniel Metcalfe, Sweden]	Editorial (with same comments 6-815, 6-817) - corrected.
6-817	6	12	55			"…d13C"???? [Zongbo Shi, United Kingdom]	Editorial (with same comments 6-815, 6-816) - corrected.
6-818	6	12	56	12	56	Remove "the" [Daniel Metcalfe, Sweden]	Editorial - corrected.
6-819	6	12	57			carbon loss compared to when? [Almut Arneth, Germany]	Accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-820	6	12				Box 6.2, Figure 1. The impulse response function is presented as if known with confidence. At the very least it should be made clear that this response function is a model-derived result that is based on assumptions; the assumptions spelled out. Key among them is that the key sinks are inorganic ocean and sediment chemistry, as opposed to biological, despite the fact that much of the decrease in atmospheric fraction to date is rather confidently attributed to uptake by terrestrial vegetation (40% in Table 6.1). Some justification for turning off the terrestrial biological sink in the model calculations should be given. [Stephen E Schwartz, USA]	The Figure 1 in the Box 6.2 is revised. The impulse response function is presented with uncertainty range.
6-821	6	13	1	13	1	favor → favour [Peter Burt, UK]	Editorial - corrected.
6-822	6	13	1	13	12	y-axis: Pg C yr-1 [Leticia Cotrim da Cunha, Germany]	Accepted - legend revised
6-823	6	13	6	12	8	Change to "reconstructing the pattern". [Daniel Metcalfe, Sweden]	Editorial - corrected. Copyedit to be completed prior to publication.
6-824	6	13	6	13	6	delete ')' after Holocene [Peter Burt, UK]	Editorial (combined with comment 6-825, 827, 828) - corrected.
6-825	6	13	6	13	6	Loose ")" in the text. [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comment 6-824, 827, 828) - corrected.
6-826	6	13	6	13	7	A similarly important process is the temperature dependence of the change in dissociation constants [Paul Halloran, UK]	Rejected - in the absence of published quantification of these effects, they are not mentionned for sake of concision.
6-827	6	13	6			remove ')' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-824, 825, 828) - corrected.
6-828	6	13	6			Delete "(" [Zongbo Shi, United Kingdom]	Editorial (combined with comment 6-824, 825, 827) - corrected.
6-829	6	13	8	13	8	Rewrite "… uncertainties in reconstructing of pattern of ocean temperature change" as " uncertainty in the reconstruction of pattern of ocean temperature changes…" [Nathaniel Ostrom, United States of America]	Accepted (combined with comments 6-831, 832) - text revised.
6-830	6	13	8	13	12	This sentence is very long and complicated, i suggest it is split up. [Daniel Metcalfe, Sweden]	Accepted - text revised
6-831	6	13	8			Delete "of" [Roger Gifford, Australia]	Editorial - (combined with comments 6-831, 832) - text revised.
6-832	6	13	8			"reconstructing" or "reconstruction"? [Zongbo Shi, United Kingdom]	Editorial - (combined with comments 6-831, 832) - text revised.
6-833	6	13	11	13	11	a → an [Peter Burt, UK]	Editorial - combined with comment 6-841 - corrected in text.
6-834	6	13	11	13	11	Abbreviation for OGCM? [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-835	6	13	11	13	11	change "pm" to "ppm" [Andrew Glikson, Australia]	Editorial - combined with other comments 6-837, 838, 840, 841 - corrected in text.
6-836	6	13	11	13	11	How does an "OGCM" differ to a "GCM"? [Daniel Metcalfe, Sweden]	Accepted - text revised
6-837	6	13	11			ppm not pm [Roger Gifford, Australia]	Editorial - combined with other comments 6-835, 838, 840, 841 - corrected in text.
6-838	6	13	11			change to 'ppm' [Jeffrey Obbard, Singapore]	Editorial - combined with other comments 6-835, 837, 840, 841 - corrected in text.
6-839	6	13	11			"OGCM": define the first time it appears [Zongbo Shi, United Kingdom]	Accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-840	6	13	13			24 pm....should be ppm [Christoph Mueller, Germany]	Editorial - combined with other comments 6-835, 837, 838, 841 - corrected in text.
6-841	6	13	16	13	16	a → an [Peter Burt, UK]	Editorial - combined with comment 6-833 - corrected in text.
6-842	6	13	16	13	17	Please check the statement the higher LGM surface salinity induced a decrease in atmospheric CO2. Because higher salinity decreases the solubility of CO2, it should cause an increase atmospheric CO2. [Eric Sundquist, United States of America]	Accepted - text revised
6-843	6	13	17	13	17	An explanation why atmospheric CO2 decreases with higher surface salinity is warranted here. [Andrew Glikson, Australia]	Accepted - text revised
6-844	6	13	18	13	18	"driving atmospheric CO2 higher." Do you mean incresing the absorption of atmospheric CO2? [Leticia Cotrim da Cunha, Germany]	Accepted - taken into account & text revised
6-845	6	13	19			change to ' a lowered' [Jeffrey Obbard, Singapore]	Editorial - accepted.
6-846	6	13	20	13	21	Change to "hence in the". Explicitly state what the effect of this "alkalinity influence" is on atmospheric CO2, as you have done for the other two factors. [Daniel Metcalfe, Sweden]	Accepted - text revised
6-847	6	13	20			delete 'hence on the longer-term' [Jeffrey Obbard, Singapore]	Rejected - time scale of process is important here
6-848	6	13	21	13	21	Maybe explain that TA decreases in this case. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-849	6	13	23	13	24	Change to "that promote the" to agree with "changes". Change to "focus of recent". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-852) - accepted.
6-850	6	13	23	13	32	Surely the most compelling evidence is from atm. radiocarbon records? [Paul Halloran, UK]	Noted - Text will include reference to some C14 studies.
6-851	6	13	23	13	33	I suggest to expand this paragraph since one really needs to differentiate between the changes in the different oceanic regions, e.g., North Atlantic Deep Water formation, Southern Ocean, etc. [Nicolas Gruber, Switzerland]	Accepted - text now explicitely mentions the distinct role of different oceanic regions
6-852	6	13	23			change to 'promote' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-849) - accepted.
6-853	6	13	24	13	24	on → of [Peter Burt, UK]	Editorial (combined with comment 6-849, 854) - accepted.
6-854	6	13	24			Change "on" to "of" [Roger Gifford, Australia]	Editorial (combined with comment 6-849, 853) - accepted.
6-855	6	13	25			change "low glacial CO2" to "low glacial period atmospheric CO2 concentration" [Roger Gifford, Australia]	Accepted - text revised.
6-856	6	13	26	13	26	CO2 → CO2 [Peter Burt, UK]	Editorial - corrected in text.
6-857	6	13	26			"CO2" should be "CO2" [Zongbo Shi, United Kingdom]	Editorial - corrected in text.
6-858	6	13	28	13	28	hold → held [Peter Burt, UK]	Typo corrected (combined with other comments: 6-859, 6-861 to 6-864).
6-859	6	13	28	13	28	"held" instead of "hold" [Leticia Cotrim da Cunha, Germany]	Typo corrected (combined with other comments: 6-858, 6-861 to 6-864).
6-860	6	13	28	13	28	highly stratified. I think this needs to be elaborated a bit. I suggest to explicitly talk about the Southern Ocean here, since the North Pacific likely did not contribute much to the glacial CO2 drawdown. I also suggest to point out that different people talk about different locations of stratification. Some people refer exclusively to surface ocean stratification, while others think more in terms of increased ocean interior stratification (e.g., Toggweiler's chemical divide idea). [Nicolas Gruber, Switzerland]	Accepted - see response to comment 6-851

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-861	6	13	28	13	28	Change to "have held a". [Daniel Metcalfe, Sweden]	Typo corrected (combined with other comments: 6-858, 6-859, and 6-862 to 6-864).
6-862	6	13	28	13	28	Change "hold" to "held" [Nathaniel Ostrom, United States of America]	Typo corrected (combined with other comments: 6-858, 6-859, and 6-861 to 6-864).
6-863	6	13	28			“held” not “hold” [Richard Bourbonniere, Canada]	Typo corrected (combined with other comments: 6-858, 6-859, and 6-861 to 6-864).
6-864	6	13	28			change to 'held' [Jeffrey Obbard, Singapore]	Typo corrected (combined with other comments: 6-858, 6-859, and 6-861 to 6-864).
6-865	6	13	30	13	30	SH → Southern Hemisphere [Peter Burt, UK]	Accepted (with similar comments 6-866, 867, 869) - text revised.
6-866	6	13	30	13	30	SH? Spelling of buoyancy. [Leticia Cotrim da Cunha, Germany]	Combined with similar comments 6-865, 867, 869 - text revised.
6-867	6	13	30	13	30	Has "SH" been defined? Also, "buyancy" is an incrrect spelling of "bouyancy" [Nathaniel Ostrom, United States of America]	Combined with similar comments 6-865, 866, 869 - text revised.
6-868	6	13	30	13	31	Buoyancy is misspelt.Is "rejections" the right word here, could you mean "injections"? [Daniel Metcalfe, Sweden]	Combined with same comment 6-870. Typo corrected.
6-869	6	13	30			What is SH? [Göran Ågren, Sweden]	Combined with similar comments 6-865, 866, 867 - text revised.
6-870	6	13	30			change to 'buoyancy [Jeffrey Obbard, Singapore]	Combined with same comment 6-868. Typo corrected.
6-871	6	13	31			add "and" after …Garabato, 2006), [Zongbo Shi, United Kingdom]	Accepted - text revised.
6-872	6	13	32	13	33	Are these changes positive or negative? [Daniel Metcalfe, Sweden]	Accepted - text revised
6-873	6	13	35	13	44	The paragraph on aeolian iron fertilisation also illustrates the need for considering spatial aspects because the source areas for dust are fairly concentrated and sensitive to both climate as well as land cover change. This may (or may not) have significant impact on the iron fertilisation, but no consideration of the stabiliyt of current dust sources over time are mentioned here. [Nikolaus Josef Kuhn, Switzerland]	Rejected. The reconstruction of aeolian dust deposition (Mahowald et al., 2006) accounts for spatial aspects as well as for changes in dust sources on land. There is no space here to go into details of the reconstruction.
6-874	6	13	35		36	…implying a …(Martin, 1990): change to …implying a potential link between Fe fertilisation of marine productivity and lower glacial CO2… [Zongbo Shi, United Kingdom]	Accepted - text revised.
6-875	6	13	37	13	37	employ → employing [Peter Burt, UK]	Editorial (combined with comment 6-877). Copyedit to be completed prior to publication.
6-876	6	13	37	13	37	Lower glacial atmospheric CO2. Replace "despite" by "although"? [Leticia Cotrim da Cunha, Germany]	Editorial - text revised. Copyedit to be completed prior to publication.
6-877	6	13	37	13	37	"generally employ" should be changed to "generally employing" [Andrew Glikson, Australia]	Editorial (combined with comment 6-875). Copyedit to be completed prior to publication.
6-878	6	13	37	13	38	This doesn't make sense, i suggest change to "despite general similarity amongst models in terms of their reconstructions of glacial dust fluxes (i.e.," [Daniel Metcalfe, Sweden]	Rejected - version from comment 880 is accepted
6-879	6	13	37	13	38	Rewrite: "However, despite models generally employ…" as "However, despite the fact that modesl generally employ…" [Nathaniel Ostrom, United States of America]	Accepted (also to address other comments: 6-875 to 6-877) - text revised.
6-880	6	13	37	37	44	A study of growth changes in European forest between 1920-2000 identified an increasing N deposition as the major driver behind observed growth increases. van Oijen M., Ågren G.I., Chertov O., Kellomäki S., Komarov A., Mobbs D. and Murray M. (2008) Evaluation of past and future changes in European forest growth by	Rejected - the comment is related to another section

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						means of four process-based models - Chapter 4.4. In Causes and consequences of Forest Growth Trends in Europe - Results of the RECOGNITION project. European Forest Institute Research Report 21. Edited by Kahle H.P., Karjalainen T., Schuck A., Ågren G.I., Kellomäki S., Mellert K., Prietzel J., Rehfuess K.E. and Spiecker H. Brill, Leiden. pp 183-199. [Göran Ågren, Sweden]	
6-881	6	13	37			change 'despite' to 'as' [Jeffrey Obbard, Singapore]	Rejected - version from comment 880 is accepted
6-882	6	13	39	13	39	"Model-model" seems strange, how about "inter-model"? [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-883	6	13	39		41	Change to: OGCM (definition-based Fe cycle models (e.g., Archer et al., 2000; Bopp et al., 2003) tend to cluster at the lower end (e.g., ? To ? Ppm CO2), with box models (e.g., Watson et al., 2000) or EMICs (define if first time appears) (e.g., Brovkin et al., 2007) at the higher end (e.g., ? to ? ppm CO2)..... [Zongbo Shi, United Kingdom]	Rejected - lack of space ; detailled explanation is given in Kohfeld and Ridgwell 2009.
6-884	6	13	39			..considerable model-model disagreement in the associated CO2 change…: Is it better to put a sentence here to explain why? For example, is it related to the assumption on the bioavailability of the iron in the dust [Zongbo Shi, United Kingdom]	Rejected - lack of space ; detailled explanation is given in Kohfeld and Ridgwell 2009.
6-885	6	13	40	13	41	It is not clear what the subject of "lower end" is. Lower end of CO2 concentrations or lower end of CO2 change? [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-886	6	13	41	13	44	This sentence is confusing and needs rewriting. Maybe explain a bit the timing between Fe fertilization and decrease in atm-CO2 concentrations? [Leticia Cotrim da Cunha, Germany]	Rejected - lack of space ; detailled explanation is given in Kohfeld and Ridgwell 2009.
6-887	6	13	43	13	44	Change to "assigning a 20ppm limit for a Southern Ocean Fe-fertilisation effect, and an 8 ppm limit for the effect in the North Pacific". [Roger Gifford, Australia]	Accepted - text revised
6-888	6	13	47	13	47	"reducing" instead of "reduces". [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comment 6-890) - corrected.
6-889	6	13	47	13	47	Change to "exchange which hence". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-890	6	13	47			change to 'reducing' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-888) - corrected.
6-891	6	13	49	13	51	This sentence is not very clear and doesn't add much information to the text. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-892	6	13	50	13	50	relative → relatively [Peter Burt, UK]	Editorial (with similar comments 6-893, 6-895) - accepted.
6-893	6	13	50	13	50	"relatively" instead of "relative". [Leticia Cotrim da Cunha, Germany]	Editorial (with similar comments 6-892, 6-895) - accepted.
6-894	6	13	50	13	51	Sentence starting with "Despite this…" is really hard to understand [Stefan Gerber, USA]	Accepted - text revised
6-895	6	13	50			“relatively” [Richard Bourbonniere, Canada]	Editorial (with similar comments 6-892, 6-893) - accepted.
6-896	6	13	51	13	51	delete brackets [Peter Burt, UK]	Editorial (combined with comments 6-898, 6-899, 6-900) - copyedit to be completed prior to publication.
6-897	6	13	51	13	51	Mention Archer et al. 2003 paper (Paleoceanography) [Nicolas Gruber, Switzerland]	Accepted - text revised
6-898	6	13	51	13	51	What is the purpose of these brackets? [Daniel Metcalfe, Sweden]	Editorial (combined with comments 6-896, 6-898 to 6-900) - copyedit to be completed prior to publication.
6-899	6	13	51			why the ( ) around increase? Maybe also add “atmospheric”. [Richard Bourbonniere, Canada]	Editorial (combined with comments 6-896, 6-898 to 6-900) - copyedit to be completed prior to publication.
6-900	6	13	51			Why use "(increase)"? Either add a word or remove "()", or else the sentence does not stand itself. [Zongbo	Editorial (combined with comments 6-896, 6-898, 6-

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Shi, United Kingdom]	899) - copyedit to be completed prior to publication.
6-901	6	13	53	13	53	Other factors [Robert Scholes, South Africa]	Accepted - text revised
6-902	6	13	53	14	3	: Entire section “Other glacial drivers” is one sentence and contains confusing fragments – reword and possibly break up to 2 thoughts. [Richard Bourbonniere, Canada]	Accepted - paragraph has been rewritten
6-903	6	13	53	14	3	The paragraph is confusing with several small errors. Substitute "further" with "other". Change to "increased glacial supply". The line "global weathering rates have" appears to be unfinished. What is "but also ´carbonate compensation'" adding to? [Daniel Metcalfe, Sweden]	Accepted - paragraph has been rewritten
6-904	6	13	54	13	55	I've not read the Berger paper for a long time, and I can’t get hold of it now, but my understanding of this hypothesis was that as sea level fell it exposed CaCO3 material (reefs etc.) on the continental shelf and this was eroded adding alkalinity to the ocean, but that the reduced shelf area prevented shallow water CaCO3 accumulation - I could well be wrong though. [Paul Halloran, UK]	Noted - but not enough space to go into details here. Text revised though.
6-905	6	13	55	13	55	reefs → reef [Peter Burt, UK]	Editorial - corrected in text.
6-906	6	13	56	13	56	"increased" instead of "increase". [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-907	6	13	56	13	56	In addition to Si, Fe from glacial runoff was also reported to have impacted marine productivity. Change to: "increased glacial supply of Si (Harrison, 2000) or Fe (Raiswell et al., 2006)," The new reference Raiswell et al 2006 is: Raiswell, R., Tranter, M., Benning, L.G., Siegert, M., De'ath, R., Huybrechts, P. and Payne, T., 2006. Contributions from glacially derived sediment to the global iron (oxyhydr)oxide cycle: Implications for iron delivery to the oceans. Geochimica et Cosmochimica Acta 70 (11), 2765-2780. [Nils Moosdorf, Germany]	Accepted - text revised & reference included
6-908	6	13	56	13	57	Seems that a bit of text is missing here. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-909	6	13	57	13	57	text mising after 'have' [Peter Burt, UK]	Accepted - text revised
6-910	6	13	57			delete "have"; "but also" inappropriately used [Zongbo Shi, United Kingdom]	Accepted - text revised
6-911	6	13				Figure 6.9. The title "Globe" likely more appropriately should be called "Global". Also, please consider increasing the font size of all titles. [Vivek Arora, Canada]	Accepted - figure modified
6-912	6	13				the overview of modeling literature on the influence of various factors affecting the carbon cycle is quite selective and does not mirror the extensive work done in the community. A good overview of literature is given in Fischer, H., Schmitt, J., Lüthi, D., Stocker , T. F., Tschumi, T., Parekh, P., Joos, F., Köhler, P., Völker, C., Gersonde, R., Barbante, C., Le Floch, M., Raynaud, D., and Wolff, E. (2010), The role of Southern Ocean processes in orbital and millennial CO2 variations - A synthesis. Quaternary Science Reviews 29, 193-205. Sigman, D. M., Hain, M. P., and Haug, G. H. (2010). The polar ocean and glacial cycles in atmospheric CO2 concentration. Nature 466, 47-55. Literature that has to be cited :Köhler, P., Fischer, H., Munhoven, G., and Zeebe, R. E. (2005). Quantitative interpretation of atmospheric carbon records over the last glacial termination. Global Biogeochemical Cycles 19, doi:10.1029/2004GB002345.Köhler, P., and Fischer, H. (2006). Simulating low frequency changes in atmospheric CO2 during the last 740,000 years. Climate of the Past 2, 57-78.Menviel, L., Timmermann, A., Mouchet, A., and Timm, O. (2008). Climate and marine carbon cycle response to changes in the strength of the southern hemispheric westerlies. Paleoceanography 23, PA4201.Bouttes, N., Paillard, D., and Roche, D. M. (2010). Impact of brine-induced stratification on the glacial carbon cycle. Climate of the Past 6, 575-589.LeGrand, P., and Alverson, K. (2001). Variations in atmospheric CO2 during glacial cycles from an inverse ocean modeling perspective. Paleoceanography 16, 604-616.Marinov, I., Gnanadesikan, A., Sarmiento, J. L., Toggweiler, J. R., Follows, M., and Mignone, B. K. (2008). Impact of oceanic circulation on biological carbon storage in the ocean and atmospheric pCO2. Global Biogeochemical Cycles 22, GB3007,.Marinov, I., Gnandadesikan, A., Toggweiler, J. R., and Sarmiento, J. L. (2006). The Southern Ocean biogeochemical divide. Nature 441, 964-987.Tagliabue, A., Bopp, L., Roche, D. M., Bouttes, N., Dutay, J.-C., Alkama, R., Kageyama, M., Michel, E., and Paillard, D. (2009). Quantifying the roles of ocean circulation and biogeochemistry in governing ocean carbon-13 and atmospheric carbon dioxide at the last glacial maximum. Climate of the Past 5, 695-706. [Hubertus Fischer, Switzerland]	Noted - text has been modified and includes now some of the references listed here. Because of space limitation though, only a selected subset of the list is included.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-913	6	13				What is the y axis of the bottom figure? Only one y-axis caption is needed for the uppter four figures. What is "CO2 flux anomalties"? Where are the "black bars"? [Zongbo Shi, United Kingdom]	Accepted - figure modified
6-914	6	14	1	14	1	Add Brzezinski et al. (2001) as they were first to propose the silica leakage mechanism. [Nicolas Gruber, Switzerland]	Accepted - text revised & reference incldued
6-915	6	14	3			Should be CO2 emission from fossil fuel by type and cemente production??? [Zongbo Shi, United Kingdom]	Accepted - text revised
6-916	6	14	5	14	5	As a ordinary reader, I just wonder whether all these "drivers" are really drivers or maybe consequences. If possible, the authors should provide some evidences to show this. [Rongshuo Cai, China]	Rejected - lack of space ; detailled explanation is given in Kohfeld and Ridgwell 2009.
6-917	6	14	5	14	6	Suggest less cryptic "in-housewording" such as "All the major drivers of the atmospheric CO2 concentration variation during glacial-interglacial cycles .....etc [Roger Gifford, Australia]	Accepted - text revised
6-918	6	14	5	14	13	I consider the timing of events another powerful constraint on the mechanisms (see Broecker and Henderson (1998) and many subsequent papers. [Nicolas Gruber, Switzerland]	Accepted - text onlu mentino very briefly the usefulness of timing of events. Leads and lags are discussed in Chap 5.
6-919	6	14	6			add 'exist' after uncertainties [Jeffrey Obbard, Singapore]	Editorial - corrected in text.
6-920	6	14	7			remove 'exist' [Jeffrey Obbard, Singapore]	Editorial - corrected in text.
6-921	6	14	10	14	11	organic matter mineralization is a new topic, should not belong in the summary, or explained earlier in the text. [Stefan Gerber, USA]	Accepted - paragraph has been rewritten
6-922	6	14	10	14	13	The choice of processes sensitive to climate is a bit arbitrary, wouldn't sea ice cover, ocean stratification also be sensitive to climate? [Stefan Gerber, USA]	Accepted - paragraph has been rewritten
6-923	6	14	11			bad (or colloquial oral) grammar: insert "to be" between "likely" and "sensitive" [Roger Gifford, Australia]	Editorial - text revised.
6-924	6	14	15		25	Synchronizing the citation format: suggested to change 1. (Joos et al., 2004) to "1. Joos et al. (2004)" as commonly used in literature. Other citation format follows [Zongbo Shi, United Kingdom]	Accepted - caption has been rewritten
6-925	6	14	15			Explain the “L” , “M”, “H” designations [Richard Bourbonniere, Canada]	Accepted - caption has been rewritten
6-926	6	14	23			Ruddiman; 2003,2007 Should be rewrite to Ruddiman 2003, Annonymous 2007. If author refer to Ruddiman 2007, this paper should be found in the reference. [Soydoa Vinitnantharat, Thailand]	Accepted - caption has been rewritten
6-927	6	14	29			change 'with' to 'to' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-928	6	14	30	14	30	800,000 → 800 ky [Peter Burt, UK]	Accepted - text revised
6-929	6	14	31	14	31	"eight" instead of "8". [Leticia Cotrim da Cunha, Germany]	Editorial - text revised.
6-930	6	14	36	14	37	It is not clear what is meant by statement that the isotopic composition of N2O has only been used to investigate causes of in situ production in ice. First I am not aware of N2O production in ice and secondly, the statement is not true as Sowers et al (2003) use the N isotopic composition of N2O in ice to determine the relative importance of marine and terrestrial sources of N2O to the atmosphere. See Science (2003) 301: 945-948. [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-931	6	14	37			insert 'level's after 14C [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-932	6	14	38	14	38	insert 'to be' after 'unlikely' [Peter Burt, UK]	Editorial (with similar comments 6-933 to 6-935) - text revised.
6-933	6	14	38			Passive voice would be appropriate here. Change “unlikely causing last” to “unlikely to have caused the last” [Richard Bourbonniere, Canada]	Editorial (with similar comments 6-932, 6-934, 6-935) - text revised.
6-934	6	14	38			bad grammar: replace "causing" with "to have caused" [Roger Gifford, Australia]	Editorial (with similar comments 6-932, 6-933, 6-935) -

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							text revised.
6-935	6	14	38			change to'were unlikely during the last degalciation as atmospheric CH4 levels increased' [Jeffrey Obbard, Singapore]	Accepted - text revised.
6-936	6	14	39	14	44	change to: suggest that most of the methane doubling during the last deglaciation results from a stronger source of tropical wetlands with stronger boreal wetlands and a longer atmospheric lifetime of methane for increasing methane concentrations also contributing to the increase. The biomass burning CH4 source apparently changed little in absolute terms on the same time scale. Over the last millenium this source experienced large fluctuations relative to its mean emission strength but still remains secondary to wetland sources throughout this time period. Accordingly, the biomass burning source has a small effect on CH4 concentration, however, it has a strong influence on the carbon isotopic signature of CH4 in the atmosphere due to its extraordinarily high d13C signature (Mischler et al., 2009, Wang et al., 2010b, Fischer et al., 2008). [Hubertus Fischer, Switzerland]	Accepted - text revised
6-937	6	14	39			What is "deltaD"? [Zongbo Shi, United Kingdom]	Accepted - deltaD will be replaced by delta Deuteriem
6-938	6	14	41	14	41	"… an increase in CH4 residence time…" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comment 6-939) - rewording accepted.
6-939	6	14	41	14	42	Change to "an increased residence", and "have change little on" [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-938) - text revised.
6-940	6	14	42			“changed little” not “little changed” [Richard Bourbonniere, Canada]	Editorial (combined with comment 6-939) - text revised.
6-941	6	14	46	14	46	modeling → modelling [Peter Burt, UK]	Editorial - corrected in text.
6-942	6	14	51	14	51	Avoid using an abbreviation in a section title. [Leticia Cotrim da Cunha, Germany]	Accepted - sectoin title will be modified
6-943	6	14	51	15	13	There should be some mention that during the LGM CH4 was very low because of source driven changes in the CH4 source - principally wetlands. These are most likely associated with changes in wetland productivity (rather than extent) in response to low tempeartures and, importanly to low CO2 reducing productivity in plants which offer peatland methanogens substrate. See: Boardman, CP., Gauci, V. Watson, JS., Blake, S and Beerling, DJ. (2011) Contrasting wetland CH4 emission responses to simulated glacial atmospheric CO2 in temperate bogs and fens. New Phytologist 192: 898-911 doi: 10.1111/j.1469-8137.2011.03849.x; and Levine, J. G., E. W. Wolff, A. E. Jones, L. C. Sime, P. J. Valdes, A. T. Archibald, G. D. Carver, N. J. Warwick, and J. A. Pyle (2011), Reconciling the changes in atmospheric methane sources and sinks between the Last Glacial Maximum and the pre-industrial era, Geophys. Res. Lett., 38, L23804, doi:10.1029/2011GL049545. [Vincent Gauci, United Kingdom]	Accepted and combined with comment 936 - text revised.
6-944	6	14	53	14	58	Maybe quickly explain that the D-O events were sharp climatic fluctuations that occured during the last glacial period (as well as how many times did these fluctuations happened), i.e. the last years of the Pleistocene, from +/- 110000 years BP to +/- 11000 years BP (hope this is correct). It is useful for the non-expert reader. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised but detailled description of DO events is given in Chap 5. Ref to chap5 to be added.
6-945	6	14	53	14	58	Requires a comment that Greenland and Antarctic temperatures can be very different, and a note on why (reference to Paleoclimate chapter) [Michael Raupach, Australia]	Rejected - reference to paleo Chapter will be included.
6-946	6	14	54	14	54	Poor English. Change to '.. climatic events, but their...' [Peter Burt, UK]	Editorial (combined with comment 6-947) - text revised.
6-947	6	14	54			change 'But' to 'However' [Jeffrey Obbard, Singapore]	Editorial - copyedit to be completed prior to publication.
6-948	6	14	55	14	55	"… differ. Atmospheric CO2 concentrations …" [Leticia Cotrim da Cunha, Germany]	Editorial - accepted.
6-949	6	14	55	14	56	"CO2 concentrations varied by about 20 ppm, increasing during cold (stadial) events in Greenland, attaining a	Accepted - sentence has been rewritten to be clearer.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						maximum around the time of the rapid warming in Greenland". The sentence is contadictory, the first part dealing with cooling, the second part with warming, in relation to CO2 variation. The sentence needs to be re-thought and re-written. By "stadial" the sentence refers to relatively cool periods, but CO2 does not normally increase during stadial periods. CO2 would increase during warming such as associated with the D-O cycles, along with other greenhouse gases, i.e. "N2O and CH4 variations during the last glacial epoch: Insight into global processes" (Global Biogeochemical Cycles, Vol. 18, GB1020, January 2004). [Andrew Glikson, Australia]	
6-950	6	14	55			increasing during cold periods? [Almut Arneth, Germany]	Accepted - sentence has been rewritten to be clearer.
6-951	6	14	58			change to 'trending with Greenland atmospheric temperatures' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-952	6	14				caption Figure 6.5 refers to Kohfeld and Ridgwell and does not give the original literature. Is Kohfeld and Ridgwell counted as grey literature? [Hubertus Fischer, Switzerland]	Rejected - Kohfeld and Ridgwell (AGU monograph) not counted as grey litterature.
6-953	6	15	1	15	2	The abbreviation "DO" is starting twice a sentence. Maybe rewrite this part? [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-954	6	15	1			CO2? [Zongbo Shi, United Kingdom]	Accepted - text revised
6-955	6	15	2	15	2	insert 'a' after 'at' [Peter Burt, UK]	Editorial - text revised.
6-956	6	15	2			delete "DO" [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-957	6	15	3	15	3	delete comma after 'events' [Peter Burt, UK]	Editorial - text revised.
6-958	6	15	6	15	6	"changes" that caused the D-O events? [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-959	6	15	7			It would be better to stick with either Gt or Pg within the chapter if not the whole report. [Roger Gifford, Australia]	Accepted - text revised : PgC is used within the whole chapter
6-960	6	15	10			delete shallow [Hubertus Fischer, Switzerland]	Accepted - text revised
6-961	6	15	11	15	11	insert commas either side of 'however' [Peter Burt, UK]	Editorial (also with comment 6-964) - text revised.
6-962	6	15	11	15	13	Is this really correct? I suggest to check this with the cited references. For example, Jaccard and Galbreith don't really investigate DO events during the glacial, but the deglacial transition (which, of course contains Heinrich event 1), but this is not what this section is about, isn't it? [Nicolas Gruber, Switzerland]	Accepted - reference has been removed as it Jaccard and Galbraith investigate deglaciation.
6-963	6	15	11	15	13	This sentence is a good example of the missing mentioning of the processes which are responsible for the uncertain results. It would improve the report significantly if such statements were more precise and mention the reasons for the different assessments in the cited literature. [Nikolaus Josef Kuhn, Switzerland]	Accepted - text revised to be more precise on the related processes.
6-964	6	15	11			change to', however,' [Jeffrey Obbard, Singapore]	Editorial (also with comment 6-961) - text revised.
6-965	6	15	13	15	13	of N2O → of the N2O [Peter Burt, UK]	Editorial - corrected in text.
6-966	6	15	13	15	13	The 2 needs to be subscript in N2O. [Daniel Metcalfe, Sweden]	Editorial (combined with comments 6-965, 6-967) - corrected in text.
6-967	6	15	13			N2O should be "N2O" [Zongbo Shi, United Kingdom]	Editorial (combined with comments 6-965, 6-966) - corrected in text.
6-968	6	15	15	15	15	Please refer to comment 133. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-969	6	15	19	15	19	carbon dioxide, methane → CO2, CH4 [Peter Burt, UK]	Editorial (see similar comments: 6-970, 6-971) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-970	6	15	19	15	19	Either use CO2, CH4 and N2O or write the name for the three gases. [Leticia Cotrim da Cunha, Germany]	Editorial (see similar comments: 6-969, 6-971) - text revised.
6-971	6	15	19			for consistency use formulas CO2, CH4 [Richard Bourbonniere, Canada]	Editorial (see similar comments: 6-969, 6-970) - text revised.
6-972	6	15	23	15	23	eleven thousands → 11,000 [Peter Burt, UK]	Editorial (see similar comments: 6-973, 6-974) - corrected in text.
6-973	6	15	23	15	23	Change "thousands" to "thousand". [Nathaniel Ostrom, United States of America]	Editorial (see similar comments: 6-972, 6-974) - corrected in text.
6-974	6	15	23	15	23	eleven thousand years [Michael Raupach, Australia]	Editorial (see similar comments: 6-972, 6-973) - corrected in text.
6-975	6	15	23	15	24	Not clear in the sentence : are more than a factor of five small than the CO2 increase. Please explain more. [Soydoa Vinitnantharat, Thailand]	Accepted - text revised.
6-976	6	15	23	15	25	Change to "the eleven thousand years preceding". "Small scale" relative to what? I suggest you change to something like "Despite the small scale of atmospheric CO2 variation prior to the start of the industrial period, these changes are nevertheless essential for understanding the role of natural forcings in CO2 dynamics." [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-977	6	15	24	15	24	"are more than five times smaller" [Leticia Cotrim da Cunha, Germany]	Noted - text revised as suggested in the comment 6-976
6-978	6	15	25	15	25	"of their smaller scale…" [Leticia Cotrim da Cunha, Germany]	Noted - text revised as suggested in the comment 6-976
6-979	6	15	25			change to 'realtively short time scales' [Jeffrey Obbard, Singapore]	Rejected - what is meant here is a magnitude of the scale and not the time scale
6-980	6	15	25			change 'a role' to 'the role' [Jeffrey Obbard, Singapore]	Editorial - copyedit to be completed prior to publication.
6-981	6	15	28		31	The format of the citation is not consistent; lots of ")" missing [Zongbo Shi, United Kingdom]	Editorial - copyedit to be completed prior to publication.
6-982	6	15	28			Figure 6.6. The legend mentions square symbols but I cannot find them in the figure or the top legend. [Göran Ågren, Sweden]	Accepted - revised 6.6 figure will include the GRIP CH4 record shown by square symbols
6-983	6	15	31			“(“ missing before circles and squares – Also fix in Fig 6.6 caption [Richard Bourbonniere, Canada]	Accepted - caption revised.
6-984	6	15	33			change 'release' to 'reports' [Jeffrey Obbard, Singapore]	Editorial - corrected in text. AR stays for "Assessment Report", therefore "release" is removed.
6-985	6	15	34	15	34	"three" instead of "3". [Leticia Cotrim da Cunha, Germany]	Editorial (combine dwith comment 6-989) - cottected in text.
6-986	6	15	34	15	34	period have been a matter [Robert Scholes, South Africa]	Accepted - text revised.
6-987	6	15	34	15	36	This sentence leaves the impression that the entire Holocene increase in CO2 was due to land-use, but I believe we are talking only of the 20 ppm increase that was different from other interglacials. [Richard Bourbonniere, Canada]	Noted - the authors do not share this impression
6-988	6	15	34			change 'were' to 'have been' [Jeffrey Obbard, Singapore]	Editorial - rewording accepted.
6-989	6	15	34			change '3' to 'three separate' and 'was not increasing' to 'did not increase' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-985) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-990	6	15	35	15	35	use "land-use" or "land use". [Leticia Cotrim da Cunha, Germany]	Editorial - corrected in text.
6-991	6	15	36	15	36	Insert "However, " before "recent ice core data" [Michael Raupach, Australia]	Editorial - text revised.
6-992	6	15	36	15	38	A reference from 2005 is not that "recent" anymore. What should the reader conclude from this remark? [Leticia Cotrim da Cunha, Germany]	Accepted - "recent" is removed
6-993	6	15	37	15	37	What is the "MIS11"? [Rongshuo Cai, China]	Accepted - MIS11 acronym is explained
6-994	6	15	37	15	37	Substitute "similar" with "similarly". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-995	6	15	38	15	38	Insert paragraph break before "Drivers of atmospheric CO2 changes" [Michael Raupach, Australia]	Editorial - accepted.
6-996	6	15	42	15	42	"with high certainty" I suggest to use IPCC's standard metric of certainty here instead. I am also not 100% convinced that we are as certain as this statement implies here. I think the evidence is strong, but not unequivocal. [Nicolas Gruber, Switzerland]	accepted - changed to very likely
6-997	6	15	42	15	43	"explains the CO2 growth through the Holocene." Not "throughout" - as shown in figure 6.6 CO2 was relatively stable until ~6000 years ago. [Andrew Glikson, Australia]	Accepted - text revised.
6-998	6	15	42	15	52	I do not agree that the term "high certainty" should be applied to the described carbonate sedimentation mechanisms of Holocene CO2 change. This mechanism is an attractive hypothesis, but it's still just a hypothesis in an area with many uncertainties. I am more comfortable with the "high certainty" applied to the relatively minor contribution of changing SST. [Eric Sundquist, United States of America]	accepted - changed to likely for sedementation
6-999	6	15	43	15	43	"… from deep sea…" [Leticia Cotrim da Cunha, Germany]	Editorial - text revised.
6-1000	6	15	43	15	44	"from a deep sea to the shallow waters". May be a good idea to add "due to sea level rise onto continental shelves" [Andrew Glikson, Australia]	Accepted - text revised.
6-1001	6	15	44	15	44	CaCO3 → CaCO3 [Peter Burt, UK]	Editorial (same comment 6-1002) - corrected in text.
6-1002	6	15	44			CaCO3? [Zongbo Shi, United Kingdom]	Editorial (same comment 6-1001) - corrected in text.
6-1003	6	15	45	15	45	"… 2003), and (ii)…" ; the text for item (ii) is not clear. [Leticia Cotrim da Cunha, Germany]	Noted. There is not enough space in the chapter to explain the carbonate compensation mechanism, however, it is detaily considered in the cited publications
6-1004	6	15	49	15	49	"… the hypothesis of the ocean as a source of carbon to the…" [Leticia Cotrim da Cunha, Germany]	Combined with comment 6-1005, 6-1006. Rewording suggestion accepted.
6-1005	6	15	49	15	49	Shouldn't this be "of an oceanic source of carbon to the atmosphere"? [Daniel Metcalfe, Sweden]	Combined with comment 6-1004, 6-1006. Copyedit to be completed prior to publication.
6-1006	6	15	49			change 'source' to 'sources' [Jeffrey Obbard, Singapore]	Combined with comment 6-1004, 6-1005. Copyedit to be completed prior to publication.
6-1007	6	15	50	15	50	Abbreviation of SST: explain once, then use it for the rest of the text. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1008	6	15	50	15	50	This sentence needs a bit of re-writing: "slightly lower atmospheric CO2 concentrations"? [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1009	6	15	50			SSTs; define if first appears [Zongbo Shi, United Kingdom]	Accepted - text revised.
6-1010	6	15	51	15	51	CO2 → CO2 [Peter Burt, UK]	Editorial - text revised.
6-1011	6	15	51			change to 'but, with high certainity, SST-driven CO2 change represents only a minor contirution [Jeffrey Obbard, Singapore]	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1012	6	15	51			CO2? [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-1013	6	15	55	15	55	Please refer to comment 117. [Leticia Cotrim da Cunha, Germany]	Rejected - comment number misplaced
6-1014	6	15	55	15	55	Remove "the" [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1015	6	15	56	15	56	"inverse calculations" Please explain [Nicolas Gruber, Switzerland]	Accepted - text revised.
6-1016	6	15	56	15	56	What inverse calculations? I suggest change to "periods. Inverse calculations yield". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1017	6	15	56	16	2	This statement seems a bit general in the light of the progressing soil and peatland development as well as the changes in soil properties after the onset and spread of agriculture. [Nikolaus Josef Kuhn, Switzerland]	Noted - statement will be mode more precise.
6-1018	6	15				Add a legend bar to the figure. It is extremely difficult to read this figure using the explanation in the figure caption [Zongbo Shi, United Kingdom]	Noted. The legend bar for the Figure 6.6 does exist.
6-1019	6	16	1	16	1	Units: Pg C instead of Gt C [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1020	6	16	1			(and elsewhere especially in Tables) General point: Need to be consistent in use of Gt vs Pg [Roger Gifford, Australia]	Accepted - changed to Pg everywhere (see 6-1019)
6-1021	6	16	5	16	6	This statement should be specified as a model-based hypothesis rather than the present wording, which suggests it is a proven fact. [Eric Sundquist, United States of America]	reject - sentence as stated is correct
6-1022	6	16	6	16	6	insert 'a' after 'represent' [Peter Burt, UK]	Editorial (same comments 6-1023, 6-1024) - text revised.
6-1023	6	16	6	16	7	Change to "fertilization represented a substantial". [Daniel Metcalfe, Sweden]	Editorial (same comments 6-1022, 6-1024) - text revised.
6-1024	6	16	6		7	…fertilization supports a substantial land sink of carbon.. [Almut Arneth, Germany]	Editorial (same comments 6-1022, 6-1023) - text revised.
6-1025	6	16	6			Were these modeling studies N constrained? If not, what does this imply? [Göran Ågren, Sweden]	Noted. The studies were not N constrained. It is not obvious that the N limitation should be considered on the milennial timescale. N-fixing bacteria could provide plants with N relatively quickly.
6-1026	6	16	6			change to 'represents' [Jeffrey Obbard, Singapore]	Editorial (same comments 6-1022 to 6-1024) - text revised.
6-1027	6	16	7	16	7	Please refer to comment 151. [Leticia Cotrim da Cunha, Germany]	comment number misplaced
6-1028	6	16	11	16	11	"Small" in what sense? Spatially they appear to have been very large. [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1029	6	16	12	16	12	Please refer to comment 151. [Leticia Cotrim da Cunha, Germany]	comment number misplaced
6-1030	6	16	13	16	14	Explain more for " a factor of two" [Soydoa Vinitnantharat, Thailand]	Accepted - text revised.
6-1031	6	16	14			add: ... Yu, 2011). Peat carbon uptakle reconstructions based on basal peat ages, however, cannot account for the loss of glacial peat deposit in the course of the deglaciation and the Holocene. [Hubertus Fischer, Switzerland]	Noted
6-1032	6	16	15	16	15	Give plausible ranges for annual (eg Pinatubo) and mean centennial (eg 19th, 20th centuries) volcanic C emissions [Michael Raupach, Australia]	ALL - giving a value for Pinatubo eruption could be misleading, as CO2 emissions are also going from sub-marine volcanoes. The Quaternary estimates are about 6 Tmol/yr or 0.07 PgC/yr. This should be reflected in the Figure 1.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1033	6	16	15	16	16	a big uncertainty or a small one? [Robert Scholes, South Africa]	taken into account - sentence will be modified to note we cannot quantify this with any certainty
6-1034	6	16	18	16	18	Please refer to comment 143. [Leticia Cotrim da Cunha, Germany]	Rejected - It was unclear to which exact comment / line of the FOD this comment was referring to. Comment 143 from V Gray does not seem to be relevant to the comment of L. Cotrim da Cunha.
6-1035	6	16	19	16	19	Please refer to comment 143. [Leticia Cotrim da Cunha, Germany]	Rejected - It was unclear to which exact comment / line of the FOD this comment was referring to. Comment 143 from V Gray does not seem to be relevant to the comment of L. Cotrim da Cunha.
6-1036	6	16	19	16	19	Change to "observational, paleoecological". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1037	6	16	26	16	26	"… estimates, the confidence…" [Leticia Cotrim da Cunha, Germany]	Editorial - text revised.
6-1038	6	16	32	16	32	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - text revised.
6-1039	6	16	33	16	33	They must have had some influence, perhaps change to "have had a significant influence". Change to "concentrations. A recent study". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1040	6	16	33	16	33	Insert "However, a " before "recent study" [Michael Raupach, Australia]	Editorial (with same somment 6-1041) - corrected in text.
6-1041	6	16	33			'A recent study' [Jeffrey Obbard, Singapore]	Editorial (with same somment 6-1040) - corrected in text.
6-1042	6	16	34			change 'attempts' to 'assumptions' [Jeffrey Obbard, Singapore]	Rejected - "attemps" stays for "studies", not "assumptions"
6-1043	6	16	35	16	35	Is it fine to use "Anno Domini"? Maybe use "… year 1850." [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1044	6	16	35			If 150Pg carbon emissions are not large enough, would 350 Pg C made any differences to CO2 concentration? [Zongbo Shi, United Kingdom]	Noted.
6-1045	6	16	38	16	38	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - text revised.
6-1046	6	16	39	16	39	Change to "as a source". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1047	6	16	45	16	45	also Bowman et al., 2009 Science Vol. 324 no. 5926 pp. 481-484 [Andrew Glikson, Australia]	Accepted - text revised.
6-1048	6	16	45	16	45	See paper by S Archibald et al in 2011 [Robert Scholes, South Africa]	Noted. The reference and its relevance to the section are not specified enough to decide on the necessary action. R. Scholes is asked offline.
6-1049	6	16	49	16	49	Substitute "has" for "have" to agree with "dynamics". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1050	6	16	49		50	you're not taking about dynamics, but concentrations. Why not be much simpler: …atmospheric CH4 levels were lowest at around 5ka, and rose between XXX and yyy ka by about 100 ppb [Almut Arneth, Germany]	Accepted - text revised.
6-1051	6	16	49		57	too many "rises" (I count five). [Almut Arneth, Germany]	Noted, text revised
6-1052	6	16	54	16	54	Substitute "explanation" for "explanations". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1053	6	16	55	16	55	"… . Kaplan et al. (2006) …" [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1054	6	16	57	16	57	methane → CH4 [Peter Burt, UK]	Editorial - corrected in text.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1055	6	16		17		Although the sections are informative about research, no connection is made with the present concerns about climate change or understanding future emissions from natural ecosystems. It would be desirable to have a discussion of this connection early on so that the reader can get the point. For instance: why is the small drop of CO2 around 1600 important? [Mohammad Aslam Khan Khalil, USA]	ALL - it is relevant because it is the only approach to estimate sensitvity of C cycle to climate change (And natural C variability) on time scales longer than last 50 years
6-1056	6	16				In general there's a good synthesis of the top-down and bottom-up estimates but I am missing any comment on whether they are consistent. [Peter Rayner, Australia]	Noted
6-1057	6	16				Fig 12. Change legend from "pub" etc to refer to the papers. MacFarling is also published. [Stephen E Schwartz, USA]	Accepted - text revised.
6-1058	6	17	1	17	1	I thin it better to change color in figure 6.13. I also think it better to add a sentence to explain meanings of colors (or add a legend). [Takashi Maki, Japan]	Accepted - legend will be added.
6-1059	6	17	2	17	2	clarify how much methane is released to the atmosphere through fire. [Andrew Glikson, Australia]	Rejected - the quantification here is rather misleading as there is no direct evidence for CH4 emissions in Holocene. Present-day pyrogenic CH4 emissions are provided in the section 6.3.3.2
6-1060	6	17	4	17	47	Fluckiger et al., 2002 provide ice core records of N2O over the last 10,000 years, although they don't have definitive explanations for the variations. [Cynthia Nevison, USA]	Noted.
6-1061	6	17	6	17	6	Please refer to comment 133. [Leticia Cotrim da Cunha, Germany]	Rejected - It was unclear to which exact comment / line of the FOD this comment was referring to. Comment 133 from P. Bousquet does not seem to be relevant to the comment of L. Cotrim da Cunha.
6-1062	6	17	8	17	8	Better: Mechanisms controlling the CO2 drop around year 1600 [Leticia Cotrim da Cunha, Germany]	Rejected - the word "control" is inappropriate here
6-1063	6	17	8	17	37	Section 6.2.4.1 This section can be made more congruent. In particular, the last paragraph seems ill connected to the rest, as it talks about the "apparent" climate sensitivity of the carbon cycle. I also miss some form of conclusion. [Nicolas Gruber, Switzerland]	Accepted - the last paragraph will be modified and moved to from this subsectino to include a more thourough discussion on the use of paleo-data to extract an estimate of climate-carbon feedbacks.
6-1064	6	17	9	17	37	To explain the drop of CO2 around 1600, why isn't the larger solubility of oceans in the colder period of the Maunder minimum considered here ? See comment to lines 34-36 of Chapter 2 Page 44. [François GERVAIS, France]	Noted - the temperature decrease is considered in the models but it is not sufficient to explain the CO2 drop in the models, see, e.g. study by Jungclaus et al. (2010)
6-1065	6	17	9			reveal (or: show) [Almut Arneth, Germany]	Editorial (also ref. to comments 6-1066 to 6-1068, and 6-1070, 6-1071) - corrected.
6-1066	6	17	10			End sentence after 1600. Start new sentence with: A study of CO2 recovery . . . is in progress; (. . [Richard Bourbonniere, Canada]	Rejected - there is no study of the CO2 recovery. Both CO2 drop and recovery are features of the CO2 variability during the past millennium, so they should be mentioned here
6-1067	6	17	11	17	11	Check the references. [Leticia Cotrim da Cunha, Germany]	Editorial (also ref. to comments 6-1065 to 6-1068, and 6-1070, 6-1071) - corrected.
6-1068	6	17	11	17	11	I believe that "in progress;" should be deleted. [Nathaniel Ostrom, United States of America]	Editorial (also ref. to comments 6-1065 to 6-1067, and 6-1070, 6-1071) - corrected.
6-1069	6	17	11	17	12	Figure reference not bold [Peter Burt, UK]	Accepted - text revised.
6-1070	6	17	11	17	12	"in progress" seems out of place, should it be removed? Change to "evaluate the strength" [Daniel Metcalfe, Sweden]	Editorial (also ref. to comments 6-1065 to 6-1068, and 6-1071) - corrected.
6-1071	6	17	11			placeholder for refs to be updated later? [Almut Arneth, Germany]	Editorial (also ref. to comments 6-1065 to 6-1068, and

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							6-1070) - corrected.
6-1072	6	17	11			cite MacFarling Meure, C., Etheridge, D., Trudinger, C. M., Steele, P., Langenfelds, R., Van Ommen, T., Smith, A., and Elkins, J. (2006). Law Dome CO2, CH4 and N2O ice core records extended to 2000 years BP. Geophysical Research Letters 33, doi:10.1029/2006GL026152. [Hubertus Fischer, Switzerland]	Accepted - text revised.
6-1073	6	17	11			What "in progress" means here? [Zongbo Shi, United Kingdom]	Editorial - accepted.
6-1074	6	17	12	17	12	17th century → 17th Century [Peter Burt, UK]	Rejected - "17th century" is the style required by the IPCC WG1 AR5 Style Guide for Chapter drafts.
6-1075	6	17	12			change ' a strength' to 'the response' [Jeffrey Obbard, Singapore]	Rewording suggestion - accepted.
6-1076	6	17	14			change to 'which was found to be dependent on the choice of global temperature reconstructions used in the model' [Jeffrey Obbard, Singapore]	Rewording suggestion - accepted.
6-1077	6	17	16			Figure 6.7. Which references are connected with the Law symbols given at the top of the figure? [Göran Ågren, Sweden]	Accepted - Law Dome is mentioned in the figure caption
6-1078	6	17	16			Figure 6.7: Law Dome missing from caption [James Christian, Canada]	Accepted - Law Dome is mentioned in the figure caption
6-1079	6	17	17			Am not sure if you want to/need to be consistent with axis labelling. For examples, some Figures say yr, others yr AD [Almut Arneth, Germany]	Noted. In the figures, we prefer to use "Yr BP" scale for the Holocene, and "Yr AD" for the last millennium. In the text, we use "Yr BP" or "Year" for "Year AD".
6-1080	6	17	21	17	21	insert 'the' after 'of' [Peter Burt, UK]	Accepted - text revised following suggestion in the comment 6-1083
6-1081	6	17	21	17	21	"… around year 1600…" [Leticia Cotrim da Cunha, Germany]	Editorial - accepted.
6-1082	6	17	21	17	21	Change to "One possible explanation of the atmospheric CO2 drop around yr 1600 is the carbon cycle response to". [Daniel Metcalfe, Sweden]	Accepted - text revised following suggestion in the comment 6-1083
6-1083	6	17	21	17	21	Rewrite this sentence as: "One of the possible explanations for the decrease in atmospheric CO2 around yr 1600…". [Nathaniel Ostrom, United States of America]	Accepted - text revised following suggestion in the comment 6-1083
6-1084	6	17	21	17	30	This section is somewhat contradicting the statement mentioned in the previous comment. Where did the CO2 move from the atmosphere? Unlikely just vegetation. [Nikolaus Josef Kuhn, Switzerland]	Accepted - text revised.
6-1085	6	17	21		30	I would argue that "drop" is rather poor style [Almut Arneth, Germany]	Accepted - "drop" is replaced with "decrease" in most of cases in this paragraph
6-1086	6	17	21			One of the..is a response of the.. [Almut Arneth, Germany]	Accepted - text revised following suggestion in the comment 6-1083
6-1087	6	17	21			add 'the' before carbon [Jeffrey Obbard, Singapore]	Accepted - text revised following suggestion in the comment 6-1083
6-1088	6	17	22	17	22	during Maunder minimum → during the Maunder Minimum [Peter Burt, UK]	Editorial (combined with comments: 6-1090 and 6-1091) - corrected.
6-1089	6	17	22	17	22	Maybe explain a bit what is the Maunder minimum, when it happened, and the effect of the sunspots on climate? [Leticia Cotrim da Cunha, Germany]	Noted. A reference to the Chapter 5 (Paleo) should be sufficient.
6-1090	6	17	22	17	22	Change to "during the Maunder". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1088 and 6-1091) - corrected.
6-1091	6	17	22			add 'the'beofre 'Maunder [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1088 and 6-1090) - corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1092	6	17	24	17	24	Change to "of the observed", and "could also be". [Daniel Metcalfe, Sweden]	Editorial (combined with a comment 6-1094) - corrected.
6-1093	6	17	24			drop of observed amplitude - what is meant here? [Almut Arneth, Germany]	Accepted - text revised.
6-1094	6	17	24			add 'the' before observed [Jeffrey Obbard, Singapore]	Editorial (combined with a comment 6-1092) - corrected.
6-1095	6	17	25			Add a reference to each of the hypothesis [Zongbo Shi, United Kingdom]	Accepted - References are added for model studies of volcanic eruption effect on CO2
6-1096	6	17	26	17	26	"Central America" [Leticia Cotrim da Cunha, Germany]	Editorial - corrected.
6-1097	6	17	27	17	27	→ Pongratz et al. (2011) do not...' [Peter Burt, UK]	Editorial (combined with comment 6-1099, 6-1100) - corrected.
6-1098	6	17	27	17	27	Substitute "does" with "do". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1102) - corrected.
6-1099	6	17	27	17	27	Remove parenthises around Pomagratz et al., 2011 and place around 2011. [Nathaniel Ostrom, United States of America]	Editorial (combined with comment 6-1097, 6-1100) - corrected.
6-1100	6	17	27	17	28	. by Pongratz et al. (2011) do not show . . . by Kaplan et al. (2011) . . . [Richard Bourbonniere, Canada]	Editorial (combined with comment 6-1097, 6-1099) - corrected.
6-1101	6	17	27			change 'does' to 'do' [Jeffrey Obbard, Singapore]	Accepted - text revised.
6-1102	6	17	27			"does not" should be "do not" [Zongbo Shi, United Kingdom]	Editorial (combined with comment 6-1098) - corrected.
6-1103	6	17	28	17	28	→ Kaplan et al. (2011) [Peter Burt, UK]	Editorial (combined with comment 6-1100) - corrected.
6-1104	6	17	28	17	29	late 16th - ealry 17th Centuries [Peter Burt, UK]	Rejected - "17th century" is the style required by the IPCC WG1 AR5 Style Guide for Chapter drafts.
6-1105	6	17	29	17	29	central → Central [Peter Burt, UK]	Editorial (combined with comments: 6-1106, 6-1107) - accepted.
6-1106	6	17	29	17	29	"The low resolution … for Central America…" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comments: 6-1105, 6-1107) - accepted.
6-1107	6	17	29	17	29	Start the sentence with "The"… "The low resolution of…" [Nathaniel Ostrom, United States of America]	Editorial (combined with comments: 6-1105, 6-1106) - accepted.
6-1108	6	17	29	17	30	. . . America do not support or reject these. . . [Richard Bourbonniere, Canada]	Accepted - text revised following the comment 6-1109
6-1109	6	17	29	17	30	This doesn't quite make sense. Change to somthing like "The resolution of central American pollen records is insufficient to support or falsify these model conclusions". Are you referring to temporal or spatial resolution, or both? [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1110	6	17	29			remove 'to support' [Jeffrey Obbard, Singapore]	Accepted - text revised following the comment 6-1109
6-1111	6	17	30			Add a reference [Zongbo Shi, United Kingdom]	Accepted - reference added
6-1112	6	17	33	17	37	This is the first mention of CO2 sensitivity in the chapter. Such estimates are inherently dependent on models, scenarios, and time scales. I suggest that all sensitivity estimates -- past, present, and projected -- be gathered into a single section of the chapter, where methods and their dependencies can be more fully described and compared. [Eric Sundquist, United States of America]	Rejected - the choice of dividing the section by time-scales prevents us from discussing CO2 sensitivity on all time-scales in the same paragraph. But the links will be made clearer between the different sections / paragraphs.
6-1113	6	17	34	17	35	Does the Jungclaus et al. (2010) estimate include nitrogen limitations to CO2 fertilization in terrestrial	Noted. The N cycle was not included into the

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						systems? "the sensitivity of atmospheric CO2 concentration to Northern Hemisphere temperature changes is diagnosed as 2.7 and 4.4 ppm K–1…" If N limitations aren't included in the ESM, it could affect the estimated sensitivity of CO2 to temperature. [Beverly Law, USA]	simulations by Jungclaus et al.
6-1114	6	17	42	17	43	in the 15th and 16th Centuries [Peter Burt, UK]	Editorial (combined with comment 6-1115) - accepted. There is no need to capitalize "Centuries" according to the IPCC WG1 AR5 Style Guide for Chapter drafts.
6-1115	6	17	42			add 'the' before '15' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-1114) - accepted.
6-1116	6	17	43	17	43	delete 'time' (remove tautology) [Peter Burt, UK]	Editorial - accepted.
6-1117	6	17	44	17	44	contributes → contribute [Peter Burt, UK]	Editorial (combined with comment 6-1118 and 6-1119) - accepted.
6-1118	6	17	44	17	44	"… likely contribute …" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comment 6-1117 and 6-1119) - accepted.
6-1119	6	17	44	17	45	. . . likely contribute . . . . . although they cannot . . . [Richard Bourbonniere, Canada]	Editorial (combined with comment 6-1117 and 6-1118) - accepted.
6-1120	6	17	53	17	53	industrial revolution → Industrial Revolution [Peter Burt, UK]	Editorial - first letters have been capitalized.
6-1121	6	17	53	17	53	This sounds strange. Suggest you change to "defined for the purpose of this discussion as the period since 1750, the". [Daniel Metcalfe, Sweden]	accepted - text will be clarified
6-1122	6	17	56			Gas flaring is also fossil fuel? [Muhammad Amjad, Pakistan]	Gas Flaring is fossil fuel emission
6-1123	6	17	56			Definition of fossil fuels: please be consistent throughout; gas flaring was not included in previous definition; also, it only needs to be defined for one time [Zongbo Shi, United Kingdom]	Noted - gas flaring is included in the fossil fuel CO2 emissions. Editorial work to be done on numerous definitions of the fossil fuels.
6-1124	6	17				Figure 6.13. The color bar that shows values from -2 to 6 ppm/year shows anomalies relative to what time period. [Vivek Arora, Canada]	Rejected - the graph shows the not anomalies, but the actual growthrates in ppm/yr.
6-1125	6	17				The 16th century drop in methane and nitrous oxide was reported more than 20 years ago. See Khalil and Rasmussen: Climate induced feedbacks for the global cycles of methane and nitrous oxide, Tellus 41B, 554-559, 1989. [Mohammad Aslam Khan Khalil, USA]	Noted. This section is not about the history of the CH4 measurements, but about recent progress in high-resolution measurements and interpretation of the CH4 record. The word "reveal" is replaced with "confirm"
6-1126	6	17				Better to make the metrics (colored bar) vertical. This figure shouuld be formated as that in Fig.. 6. 17 [Zongbo Shi, United Kingdom]	Rejected - there are not enough latitudinal observations for extending the hovmoller diagram all the way back to 1959. the location of the colorbar was chosen for saving space
6-1127	6	18	1	18	1	Do land conversion mean "land use change"? If so, it would be better to keep consistent words throughout the chapter. [Rongshuo Cai, China]	Accepted - text revised
6-1128	6	18	1	18	1	151±51 Pg C: see comment above on overconfidence. This number is the average of three numbers that diverge substantially.I therefore don't think that the number 151 is meaningful [Nicolas Gruber, Switzerland]	Accepted - all integrated values rounded to nearest 5
6-1129	6	18	1	18	1	Boden citation for web link doesn't work. The correct web link as of Jan 2012 is: http://cdiac.ornl.gov/ftp/trends/emissions/ [Beverly Law, USA]	web link is no longer provided, only reference.
6-1130	6	18	5	18	5	Table 6.1. "ocean to atmosphere flux". It should be "atmosphere to ocean flux" as specified in line 36 below, where it is stated: "storage of 1544+/-20 Pg of anthropogenic C into the ocean" [Andrew Glikson, Australia]	Taken into account - all signs checked for consistency
6-1131	6	18	5	18	5	Shouldn't "cumulated" be "accumulated"? [Daniel Metcalfe, Sweden]	accepted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1132	6	18	5	18	7	Table 6.1. the 1850-2001 ocean to atmosphere flux should read -154 not +154. Should the first top-liner heading read "1750-2011" (see also p23, line 26). [Roger Gifford, Australia]	accepted
6-1133	6	18	5	18	7	Under Land-to-atmosphere flux, "residual terrestrial sink" should read "residual terrestrial source" to be consistent in direction, and the figure should read -124 rather than +124. [Roger Gifford, Australia]	Taken into account - all signs checked for consistency
6-1134	6	18	5			Table: Ocean to atmosphere flux, and residual terrestrial sinnk should be given as negative numbers. [Almut Arneth, Germany]	accepted
6-1135	6	18	5			Table 6.1. Capitalize "revolution" [Marcelo Galdos, Brazil]	Editorial - accepted.
6-1136	6	18	5			Table 6.1 replace "1850-2011" for "1750-2011" on the heading of the second column. [Marcelo Galdos, Brazil]	accepted
6-1137	6	18	5			Table 6.1. describes the problem alluded to in my first comment (see above). I do think you should call the third row the "Ocean sink" and give it a negative sign in the first numerical column. Likewise, the residual terrestrial sink should be negative (-124). Otherwise, the whole table becomes confusing. [Peter Högberg, Sweden]	Taken into account - all signs checked for consistency
6-1138	6	18	5			change 'revolution to U/C [Jeffrey Obbard, Singapore]	accepted
6-1139	6	18	6	18	7	Table 6.1. Should it not be -154 and -124? [Göran Ågren, Sweden]	accepted
6-1140	6	18	8	18	8	The website provided as a reference for the atmospheric carbon increase is www.esrl.noaa.gov/gmd/ccgg/trends/ but this website does not have the exact information in the table. It provides the annual changes in atmospheric CO2 in ppm, which I assume were used to derive the decadal changes in PgC for the table, but to enhance clarity, this should be stated including the conversion factor applied. [Ray Nassar, Canada]	accepted
6-1141	6	18	8			Please cite C.D. Keeling as well as NOAA for the atmospheric CO2 data. [Eric Sundquist, United States of America]	accepted
6-1142	6	18	17	18	18	“the current atmospheric CO2 concentration” should be changed to “an atmospheric CO2 concentration” since by the time that AR5 is released in 2013, 389.8 ppm will no longer be current and 2013 values will be in the 395-396 ppm range. It should also be clarified that the 2010 value is for the end of 2010 (as stated on p 6-4 line 13). I think this value is the usual background surface global average, which is a close to the global atmospheric mean, but not exactly the same, and this should be clarified too. [Ray Nassar, Canada]	taken into account (average of 2011 now shown)
6-1143	6	18	18	18	18	insert 'the' after first 'by' [Peter Burt, UK]	Editorial - accepted.
6-1144	6	18	18			be prepared to update the figure on 2011 result [Jeffrey Obbard, Singapore]	accepted
6-1145	6	18	19	18	19	– → : [Peter Burt, UK]	Editorial - accepted.
6-1146	6	18	20			"drives"; better: "diminishes the growth rate of atmospheric CO2, which decreases the increase in radiative forcing that would otherwise result from emissions of CO2 from fossil fuel combustion and land use change." [Stephen E Schwartz, USA]	Taken into account - sentence deleted
6-1147	6	18	23			Figure 6.8. What do the symbols I in the right hand part of the figure stand for? [Göran Ågren, Sweden]	Accepted
6-1148	6	18	23			Figure 6.8: I don't see how the atmosphere growth can be negative in some recent years when the observed values in Figure 6.13 are consistently positive. [James Christian, Canada]	Rejected - this is a misunderstanding. The atmospheric growth is always positive, it is the land sink which is sometimes negative.
6-1149	6	18	23			This could be updated to 2010 using Peters et al 2012 Nature Climate Change [Glen Peters, Norway]	Accepted
6-1150	6	18	23			Is it possible here, or elsewhere, to include the concept of Gross and Net deforestation as in Pan et al 2011 Science? [Glen Peters, Norway]	Accepted - included in section 6.2.3.2

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1151	6	18	26			Caption for Fig 6.8 -- No cement production is shown on this figure so the “US Geological Survey” reference needs deletion or editing --- OR Cement added to the Figure. [Richard Bourbonniere, Canada]	Accepted - cement label added
6-1152	6	18	31	18	31	"Tans, 2011)The" change to "Tans, 2011). The" [Andrew Glikson, Australia]	Editorial (combined with comments: 6-1153, 6-1154) - accepted.
6-1153	6	18	31	18	31	Change to "2011). The" [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1152, 6-1154) - accepted.
6-1154	6	18	31			add '.' after ')' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1152, 6-1153) - accepted.
6-1155	6	18	31			change to 'inter-annual' [Jeffrey Obbard, Singapore]	rejected - interannual is used in our field
6-1156	6	18	32			a dashed line [Almut Arneth, Germany]	accepted
6-1157	6	18	35	18	35	"… partial pressure of the gas…" [Leticia Cotrim da Cunha, Germany]	sentence deleted
6-1158	6	18	35	19	35	There is a disconnect between uptake of emitted CO2 by the terrestrial biosphere (given as 40% in Table 6.1), and the discussion in the box which focuses entirely on ocean inorganic processes. What is the evidence, in the hypothetical example of page 6-19, line 4 "If CO2 emissions stopped" that the uptake by the terrestrial biosphere would not continue to draw down CO2 as implied in the discussion in the cited text and in the box. Moreover at page 6-27, line 30, it is stated that the rate of terrestrial uptake of anthro CO2 is increasing. [Stephen E Schwartz, USA]	accepted - text of box 6.2 will be re-written to include discussion of different time scales moved to after airborn fraction
6-1159	6	18	35			Sometimes "the ocean" is used; sometimes "the oceans" is used. Unless there is a particular reason, please be concistent [Zongbo Shi, United Kingdom]	accepted
6-1160	6	18	38	18	38	"high solubility". I suggest to replace this with "given the high bufffer capacity", since this is not a process driven by "classical" solubility. [Nicolas Gruber, Switzerland]	sentence deleted
6-1161	6	18	40	18	40	At the same time as the ocean warms less CO2 can be dissolved. [Andrew Glikson, Australia]	sentence deleted
6-1162	6	18	45	19	9	I think Box 6.2 is very important and useful. But the word "residence time" may cause confusion since we are mainly interested in the lifetime of the change in concentration, i.e. perturbation lifetime or adjustment time. There is a lot of confusion about the residence time of the emitted molecules vs the adjustment time of the system. I think it would be useful if the differences between these concepts are discussed and made more clear (perhaps with numerical examples). [Jan Fuglestvedt, NORWAY]	accepted - text of box 6.2 will be re-written to include discussion of different time scales moved to after airborn fraction
6-1163	6	18	45	19	35	Do you mean here only the fossil fuel (and cement) fraction of emitted anthropogenic CO2 (365 Pg C)? Or the whole picture (516 Pg C), emitted by global human activity? [Leticia Cotrim da Cunha, Germany]	rejected - the box does not refer to a process, but just to the dynamics of transfer of CO2 once it has been emitted in the atmosphere
6-1164	6	18	45	19	35	I think it could be useful to mention the Impulse Response Function concept in Box 6.2, explain what it is used for and also relate this to FAQ 6.1. [Jan Fuglestvedt, NORWAY]	accepted - text of box 6.2 will be re-written to include discussion of different time scales moved to after airborn fraction
6-1165	6	18	45	19	42	carelessly written, some sentences incomplete, formulas need correction..etc [David Newbery, CH]	Accepted - box rewritten
6-1166	6	18	45			Care needs to be taken with the use of residence time, adjustment time, lifetime, etc. Check with Chapter 8, eg, table 8.10. CO2 has the additional issue in that CO2 is resident in the atmosphere for about 5 years. The text here refers to the lifetime of the CO2 perturbation? [Glen Peters, Norway]	accepted - text of box 6.2 will be re-written to include discussion of different time scales moved to after airborn fraction
6-1167	6	18				Table 6.1. Table title says from 1750, but 1st column is 1850-2011. Should be 1750-2011 (as in the main text). [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted
6-1168	6	18				Figure 6.8 Needs to say in the caption that the land uptake is the residual of all other terms [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1169	6	18				Table 6.1: header col 2 gives time range for cumulative anthropogenic CO2 as 1850-2011, text (P6-17 L55) gives 1750-2011. It is also necessary to specify whether 2011 refers to beginning or end of year, because it makes a difference with a current accumulation rate of 10 PgC/y. [Michael Raupach, Australia]	rejected - we now round off to the nearest 5 so our estimates are not as precise (1750 corrected though)
6-1170	6	18				Table 6.1. There appears to be a problem in the sign convention in col 1 vs the rest of the cols. I prefer no minus signs; then the sources to the atm equal the sinks from atm plus the atm increment. Line 3 would be atm to ocean flux; and last line might be entitled atm to land flux, calc'd as a residual. [Stephen E Schwartz, USA]	taken into account - table will be modified to clarify
6-1171	6	18				Table 6.1 indicates that 3.7 Pg C yr-1 is removed from the atmosphere into ocean and land. The present excess CO2 in the atmosphere relative to preindustrial is 390 - 278 = 112 ppm = 240 PgC, so the fractional removal rate is 1.5% yr-1 corresponding to a lifetime of excess CO2 against removal of 67 years. This observationally based removal rate would yield a much greater reduction in CO2 than indicated in the impulse response profile of Box 6.2, Figure 1, which is based on a carbon cycle model that is dominated by inorganic removal processes. There is at least one published paper (Jacobson) and other unpublished work (Schwartz) that makes this argument. If there is strong argument against this observationally based argument it needs to be presented. . Jacobson, M. Z. (2005), Correction to ‘‘Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming,’’ J. Geophys. Res., 110, D14105, doi:10.1029/2005JD005888.. Schwartz, S. E. Well Known . . . to a Few People: Attribution of Excess Atmospheric CO2 and Resulting Global Temperature Change to Fossil Fuel and Land Use Change Emissions. American Geophysical Union Fall Meeting, San Francisco CA, December, 2010. Poster A21A-0018. http://www.ecd.bnl.gov/steve/pres/WellKnownAGU10vgphs.pdf [Stephen E Schwartz, USA]	rejected - this provides an incorrect view of how the carbon cycle operates
6-1172	6	18				Add legend [Zongbo Shi, United Kingdom]	Accepted - legend included
6-1173	6	18				Table 6.1: in the column headed '1850-2011' the entries in rows labelled 'Ocean-to-atmosphere flux' and 'Residual terrestrial sink' should surely have minus signs, i.e. be '-154' and '-124' respectively. [Ian Totterdell, United Kingdom]	taken into account - see reply to comment 6-1170
6-1174	6	19	1	19	1	change "characteristic lifetime" to "atmospheric lifetime" or "characteristic atmospheric lifetime" [James Christian, Canada]	Accepted - Box text is re-written
6-1175	6	19	1	19	4	The logic of these sentences doesn't come through clearly. [Daniel Metcalfe, Sweden]	Accepted - Box text is re-written
6-1176	6	19	1	19	33	This section focuses on the long term behaviour of CO2, but the short term behaviour is also important. The figure, for example, tells us nothing about 0-100 years. [Glen Peters, Norway]	Accepted - New IRF figure coming from Glen Peters and Fortunat Joos will be added to the box
6-1177	6	19	1			mean charactersitic atmospheric lifetime [Almut Arneth, Germany]	Accepted - Box text is re-written
6-1178	6	19	2	19	2	"Because anthropogenic CO2 is released" might be better [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - Box text is re-written
6-1179	6	19	4	19	5	This is misleading : CO2 does not approach equilibrium after several centuries (see figure 1 box 6.2). As explained in the next paragraph, CO2 will continue to decrease for several thousands years and then for another 100,000 yrs... [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - see reply to comment 6-1158
6-1180	6	19	5	19	5	insert 'the' before 'released' [Peter Burt, UK]	Noted - Box text is re-written
6-1181	6	19	5	19	12	What is shown in the bottom panel (bar graph) and what are the units? [Roger Gifford, Australia]	Noted - figure is redone
6-1182	6	19	5			Which is "gray shading"? [Zongbo Shi, United Kingdom]	Noted - figure is redone
6-1183	6	19	6	19	6	Bad English: 'CO2 ends up in the form of..' [Peter Burt, UK]	Accepted - Box text is re-written

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1184	6	19	6	19	7	Change to "in the form". What on earth is "the CO2 slug"?! [Daniel Metcalfe, Sweden]	Accepted - Box text is re-written
6-1185	6	19	6			most of the released [Almut Arneth, Germany]	Editorial (combined with comment 6-1180) - accepted.
6-1186	6	19	7	19	7	I don't know what is meant by the term 'slug'! [Peter Burt, UK]	Accepted - Box text is re-written
6-1187	6	19	7	19	9	Since the report is written for a general audience, I am not sure if the last sentence of this first paragraph on page 19 is totally clear. Does every body understand what is a CO2 slug - may be not. In addition, just by reading the sentence I am unclear why the airborne fraction must be between 15-40%. Please consider rewording this sentence. The role of "ocean carbonate buffer" is unclear to me. [Vivek Arora, Canada]	Accepted - Box text is re-written
6-1188	6	19	7	19	9	"depletes the carbonate buffer system of the ocean" I understand what you are trying to say here but the present wording does not make sense. [James Christian, Canada]	Accepted - wording is changed
6-1189	6	19	7			CO2 slug? [Almut Arneth, Germany]	Accepted - Box text is re-written
6-1190	6	19	11	19	13	"seeks a balance between CaCO3 sedimentation and terrestrial weathering" This doesn't really make sense. First one wants to get rid of the teleological "seeks a balance". But the point here is that they are NOT in balance: weathering exceeds sedimentation during a transient phase where atmospheric CO2 is restored towards preindustrial. If the two were in balance, atmospheric CO2 would not decline. [James Christian, Canada]	Accepted - Box text is re-written
6-1191	6	19	12	19	12	It takes some time here to work out what "it" is referring to? Can the ocean "seek" something? [Daniel Metcalfe, Sweden]	Accepted - Box text is re-written
6-1192	6	19	13	19	13	thousand years → ky [Peter Burt, UK]	Editorial - accepted.
6-1193	6	19	13	19	16	The magnitude and time scale of CO2 neutralization by carbonate dissolution was first calculated by [Sundquist, E.T., 1990, Influence of deep-sea benthic processes on atmospheric CO2: Philosophical Transactions of the Royal Society of London A, v. 331, p. 155-165]. A copy of this paper can be provided on request. [Eric Sundquist, United States of America]	Accepted - reference added
6-1194	6	19	14	19	14	10,000 years → 10 ky [Peter Burt, UK]	Editorial - accepted.
6-1195	6	19	14	19	14	Change to "of the original". [Daniel Metcalfe, Sweden]	Editorial (combined to comment 6-1196) - accepted.
6-1196	6	19	14			of the original [Almut Arneth, Germany]	Editorial (combined to comment 6-1195) - accepted.
6-1197	6	19	18	19	19	"a slow process of CO2 reaction with CaO of igneous rocks" a bit oversimplified: other minerals like MgO also important here [James Christian, Canada]	Accepted - "other minerals" added
6-1198	6	19	18	19	20	The time scales of the silicate weathering response were first examined in detail by [Sundquist, E.T., 1991, Steady- and non-steady-state carbonate-silicate controls on atmospheric CO2: Quaternary Science Reviews, v. 10, p. 283-296]. [Eric Sundquist, United States of America]	Accepted - see response to comment 6-1193
6-1199	6	19	19	19	19	Do you mean CaSiO3, or simply silictes? [Leticia Cotrim da Cunha, Germany]	Noted
6-1200	6	19	20			(e.g., (Walker and Kastng, 1992)); shouldbe (e.g., Walker and kasting, 1992) [Zongbo Shi, United Kingdom]	Editorial - accepted.
6-1201	6	19	22	19	22	The main... removal are: [Peter Burt, UK]	Editorial - accepted.
6-1202	6	19	22	19	26	This seems like a disconnected section and is poorly laid out. Something that looks like "equals" in the first equation presumably should be "2-" as superscript. Use the proper symbol for a reversibale reaction. Don't run on from the title (ending in CaCO3) to the first compound in the equation (CO2) in the second equation. [Iain Colin Prentice, Australia]	Accepted - equations corrected
6-1203	6	19	24	19	26	These equations are confusingly formatted, with '=' for two minus charges getting confused with '+' for the addition operator, amongst other things. The explanation 'Reaction with calcium carbonate, CaCO3' on line 25	Accepted - equations corrected

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						gets confused with the reaction formula, and the reaction formula does not balance. Though maybe some of this would be solved by better typesetting in the final document. [Ian Totterdell, United Kingdom]	
6-1204	6	19	24		26	Add ":" before equations [Zongbo Shi, United Kingdom]	Editorial - accepted.
6-1205	6	19	24			Correctly balanced equation: CO2 + H2O = H2CO3 < > HCO3- + H+ [Richard Bourbonniere, Canada]	Accepted - equations corrected
6-1206	6	19	25	19	25	need Ca++ ion on RHS to balance equation [James Christian, Canada]	Accepted - equations corrected
6-1207	6	19	25			I miss a Ca2+ on the right hand side. [Göran Ågren, Sweden]	Accepted - equations corrected
6-1208	6	19	25			Correctly balanced equation IF we mean added calcium carbonate from terrestrial weathering in Phase 2 (although I suppose marine calcium carbonate could also be a reactant): CaCO3 + CO2 + H2O = 2 HCO3- + Ca+2 (NOTE Eq 6.1 Pg 6-65 ln 16 is correct) [Richard Bourbonniere, Canada]	Accepted - equations corrected
6-1209	6	19	25			Add "solid" before" calcium carbonate". Delete the first "CaCO3", and complete the chemical equation on the RHS of the arrow. [Roger Gifford, Australia]	Accepted - equations corrected
6-1210	6	19	25			Format equation [Christina Tonitto, USA]	Accepted - equations corrected
6-1211	6	19	26			This equation suggests that silicate weathering leads immediately to precipitation of calcium carbonate and silica, but it takes a hundred thousand years (see text), so I suggest: CaSiO3(aq) + CO2 + 2H2O = Ca+2 + HCO3- + H2SiO3(aq) . . . (time) . . . = CaCO3 (ppt) + SiO2 (ppt) + H2O Note Eq 6.2 (Pg 6-65 ln17) is more correct [Richard Bourbonniere, Canada]	Noted - equation corrected
6-1212	6	19	29	19	33	This refers to experimentas that have a massive (and unrealistic) release of CO2. This experiment is to look at the long term behaviour of CO2. It is also of interest to know the short term behaviour (lets say, from 0-100 years) and then a smaller pulse size is needed, for example, as for IRF from the Bern CC used in the IPCC reports. [Glen Peters, Norway]	taken into account - see reply to comment 6-1158
6-1213	6	19	29			The figure also starts at 0.7 and not 1 [Glen Peters, Norway]	Noted - figure is redone
6-1214	6	19	32			The buffer capacity should be put in context that a pulse of this size would (probably) never occur. The buffer capacity would be of interesting comparing pulses of 1GtC, 10, 20, 50, 100, etc. That are more likely in reality. [Glen Peters, Norway]	Noted. 5000 GtC of antropogenic C is close to the total emissions in the RCP8.5 scenario untill 2300
6-1215	6	19	38	19	39	Terrestrial ecosystems have accumulated 124 ± 59 Pg of anthropogenic C during the same period, largely compensating the C losses from deforestation since 1750, mainly through the uptake of CO2 by enhanced…' this text need to tie-in better with the statement on page 4 (lines 10-20) [Dave Reay, UK]	Accepted - remve sentence causing the problem.
6-1216	6	19	38	19	41	As in the Exec. Summ. 124 is less than 151, so I would use almost compensating (as oppsoed to "largely" here or "more than" in the Exec. Summ.) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - remve sentence causing the problem.
6-1217	6	19	38	19	42	Add to this para a sentence something like "There is much more year-to-year variability in the terrestrial carbon sink than the ocean sink (Figure 6.8), because of the effects of interannual variability of precipitation and temperature on plant growth and ecosystem respiration (see section 6.3.2.5)". [Michael Raupach, Australia]	Rejected - the issue is dealt later on in the section and the overall chapter needs to be reduced by two pages requiring that there is no redundancy in the text.
6-1218	6	19	41	19	41	"increase" instead of "increased. [Leticia Cotrim da Cunha, Germany]	Typo (combined with comments: 6-1219, 6-1223) - corrected in text.
6-1219	6	19	41			This increase is [Almut Arneth, Germany]	Typo (combined with comment 6-1218, 6-1223) - corrected in text.
6-1220	6	19	41			a better expression for "thickening of the forest" would be "increased biomass density of forests" [Per Erik	Rewording suggestion - accepted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Karlsson, Sweden]	
6-1221	6	19	41			"temperal" should be replaced by "temperal and boreal" [Per Erik Karlsson, Sweden]	Accepted - boreal added
6-1222	6	19	41			"and confirmed by National Forest Inventories" [Per Erik Karlsson, Sweden]	Rejected - the section is not discussing methodologies which are discussed in a later section.
6-1223	6	19	41			"increased" change to "increase" [Zongbo Shi, United Kingdom]	Typo (combined with comment 6-1218, 6-1219) - corrected in text.
6-1224	6	19	46	19	46	delete 'Fourth Assessment Report and the brackets around AR4 [Peter Burt, UK]	Editorial (combined with comment 6-1225) - accepted.
6-1225	6	19	46			Fourth Assessment Report: in previous sections, AR4 is used; so please simply use AR4 and define the first time it appears [Zongbo Shi, United Kingdom]	Editorial (combined with comment 6-1224) - accepted.
6-1226	6	19	48	19	48	Friedlingstein et al. 2010: This reference provides only a very weak foundation for such an important statement (and number). It is 1 page correspondence without a supplementary material section (at least as far as I was able to check). I think it is critical to put the land use change number of a better footing. [Nicolas Gruber, Switzerland]	agreed - replaced by land use number from recent synthesis paper of Houghton et al. 2012.
6-1227	6	19	48			FAO in full [Jeffrey Obbard, Singapore]	Editorial - accepted.
6-1228	6	19	49	19	51	The "albeit with very scarce data for tropical forest" illustrates my genral statement on the chapter: while true and necessary, the consequences of the data scarcity are not really discussed anywhere in the chapter and thus difficult to interpret with regards to the results from the cited literature. [Nikolaus Josef Kuhn, Switzerland]	Agreed and a great effort has gone in quantify the uncertianty of each fluxes as reported in the various tables of section 6.3.
6-1229	6	19	49			change '100,000s' to 'literally thousands' [Jeffrey Obbard, Singapore]	Combined with comment 6-1234 - rewording accepted.
6-1230	6	19	52	19	53	Global pCO2 climatology. I am afraid to say so, but the pCO2 climatology is a poor source for establishing the global budget. In contrast, it is a great resource to look at regional budgets. I suggest to rephrase this here. In addition, I do think that the development of the ocean inversion methodology represents an important step forward to establish the global ant. CO2 sink, particularly since it uses the data-based estimates of Sabine et al. as a basis for estimating the ant. CO2 fluxes. In addition, the combination of the ocean and atm. CO2 inversions also provided new insights into the global budget, since it made the land fluxes consistent with the ocean fluxes, which is not the case for the standard Transcom inversions. [Nicolas Gruber, Switzerland]	accepted (partly) - included the specific use of the CO2 flux climatology, and added a reference to ocean inversions
6-1231	6	19	53	19	53	pCO2 measurements are mentioned but these refer to the oceans. There are thousands of pCO2 estimates available from freshwaters which should be included (see e.g. Sobek et al. 2003 Gobal Change Biology) [Gesa Weyhenmeyer, Sweden]	rejected - the pCO2 measurements from lakes have not been used to improve our understanding of the global co2 budget so far, and thus should not be mentioned here even if they are new
6-1232	6	19	54	19	55	It takes some time here to work out what "it" is referring to? Can the ocean "seek" something? [Daniel Metcalfe, Sweden]	accepted - text revised
6-1233	6	19	55	19	55	modeling → modelling [Peter Burt, UK]	Editorial - accepted.
6-1234	6	19	55			“100,000s” is ambiguous try: “hundreds of thousands of individual . . . “ or “a hundred thousand individual . . .” whichever is correct [Richard Bourbonniere, Canada]	Combined with comment 6-1229 - rewording accepted.
6-1235	6	19	55			“t” missing in constraints [Richard Bourbonniere, Canada]	Typo (combined with comments: 6-1236 to 6-1238) - corrected in text.
6-1236	6	19	55			sp: "constraints" [Roger Gifford, Australia]	Typo (combined with comments: 6-1235 to 6-1238) - corrected in text.
6-1237	6	19	55			change to 'constraints' [Jeffrey Obbard, Singapore]	Typo (combined with comments: 6-1235 to 6-1238) - corrected in text.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1238	6	19	55			typo: constraints [Christina Tonitto, USA]	Typo (combined with comments: 6-1235 to 6-1238) - corrected in text.
6-1239	6	19	56	19	56	"... provides coarse scales consistent checks on the estimates for a number of regions". Estimates of what? [Vivek Arora, Canada]	Accepted - text revised
6-1240	6	19	57	20	3	I can broadly follow what this sentence is implying but it is very scientific with a lot of information condensed into one long sentence. Please consider rewording this sentence into smaller sentences with simple language for a general audience. [Vivek Arora, Canada]	accepted - sentence modified
6-1241	6	19				Figure 6.15. The figure caption says "gray shading shows …". Is this referring to the red shading. There is no gray shading in the figure. [Vivek Arora, Canada]	accepted
6-1242	6	19				Fig 6.15. Something is terribly wrong with caption and/or legend. Caption refers to gray shading; there is none. I am guessing that the red refers to the time series of the land sink, eval as residual. Legend refers to DGVM but no reference to that in caption. Caption refers to models but legend does not. Page 6-41, line 26 says "Estimation from the observed residual land sink shows that global terrestrial net carbon uptake in response to 1oC increase of global mean annual temperature could decrease by about 4 PgC yr–1 °C–1 (Figure 6.15)." but this is also terribly wrong. [Stephen E Schwartz, USA]	accepted
6-1243	6	20	2	20	2	Substitute "remain" with "remains". [Daniel Metcalfe, Sweden]	Editorial - accepted.
6-1244	6	20	2	20	3	This doesn't make sense. Tropical latitudes per se don't drive variability, i suggest change to "explained (Section 6.3.2.5.1), but is largely driven by some process/es at tropical latitudes". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1245	6	20	3	20	3	I also think that the significant increase in the terrestrial carbon sink in the 1990s and 2000s relative to the 1980s is a highlight worth noting - a (Sarmiento et al., 2010, Beaulieu et al., 2012) [Nicolas Gruber, Switzerland]	noted - already addressed 6.3.2.5.1
6-1246	6	20	5	20	12	What does the light-red bars at the bottom of the figure represent? [Akihiko Ito, Japan]	These light-red bars represent a number of TRANSCOM models used for calculation of the ansembled mean - to be explained in Figure caption.
6-1247	6	20	5	20	12	The orange bars at the bottom of the figure are not at all explained. [Ray Nassar, Canada]	See response on previos comment: 6-1246
6-1248	6	20	5			Figure 6.9. I do not see any “back bars” in the figure. What is the meaning of the orange bars at the bottom of the figure? I think adding June 1991 to Mt. Pinatubo eruption would be helpful to the reader. [Göran Ågren, Sweden]	Accepted - figure was changed. See also response to comment 6-1246
6-1249	6	20	5			Figure 6.9 --- on figure, label for Southern Hemisphere should be: (>25S) NOT (<25S). Also the caption calls the Mt. Pinatubo “bars” black, but they are darker gray. NOTHING is said about what the red bar graph on the bottom of the figure means, not even a label on the Y-axis. [Richard Bourbonniere, Canada]	Accepted - changes made. See also response to 6-1246 above.
6-1250	6	20	5			Figure 6.9: The timing of the early 1990s El Nino doesn't make sense, and the "back" bars aren't black. Is the intent here to have the El Nino last from 1990-95? There is some justification for this (e.g. Trenberth and Hoar 1996 GRL 23: 57-60), but the graphic needs to show that it continued through the indicated period of Pinatubo influence. The peak El Nino conditions were in the winter of 1991-92, which appear on this figure to be after an El Nino just ended. [James Christian, Canada]	Accepted - see reply to 6-1246 above
6-1251	6	20	6	20	12	It is not clear what the lower bar chart in figure 6.9 shows. [Jan Fuglestvedt, NORWAY]	Accepted - See comments: 6-1246 to 1249.
6-1252	6	20	11	20	12	Shouldn't "back" be "black"? How was the "normal source of CO2" determined? [Daniel Metcalfe, Sweden]	Accepted - Figure was changed and figure caption revised.
6-1253	6	20	11	20	12	Edit descriptor of the Mt. Pinatubo effect on the graph. ‘Back bar’ is current description. This region looks grey in tone on the .pdf. [Christina Tonitto, USA]	Accepted - Figure was changed and figure caption revised.
6-1254	6	20	16			Another definition of fossil fules is not needed [Zongbo Shi, United Kingdom]	accepted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1255	6	20	27	20	29	"The increased growth since 2000 was caused primarily by rising use of coal for energy production in emerging economies and the growth in global wealth (Raupach et al., 2007); Figure 6.10)." This is not necessary. [James Christian, Canada]	Accepted - the sentense was deleted.
6-1256	6	20	31	20	31	The word “record” should be removed since the 2010 “record” was already broken in 2011 and 2012 will likely surpass the previous two years. [Ray Nassar, Canada]	accepted
6-1257	6	20	31			I think Peters et al 2012 Nature CC is intended, and not Peters et al 2011 PNAS. [Glen Peters, Norway]	accepted
6-1258	6	20	34			Is gas flaring included in this figure or not? [Glen Peters, Norway]	accepted (not included, legen modified)
6-1259	6	20	38	23	17	Since there exists a wide variety of understanding of what "land use change" actually is, I would add here right at the beginning a definition. In fact, there is some text on page 23 (lines 10ff) that make a statement to this effect. I suggest to move this paragraph to the beginning of section 6.3.2.2 [Nicolas Gruber, Switzerland]	Accepted - text moved and revised.
6-1260	6	20	38			Section 6.3.2.2. This whole section on land-use change should be extended and improved. It has such large uncertainties (uncertainty as large as the recent estimate), yet it is a critical component of the GHG contributions. For example, critical evaluation of omissions/comissions in the remote sensing estimates, different methods used for different regions, etc., and explanation of why there is such a problem with land-use change estimates. Why does the uncertainty remain at 0.5 Pg for all three periods? There are more regional estimates of peatland C loss, and you could elaborate on them or compare with van der Werf. [Beverly Law, USA]	Accepted - while we cannot extend the length of the section, care has been taken in showing the uncertianty of the various estimates, including in tables.
6-1261	6	20	40	20	42	Clearing land for agriculture and other land use releases CO2, often through combustion, and the subsequent decomposition of dead plant material and soil organic matter. Please consider including “the subsequent”. [Vivek Arora, Canada]	Text modified and comment no long relevant
6-1262	6	20	43	20	45	“Logging and other forms of biomass removal emit CO2 when wood products reach the end of their lifetime (e.g., through combustion or decaying in landfills)”. This sentence needs rewording since it combines logging and wood products in a single sentence implying that all logging related carbon leads to manufacture of wood products. In addition, this sentence seems to implies that eventual CO2 release from decomposition of wood products is somehow a bad thing. In fact, wood products probably lead to longer residence time of carbon than if that same carbon were in its natural cycle. Please consider rewording. [Vivek Arora, Canada]	Accepted - text revised
6-1263	6	20	46	20	46	bookkeeping' → book keeping [Peter Burt, UK]	Editorial (combined with comments: 6-1264, 6-1270 to 6-1275) - text revised.
6-1264	6	20	46			change to 'book keeping' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1263, 6-1270 to 6-1275) - text revised.
6-1265	6	20	50	20	50	insert comma after first) [Peter Burt, UK]	Editorial - text revised.
6-1266	6	20	50	20	51	Change to "data that estimates changes", and "with the above mentioned bookkeeping". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1267	6	20	50	20	52	“ … (3) detailed regional analysis based on satellite data that estimate changes in forest area combined with abovementioned bookkeeping models or estimates of biomass loss with land use change, and subsequent decomposition of soil organic matter.” Please consider include "that". In addition, the phrase " estimates of biomass loss with land use change" seems little out of place. [Vivek Arora, Canada]	Accepted - text revised
6-1268	6	20	50		51	based on estimates of changes in forest area derived from satellite data, combined with.. [Almut Arneth, Germany]	Text modified and comment no longer relevant
6-1269	6	20	50			add "that" between "data" and "estimate" [Roger Gifford, Australia]	Accepted - text revised
6-1270	6	20	51	20	51	bookkeeping' → book keeping [Peter Burt, UK]	Editorial (combined with comments: 6-1263, 6-1264, 6-1271 to 6-1275) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1271	6	20	51			abovementioned need space [Muhammad Amjad, Pakistan]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275) - text revised.
6-1272	6	20	51			bookkeeping need space [Muhammad Amjad, Pakistan]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275) - text revised.
6-1273	6	20	51			as for 46 [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275) - text revised.
6-1274	6	20	53	20	53	bookkeeping' → book keeping [Peter Burt, UK]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275) - text revised.
6-1275	6	20	53			as for 46 [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1274) - text revised.
6-1276	6	20	54	20	54	Substitute "as" with "such as". [Daniel Metcalfe, Sweden]	Editorial - accepted.
6-1277	6	20	54		55	the meaning of this sentence escapes me: how does a model generate ist 'own' biomass, which forms off that differ? [David Newbery, CH]	Taken into account - the sentence entirely rewritten.
6-1278	6	20	55			add 'profiles' after 'carbon' [Jeffrey Obbard, Singapore]	sentence deleted
6-1279	6	20				Figure 6.9. I guess the bottom panel ondicates the number of available inversions for each time period. Need to say it in the caption. However the caption says up to 17 inversions and the bottom panel Y-scale goes up to 16 only ... [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - see reply to 6-1246 above
6-1280	6	20				Fig. 6.9. The bottom-most box of the picture is not, I think, mentioned in the caption. Can the caption be extended to explain it? [David Pearson, United Kingdom]	Accepted - see reply to 6-1246 above
6-1281	6	21	2	21	3	This sentence shows again a shortcoming in the cited literature, but without clear assessment of the relevance of the missing consideration of the peatland drainage. [Nikolaus Josef Kuhn, Switzerland]	Accepted - added text and references
6-1282	6	21	4	21	4	In the caption for figure 6.17 - should be "ppb" not "ppm" [Andrew Glikson, Australia]	Accepted - text revised
6-1283	6	21	7	21	9	Table 6.2: One aspect that requires attention in my opinion is the very different basis for computing the average LUC emissions between the different decades. The mean LUC flux for the 2000s imply a substantial decrease from the 1990s and 1980s, while the actual underlying estimates don't have this information in them. This apparent decrease stems almost solely from the fact that the high emission studies don't have an estimate for the 2000s. I unfortunately don't have an truly satisfactory solution for this, but that more discussion is needed beyond the statement provided on line 24 "is within the error bar of the data and method". [Nicolas Gruber, Switzerland]	Accepted - text revised
6-1284	6	21	7	21	20	Units in Table 6.2 (Pg C yr-1) instead og Gt C yr-1 [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1285	6	21	7	21	20	In Table 6.2, it is unclear why the uncertainty (explained in g footnote) doesn't change from decade to decade. In addition, it would be good to explain more about why the uncertainty in 2000-09 is almost as large as the mean. It is difficult to really say this is a meaningful value (0.9 +/- 0.5 global average). [Beverly Law, USA]	accepted - uncertainty is explained more clearly
6-1286	6	21	8	21	9	In Table 6.2, the entries in the column "Climate" are not always consistent. For example, for the Bookkeeping method (Friedlingstein et al. 2010) instead of "no-variability" the term "not applicable" seems more appropriate. In addition, under process models, Shevliakova et al. (2009) actually used observed climate data repeatedly. So saying "no-variability" in the "Climate" column is incorrect. Finally, for Arora and Boer (2010) estimates under process models the term "averaged" in the "Climate" column actually refers to the fact that the values reported for 1980-89, 1990-1999 and 2000-2009 are obtained by averaging over the three decades (as mentioned in foot note e) and not that "averaged" climate data was used. The study in fact used model climate with inter-annual variability. Is the column "Climate" actually needed. [Vivek Arora, Canada]	Accepted; we revised the column in the table to provide processes included and eliminated climate
6-1287	6	21	8	21	9	I doubt the wisdom of averaging process models, book-keeping method and satellite-based methods. [Iain Colin Prentice, Australia]	accepted - will use book-keeping as standard including statement of uncertainty based on expert

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							judgement and then provide range of values from the different methods
6-1288	6	21	17			what is a 'mean absolute deviation': when is it not absolute, and when +/-? Is SD meant? Confusing [David Newbery, CH]	taken into account - we clarified the text but also note that mean absolute deviation is a know statistical metric
6-1289	6	21	19	21	19	The reference for the GFED database (version 3) should be van der Werf et al. (2010) not (2009), which was just a brief commentary in Nature GeoScience. [Ray Nassar, Canada]	Accepted - changed.
6-1290	6	21	24	21	24	delete comma after 1990s [Peter Burt, UK]	Editorial - accepted.
6-1291	6	21	26	22	4	The decrease in deforestation estimates in the 2000s needs to be explained in more detail. The large variation in estimates for the tropics is troubling (Table 6.3), particularly since it accounts for the largest portion globally. [Beverly Law, USA]	Unfortunately there is no room for explaining the reasons of the change which are proivded in the references cited; the section needs to be shorten by two pages
6-1292	6	21		21		Figure 6.17: It would be very useful if a thicker line was used for a growth rate of zero in the Hovmöller diagram [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Noted - revised figure will include this
6-1293	6	21				Figure 6.17. The anomalies in the Hovmoller plot are relative to what time period. [Vivek Arora, Canada]	Rejected - the graph does not show anomalies
6-1294	6	21				Table 6.2 bookeeping → book keeping [Peter Burt, UK]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275) - text revised.
6-1295	6	21				Talbe 6.2: Kato et al., (2011, Journal of Land Use Science, doi:10.1080/1747423X.2011.628705) estimated land-use change carbon emission in 1980s as 1.03 to 1.53 Pg C yr-1, and 1990s as 1.00 to 1.28 Pg C yr-1 using a process based model VISIT, with observed climate CRU TS2.1 and harmonized land-use change dataset by Hurtt et al. (2011, Climatic Change, doi:10.1007/s10584-011-0153-2). [Michio Kawamiya, Japan]	accepted - new estimate added
6-1296	6	21				Table 6.2: I do not understand a rationale for adding the uncertainties quadratically. In many cases the uncertainties are not even reported. Additionally there are established methods for uncertainty addition that may be applicable. [Mohammad Aslam Khan Khalil, USA]	taken into account - we don't add the uncertainties anymore but selected one central estimate
6-1297	6	21				Table 6.2 and couple places later: not use of two units (Pg vs Gt, one with C one without).. [David Newbery, CH]	Accepted - text revised.
6-1298	6	22	1	22	1	Sentence starting with a number. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-1299	6	22	1	22	7	N2O units: ppb yr-1 or ppm yr-1? [Leticia Cotrim da Cunha, Germany]	Accepted - The text revised to show N2O values in ppb units.
6-1300	6	22	4	22	4	bookkeeping' → book keeping [Peter Burt, UK]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275, 6-1294) - text revised.
6-1301	6	22	4			as for 46 [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1263, 6-1264, 6-1270 to 6-1275, 6-1294, 6-1300) - text revised.
6-1302	6	22	7	22	24	Maybe use "Central and South americas" instead of Tropical Americas. There is a large area there outside the tropical belt. [Leticia Cotrim da Cunha, Germany]	Rejected -tropical americas means the america that is tropical.
6-1303	6	22	11	22	11	Why aren't the van der Werf et al. (2010) values for North America, Eurasia, East Asia and Oceania quoted? [Ray Nassar, Canada]	Because there are no fire emissions associated to deforestation in those regions.
6-1304	6	22	13	22	13	"updated results" Here and elsewhere. This should be more specific. How were the data and results updated? [Nicolas Gruber, Switzerland]	Accepted
6-1305	6	22	17	22	17	Change to "total is 0.71". [Daniel Metcalfe, Sweden]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1306	6	22				Table 6.3: A new paper by Baccini et al. (2012. Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. Nature Climate Change (published online 29 January 2012; doi 10.1038/NCLMIAT1354) provides new estimates of emissions from land use change using a new pan-tropical forest biomass map. These should be added to the table. [Eric Davidson, USA]	Accepted; estimate added
6-1307	6	22				I seemed to have missed the method of uncertainty estimation for all the numbers given. Since it is stated that uncertainties have been reduced from AR4, it would be good to know how they were calculated in the first place. [Mohammad Aslam Khan Khalil, USA]	Taken into account - uncertainty clarified.
6-1308	6	22				Table 6.3. Rubric: Estimate of what? Are the values in table 'net' or 'gross' rates: see page 23 lines 16-17? [David Newbery, CH]	Accepted; clarification added that estimates are net flux
6-1309	6	22				Table 6.3: say in caption what estimates from Table 6.2 are included. [Michael Raupach, Australia]	Accepted -text corrected
6-1310	6	22				To make the figure readable itself, it is suggested to add more details such as Growth Rate of N2O to the y-axis title [Zongbo Shi, United Kingdom]	Figure amended
6-1311	6	23	1	24	7	Figure 6.19: despite the good quality, some figures may be too small. Could this be splitted? For panel (g), is there a colour scale for the averaged CH4 concentrations? [Leticia Cotrim da Cunha, Germany]	figure removed
6-1312	6	23	3			Figure 6.11 is difficult to follow, perhaps split it into two figures? [Richard Bourbonniere, Canada]	Rejected - we think it is important to view all estimates in one single graph to understand the spread of the results
6-1313	6	23	3			Is there any way to modify this figure to get a clear picture, general trend and a spread, etc? It is hard to get anything from here other than a lot of uncertainty! E.g., Fig 6.15 shows the mean and spread and not the separate models. [Glen Peters, Norway]	figure deleted
6-1314	6	23	4			CO2? [Zongbo Shi, United Kingdom]	Yes, CO2 emissions
6-1315	6	23	5	23	6	Sorry, i don't know what color "cyan" is. My guess is that many readers will share my ignorance. Should "vanMinnen" be one word? [Daniel Metcalfe, Sweden]	Colors will be amended in final version.
6-1316	6	23	12			in relation to point 3) it needs to be explicilty clarified here whether or not the uptake by secondary forest regrowth that contributes a term to the net source from land use change, is entirely distinct from the terrestrial sink mentioned on p19, line 41 deriving from expansion and thickening of forests in temperate regions. [Roger Gifford, Australia]	Yes, there is overlap but it doesn't interfer the calculation of the terrestrial sink which is considered as residual after substracting emissions from FF and LUCC, and ocean uptake.
6-1317	6	23	16	23	17	Change to "regrowth compensates for about half". [Daniel Metcalfe, Sweden]	Rewording suggestion (combined with comment 6-1318) - accepted.
6-1318	6	23	16			add 'for' before 'half' [Jeffrey Obbard, Singapore]	Rewording suggestion (combined with comment 6-1317) - accepted.
6-1319	6	23	19	23	24	Review the whole paragraph. Seems that bits of text are missing, and the final sentence could be split. [Leticia Cotrim da Cunha, Germany]	taken into account - paragraph reviised
6-1320	6	23	21	23	21	delete 'a' [Peter Burt, UK]	Editorial (combined with comments: 6-1321 to 6-1326) - text revised.
6-1321	6	23	21	23	21	"a the" large... ? [Rongshuo Cai, China]	Editorial (combined with comments: 6-1320 to 6-1326) - text revised.
6-1322	6	23	21	23	21	Change to "data, the larger". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1320 to 6-1326) - text revised.
6-1323	6	23	21			satellite data, the larger.. [Almut Arneth, Germany]	Editorial (combined with comments: 6-1320 to 6-1326) - text revised.
6-1324	6	23	21			change 'a' to 'and' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1320 to 6-1326)

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							- text revised.
6-1325	6	23	21			delete "a" [Zongbo Shi, United Kingdom]	Editorial (combined with comments: 6-1320 to 6-1326) - text revised.
6-1326	6	23	21			typo: '…satellite data, the …' [Christina Tonitto, USA]	Editorial (combined with comments: 6-1320 to 6-1325) - text revised.
6-1327	6	23	22	23	22	Replace "were" with "where". [Nathaniel Ostrom, United States of America]	This sentence and whole Section have been substantially revised (see similar comments: 6-1328 to 6-1334)
6-1328	6	23	22	23	23	Reword and typo: '…the FAO estimate of forest area loss was revised downwards in 2010….Indonesia where…' [Christina Tonitto, USA]	see response to comment 6-1327
6-1329	6	23	23	23	23	Change to "Indonesia where new". [Daniel Metcalfe, Sweden]	see response to comment 6-1327
6-1330	6	23	23	23	24	over Indonesia "were" new data? [Rongshuo Cai, China]	see response to comment 6-1327
6-1331	6	23	23			"where" after Indonesia [Richard Bourbonniere, Canada]	see response to comment 6-1327
6-1332	6	23	23			change the first "were" to "where" [Roger Gifford, Australia]	see response to comment 6-1327
6-1333	6	23	23			delete 'were' after' Indonesia' [Jeffrey Obbard, Singapore]	see response to comment 6-1327
6-1334	6	23	23			"were" should be "where"? [Zongbo Shi, United Kingdom]	see response to comment 6-1327
6-1335	6	23	26	23	32	This paragraph is badly written. It isn not clear which references are associated with the measurements cited, and the hyphens look like minus signs! [Peter Burt, UK]	Accepted -reference made it clearer.
6-1336	6	23	26	23	32	"average of three models". I would prefer if the emissions were given as a range and not as a mean with a standard deviation. [Nicolas Gruber, Switzerland]	taken into account - see reply to comment 6-1287
6-1337	6	23	28	23	29	Formatting used appears to switch land use CO2 emissions sign from '+' in L26 to '–' in L28-29 [Christina Tonitto, USA]	Accepted. It was confusing, now fixed.
6-1338	6	23	36	23	38	How can an estimate of the concentration in 2010 have been published in 2006? [James Christian, Canada]	Accepted - it was updated, now text revised.
6-1339	6	23	37	23	37	388.5±0.1ppm in 2010 year, but 389.8 ppm by year 2010 appears in page 4, line 14 and page 18, line 18. The number should keep consistent. [Rongshuo Cai, China]	Accepted - corrected but all numbers will be updated to 2011 in final version.
6-1340	6	23	37	23	37	"year 2010" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comment 6-1341) - text revised.
6-1341	6	23	37	23	37	Remove "year". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1340) - text revised.
6-1342	6	23	37			Check "388.5ppm" again; Fig. 6.12 does not show that high number; either Fig. 6. 12 is wrong or the number here is wrong; I also remembered somewhere else there is a number for year 2010, please check that number as well [Zongbo Shi, United Kingdom]	Accepted - Atmospheric CO2 concentrations updated in SOD up to 390.4 ppm for year 2011; Figure 6.11 (6.12 in FOD) revised accordingly.
6-1343	6	23	38	23	40	Please cite C.D. Keeling as well as NOAA for the atmospheric CO2 data. [Eric Sundquist, United States of America]	Accepted - added
6-1344	6	23	40	23	40	Is the NOAA link also a citation/reference? [Leticia Cotrim da Cunha, Germany]	Yes
6-1345	6	23	46			check reference to 'firn air'? [Jeffrey Obbard, Singapore]	Accepted - revised spelling
6-1346	6	23	46			Add "CO2" after "Atmospheric" [Zongbo Shi, United Kingdom]	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1347	6	23	49	23	52	It would be helpful to show these 14C and O2 data. Figure 6.1 is cited in line 52, but it doesn't really demonstrate this point well. [Eric Davidson, USA]	Rejected - 14C would require too much additional discussion because of the contamination of the nuclear bombs. O2 is shown in Figure 6.3 and discussed in the text
6-1348	6	23	49	23	55	Could also mention 13C. Although all of this is a repeat of what is already wruitten on page 6.9 [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Noted - section moved and merged into the introduction
6-1349	6	23	49	23	55	This is repetitious. See comment 16 above. Furthermore, it should read "decreases" on line 50 instead of "increases", and one should add "relative" to abundance. [Nicolas Gruber, Switzerland]	Accepted - text corrected and moved into introduction in order to remove repetition
6-1350	6	23	49	23	55	This paragraph needs to be rewritten to correctly describe the 14C Suess effect (a decrease in pre-bomb 14C, not an increase as stated in the text), as well as the evidence from the declining ratio of 13CO2 to 12CO2. [Eric Sundquist, United States of America]	Noted - revised text will mention this, but in very brief form - see comment 6-1347
6-1351	6	23	49	26	50	Surely the burning of fossil fuels is adding 14C depleted CO2 to the atmosphere so DECREASING the relative abundance of 14CO2? [Paul Halloran, UK]	Accepted - text corrected
6-1352	6	23	49			"ample evidence"; suggest replace with standard language "strong evidence"; "medium strong evidence"; ample for what? [Stephen E Schwartz, USA]	Accepted - text corrected
6-1353	6	23	50	23	51	Move text in brackets to after 'isotopes' [Peter Burt, UK]	Noted - text revised
6-1354	6	23	50	23	51	"increases in the abundance of 14CO2 (before nuclear bomb testing)" decreases [James Christian, Canada]	Accepted - text corrected
6-1355	6	23	50	23	51	14C is an isotope of C, but a molecule can not be an isotope. The molecule 14CO2 is an isotopologue of CO2. Simply removing the word isotope would be the easiest remedy. [Ray Nassar, Canada]	Accepted - text corrected
6-1356	6	23	50			"increases"; I assume typo; decreases. [Stephen E Schwartz, USA]	Accepted - text corrected
6-1357	6	23	50			increases' surely should be 'decreases'? The fossil-fuel carbon will be almost devoid of C-14 and so will dilute that already in the atmosphere (before the nuclear tests). [Ian Totterdell, United Kingdom]	Accepted - text corrected
6-1358	6	23	51	23	51	Delete "isotopes"; not needed, further 14CO2 would be an isotope not isotopes [Nathaniel Ostrom, United States of America]	Noted - text revised
6-1359	6	23	51			"small"; measd in ppm, its about the same. [Stephen E Schwartz, USA]	Noted - text revised
6-1360	6	23	52			I doubt the molecular oxygen signal allows attribution to fossil fuel vs terrestrial carbon loss. Given that this argument is still made from time to time here would be a good place to spend a few lines making the case clear [Peter Rayner, Australia]	Noted - text clarified
6-1361	6	23	53	23	55	"increases faster in the Northern hemisphere" The concentration is higher in the NH; the year-on-year rate of increase is the same. [James Christian, Canada]	Accepted - text corrected
6-1362	6	23	53			change 'increases' to 'increased' [Jeffrey Obbard, Singapore]	Noted - text revised
6-1363	6	23	53			"increases faster"; I think CO2 the NH leads the SH but hard to argue that it increases faster. But to make the point, lets see graphs of CO2 by hemisphere; tough to decide from the Hovmuller diagram, Fig 6.13. [Stephen E Schwartz, USA]	Noted - text clarified
6-1364	6	23	55	23	55	Check the use of capital letter for Northern hemisphere. [Leticia Cotrim da Cunha, Germany]	Noted - the term of "Northern Hemisphere" revised throughout the Chapter.
6-1365	6	23	57	24	3	Two other very interesting features of the 20th century record of atmospheric CO2 are (1) the lack of increase during the Arab oil embargo (1973-1975) and (2) the lack of increase following the Pinatubo eruption (1992-1994). The point about Pinatubo is made later in this chapter, but this spot on the top of page 24 is also an excellent place to make the point that the long term record demonstrates how human activity (conservation resulting from the oil embargo) and nature (a volcanic eruption) can make a clearly perceptable change in the	Good point. Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						growth of atmospheric CO2. [Eric Davidson, USA]	
6-1366	6	23	58	24	1	delete "time". "time interval" is redundant. [James Butler, United States of America]	Accepted - text revised.
6-1367	6	23				Figure 6.19. In the figure caption change the last g) to h). [Vivek Arora, Canada]	Figure removed
6-1368	6	23				Figure 6.11: Kato et al. (2011, Journal of Land Use Science, doi:10.1080/1747423X.2011.628705) also shows the global net land-use change carbon emission estimates from 1901 to 2000. [Michio Kawamiya, Japan]	Accepted
6-1369	6	23				Some of the figures are not readable; what is the unit in Fig. e? Fig. g missing legend; Fig H missing unit [Zongbo Shi, United Kingdom]	Figure removed
6-1370	6	24	1	24	1	1960's → 1960s [Peter Burt, UK]	Editorial - accepted.
6-1371	6	24	2			Forest flux---> Forext carbon flux? [Zongbo Shi, United Kingdom]	Rejected - page and line not consistent with comment
6-1372	6	24	5	24	5	no need to use "from". [Leticia Cotrim da Cunha, Germany]	Noted - Editorial - to be addressed in next version of the Chapter.
6-1373	6	24	5	24	5	A second close parenthesis,), symbol is needed after "(Keeling et al., 2005)" [Nathaniel Ostrom, United States of America]	Editorial (same comment: 6-1374) - text revised.
6-1374	6	24	5			missing ")" [Zongbo Shi, United Kingdom]	Editorial (same comment: 6-1373) - text revised.
6-1375	6	24	6	24	6	I guess you mean Figure 6.13. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-1376	6	24	7	24	7	"The Hovmoller diagram suggests …". Is this referring to Figure 6.13. If yes, please say so explicitly. [Vivek Arora, Canada]	Accepted - text revised
6-1377	6	24	7	24	8	"in El Niño years (e.g., 1987/1988 and 1997/1998)" 1986-1987 was a weak El Nino, 1982-1983 a major one like 1997-1998. 1987-1988 was a period of transition from weak El Nino in 1986-1987 to strong La Nina in 1988-1989. It is possible that the phasing of atmospheric CO2 growth anomalies relative to other indicators differs among events because e.g. the 1997-98 event started unusually early in the year (positive SST anomaly from ~ April 1997 onwards). [James Christian, Canada]	Rejected - the propagation to and from different latitudes should not be influenced by the starting time of the ElNinos.
6-1378	6	24	7			Many readers will not know what a Hovmoller diagram is. Perhaps it would be best to refer simply to Fig. 6.13. [Eric Sundquist, United States of America]	Accepted - made it clearer.
6-1379	6	24	8	24	8	remove bold text [Peter Burt, UK]	Editorial - accepted.
6-1380	6	24	9			The attribution of the 2003 anomaly to the European heatwave on the basis of a zonal mean diagnostic is too speculative. The Hovmoeller diagram is, anyway, a pretty risky method of attributing source regions since all it takes is a displacement in the ITCZ for an anomaly to show up differentially in one hemisphere (and hence be erroneously attributed). Inversions, for all their weaknesses, are a better tool for this. I certainly doubt the attribution of the 2005 anomaly to the northern hemisphere midlatitudes. P35L42 variations in OH may also play a role in interannual variability, Butler et al., JGR 2005 doi:10.1029/2005JD006071 [Peter Rayner, Australia]	Accepted - statement about the European heat wave replaced.
6-1381	6	24	12			Figure 6.13. What are the differences between the two curves in the top panel? [Göran Ågren, Sweden]	noted - explained in revised caption
6-1382	6	24	12			Figure 6.13: The green symbols are not explained in the caption. It looks like they are associated with the bottom panel. [Richard Bourbonniere, Canada]	noted - explained in revised caption
6-1383	6	24	12			Figure 6.13: The two sets of lines and symbols are not explained. [James Christian, Canada]	noted - explained in revised caption
6-1384	6	24	14			delete ")" and "(" [Zongbo Shi, United Kingdom]	Editorial - corrected

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1385	6	24	17	27	13	Is it possible to explain more about the different kinds of ocean sinks and their relative size and changes observed and projected eg. including so called "blue carbon"? [Øyvind Christophersen, Norway]	Noted - under team discussion.
6-1386	6	24	21	25	10	Maybe it is clear to the workers in the immediate field, but not to me, how distinction is made between uptake of natural CO2 and anthro CO2, both what the distinction is, and the means by which the uptake rate is apportioned. Seems like a defining equation is required: Uptake rate R = k [(CO2)-(CO2)_0]; Delta R = [(CO2)-(CO2)_0] [partial k/partial Climate] * DeltaClimate + k * Delta(CO2) and (if this is correct) some outline of how these are separated out by observation or model. and (again if this is correct) it is not clear how this relates to Fig 6.14. Fig gives Atm to ocean flux; table gives ocean to atm flux; Suggest make consistent (if indeed they refer to the same thing; I am not yet convinced); nor do I have any confidence whether the atmos to ocean flux from the table is the same quantity as in Fig 6.14. After I change sign on tablulated numbers, the atm to ocean anthro flux is negative in the 80's but positive in the 00's; yet in the middle panel of the figure, they are both of the same sign. But if there is a different convention of the base case CO2, CO2_0 in the above equation, it would seem that the calculated fluxes would change markedly. So this needs to be clarified. As for the natural, it does seem as if the 00's show less flux to the ocean than the 80's consistent with the table (once the signs are reversed). So all this needs to be clarified. [Stephen E Schwartz, USA]	taken into account - figure and caption modified to improve clarity. No equations provided as this would not necessarily clarify the text.
6-1387	6	24	23	24	24	Primarily used 2x in the sentence. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1388	6	24	26	24	28	What is the anthropgenic uptake? [Rongshuo Cai, China]	Accepted - text revised.
6-1389	6	24	27	24	27	delete comma after 'circulation' [Peter Burt, UK]	Editorial - corrected in text.
6-1390	6	24	33	24	33	"… show that, to a first…" [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1391	6	24	33	24	35	(Inoue and Ishii, 2005) also supports this with the long-term observations since late 1960s in the Southern Ocean. Inoue, H. Y., and M. Ishii, 2005: Variations and trends of CO2 in the surface seawater in the Southern Ocean south of Australia between 1969 and 2002. Tellus 57B, 58-69. [Masao Ishii, Japan]	Accepted - text revised.
6-1392	6	24	34	24	34	insert 'in' after 'as' [Peter Burt, UK]	Editorial - corrected in text.
6-1393	6	24	39	24	39	Replace Le Quere et al. 2007 with Metzl et al. And Takahashi et al., 2009, since Le Quere et al did not provide any pCO2-data based evidence. [Nicolas Gruber, Switzerland]	Accepted - clarified the statement rather than changed the reference, as the Le Quere analysis includes more information from observations than the suggested references
6-1394	6	24	40	24	41	"thus a growing CO2 sink" [Richard Bourbonniere, Canada]	Rewording suggestion - accepted.
6-1395	6	24	40	24	41	In the past, pCO2 trends were not detected in the North Pacific. Being almost constant as for atmospheric CO2. Don't the trends found by Takahashi et al. (2006) imply weakening sink? [AKIHIKO MURATA, Japan]	Taken into account - The Northern North Pacific is meant here, the text has been clarified.
6-1396	6	24	45	24	45	Insert "a" between "of" and "different"; should read "… are of a different nature…" [Nathaniel Ostrom, United States of America]	Editorial (combined with comment 6-1398) - corrected in text.
6-1397	6	24	45	24	50	The text says 5 methods, the 4 are listed , the table gives all estimates but doesn't really say what the methods are. One can guess from the references that the table also has only 4 methods. The text refers to	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Aumont and Bopp (2006), it is in the figure, but not in the table ! [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	
6-1398	6	24	45			change to 'differ in nature' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-1396) - corrected in text.
6-1399	6	24	47	23	47	Should "MikaloffFletcher" be one word? [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1400, 6-1401) - the reference updated.
6-1400	6	24	47	24	47	"MikaloffFletcher" since "Fletcher" begins with a capital letter there ought to be a gap between the two aprts of the name both here and in the references. [Andrew Glikson, Australia]	Editorial (combined with comments: 6-1400, 6-1401) - the reference updated.
6-1401	6	24	47			check wording on Mikaloff' reference. [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1400, 6-1401) - the reference updated.
6-1402	6	24	50	24	51	"All these different methods suggest that in the absence of recent climate change and climate variability". Which period does this part of the sentence refer to? In the absence of such specification the setence is not understood and can not be correct. [Andrew Glikson, Australia]	rejected - the information requested is already provided later in the sentence
6-1403	6	24	53	24	53	Don't capitalise mean absolute deviation [Peter Burt, UK]	Editorial - text revised.
6-1404	6	24	54	24	54	Apparent discrepancy between air-sea flux in fig 6.14 and the text (P6-24 L22) arises axis in fig 6.14 is zero in 1950. This is confusing. Also, fig 6.14 needs colour legend, not verbal description (cyan, magenta etc). [Michael Raupach, Australia]	Accepted
6-1405	6	24				Fig. 6.13. This should be made more legible by moving the contour plot downwards about a centimetre, so the labels on x-axis of the top plot are revealed. [David Pearson, United Kingdom]	noted - revised graph shows time axes more clearly
6-1406	6	25	3	25	3	Table 6.4 heading. insert hyphen between 1980 and 1989 [James Butler, United States of America]	Accepted, revised text
6-1407	6	25	3	25	3	I think it better to add top-down results (ex. TRANSCOM) in Table 6.4. [Takashi Maki, Japan]	rejected - results are not robust
6-1408	6	25	3	25	10	The table need a bit of re-organization: (1) Units in Pg C yr-1; (2) What is the meaning (increase/decrease in sink/source) of the "+" and "-" signs for the fluxes?; (3) The text in page 24 refers to ocean uptake of anthropogenic CO2, sink, etc; and, (4) the table caption says "ocean-to-atmosphere CO2 flux" - it could be a bit confusing for the reader. [Leticia Cotrim da Cunha, Germany]	Accepted - table revised
6-1409	6	25	3			Without the figure 6.14, I would not have understood the table. The words "Anthropogenic" and "Natural" are not clear enough. No time to read further your very interesting chapter. I hope that little helped. [Francois DANIS, France]	taken into account - table will be modified to clarify
6-1410	6	25	6			add "by" after "results" [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-1411	6	25	16		18	citations are not consistent [Zongbo Shi, United Kingdom]	Editorial - copyedit to be completed prior to publication.
6-1412	6	25	17	25	17	Sorry again, I seem to have relatively poor knowledge of different colors!: i think "Magenta" may be a bit of an obscure color for many readers. I'd advise that figures stick to well known, primary colors wherever possible. [Daniel Metcalfe, Sweden]	accepted - figure legend provided
6-1413	6	25	21	25	21	I suggest to rephrase "because of the importance of the natural carbon cycle" to "because of the superposition of an intense natural cycle and the anthropogenic perturbation" or similar [Nicolas Gruber, Switzerland]	Accepted - text revised
6-1414	6	25	24	25	24	"The Equatorial Pacific (14°N–14°S) is a major source for atmospheric CO2, losing about 0.5 Pg C yr–1." It will help if it is clarified whether it is the higher temrpature of equatorial sea water which results in reduced solubility and thereby loss of CO2 [Andrew Glikson, Australia]	Accepted - text revised.
6-1415	6	25	24	25	24	"The Equatorial Pacific (14°N–14°S) is a major source for atmospheric CO2, losing about 0.5 Pg C yr–1." It will help if it is clarified whether it is the higher temrpature of equatorial sea water which results in reduced	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						solubility and thereby loss of CO2 [Andrew Glikson, Australia]	
6-1416	6	25	25	25	27	Surely the areas mentioned are strong sinks because (in addition to biological productivity and cooling as mentioned) they are regions of strong deep-water formation, carrying the CO2 that has been absorbed from the atmosphere away from the surface. [Ian Totterdell, United Kingdom]	Accepted - text revised.
6-1417	6	25	25			in both hemispheres [Almut Arneth, Germany]	Editorial - text revised.
6-1418	6	25	28			Suggested alternative wording: " The net annual sink is not as intense in the Southern Ocean owing to the summer uptake of CO2 being offset of by release in winter caused by upwelling of CO2-enriched deepwater." [Roger Gifford, Australia]	Rejected - but modified the sentence to clarify its meaning
6-1419	6	25	50	25	50	I suggest to replace ETH model with Graven et al. (in prep.). The paper will be submitted within the next month. It's full citation will be Graven, H.D., N. Gruber, X. Giraud, R. Key and S. Khatiwala, Changing controls on oceanic radiocarbon: New insights on shallow-to-deep ocean exchange and anthropogenic CO2 uptake, Global Biogeochemical Cycles. [Nicolas Gruber, Switzerland]	Accepted - text revised.
6-1420	6	25				Figure 6.20. Unless I missed this I couldn't find what the various models used in this figure are (Are these A, B, C … K)? Which study are these numbers coming from. Need a reference to that study. [Vivek Arora, Canada]	Accepted-text revised
6-1421	6	25				The column for 1990-1999 should be deleted [Mohammad Aslam Khan Khalil, USA]	Accepted
6-1422	6	25				Fig 6.20. Figure and/or caption need a lot of work.There are two large circles labeled "Land sink" and "Model mean" but those hardly seem parallel or contrasting. Is the land sink derived from observations? if so, how? Is this somehow a regression of observed residual land sink on temperature and precip? Not sure how you get two sensitivities out of that. and what is the uncertainty on that? And I guess the model points are the same. Not clear why a negative sign implies an increase in sink; but so be it. That said (guessed), it seems as if the observations and all the models indicate that if temperature (local? global?) increases the land sink of CO2 decreases; and that if precip (local? global?) increases the land sink of CO2 increases. But the caption says "Interannual sensitivity of model estimated global Net Ecosystem Production (NEP) and residual global carbon sink to change in atmospheric CO2 and climate, " so now somehow the independent variable for the sensitivity is CO2, despite the appearance otherwise from the axis labels. [Stephen E Schwartz, USA]	Accepted-text revised
6-1423	6	25				Further comment on Fig 6.20. Although it appears that all the models agree in sign for both plotted quantities, the values vary by an order of magnitude. That said, it would seem to suggest that little confidence can be placed in the models. The text on page 6-41 seems to agree: " In comparison to the estimation based on residual land sink (-0.01 PgC yr–1 mm–1), most models (eight of nine models) overestimate the interannual precipitation sensitivity of global terrestrial net carbon uptake." but nowhere on the figure does there appear to be a point corresponding to the -0.01 number cited in the text. [Stephen E Schwartz, USA]	Accepted-text revised
6-1424	6	25				What A, B, C…. Mean? [Zongbo Shi, United Kingdom]	Accepted
6-1425	6	25				Table 6.4: Format column heading 1980-1989 [Christina Tonitto, USA]	Editorial - text revised.
6-1426	6	25				Table 6.4: this is presented very confusingly, with increases in the sink from the 1980s to the 1990s and from the 1990s to the 2000s having opposite signs. It would probably be better to just have two columns,	taken into account - see comment response to 6-1407

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						respectively labelled 'Change from (1980-1989) to (1990-1999)' and 'Change from (1990-1999) to (2000-2009)', with the corresponding numbers. This would tie in better with the associated text at the foot of p24, which is clearly worded. [Ian Totterdell, United Kingdom]	
6-1427	6	26	3	26	3	delete 'year' [Peter Burt, UK]	Editorial - text revised.
6-1428	6	26	5	26	5	"The flux of anthropogenic carbon into the ocean is increasing faster in the high latitudes'. I t will help to specify "due to lower water tempratures" [Andrew Glikson, Australia]	Accepted - text revised.
6-1429	6	26	5	26	6	Is it the flux of anthropogenic carbon into the ocean that is increasing faster at high latitudes (as the draft claims) or the storage of anthropogenic carbon? Text on p31 (lines 1-8) indicate that the North Atlantic sink has recently weakened. Anthropogenic CO2 can be taken up in one location and then transported and stored in another, is that what is happenning? Or is the text here referring to longer time-periods? [Ian Totterdell, United Kingdom]	taken into account - text clarified
6-1430	6	26	7	26	7	"repeated measurements" [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1431	6	26	10			Change '(' on referecne [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1432	6	26	14	26	14	delete 'time' (tautology) [Peter Burt, UK]	Editorial - text revised.
6-1433	6	26	14	26	14	There is a sllight inconsistency between the way the global inventory for 2010 is constructed and in how the temporal evolution in Figure 6.8 has been established. Here, the global inventory is based on Sabine et al., and extended to 2010 on the basis of the model etc based uptake fluxes for the years since 1994.In contrast, Figure 6.8 plots the uptake fluxes on the basis of Khatiwala et al.. which do not match the Sabine et al. inventory estimate. A more consistent approach would be the use of the ocean inversion based fluxes of Mikaloff Fletcher since they match the Sabine et al. estimate exactly and also provide a full time history of the ant. CO2 uptake by the ocean (see Sarmiento et al., 2010). I have to admit that the inconsistency is not large, but the authors need to give a reason for why they have chosen this approach. [Nicolas Gruber, Switzerland]	taken into account - we now round off the historical estimates and the inconsistency (very small) has been taken care of
6-1434	6	26	14	26	15	→ '..on Sabine et al. (2004) up to..' [Peter Burt, UK]	Editorial - text revised.
6-1435	6	26	19	26	19	Table Units: should one use g C m-2 yr-1 (or mg C m-2 yr-1) ? [Leticia Cotrim da Cunha, Germany]	Rejected - mol units are used in the ocean research community for storage rates
6-1436	6	26				Fig 21. this is a very powerful figure. The leading term is uncertain to an order of magnitude. That says it all. A proper assessment of the situation would note that and note the resulting confidence that can be attached to any model that trys to represent this. [Stephen E Schwartz, USA]	taken into account - confidence is now discussed in the text
6-1437	6	26				Why some factors show a colored bar when there is only one data point; for example, climate-dust? [Zongbo Shi, United Kingdom]	rejected - explained in caption
6-1438	6	27	5	27	5	Change to "a few tenths of 1 PgC-1 more". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1439	6	27	6	27	6	"suppression of the source of CO2 to the atmosphere". Specify whhat"source" [Andrew Glikson, Australia]	Accepted - text revised.
6-1440	6	27	7	27	7	no comma after "Pacific"; spelling of "Niño" [Leticia Cotrim da Cunha, Germany]	Editorial - text revised.
6-1441	6	27	7	27	9	Change to "of ~0.3 PgC", Substitute "attributions" for "attribution". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1442	6	27	8			of changes in surface CO2 concentrations [Almut Arneth, Germany]	Rewording suggestion - accepted.
6-1443	6	27	8			changes in surface ocean CO2': is this referring to DIC concentration or surface ocean pCO2? [Ian Totterdell, United Kingdom]	accepted (pCO2)
6-1444	6	27	14	28	16	indicate sinks as negative numbers [Almut Arneth, Germany]	Accepted-now we correct 'atmosphere-to-land' from 'land-to-atmosphere'

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1445	6	27	18	27	18	is hard to measure directly [Robert Scholes, South Africa]	taken in to account-combined with other comments
6-1446	6	27	18	27	19	The lack of understanding the spatial heterogeneity of pools and fluxes and ist integration into global scale models is definitely a major research challenge and should be indicated as such. [Nikolaus Josef Kuhn, Switzerland]	Accepted-text revised
6-1447	6	27	20	27	20	sink → sinks [Peter Burt, UK]	Editorial (combined with comments 6-1448, 6-1449) - text revised.
6-1448	6	27	20			of the land sink [Almut Arneth, Germany]	Editorial (combined with comments 6-1447, 6-1449) - text revised.
6-1449	6	27	20			change 'sink' to 'sinks' [Jeffrey Obbard, Singapore]	Editorial (combined with comments 6-1447, 6-1448) - text revised.
6-1450	6	27	22	27	22	I suggest not to use "net land sink" since the numbers mentioned refer to the sink before land-use emissions, the "net" is then rightly used one paragraph below (line 30) [Stefan Gerber, USA]	Accepted-text revised
6-1451	6	27	24		25	of terrestrial ecosystems to [Almut Arneth, Germany]	Editorial - text revised.
6-1452	6	27	25	27	25	I believe Lucht et al., 2002 was the first paper on the effect of Pinatubo on land carbon uptake. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - reference added
6-1453	6	27	25			explain in more detail the Mount Pinatubo effect [Christoph Mueller, Germany]	Accepted-text revised
6-1454	6	27	25			specify date of erupton [Jeffrey Obbard, Singapore]	Accepted-text revised
6-1455	6	27	27	27	36	Table 6.6: There is not any discussion in the text regarding the different results presented in this table depending upon whether the model includes N limitation. [Eric Davidson, USA]	Taken in to account-see response to comment #62234
6-1456	6	27	28	27	29	Could units please be given with these numbers? [David Pearson, United Kingdom]	Accepted-text revised
6-1457	6	27	29	27	29	"include" should be singular. [James Butler, United States of America]	Editorial - text revised.
6-1458	6	27	29	27	29	Not true, some of the TRENDY models do account for land use change and did perform historical simulations with land use (S3 simulations in the TRENDY protocol). [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Noted-here we only provide simulation without considering land use change
6-1459	6	27	29	27	30	Again, a statement on an omission without mentioning ist relevance. [Nikolaus Josef Kuhn, Switzerland]	accepted - text clarified to explain potential bais
6-1460	6	27	29		30	forest demography' is rather vague: suggest 'forest dynamics (i.e. mortality and recruitment rates)' [David Newbery, CH]	Accepted - text revised
6-1461	6	27	33	27	33	estimate → estimated [Peter Burt, UK]	Editorial - text revised.
6-1462	6	27	33	27	35	In fact Gurney and Eckels (2011) is not quite consistent with the global CO2 budget in Le Quere et al (2009) and here, suggesting a land-ocean dipole in the inversions; see Raupach (2011). Suggest the following: "This is nearly consistent with trends in the net flux over land estimate from inversion methods, which estimate an increasing air-to-land flux of 0.57 ± 0.1 PgC/y per decade (Gurney and Eckels, 2011; Raupach, 2011)". [Michael Raupach, Australia]	Accepted - text revised and reference added
6-1463	6	27	33	27	35	Reference for above comment: Raupach, M.R. (2011). Pinning down the land carbon sink. Nature Climate Change 1, 148-149 [Michael Raupach, Australia]	Accepted - text revised
6-1464	6	27	33	27	36	..could be driven by decreased LUC…and response of veg to climate change and variability…' But the 2000+ period had large-scale multi-year droughts, which would suggest less C uptake associated with climate during 2000+. Wouldn't the combined effects of increased CO2 and N deposition in the northern hemisphere lead to an increase? I think this should be analyzed more closely, rather than general suggestion of climate and climate variability as the causes. More could be said about the model results in Table 6.6 here, for attribution.	Accepted - explanation removed.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						[Beverly Law, USA]	
6-1465	6	27	36	27	36	I guess the increasing air-land flux could also be driven by increasing atmospheric CO2. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - explanation removed.
6-1466	6	27	36			"and forest management improvements" [Per Erik Karlsson, Sweden]	rejected - forest management is included in the 'decreased land use change emissions', which contain a range of processes.
6-1467	6	27	39	27	39	If the flux is "land to atmosphere" and the net flux goes into the land, why are the numbers positive? [James Butler, United States of America]	Rejected - the flux reported is air to land, not land to air.
6-1468	6	27	39	27	39	Table units: Pg C yr-1 [Leticia Cotrim da Cunha, Germany]	Accepted - changed to Pg C everywhere
6-1469	6	27	39	28	16	Table 6.6 may contain flux values with different definitions. Namely, some models estimate net ecosystem production (NEP) but others estimated net biome production (NBP) including disturbance impacts. This point should be specified. [Akihiko Ito, Japan]	accepted - table modified
6-1470	6	27	39	28	19	Surely these must be atmosphere-to-land fluxes? Or should have negative signs (better). Use full acronyms for models: e,g, TRIFFID, not TRI, etc. [Iain Colin Prentice, Australia]	Accepted-text revised
6-1471	6	27	39	39		Presumably the ? In the table will be updated? [Almut Arneth, Germany]	Accepted-text revised
6-1472	6	27	39			It would be good to say what the "N-limitation" is. Nitrogen? [Francois DANIS, France]	Accepted-text revised
6-1473	6	27				Figure 6.22. Please change CanESM to CanESM2 [Vivek Arora, Canada]	Accepted - text revised.
6-1474	6	27				Figure 6.22. Please say explicitly in the caption that C4MIP results are based on A2 scenario and CMIP5 rsults are based on 1% per year increasing CO2 simulations. [Vivek Arora, Canada]	Accepted - text revised.
6-1475	6	27				Table 6.6 I suggest giving full names for the models. You might want to be consistent with Table 6.4 where refs are given, not model names. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account-the original ref of model description did not provide the value of c sink for different decades, and thus we prefer to provide model names.
6-1476	6	27				Table 6.6. That doesn't seem to be the proper web link for TRENDY. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted-text revised
6-1477	6	28	7			consistency in citation [Zongbo Shi, United Kingdom]	Editorial - copyedit to be completed prior to publication.
6-1478	6	28	14			CO2? [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-1479	6	28	19			Figure 6.15. I do not see any grey shading. What is the meaning of the black line? [Göran Ågren, Sweden]	Accepted - text revised.
6-1480	6	28	22			Format clarification. Shading is not grey. [Christina Tonitto, USA]	Accepted - text revised.
6-1481	6	28	24	28	2	This entire section again states that regional differences exist, but fails to connect them to the relevant processes in these ecosystems. This renders the reported numbers opne to criticism, e.g. that they just reflect a snapshot during time of observation. From the text it would appear that the data were gathered either through inversions or flux measurements, but no underlying studies of ecosystem processes. This should be indicated more cleary also in other sections of the text. [Nikolaus Josef Kuhn, Switzerland]	Noted - under team discussion.
6-1482	6	28	24	28	24	consistency in terminology called for. See table 6.6 title. [James Butler, United States of America]	Taken into account. Homogeneity in naming convention is improved throughout the text, but we need to keep the atmosphere-to-land in Table 6.6 so that it is easy to see the relation with table 6.1. Hovewer, we don't want to use atmosphere-to-land throughout the text, and thus air-land is kept where

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							appropriate.
6-1483	6	28	25	28	27	Figure 6.16 only shows atmospheric inversion. Could it be simplifierd (less regions may be ?) and combined with other estimates (DGVMs and inventories) ? [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account - figure was revised
6-1484	6	28	26	28	26	Northern → northern [Peter Burt, UK]	Editorial - text revised.
6-1485	6	28	26	28	26	Do you mean extra-tropics? [Beverly Law, USA]	Yes - text changed
6-1486	6	28	27	28	32	The later part of this sentence doesn't tie up with its first part. This long sentence needs breaking into smaller sentences and rewording to make it more clear. [Vivek Arora, Canada]	Accepted - text revised
6-1487	6	28	28		29	..ranging from ' unclear. At least which value- 0.5 or 1.0? [David Newbery, CH]	Accepted - text revised
6-1488	6	28	29	28	29	→ Stephesn et al. (2007) [Peter Burt, UK]	Editorial (combined with comment 6-1490) - text revised.
6-1489	6	28	29	28	30	Change to "from an ensemble of inversion models those that". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1490	6	28	29		30	Stephens et al (2007) selected from an ensemble [Almut Arneth, Germany]	Editorial (combined with comment 6-1488) - text revised.
6-1491	6	28	30	28	30	delet coma after 'models' [Peter Burt, UK]	Editorial - text revised.
6-1492	6	28	31	28	31	Tropical → tropical [Peter Burt, UK]	Editorial (combined with comment 6-1493) - text revised.
6-1493	6	28	31	28	31	Should "Tropical" be in capitals? [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1492) - text revised.
6-1494	6	28	31	28	32	northern hemisphere → Northern Hemisphere [Peter Burt, UK]	Editorial - text revised.
6-1495	6	28	34			Why are 2000s values shown before 1990s values in Figure 6.16? This ordering if a bit unconventional. [Christina Tonitto, USA]	Noted - we prefered to show first the most recent decade
6-1496	6	28	40	28	41	This sounds strange, the regions themselves haven't done the analyses. I suggest you substitute "regions" for "studies" or "analyses". Change to "and so provided an". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1497	6	28	41	28	41	providing → provide [Peter Burt, UK]	Editorial (combined with comments 6-1499, 6-1500) - text revised.
6-1498	6	28	41	28	41	on → of [Peter Burt, UK]	Editorial - text revised.
6-1499	6	28	41			“provide” not ”providing” [Richard Bourbonniere, Canada]	Editorial (combined with comments 6-1497, 6-1500) - text revised.
6-1500	6	28	41			change to 'provide' [Jeffrey Obbard, Singapore]	Editorial (combined with comments 6-1497, 6-1499) - text revised.
6-1501	6	28	47	29	2	needs to be made clear that you are now talking of cancellation in terms of climate effects (rather than sinks as a mass effect) [Almut Arneth, Germany]	Accepted - text removed
6-1502	6	28	47	29	2	Needs to explain a bit more. Accounting for non-CO2 DOES not decrease the strength of the carbon sink. It decreases the contribution of that region to decrease the global radiative forcing. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - text removed
6-1503	6	28	47	29	2	This compensation of CO2 uptake and CH4/N2O emissions needs to be better explained [Nicolas Gruber, Switzerland]	Accepted - text removed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1504	6	28	48	28	48	Change to "to their complete" otherwise it is not obvious to what the "the complete cancellation" refers. [Daniel Metcalfe, Sweden]	Accepted - text removed
6-1505	6	28	48	28	48	leads to a decreased net climate benefit… [Robert Scholes, South Africa]	Accepted - text removed
6-1506	6	28				Figure 6.23. Consider writing figure titles with units in brackets e.g "Reconstructed (K)" rather than as "reconstructed / K". [Vivek Arora, Canada]	taken into account - figure revised
6-1507	6	28				Fig. 6.15. The caption refers to "gray shading". Should this say "pink shading"? [David Pearson, United Kingdom]	Accepted - text revised.
6-1508	6	29	1	29	2	Elsewhere it is mentioned that the idea of a single mean lifetime of CO2 is misleading. But any time a calculation like this (Schuilze et al. 2009) is done you are accepting the idea of "CO2 equivalent", which is predicated on exactly that concept! It is nonsense to claim that an emission of N2O, with a lifetime of about 100 years, "cancels" an uptake of CO2 of which a substantial part has a lifetime over 10,000 years. I would prefer not to see this meaningless comparison quoted at all, but if it has to be, then there should be an explicit and strong caveat along the lines I have mentioned. [Iain Colin Prentice, Australia]	Accepted - text removed
6-1509	6	29	1	29	9	Figure 6.24 - Please also use "beta" and "gamma" for the panel captions [Leticia Cotrim da Cunha, Germany]	taken into account - figure revised
6-1510	6	29	1			add 'for example' before 'Europe' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1511	6	29	4	29	8	I would break up this sentence something as follows - Pan et al. (2011) assessed the contribution of regional forests to the land carbon sink based on forest biomass inventory data, coarse estimates of soil carbon balance and the book keeping model of Houghton (2003) for deforestation estimates. For the period 2000-2007, they assigned a carbon sink of 0.5 Pg C/yr and 0.8 Pg C/yr to the boreal and temperate forests and found tropical forests to be near neutral. In its current form the sentence is too long and somewhat hard to interpret. [Vivek Arora, Canada]	Accepted - text revised
6-1512	6	29	5	29	5	bookkeeping' → book keeping [Peter Burt, UK]	Editorial - text revised.
6-1513	6	29	5		8	Very long & convoluted sentence, consider splitting in two [Almut Arneth, Germany]	Accepted - text revised
6-1514	6	29	5			Houghton (2003) [Almut Arneth, Germany]	Editorial - copyedit to be completed prior to publication.
6-1515	6	29	7			It would be worth including in the parentheses, the magnitude of the gross sink in tropical forests eg "(0.9 PgC yr-1 sinks less the same sized source via deforestation)" [Roger Gifford, Australia]	Accepted - we have added full explanation of net and gross fluxes at the beginning of the the land use section.
6-1516	6	29	11	29	21	Section 6.3.2.5.3 - It may be worth while to mention the Schwalm et al. paper (www.biogeosciences.net/8/2493/2011/) which suggests that other than in Amazônia, Australia and southern Africa El-Nino has no spatially coherent signature. [Vivek Arora, Canada]	Rejected - very interesting but it requires a further expansion of the section which needs to shrink by two pages.
6-1517	6	29	11		12	Simplify: The residual term of the global carbon budget shows that land flux variability accounts for most… [Almut Arneth, Germany]	Accepted - text revised
6-1518	6	29	13			CO2 regional anomalies? Presumably, inferred regional anomalies in atmospehric CO2? [Almut Arneth, Germany]	Accepted - text revised
6-1519	6	29	14	29	14	ñ for 2nd 'n' of Nino [Peter Burt, UK]	Editorial (combined with comments 6-1520 to 6-1522) - text revised.
6-1520	6	29	14	29	14	spelling of "Niño" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comments 6-1519 to 6-1522) - text revised.
6-1521	6	29	14	29	14	Spell "El Nino" consistently. [Daniel Metcalfe, Sweden]	Editorial (combined with comments 6-1520 to 6-1522) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1522	6	29	14			in El Nino years [Almut Arneth, Germany]	Editorial (combined with comments 6-1519 to 6-1521) - text revised.
6-1523	6	29	17	29	17	Positive → The positive [Peter Burt, UK]	Editorial - text revised.
6-1524	6	29	17		18	A positive phase.. . with an enhanced land…., and a negative phase…with an enhanced.. [Almut Arneth, Germany]	Accepted - text revised
6-1525	6	29	18	29	18	negative → the negative [Peter Burt, UK]	Editorial - text revised.
6-1526	6	29	18			Surely it is worth finishing this section off with a remark that in the long term it is inevitable that the airborne fraction will increase with increasing atmospheric CO2 concentration, on account of saturation effects(and increasing temperature effects) on net uptake of CO2 by both ocean and vegetation, but that it is not clear that these are having an observable role yet. [Roger Gifford, Australia]	Declined - there is a whole section devoted to past and possible future dynamics of airborne fraction. Spatial limitations prevent from repeating some of the materials here.
6-1527	6	29	19	29	21	The observations are about ocean? Does this "eddy" refer to the ocean eddy? But the subtitle is about land fluxes? [Rongshuo Cai, China]	Rejected - this section is all about land fluxes and refers to eddies covariance from land measurements
6-1528	6	29	19	29	21	This was shown before by Piao et al (GBC 2009), based on a bottom up DGVM approach. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised.
6-1529	6	29	23	29	32	The value for DIC can be found in Amiotte-Suchet & Probst (1995), Hartmann et al. and Gaillardet et al. 1999. They estimated the DIC counterbalanced by the consrevative cations. Please compare: Amiotte-Suchet, P., Probst, J.L., 1995. A global-model for present-day atmospheric soil CO2 consumption by chemical erosion of continental rocks (Gem-CO2). Tellus Series B—Chemical and Physical Meteorology 47 (1–2), 273–280. Hartmann, J., , Jansen, N., Kempe, S, Dürr, H.H., Köhler, P. (2009) Global CO2-consumption by chemical weathering: What is the contribution of highly active weathering regions? Global and Planetary Change, 69, 185-194. doi: 10.1016/j.gloplacha.2009.07.007 AND Gaillardet, J., Dupre, B., Louvat, P., Allegre, C.J., 1999. Global silicate weathering and CO2 consumption rates deduced from the chemistry of large rivers. Chemical Geology 159 (1–4), 3–30. Please note that I am an author of one of the publications. Probably another Reference should be found. Note that the DIC-value of 0.3 provided in this section is including the lithogenic carbonate-C, which is estimated to about 0.1 to 0.148 and is not the same as the reported CO2-consumption reported on page 65. So there are two pools/sources. [Jens Hartmann, Germany]	taken into account - added sentence on weathering with references
6-1530	6	29	23	29	40	There is also strong evidence that increasing DOC delivery to the oceans - as observed in Europe and NE America in recent decades, is the result of recovery from past acid deposition. Papers by Evans et al should be consulted in this regard. [Vincent Gauci, United Kingdom]	Accepted.
6-1531	6	29	24	29	25	Quantities are given without units. Units should be stated. [David Pearson, United Kingdom]	Accepted - text revised.
6-1532	6	29	24	29	26	Don't capitalise the full names for DOC, DIC and POC [Peter Burt, UK]	Accepted - text revised.
6-1533	6	29	24	29	32	This paragraph probably needs to be expanded with some consideration of what happens to the various forms of carbon when they are delivered by rivers to the ocean, because usually they are not delivered to the open ocean (the domain that the ocean BGC models describe) but instead the coastal ocean, and that is usually a shelf sea. Carbon is heavily re-processed there in the water-column and in the sediments, and it is far from clear how much makes it to the open ocean, how much gets stored in sediments and how much is released back to the atmosphere. [Ian Totterdell, United Kingdom]	Sentence added: The robust partitioning between natural and anthropogenic C flows is not yet possible, nor a quantification of its ultimate fate in the coastal and open oceans.
6-1534	6	29	28	29	28	Change to "and, coupled with climate change, can". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1535	6	29	30	29	30	Substitute "suggests" with "suggest". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1536	6	29	32	29	32	text missing after 'anthropogenic' [Peter Burt, UK]	Accepted - text revised.
6-1537	6	29	32	29	32	Some partition is possible, but i guess not a very good one? I suggest "a robust partitioning of the drivers of DIC fluxes between natural" [Daniel Metcalfe, Sweden]	Accepted - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1538	6	29	32			add 'estimate' after 'partition' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1539	6	29	34	29	37	Downing et al. (2008) might be referred here (see the previous comment). [Pirkko Kortelainen, Finland]	Rejected - innapropriate citation to support the statements above (it only deals with inland water bodies).
6-1540	6	29	37	29	37	The references are a bit outdated. Lake sediments alone lead to a sink of about 0.6 PgC yr-1 (Tranvik et al. 2009 Limnology and Oceanography) [Gesa Weyhenmeyer, Sweden]	taken into account - the text has been clarified . It refers to changes rather than mean fluxes
6-1541	6	29	37	29	40	Damming might also be an important anthropogenic driver for DOC transport. A series of studies in major global rivers have demonstrated that river regulation and damming leads to a decreased nutrient transport to coastal seas, although the mechanisms are multi-fold (Humborg et al., 2000). Similar patterns have been recorded for the role of lakes in the watershed, the higher the lake percentage, the lower the DOC, DON and DOP concentrations/fluxes. In the boreal landscape the percentage of lakes in the catchment was a better predictor for riverine DOC transport than percentage of peatland (e.g. Mattsson et al. 2005). Humborg, C., et al. (2000), Silicon retention in river basins: Far-reaching effects on biogeochemistry and aquatic food webs in coastal marine environments, Ambio, 29(1), 45-50. Mattsson, T., Kortelainen, P. & Räike, A. 2005. Export of DOM from boreal catchments: Impacts of land use cover and climate. Biogeochemistry 76: 373-394. [Pirkko Kortelainen, Finland]	rejected - It is agreed that this is probably very important, particularly for the quality of DOM, but DOM response is arguably very different than for silicate. The autotrophic production stimulated by these damns (which remove the silicate) also produce DOM and so the impact on DOM export could be offset. Furthermore, much of DOM export occurs during high flows when residence time changes are not as important.
6-1542	6	29	42	30	18	With reference to my general comment above to chapter 6, this could be a place for presenting and assessing the IRF concept for CO2. (See: www.climate.unibe.ch/~joos/IRF_Intercomparison/index.htm) [Jan Fuglestvedt, NORWAY]	rejected - this material is covered in box6.2
6-1543	6	29	42			Section 6.3.2.6: suggest heading "CO2 airborne fraction" [Michael Raupach, Australia]	Accepted - text revised
6-1544	6	29	44	29	45	Replace hyphens with commas [Peter Burt, UK]	Editorial suggestion - accepted.
6-1545	6	29	44	29	45	The acronym AF is also used in Ch7 and Ch8 for adjusted forcing. A discussion between Ch6 and Ch7/Ch8 is needed on this. [Gunnar Myhre, Norway]	Need to links will be check in final version
6-1546	6	29	44	29	45	Suggest: "The ratio of CO2 accumulation in the atmosphere to total CO2 emissions (fossil fuel + LUC), or the fractiuon of total emissions remaining in the atmosphere, is the 'airborne fraction' (AF). This is an important diagnostic ..." [Reason: need to indicate that the AF discussed here is essentially an instantaneously defined quantity, different from the corresponding cumulative AF]. [Michael Raupach, Australia]	Accepted - text revised
6-1547	6	29	44	30	18	In chapter 2 there is also a paragrprph descirbing Airborne Fraction (AF). The AF discussed in the two chapters have very similar statements,my idea is that in chapter 2 the description stays at the concentrations and emissions, while the chapter 6 deals mainly on the linkage between the concentrations and emissions, and also more xexplanations on the changes in emissions. Therefore I would like to suggest taking out the discussion on AF in chapter 2 and discuss the issue here in chapter 6. [Xuemei Wang, China]	Accepted - comment passed onto chapter 2.
6-1548	6	29	47	29	48	Suggest: "First and most importantly, the AF responds to the emissions trajectory through the effect of atmospheric CO2 on sinks. The AF is predicted to be constant if emissions grow exponentially with a constant e-folding time and if the sinks respond linearly to increasing CO2 (Bacastow and Keeling, 1979; Gloor et al., 2010). As emissions depart from exponential growth, the AF departs from constancy [for example, decreasing emissions in response to mitigation will cause the AF to fall (Raupach et al. 2011)]." [Reasons: (1) linearity is also a critical assumption; (2) the response route is emissions -> atmos concs -> sinks -> C reservoirs]. [Michael Raupach, Australia]	Accepted - text included
6-1549	6	29	47	29	48	Reference for above comment: Raupach MR, Canadell JG, Ciais P, Friedlingstein P, Rayner PJ, Trudinger CM (2011) The relationship between peak warming and cumulative CO2 emissions, and its use to quantify vulnerabilities in the carbon-climate-human system. Tellus Ser. B 63:145-164 (DOI 10.1111/j.1600-0889.2010.00521.x) [Michael Raupach, Australia]	Accepted - reference included

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1550	6	29	47	29	51	"The AF fraction should be constant if emissions grow exponentially …". It would be useful to add a sentence explaining why this should be the case. I can see why this should happen but it is not directly obvious to me. Also, in this sentence remove "warming" since it is implicitly already included in "changes in physical climate". [Vivek Arora, Canada]	Text has been revised
6-1551	6	29	47			should this not incude that annual sinks can respond to both the absolute concentration of greenhouse gases and the rate of change of their emission? Eg the CO2 fertilisation effect on terrestrial C-storage is affected by both. And the ocean sink declines with increasing absolute atmospheric CO2 concentration. [Roger Gifford, Australia]	Rejected - there is a whole section on the CO2 fertilization effect. In the interest of space (need to shorten section, not to expand), we don't add it here.
6-1552	6	29	47			"should"; better "is expected to"; but this is assumption dependent. Need to spell out the assumptions in addition to exponential growth. [Stephen E Schwartz, USA]	Accepted - text revised
6-1553	6	29	48	29	48	"exponentially with a constant e-folding time". Specify what "e-fodling" means [Andrew Glikson, Australia]	Accepted - described in text
6-1554	6	29	48	29	48	Role of fossil fuel emissions for the AF. Gloor et al. Made two other important statements that I consider to be very relevant here. First, they point out that the timescale for establishing this "transient" steady-state is 200 to 300 years. Second, they emphasize that variations in the relative growth rate of the ant. emissions leave a large imprint on the AF. [Nicolas Gruber, Switzerland]	Taken into account - the role of emissions for AF and the entire section has been clarified. We did not include specifically the information on time scale here (200-300) because we have shortened this section and this information was less relevant.
6-1555	6	29	48	29	48	e-folding time is jargon which I find even the scientists don't understand. [Robert Scholes, South Africa]	Accepted - described in text
6-1556	6	29	48	29	49	Suggest replacing "However, other secondary factors … elevated CO2, ... " with: "In addition, other factors can influence the AF, such as the response of carbon exchanges to elevated CO2, ..." [Michael Raupach, Australia]	Accepted - revised text
6-1557	6	29	48			what is a "e-folding time"? [CATHERINE BELTRAN, France]	Accepted - described in text
6-1558	6	29	49	29	49	Isn't the response of reservoir to CO2 the critical mechanism to maintain a constant AF ? [Stefan Gerber, USA]	Yes, that is why we say it is the most important. Other issues have been found to paly a role too.
6-1559	6	29	51	29	51	"i.e." [Leticia Cotrim da Cunha, Germany]	Editorial suggestion (same comment 6-1561) - accepted.
6-1560	6	29	51	29	51	"Climate and CO2 effects were suggested to be important drivers of AF changes in future projections". This is too obvious a statement to make! [Andrew Glikson, Australia]	Never hearst to repeat the important mechanisms
6-1561	6	29	51			change 'ie' to 'i.e.' [Jeffrey Obbard, Singapore]	Editorial suggestion (same comment 6-1559) - accepted.
6-1562	6	29	52	29	53	These numbers arez actually already in Friedlingstein et al., 2006, no need to refer to Canadell et al. 2007. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Rejected - we haven't found the number in the paper
6-1563	6	29	53			what is a "A2 high emission"? [CATHERINE BELTRAN, France]	Accetped - added that is a SRES scenario
6-1564	6	29	56	29	56	Replace "in the recent past." with "over the period since 1959 (for which high-quality in-situ CO2 data are available)." [Michael Raupach, Australia]	Accepted - text revised
6-1565	6	29	56			change to" Up to the date of publication of the AR4' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-1566	6	29				Figure 6.24. Change b and g in figure titles to beta and gamma [Vivek Arora, Canada]	taken into account - figure revised
6-1567	6	29				Figure 6.24. I have two concerns about this figure. The first is that globally-average temperature change is used for calculating local gamma. Second, the boundary between negative and positive gamma over land seems too far north. In Boer and Arora (2010) J. Clim, 23, 775-784 the gammas which are calculated using local temperature change and Boer and Arora methodology show this boundary around 35 -40 N and not around 50-60 N. I can't help wonder if this is the result of using global temperature change and/or that	reject - the use of global T is consistent with Friedlingstein et al, Roy et al, and does not affect the sign of gamma. The sign of gamma depends on the sign of carbon change, not the magnitude of warming. It is not unexpected that different models have a

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Friedlingstein et al. gammas are temperature weighted form of Boer and Arora's gammas. Temperate forests have shown positive growth and longer growing seasons with historical CO2 increase and the associated warming. Figure 6.24 suggests that only boreal forests would have benefitted from the warming in terms of net carbon balance. I know it is hard to disentangle the CO2 and temperature effects separately from the observed record but 50-60 N seems too far north. [Vivek Arora, Canada]	different quantitative response. this figure will be expanded to include more CMIP5 models (including CanESM2) which are available
6-1568	6	29				I would highly recommend using initials for words sparingly. AF is not necessary. “Airborne fraction” can be written out. After a while there are so many such abbreviations that the text becomes hard to understand. [Mohammad Aslam Khan Khalil, USA]	Rejected - the acronym is very well rooted in the scientific community studying airborne fraction and we have chosen to keep the term for consistency also across IPCC reports.
6-1569	6	29				Fig 24. This is from 3 models; not clear if average, median....; no citation given; one hopes from a peer-reviewed paper. At best this result is dependent on the assumed temperature sensitvity of the models employed (and lots of other model-dependent quantities) so at minimum the figure should be so qualified. [Stephen E Schwartz, USA]	taken into account - figure revised. Roy et al refers to the method and this is now applied to CMIP5 models
6-1570	6	29				What the shading in Fig. c and d represent? [Zongbo Shi, United Kingdom]	taken into account - caption revsied to clarify the shading
6-1571	6	30	3	30	3	"0.3% yr-1" is stated. It would be useful to say if this is an absolute or relative change. [David Pearson, United Kingdom]	taken into account
6-1572	6	30	4	30	4	delete 'time' (tautology) [Peter Burt, UK]	Editorial - text revised.
6-1573	6	30	4	30	4	Suggest replacing "there is disagreement" with "there is not yet consensus" [Michael Raupach, Australia]	Rewording suggestion - accepted.
6-1574	6	30	8	30	8	chances → chance [Peter Burt, UK]	Editorial - text revised.
6-1575	6	30	8	30	8	V Raupach et al. (2008) [Peter Burt, UK]	Editorial - text revised.
6-1576	6	30	8	30	17	"accidental" is an odd choice of terms [James Christian, Canada]	Accepted - text revised.
6-1577	6	30	9	30	9	Which specifically are these other "independent studies"? [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-1578	6	30	9	30	9	Suggest replacing "but not in the other two independent studies." with "but other studies (Knorr 2009, Gloor et al 2010) report a lower significance (of around 75% to 80%) because of differences in data processing methods, such as the choice of sampling interval." [Michael Raupach, Australia]	Accepted - text revised.
6-1579	6	30	9	30	10	Please re-write the sentence "The cause…". It is not clear. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1580	6	30	9	30	18	Suggest replacing the text from "The cause of the trend …" to "… in the published literature." with a new stand-alone paragraph, given in the following 2 comment boxes. [Michael Raupach, Australia]	sentence deleted
6-1581	6	30	9	30	18	New para, part 1: "Three broad causes have been proposed for the observed positive AF trend: (1) departure of total anthropogenic CO2 emissions from exponential growth with constant e-folding time (Gloor et al. 2009); (2) natural (non-anthropogenic) variability of carbon sinks, through interannual variability driven mainly by ENSO (Section 6.3.2.5.3) and also through the influence of major volcanic eruptions such as Pinatubo in 1991 (Sarmiento et al. 2010); and (3) anthropogenic perturbation of carbon sinks through nonlinear responses to elevated CO2, nutrient availability, land management, warming, precipitation and ecosystem changes (Le Quere et al 2009)." [Michael Raupach, Australia]	rejected - the three broad causes are given in head paragraph in this section
6-1582	6	30	9	30	18	New para, part 2: "Recent work (Frolicher et al [submitted but should be published soon]) suggests that the combination of factors (1) and (2) is sufficient to account for the observed trend in the total AF, and that when these factors – principally (2) – are removed, the resulting "anthropogenic AF" has no trend. This suggests that there is not yet evidence in the AF trend for factor (3), an anthropogenic nonlinear perturbation of carbon sinks." [Michael Raupach, Australia]	taken into account - the findings of Frolicher are mentioned, but more briefly than suggested
6-1583	6	30	10	30	10	preeminent → pre-eminent [Peter Burt, UK]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1584	6	30	11			delete a "," before (Gloor… [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-1585	6	30	12			correct LeQuere reference. [Jeffrey Obbard, Singapore]	Editorial - the reference corrected.
6-1586	6	30	13	30	18	It looks like my question on line 25 above is addressed here, with LeQuere's results using 4 models, suggesting climate is the major cause, but here it is talking about the airborn fraction. This needs to be connected with the point above (spreadsheet line 25, i.e. p 27, lines 33-36) [Beverly Law, USA]	taken into account - this section was shortened but the text on p.27 has been modified
6-1587	6	30	13			as for 12 [Jeffrey Obbard, Singapore]	Editorial - the reference corrected.
6-1588	6	30	15			correct Gloor reference [Jeffrey Obbard, Singapore]	Editorial - the reference corrected.
6-1589	6	30	16	30	16	What kind of "extreme events", volcanoes, El nino events? [Daniel Metcalfe, Sweden]	sentence deleted
6-1590	6	30	17	30	17	Change to "early to reach a conclusion about the". [Daniel Metcalfe, Sweden]	Rewording suggestion - accepted.
6-1591	6	30	20	30	43	There aren't any bibliographic references in this passage. Maybe it needs to be checked? [Leticia Cotrim da Cunha, Germany]	accepted
6-1592	6	30	20	32	43	I found these two sections on processes driving the sinks very descriptive (and hence a bit generic, i.e. boring…) Could it be more quantitative, trying to attribute sinks to the different drivers. Even if there is a significant uncertainty and essentially based on models (with their known limitations (eg. they can only attribute to the processes they include...) I think it would be good to have assess these studies here. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted - section revised
6-1593	6	30	20	39	20	Another sudden switch from emissions and sinks to "fluxes" which are concentrations. You continue to keep us in the darkl on how they are related. Perhaps you do not know. [VINCENT GRAY, NEW ZEALAND]	taken into account - text revised for clarification (in the introduction)
6-1594	6	30	30	30	31	I would change the definiton of alkalinity from "the ability of the water to neutralize acids" to "a measure of the capacity of an aqueous solution to neutralize acids" [James Christian, Canada]	Accepted - text revised.
6-1595	6	30	30	30	31	This definition of alkalinity is a bit "simplistic", and could be classified as "one of the possible alkalinity definitions". For more references: Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to best practices for ocean CO2 measurements. PICES Special Publication 3, 191 pp. ; CO2 in Seawater: Equilibrium, Kinetics, Isotopes, By R.E. Zeebe & D. Wolf-Gladrow, ELSEVIER, ISBN: 978-0-444-50946-8 [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-1596	6	30	31	30	31	warmer → higher (warmer temperature is a physically meaningless term) [Peter Burt, UK]	Rewording suggestion - accepted.
6-1597	6	30	31	30	31	Add "for a given alkalinity" before "decreases at warmer temperature. This is critical since the warm ocean has a higher uptake capacity than the cold ocean. This is because the alkalinity effect is more important than the temperature effect. [Nicolas Gruber, Switzerland]	Accepted - text revised.
6-1598	6	30	31	30	32	Why does the capacity of the ocean to take up additional CO2 decrease at "elevated CO2"? Does this refers to ocean CO2 or atmosphere or both? I assume this refers to the reduction of buffering capacity with accumulation of anthropogenic DIC, but the wording needs to be clearer. Depending on the time and space scales under consideration, this effect could be very small compared to other influences that can both increase and decrease ocean uptake. [James Christian, Canada]	accepted - text clarified
6-1599	6	30	32			add 'concentrations' after CO2 [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1600	6	30	37	30	37	"hundreds" instead of "100s" [Leticia Cotrim da Cunha, Germany]	Editorial - text revised.
6-1601	6	30	42	30	43	"A more vigorous circulation generally results in more uptake of anthropogenic carbon, compensated by an outgassing of natural carbon." It will help if an explanation is given regarding the discrmination between the uptake of "anthropogenic carbon" and outgassing "natural carbon", i.e. what characteristics does each of these types has which determines its different behaviour in this regard? [Andrew Glikson, Australia]	sentence deleted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1602	6	30	42		43	In short term, it is true that more CO2 will be taken up by the ocean. But is it true over longer, e.g., 1000s y time scale? These CO2 will be brought up to the surface ocean eventually? [Zongbo Shi, United Kingdom]	sentence deleted
6-1603	6	30	43	30	43	Fully "compensated" or only partially? [Daniel Metcalfe, Sweden]	sentence deleted
6-1604	6	30	45	30	46	phytoplankton are not plants; aggregates are not the only form of sedimenting particulate carbon. How about "Marine phytoplankton and other organisms take up carbon in the surface ocean, some of which is incorporated into particles that sink and are remineralized in the intermediate and deep ocean"? [James Christian, Canada]	Accepted - text revised.
6-1605	6	30	45	30	56	Not mentioned in this paragraph is the fact that increasing quantities of anthropogenically derived nitrogen are entering and fertilizing the ocean, resulting in additional export of carbon to the deep ocean with consequent additional drawdown of atmospheric CO2. In the Science paper by Duce et al “Impacts of atmospheric anthropogenic nitrogen on the open ocean”, Science, 320, 893 (2008) it was calculated that this increasing quantity of atmospheric anthropogenic fixed nitrogen entering the open ocean could account for up to about a third of the ocean’s external (nonrecycled) nitrogen supply and up to ~3% of the annual new marine biological production, ~0.3 petagram of carbon per year. [Robert Duce, USA]	taken into account - N effect discussed
6-1606	6	30	46	30	46	"remineralized". The term is not quite correct since the organic matter breaks down to CO2 and methane which are gases, it is only when they combine with a metal, i.e. CO2+CaO=CaCO3, that the compound becomes a mineral. [Andrew Glikson, Australia]	rejected - technically this is true but remineralisation is widely used in the context it is used here, and it is also described as such in carbon textbooks (e.g. Sarmiento and Gruber Ocean biogeochemical dynamics)
6-1607	6	30	47	30	56	This sentence is spread voer 8 lines and is far too long and thereby difficult to follow [Andrew Glikson, Australia]	accepted - text revised
6-1608	6	30	48	30	56	This sentence is 8 lines long! It's not very clear [CATHERINE BELTRAN, France]	accepted - text revised
6-1609	6	30	48	30	56	This is an extremely long, complex sentence. I suggest it is split up. [Daniel Metcalfe, Sweden]	accepted - text revised
6-1610	6	30	48			Over the geological past, the ocean was limited by P; Fe, N are important but P is also important [Zongbo Shi, United Kingdom]	accepted
6-1611	6	30	51	30	51	modeling → modelling [Peter Burt, UK]	Editorial - suggestion accepted.
6-1612	6	30	51	30	51	insert 'on' after 'impacted' [Peter Burt, UK]	accepted
6-1613	6	30	53	30	56	I think it should be stated here how much of this enhanced dust flux is due to LUC vs climate change, or if this is known. I would assume LUC dominates, but see McConnell et al 2007 PNAS 104: 5743–5748 [James Christian, Canada]	accepted
6-1614	6	30	53	30	56	Isn't the iron fertilisation effect mostly an increase in rapid cycling of carbon (temporary), rather than accumulation? [Beverly Law, USA]	rejected - the effect on CO2 will continue as long as the iron flux continues. The study cited takes the timing into account
6-1615	6	30	54	30	54	What is the convention for this document as regards US or UK english? Elsewhere "fertilisation" has been spelt with a z. Whatever the convention chosen, it needs to be applied consistently. [Daniel Metcalfe, Sweden]	accepted - UK convention
6-1616	6	30	55			Add "PgC" before "during"?; What about N fertlisation? What about P fertilisation? Any contribution to CO2 uptake? [Zongbo Shi, United Kingdom]	accepted
6-1617	6	30	56	30	56	To increase the link with the nitrogen component of this chapter, I suggest to add here the work of Krishnamurty et al. Who looked at the impact of N deposition on marine export production and air-sea CO2 fluxes [Nicolas Gruber, Switzerland]	accepted
6-1618	6	30	56			Is it worth commenting here about any evidence of the potential effects of atmospheric deposition of anthropogenic N onto the ocean and agricultural fertiliser runoff to the ocean, in increasing the biological C	accepted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						"pumping" rate?? [Roger Gifford, Australia]	
6-1619	6	30	57	58	1	In your front paper you ask for reviewers to consider coverage of the chapter. Therefore, I restrict my comments to a most concerned single matter, which appears to be largely overlooked in the present version of the Fifth Assessment Report of IPCC. [Sven Blomqvist, Sweden]	Noted.
6-1620	6	30	57	58	1	To my opinion, many parts of the report are very well written, broad and convincing, but the fact that other nutrients than nitrogen might act as main drivers of the global carbon cycling by limiting the primary production, is not attended enough. Without doubt, this is true for phosphorus in many aquatic environments (Wu et al. 2000, Blomqvist et al. 2004, Mather 2008), but applies significantly also to other elements, for instance, silica (Leynaerta et al. 2001, Brzezinski, et al. 2011). [Sven Blomqvist, Sweden]	taken into account - we expanded our comments on other nutrients, but there is no evidence of trends in silica. The Brzezinski et al 2011 papers are all on the mean effect of Si.
6-1621	6	30	57	58	1	This is a most essential aspect when dealing with the global biogeochemistry of carbon cycling and nutrient dynamics. Actually, to my opinion, this research field is so important that it deserves a paragraph on its own, and I do recommend elaboration the present state-of-the-art. Not least when modeling the global carbon cycling, reliable knowledge on limiting nutrients is of great importance. Therefore, I strongly urge you to include this aspect in the Fifth Assessment Report of IPCC. [Sven Blomqvist, Sweden]	taken into account - we expanded the text on nutrients, but we focus this chapter on carbon and have only limited place for a full assessment of other biogeochemical cycles
6-1622	6	30	57	58	1	References [Sven Blomqvist, Sweden]	rejected - this paper focuses on the processes driving the mean state, while the section focuses on processes that can drive anthrpogenic change
6-1623	6	30	57	58	1	Blomqvist, S., Gunnars, A. & Elmgren, R., 2004. Why the limiting nutrient differs between temperate coastal seas and freshwater lakes: A matter of salt. Limnology and Oceanography 49: 2236-2241. [Sven Blomqvist, Sweden]	rejected - this paper focuses on the processes driving the mean state, while the section focuses on processes that can drive anthrpogenic change
6-1624	6	30	57	58	1	Brzezinski, M.A., Baines, S.B., Balch, W.M., Beucher, C.P., Chai, F.; Dugdale, RC.Krause, J. ,Landry, MR. Marchi, A., Measures, C.I., Nelson, D.M., Parker, A.E., Poulton, A.J., Selph, K.E., Strutton, P.G., Taylor, A.G. & Twining, B.S., 2011. Co-limitation of diatoms by iron and silicic acid in the equatorial Pacific Deep-Sea Research II 58: 493-511 [Sven Blomqvist, Sweden]	rejected - this paper focuses on the processes driving the mean state, while the section focuses on processes that can drive anthrpogenic change
6-1625	6	30	57	58	1	Leynaerta, A., Tréguera,P., Lancelot, C. & Rodierc, M., 2001. Silicon limitation of biogenic silica production in the Equatorial Pacific. Deep-Sea Res. 48: 639-660. [Sven Blomqvist, Sweden]	rejected - this paper focuses on the processes driving the mean state, while the section focuses on processes that can drive anthrpogenic change
6-1626	6	30	57	58	1	Mather, R.L., Reynolds S.E., ,Wolff, G.A.,1, Richard G. Williams, R.G., Torres-Valdes, S., Woodward, E.M.S., Landolfi, A., Pan, X.I., Sanders, R. & Achterberg, E.P., 2008. Phosphorus cycling in the North and South Atlantic Ocean subtropical gyres. Nature Geoscience 1: 439-443. [Sven Blomqvist, Sweden]	rejected - this paper focuses on the processes driving the mean state, while the section focuses on processes that can drive anthrpogenic change
6-1627	6	30	57	58	1	Wu, J.F., Sunda, W., Boyle, E.A. & Karl, D.M., 2000. Phosphate depletion in the western North Atlantic Ocean. Science 289: 759-762 [Sven Blomqvist, Sweden]	rejected - this paper focuses on the processes driving the mean state, while the section focuses on processes that can drive anthrpogenic change
6-1628	6	30				Figure 6.25. Change y-axis label of top left panel to "Globally-averaged crop and pasture fraction" or is it "Land-averaged crop and pasture fraction". Or show the actual area in millions of km2. Text on page 6-46 refers to Figure 6.25c but the panels are not labelled. The right hand side panels in which agric fraction (please be explicit is this crop, pasture or crop+pasture fraction) and LUC emissions are plotted against radiative forcing, as expected, have no relationship. So why plot these and confuse the reader. [Vivek Arora, Canada]	taken into account - caption and labelling revised for clarity
6-1629	6	30				I think it would read better if sections 6.3.2.7.1 and 6.3.2.7.2 on ocean and land processes where within the ocean (6.3.2.4) and land (6.3.2.5) sections respectively. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - sections restructured
6-1630	6	31	1	31	2	"The recent increase in North Atlantic surface water pCO2 values since about 1990 at rates faster than atmospheric CO2 (causing a sink decrease) appear to be related to sea surface warming". Is it not that sea water warming result in a lesser solubility and thereby lower CO2? [Andrew Glikson, Australia]	taken into account - text clarified

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1631	6	31	3	31	16	Regarding the NAO and AMV references, then the statement on line 18 about the lack of evidence that changes other than S. Ocean can be attributed to climate change or variability - surely there are plenty of studies which (correctly of incorrectly) link N. Atlantic CO2 uptake to variability? Further, we've just had a paper accepted in Nature which strongly suggests that the AMV is not natural variability, it is instead a forced mode of variability (see Booth et al. reference in detection and attribution and climate variability chapters). [Paul Halloran, UK]	rejected - the following sentence already cites 3 papers on the role of NAO. Also comments on the anthropogenic influence on AMV are treated in the D&A chapter.
6-1632	6	31	4	31	4	mid-nineties → mid-1990s [Peter Burt, UK]	Editorial - corrected in text.
6-1633	6	31	10	31	10	I suggest to add here the interesting (model-based) finding that the enhanced outgassing of natural carbon is not compensated by an increase in the uptake of anthropogenic CO2 (Lovenduski et al., 2008). This is relevant since elsewhere in the chapter, this tendency for compensation is explicitly mentioned. [Nicolas Gruber, Switzerland]	rejected - we have removed the sentence about the anthropogenic compensation, as we already refer to the 2007 paper of Lovenduski so this comment is not relevant any longer
6-1634	6	31	10			You probabky have seen this as well: there is an interesting paper by Swart & Fyfe on ocean C uptake in the January 2012 issue of Nat. Clim. Change [Almut Arneth, Germany]	Noted - reference will be cited in Section 6.4 as it may be more relevant for future changes in ocean carbon uptake.
6-1635	6	31	12	31	13	Change to "driving increased upward transport". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1636	6	31	15	31	15	"and by primary production and export changes". It would help if "export chages" is explained. [Andrew Glikson, Australia]	accepted
6-1637	6	31	15	31	16	"The increase in winds has been attributed to the depletion of stratospheric ozone (Thompson and Solomon, 2002), and is projected to recover sometime this century." No, there is a GHG component as well (e.g. Saenko et al 2005, Clim Dyn 25: 415, Fyfe and Saenko 2006 GRL). [James Christian, Canada]	accepted
6-1638	6	31	16	31	17	Sentence does not make sense. I presume you mean that stratospheric ozone is projected to recover, rather than the winds (which is what the sentence currently states). [Peter Burt, UK]	accepted - sentence clarified
6-1639	6	31	16			Korhonen et al. GRL (L02805) provides new insights in this issue. I would recommend to add this reference [Zongbo Shi, United Kingdom]	rejected - reference discusses the aerosol feedback and is too detailed for our section
6-1640	6	31	20			This sentence is incomprehensible. [Göran Ågren, Sweden]	accepted - sentence clarified
6-1641	6	31	22	31	23	Abbreviations: NCEP, NCEP2, ECMWF, JPL [Leticia Cotrim da Cunha, Germany]	taken into account - acronyms removed
6-1642	6	31	29	32	43	I section 6.3.2.7.2 I miss a refererence to: Sitch, S., P. M. Cox, W. J. Collins, and C. Huntingford (2007), Indirect radiative forcing of climate change through ozone effects on the landcarbon sink, Nature, 448, 791–794. [Jan Fuglestvedt, NORWAY]	Accepted - text added and reference
6-1643	6	31	30	31	30	type → types [Peter Burt, UK]	Editorial (same comments: 6-1645, 6-1646, 6-1648) - corrected in text.
6-1644	6	31	30	31	30	CO2 → CO2 [Peter Burt, UK]	Editorial (same comment 6-1649) - corrected in text.
6-1645	6	31	30	31	30	"type" should be plural. [James Butler, United States of America]	Editorial (same comments: 6-1643, 6-1646, 6-1648) - corrected in text.
6-1646	6	31	30	31	30	"Three types…" [Leticia Cotrim da Cunha, Germany]	Editorial (same comments: 6-1643, 6-1645, 6-1648) - corrected in text.
6-1647	6	31	30	31	30	consider inserting "net" before "fluxes" as the authors intend to discuss accumulation of carbon [Stefan Gerber, USA]	Accepted - text revised
6-1648	6	31	30			change to 'types' [Jeffrey Obbard, Singapore]	Editorial (same comments: 6-1643, 6-1645, 6-1646) - corrected in text.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1649	6	31	30			CO2?# [Zongbo Shi, United Kingdom]	Editorial (same comment 6-1644) - corrected in text.
6-1650	6	31	31	31	31	Nitrogen → nitrogen OR N [Peter Burt, UK]	Editorial sugestion - accepted.
6-1651	6	31	31	31	32	Changes in atmospheric composition could have also exerted adverse effects on terrestrial CO2 flux through pollution and acidification, especially in urban and industrial areas. [Akihiko Ito, Japan]	yes, agreed, we are only providing examples as indicated by "eg." not the full list of drivers.
6-1652	6	31	33	31	33	net primary productivity [Peter Burt, UK]	Editorial sugestion - accepted.
6-1653	6	31	33	31	33	Please add the abbreviation "NPP" - it is being used further in the text. [Leticia Cotrim da Cunha, Germany]	Editorial (same comment 6-1654) sugestion - accepted.
6-1654	6	31	33			Add "NPP" after "Productivity" [Zongbo Shi, United Kingdom]	Editorial (same comment 6-1653) sugestion - accepted.
6-1655	6	31	34			CO2 - and Temperature increase are missing as drivers [Christoph Mueller, Germany]	Temperature is spell aout and included in the section of the physical climate (2) processes driven by changes in the 33 physical climate (e.g., Net Primary Productivity and respiration, disturbance response to changes in 34 temperature, radiation or precipitation)), AND CO2 is single out in 2) processes driven by changes in the 33 physical climate (e.g., Net Primary Productivity and respiration, disturbance response to changes in 34 temperature, radiation or precipitation),
6-1656	6	31	37	31	44	The relevance of effects related to soil erosion (see studies cited under 2) should be mentioned here, in partciluar the burial mechanism postulated by van Oost, SOM mineralisation during erosion identified by Lal (2003, cited later in chapter 6) and the conceptual model of "soil as a mobile system" developped by Quinton et al. (2010), kind of a terrestrial equivalent of long-term ocean circulation. Questions related to the permancy of terrestrial sinks and the spatial pattern of sinks (burial and dynamic replacment) as well as their longevity and dependency on fertilisation as well as grey emissions for fertiliser production should also be mentioned here to illustrate the full complexity of the land sink. Similar explanations for vegetation would be desirable, however, since I am not an expert, I cannot comment on issues related to stand age, structure, biodiversity etc. and their effect on C uptake over space and time. [Nikolaus Josef Kuhn, Switzerland]	We agree but the literature that shows this would be a small global flux, albeit important for some regions. The focus on the section is on the main process at the global scale.However, in response to your comment we have added a comment in the section land to ocean fluxes.
6-1657	6	31	37		53	N may limit agricultural production but rarely limits natural or semi-natural managed forests due to adaptations of the tree species (N-fixing, etc.). However, P is the major limiting soil-plant macronutrient in most of the worlds forests, and especially in the tropics. A very large problem in the future will be global P-supply, and one to support agriculture. We expect that Co2 sequestration in many forests is not only sometimes N-limited (tests so far on young plantations on reused land) but P-limited. The report does not recognize this aside from a reference to Vitousek 2010 who mainly worked on volcanic soils in Hawaii. [David Newbery, CH]	Accepted - we have added additional text on the role of phosphorus limitation
6-1658	6	31	38	31	38	specific rather than explicit [Robert Scholes, South Africa]	Rewording suggestion (same comment 6-1659) - accepted.
6-1659	6	31	38			Should "explicit" not be "specific"? [Roger Gifford, Australia]	Rewording suggestion (same comment 6-1658) - accepted.
6-1660	6	31	39	31	39	modeling → modelling [Peter Burt, UK]	Editorial suggestion - accepted.
6-1661	6	31	39	31	40	Change to "include the CO2" [Daniel Metcalfe, Sweden]	Editorial suggestion - accepted.
6-1662	6	31	39			…that the processes involved in the contemprary land C sink…. (no need to have two times "sink" in this sentence) [Almut Arneth, Germany]	Editorial suggestion - accepted.
6-1663	6	31	41	31	44	Far too many quotations if you comapre it with the rest of the text. Please only quote the most important one or two. [Christoph Mueller, Germany]	Accepted - reduced number of references

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1664	6	31	42	31	42	Do "forest regrowth and afforestation" include the influence of elongation of growing period as a result of past warming? Several studies imply that the past warming enhanced vegetation growth (e.g., Myneni et al. 1997). In contrast, Piao et al. (2008) imply that autumn warming would lead to carbon loss. Myneni, R. B., C. D. Keeling, C. J. Tucker, G. Asrar, and R. R. Nemani, 1997: Increased plant growth in the northern high latitudes from 1981 to 1991. Nature, 386, 698-702. Piao, S., and Coauthors, 2008: Net carbon dioxide losses of northern ecosystems in response to autumn warming. Nature, 451, 49-52. [Akihiko Ito, Japan]	Accepted - included in text and new reference to Box updated Myneni.
6-1665	6	31	42			See also my comment no.2: this is another comment when forestry becomes a matter of regrowth and afforestation, and the huge potential effects of management practices is not considered. [Peter Högberg, Sweden]	Accepted - text and reference included
6-1666	6	31	43	31	43	increase → increased [Peter Burt, UK]	Editorial suggestion (combine dwith comments 6-1667, 6-1670) - accepted.
6-1667	6	31	43	31	44	Substitute "increase" with "increased". This seems like one source, so i suggest change to "2010). The dominant anthropogenic source is emissions". [Daniel Metcalfe, Sweden]	accepted - text revised
6-1668	6	31	43			..increased radiation in the tropi. Also, can you add a short explanantion why that is (rediced cloud cover? Reduced aerosol load?) [Almut Arneth, Germany]	Unfortuantely, the text cannot be expanded with additional explanations. Section needs to be shorten by 2 full pages
6-1669	6	31	43			The carbon sink to Northern European forests strongly depends on the fact that forest harvest rates are kept well below growth rates (Nabuurs, G.J., E. Thurig, N. Heidema, K. Armolaitis, P. Biber, E. Cienciala, E. Kaufmann, R. Mäkipää, P. Nilsen, R. Petritsch, T. Pristova, J. Rock, M.J. Schelhaas, R. Sievanen, Z. Somogyi, P. Vallet. Hotspots of the European forests carbon cycle. Forest Ecology and Management 256, pp. 194–200.) [Per Erik Karlsson, Sweden]	Accepted - text and reference included
6-1670	6	31	43			change to 'increased' [Jeffrey Obbard, Singapore]	Editorial suggestion (combine dwith comments 6-1666, 6-1667) - accepted.
6-1671	6	31	46	31	46	It would be useful to make sure that the assessment of fertilisation in Chapter 6 is consistent with what will come up in WGII on CO2 fertilisation for crops. [Olivier Boucher, France]	Accepted - will check when WGII available
6-1672	6	31	46	31	46	Although net primary production (NPP) is one of the most important parameters for the global carbon cycle, it was insufficiently described in this draft. It is recommended referring a recent meta-analysis of global terrestrial NPP (Ito 2011). Ito, A., 2011: A historical meta-analysis of global terrestrial net primary productivity: Are estimates converging? Global Change Biol., 17, 3161–3175. [Akihiko Ito, Japan]	taken into account- added to introduction
6-1673	6	31	46	31	53	This section is useful but it should link better to the CO2 physiological effect which is mentioned (and not really defined) elsewhere in the chapter. It would be useful to have an assessment of whether the increased water use efficiency under rising CO2 (and the associated decrease in evapotranspiration) holds true even if the CO2 fertilisation effect decreases (eg because of N or P limitation). [Olivier Boucher, France]	accepted - text will be clarified
6-1674	6	31	46	31	53	This discussion should be moved to page 27 where Table 6.6 is presented, or at least Table 6.6 should be discussed here. [Eric Davidson, USA]	accepted - sections will be rearranged to put all the land together, same will be done for oceans
6-1675	6	31	46	31	53	Note that there is a much fuller treatment of this topic in WGII ch 4 and WGII ch 7. You should rather point there [Robert Scholes, South Africa]	noted - WG II schedule is beind WG I so we cannot point to this section until it is completed
6-1676	6	31	46			net primary productivity (NPP) [Almut Arneth, Germany]	Noted. Abbreviation of the net primary production (NPP) has been introduced earlier in revised version of the Chapter. The only NPP would be essential to state here.
6-1677	6	31	49	31	53	This paragraph is weak and confused. It should instead highlight the fact that *interpretations* differ, as well as experimental results. I'm particularly concerned that out of four references cited for the involvement of "nutrient limitation" in the supposed "decline" of the CO2 fertilization effect, only one (Norby et al.) is a primary data	taken into account - primary reference added

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						source. The others are interpretations, and in at least one case (Korner) a remarkably one-sided interpretation. There is no mention of, for example, recent work by Peter Reich's group showing that CO2 fertilization in grasslands is persistent over a decade, and independent of nutrient status. Also relevant is my own work on the glacial-interglacial increase of land carbon storage (Prentice et al. New Phytologist 2011) which shows that the geophysical data can't be reconciled with a "disappearing" CO2 fertilization effect. [Iain Colin Prentice, Australia]	
6-1678	6	31	49	31	53	These latter experiments suggest that nutrient limitation is the possible cause of the decline, particularly in N limited boreal and temperate forests (Canadell et al., 2007; Johnson, 2006; Körner, 2006; Norby et al., 2010). A recent meta-analysis of data also suggests that soil respiration may decrease with added nitrogen (Janssens et al., 2010).' Suggest the authors include some comment/estimate of impact of increased N deposition on terrestrial C sinks (esp. forests) - this would also then link in better with Box 6.1. One area of contention not covered here is the C uptake response of forests to N dep (e.g. Magnani et al.). [Dave Reay, UK]	Accepted - the importance of N fertilization. It is single out in text with three references.
6-1679	6	31	49			The reference listed at the back seems to be incorrect. Should it be McCarthy HR, et al. (2010) Re-assessment of plant carbon dynamics at the Duke free `air CO(2) enrichment site: Interactions of atmospheric [CO(2)] with nitrogen and water availability over stand development. New Phytol 185:514–528 [Roger Gifford, Australia]	Accepted - revised reference
6-1680	6	31	51	31	53	Perhaps worth noting somewhere here that there is little/no data about CO2 fertilization in tropical systems. [Daniel Metcalfe, Sweden]	Accepted - a new box created that addresses comment.
6-1681	6	31	51			The PNL Theory as described by Luo et al. (2004) needs to be quoted and others can then be dropped : Luo, Y., Currie, W. S., Dukes, J. S., Finzi, A. C., Hartwig, U., Hungate, B. A., McMurtrie, R. E., Oren, R., Parton, W. J., Pataki, D. E., Shaw, M. R., Zak, D. R., and Field, C. B. (2004). Progressive nitrogen limitation of ecosystem responses to rising atmospheric carbon dioxide. BioScience 54, 731-739. [Christoph Mueller, Germany]	Accepted - reference included
6-1682	6	31	52	31	53	How does soil respiration affect the atmosphere-land CO2 fluxes? This last sentence needs this information, otherwise it seems a bit of text lost in the paragraph. [Leticia Cotrim da Cunha, Germany]	Unfortunately, the section needs to be shorten by 2 pages and cannot be expanded with additional explanations
6-1683	6	31	55	31	55	have → has [Peter Burt, UK]	Editorial (same comments 6-1684, 6-1685) - corrected in text.
6-1684	6	31	55	31	55	"have" should be "has" [James Butler, United States of America]	Editorial (same comments 6-1683, 6-1685) - corrected in text.
6-1685	6	31	55	31	55	Substitute "have" with "has". [Daniel Metcalfe, Sweden]	Editorial (same comments 6-1683, 6-1684) - corrected in text.
6-1686	6	31	55	32	2	almost the only recognition of P. [David Newbery, CH]	taken into account - more detail added to this paragraph, and additional text added in section 6.4
6-1687	6	31	55	32	2	This part dealing with P limitation is even weaker as *no* experimental evidence is given: only a pure modelling result. [Iain Colin Prentice, Australia]	taken into account - additional text added to reference recent meta-analysis of observational evidence for P limitation (Elser et al., 2007)
6-1688	6	31	55	32	2	This snippet is too brief to be useful. Delete [Robert Scholes, South Africa]	taken into account - combined with comments 1686 and 1687
6-1689	6	31	56			"therefore" doesnt fit here. How about "Old, well-weathered soils in the tropics and subtropics are more P-limited than relatvely young, freshly (on geological time scales) deglaciated regins in … [Almut Arneth, Germany]	Rewording suggestion (combined with comment 6-1690, 6-1691) - accepted.
6-1690	6	31	56			add 'the' prior to 'tropics' [Jeffrey Obbard, Singapore]	Editorial suggestion (combined with comment 6-1689, 6-1691) - accepted. The final copyedit to be completed prior to publication.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1691	6	31	56			…the tropics and subtropics are more P-limited than…. [Christina Tonitto, USA]	Editorial suggestion (combined with comment 6-1689, 6-1690) - accepted. The final copyedit to be completed prior to publication.
6-1692	6	31		56		below some more scientific comments: I concentrate on aspects vegetation and land, and do not comment on oceans [David Newbery, CH]	Okay
6-1693	6	31				Figure 6.26. Please change CanESM to CanESM2 in figure caption. Also, it would be nice if the third panel (bottom right) can be plotted in some other way. Too many lines. [Vivek Arora, Canada]	taken into account - model names updated and clarity of figure
6-1694	6	31				since this is 'Physical Science Basis' and I a tropical ecologist some of what follows may not be wished for, and for that reason I do not try to detail changes (for now). There is a good literature in estimating forest C-stocks, forest dynamics and the problems and errors of the field methodology and modelling. I simply list the main missing aspects which you might like to pull in. Get back to me for a Bibliography if needed. [David Newbery, CH]	Okay, thank you.
6-1695	6	31				Legends for fig. c and d mssing [Zongbo Shi, United Kingdom]	Figure has been deleted.
6-1696	6	32	1	32	1	delete comma after 'N' [Peter Burt, UK]	Editorial - accepted.
6-1697	6	32	2	32	2	modeling → modelling [Peter Burt, UK]	Editorial - accepted.
6-1698	6	32	4	32	7	This section should also mention the Sitch et al. Nature 2007 study which calculated a 50-90 PgC decrease in land carbon uptake over the 20th Century (their table S2).. [William Collins, United Kingdom of Great Britain & Northern Ireland]	Unable to find a publication by Sitch et al. in Nature. But included other new references.
6-1699	6	32	4	32	7	Please use "USA"; Please explain briefly the mechanism causing NPP reduction: was there so much tropospheric O3 over the USA territory during this period? [Leticia Cotrim da Cunha, Germany]	Accepted - revised but don't report longer explanation due to space limitation
6-1700	6	32	4	32	7	It should be noted that the Felzer et al. 2004 paper reports on extrapolation of a few field data by applying a model to the entire US. Hence, the reported reduction in NPP of the US is really a modeling result. [Eric Davidson, USA]	Accepted - made it clear
6-1701	6	32	5	32	7	"Trophospheric ozone results from photochemical reaction between hydrocarbons and nitrogen oxides both from various pollution sources" is incorrect. Tropospheric ozone results from the oxidation of carbon monoxide, methane, and other non-methane hydrocarbons in the present of nitrogen oxides, with ozone-precursor and nitrogen oxide emissions from various pollution sources ... i.e. nitrogen oxides themselves are not removed from the atmosphere during tropospheric ozone production, they simply act as catalysts. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted -text revised
6-1702	6	32	9		21	The C-sink has been much debated and discussed in tropical forest ecology. There are other references besides Lewis et al. 2003. However, the key issue to bring out is that C-stocks estimates are highly prone errors in field plot design, tree measurements (often overestimating tree volume, biomass), the allometric equation (very few and for above ground biomass only); the almost complete lack of data for below ground C resources in forests in tropics at least), time- related successional recovery influences, etc. Few ecologists put much store on C-balance figure presently because many studies are defective and we need much more sampling. The report should be open to all these things and not use bland unqualified overview estimates. [David Newbery, CH]	taken into account - text will be revised to address different approaches
6-1703	6	32	10	32	11	Change to "observations in some regions to use", "key processes explaining the US" [Daniel Metcalfe, Sweden]	Rewording suggestions - accepted.
6-1704	6	32	11	32	11	process → processes [Peter Burt, UK]	Editorial - text revised.
6-1705	6	32	12	32	12	Please avoid using semi-colon. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-1706	6	32	12	32	12	Change to "demographics do not fully explain the". [Daniel Metcalfe, Sweden]	Rewording suggestion - accepted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1707	6	32	14	32	14	Other → In other..' [Peter Burt, UK]	Editorial (combined with comments: 6-1707 to 6-1709) - text revised.
6-1708	6	32	14	32	14	"In other parts…" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comments: 6-1706 to 6-1709) - text revised.
6-1709	6	32	14	32	14	Change to "2010). In other parts". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1706 to 6-1708) - text revised.
6-1710	6	32	16	32	16	exist → exists [Peter Burt, UK]	Editorial (same comments 6-1704, 6-1713) - text revised.
6-1711	6	32	16	32	16	decrease → decreased [Peter Burt, UK]	Editorial (combined with comment 6-1713) - text revised.
6-1712	6	32	16	32	17	"Increased incident solar radiation due to decrease cloud cover over the last two decades in the tropics". It will help to explain to the reader why clounding decreased while ocean warming has enhanced the hydrological cycle. [Andrew Glikson, Australia]	Section needs to be shorten; unfortunately we cannot expand text and explanations unless missing processes or key references.
6-1713	6	32	16	32	18	Substitute "exist" with "exists", "decrease" for "decreased", "processes" for "process", and "invoke" for "invoked" [Daniel Metcalfe, Sweden]	Editorial (combined with other comments: 6-1704, 6-1710, 6-1711, 6-1714, 6-1716) - text revised.
6-1714	6	32	16			change to 'exisits' [Jeffrey Obbard, Singapore]	Editorial (same comments 6-1710, 6-1713) - text revised.
6-1715	6	32	18	32	18	The second part of this sentence - " … as well as the CO2 fertilization effect largely invoke in the absence of other possible processes", somehow doesn't seem to tie in properly with the first half of the sentence. Please consider rewording. [Vivek Arora, Canada]	Accepted - text revised
6-1716	6	32	18	32	18	invoke → invoked [Peter Burt, UK]	Editorial (combined with comment 6-1713) - text revised.
6-1717	6	32	19	32	21	This last sentence can also use some rewording. [Vivek Arora, Canada]	accepted - text revised
6-1718	6	32	20	32	20	delete comma after 'products' [Peter Burt, UK]	Editorial - corrected in text.
6-1719	6	32	23	6	26	In many tropical, subtropical, and temperate regions, devastating impacts of storms (e.g., hurricane, cyclone, and typhoon) are not negligible through tree felling , defoliation, and soil erosion. For example, Chambers et al. (2007) estimated the impact of Hurricane Katrina on the U.S. Gulf Coast forests. Chambers, J. Q., J. I. Fisher, H. Zeng, E. L. Chapman, D. B. Baker, and G. C. Hurtt, 2007: Hurricane Katrina's carbon footprint on U.S. Gulf Coast forests. Science, 318, 1107. [Akihiko Ito, Japan]	Accepted - reference and text included
6-1720	6	32	23	32	30	Maybe a bit of re-writing could result in one paragraph. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-1721	6	32	23	32	32	"Disturbances such as fires,' According to Bowman et al. 2009 fires release between 2 and 4 Pg C year−1 (see comment on page 4 line 23). [Andrew Glikson, Australia]	Thank you
6-1722	6	32	23	32	43	Heat stress should be included among the drivers. See Clark et al. Global Change Biology (2009), doi: 10.1111/j.1365-2486.2009.02004.x. Annual wood production in a tropical rain forest in NE Costa Rica linked to climatic variation but not to increasing CO2. [Eric Davidson, USA]	Accepted - text revised and refernece added
6-1723	6	32	23		30	This is quite superficial. On the topic of droughts and ENSO events we have indications that dryness and temp changes can operate in different ways on growth (CO2 uptake) at different sites depending on the adaptations of the species and other enviromental factors (soil nutrients, water balance, etc). E.g. droughts (extensions to dry season) and moderate ENSOs can open up the canopy slightly and enhance understroey growth. [David Newbery, CH]	We agree it is a shallow treatment of the topic but there is space limitations to expand; in fact section needs to be shorten by 2 pages. Our statemetns are quite neutral understanding that the effects are not in one direction.
6-1724	6	32	24	32	24	"which" should be "what" [James Butler, United States of America]	Editorial sugestion - accepted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1725	6	32	25	32	25	Substitute "savannas" with "savanna". [Daniel Metcalfe, Sweden]	Editorial sugestion - accepted.
6-1726	6	32	26	32	26	An extra bracket needs to be inserted somewhere here. [Daniel Metcalfe, Sweden]	Editorial - copyedit to be completed prior to publication.
6-1727	6	32	28	32	28	" … disturbances are expected to become …". Please insert "to" before become. [Vivek Arora, Canada]	Editorial (combined with comments 6-1728, 6-1729) - accepted.
6-1728	6	32	28	32	28	insert 'to' after 'expected [Peter Burt, UK]	Editorial (combined with comments 6-1727, 6-1729) - accepted.
6-1729	6	32	28	32	28	Change to "expected to become". [Daniel Metcalfe, Sweden]	Editorial (combined with comments 6-1727, 6-1728) - accepted.
6-1730	6	32	28			add 'several' after 'next' [Jeffrey Obbard, Singapore]	Editorial sugestion - accepted.
6-1731	6	32	29	32	29	delete 'it has' [Peter Burt, UK]	Accepted - text revised.
6-1732	6	32	29	32	29	being → been [Peter Burt, UK]	Accepted with same comment 6-1734 - text revised.
6-1733	6	32	29	32	29	I'm not sure what a long-term trend in dynamics really means. I suggest "trend" is removed. Remove "it". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1734	6	32	29			“been” not “being” [Richard Bourbonniere, Canada]	Accepted with same comment 6-1732 - text revised.
6-1735	6	32	32	32	32	The phrase "… are in rising importance …" seems weird. Please consider rewording this phrase and breaking this long sentence into two sentences. This sentence doesn't read well. In addition, "… the savannaization of the drier parts of the tropics" does not read well. In reality, the drier parts of the tropics are already savannas. What is being implied here with the reference to Cox et al. 2000 is that MORE parts of the tropics can become savanna like. This is not explicitly clear from the way this sentence is currently written. [Vivek Arora, Canada]	Accetped - text revised
6-1736	6	32	32	32	32	"in rising" should be "rising in" [James Butler, United States of America]	Accepted with same comment 6-1738.
6-1737	6	32	32	32	33	This sentence is not very clear. [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1738	6	32	32			change 'are in rising importance' to 'of increasing importance' [Jeffrey Obbard, Singapore]	Accepted with same comment 6-1736.
6-1739	6	32	34	32	35	What is a "carbon consequence", perhaps change to "large consequence for carbon storage". Substitute "savanization" to "savannization" [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1740	6	32	34			More standard now to say 'permafrost thaw' [Edward Schuur, USA]	Accepted - text revised.
6-1741	6	32	35	32	35	insert comma after 2009) [Peter Burt, UK]	Editorial - text revised.
6-1742	6	32	35	32	35	savannization is not a term with a well-defined meaning. Rather say conversion of closed, moist forest into open, drier savannas [Robert Scholes, South Africa]	Accepted - text revised
6-1743	6	32	35	32	36	I was very surprised to read about "savanization" here. Both papers cited are pure model results and furthermore the result by Cox et al. (2000) is surely now entirely discredited (certainly by its first author!) On the other hand the very widespread process of "woody thickening", which is exactly thh opposite of savanization and has the opposite effect in the carbon cycle, is never mentioend!! [Iain Colin Prentice, Australia]	Accepted - woody thickening included with references
6-1744	6	32	38	32	38	"had" should be "has" [James Butler, United States of America]	Editorial - text revised.
6-1745	6	32	38	32	43	The controversy about the reasons for the observed greening should be explained in more detail, as well as the controversy surrounding it. [Nikolaus Josef Kuhn, Switzerland]	Accepted - a box address the greening issue

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1746	6	32	38	32	43	I suppose there is no alternative to labelling this as a "controversy". However, there are a couple more points to make that have not been aired in Science. First, if these results were correct, they would imply that all of the interannual variability in land-atmosphere CO2 exchange is due to variation in NPP (and thus, SOM decomposition has no role). Second, rather crucially I think, the reported trend depends on one year only, and is not statistically significant. [Iain Colin Prentice, Australia]	Accetped - a full box devoted to the issue with more indepth explanation
6-1747	6	32	40	32	40	Change "… primarily to due relaxation …" to "… primarily due to relaxation …" [Vivek Arora, Canada]	Editorial (combined with comments 6-1748, 6-1749) - text revised.
6-1748	6	32	40	32	40	Change to "primarily due to relaxation". [Daniel Metcalfe, Sweden]	Editorial (combined with comments 6-1747, 6-1749) - text revised.
6-1749	6	32	40			“due to” not “to due” [Richard Bourbonniere, Canada]	Editorial (combined with comments 6-1747, 6-1748) - text revised.
6-1750	6	32	41	32	41	Citations in the text have always been presented in brackets elsewhere in this document. [Daniel Metcalfe, Sweden]	Editorial - copyedit to be completed prior to publication.
6-1751	6	32	42	32	42	In the last part of the sentence, " … a controversy has risen as the trend was a product of the NPP model used." what does the phrase "a product of the NPP model used." actually means. Please consider rewording this sentence. I suppose, more info is needed to say why are these model results controversial. [Vivek Arora, Canada]	Accepted - a full box devoted to the issue with more indepth explanation, and sentence rewritten
6-1752	6	32	42	32	42	Substitute "risen" with "arisen". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1753	6	32	42	32	43	"controversy has risen as the trend was a product of the NPP model used." Do the authors mean to say that the decline in NPP with drought was due to a hyper-sensitivity of NPP to drought in the model used? What is the resolution of this controversy and the discrepancy with Nemani et al? Xiao et al. 2011 estimated NEE over the coterminous US and found declining NEE with drought during the drought years using eddy covariance data, remote sensing and MTE. Perhaps this independent analysis can help resolve discrepancies pointed out in this paragraph (or another large-scale study that looked at NPP specifically). Zhao& Running 2010 isn't in the references (Zhao&Running 2011 response to comments is in the refs though) [Beverly Law, USA]	accepted - a box explain the issue in more detail.
6-1754	6	32	45	32	45	Yet another confusing switch to emissions and sinks [VINCENT GRAY, NEW ZEALAND]	Care has been taken in the text to clearly define sinks, sources, and overall budgets (or net balances).
6-1755	6	32	45	37	38	These compilations for CH4 and N2O, with the acccompanying figures and tables, are very valuable. (They set a standard that should be applied to the figure and text describing the carbon cycle.) They would be more useful if estimates of uncertainties could be added to the extent possible. [Eric Sundquist, United States of America]	Noted.
6-1756	6	32	47	32	50	It is said that AR5 is the first assessment report to do a complete CH4 global budget for various decades using an ensemble of inversion models, process-based models, and emission inventories. This is misleading as Table 6.7 appears to be mostly a re-reporting of various published estimates rather than providing any new estimates. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	It is the bottom up and top down multiple model ensemble that is new. Of course, all literature needs to be published to be part of the IPCC. We have added now the key new paper that reports on the new compilations (not submitted in the previous version)
6-1757	6	32	51	32	52	CH4 or methane? Whichever is chosen, it should be applied consistently through the document. [Daniel Metcalfe, Sweden]	All methanes have been replaced with CH4.
6-1758	6	32	52	32	53	In the sentence, "Estimations of CH4 sinks in tropospheric-OH, soils and stratosphere are also reported for the past decades.", replace the word "in" with "by". [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised.
6-1759	6	32	55			Section 6.3.3.1 Better title would be “Atmospheric burden and trend” [Christopher Butenhoff, USA]	Accepted new title
6-1760	6	32	55			move heading down to page 33 [Jeffrey Obbard, Singapore]	Editorial - copyedit to be completed prior to publication.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1761	6	32				Figure 6.27. It might be useful to put model names in the figure or in the figure caption. [Vivek Arora, Canada]	taken into account - models used will be listed
6-1762	6	32				Fig 27. The use of the ternary composition diagram for the three reservoirs is very clever. However the triangle should be made equilateral. And the problem of land use is manifested it would appear in the possible fraction exceeding unity. If Total emissions is preferred, suggest that that convention be adopted in constructing the figure. The figure as drawn violates the usual counterclockwise convention for ternary compsition diagrams; see e.g., http://csmres.jmu.edu/geollab/fichter/SedRx/readternary.html [Stephen E Schwartz, USA]	taken into account - figure redrawn
6-1763	6	32				Edit this page for grammatical errors [Christina Tonitto, USA]	Noted. A number of grammatical errrors pointed our in other review comments to be corrected for the Second Order Draft.
6-1764	6	33	1	33	1	Change to "factor of 2.5". [Daniel Metcalfe, Sweden]	Editorial - corrected in text.
6-1765	6	33	1	33	4	This should indicate that these are global average surface values. The numbers need to be check for consistency with chapters 2 and 8 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepted, corrected in text.
6-1766	6	33	3	33	3	planetaryboundaries'. Define the term [Andrew Glikson, Australia]	Accepted -added in the text
6-1767	6	33	4	33	4	Figure 6.11 should be 6.12 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepted - corrected in text
6-1768	6	33	4	33	6	This sentence is a bit confusing. I suggest it is changed to "emissions, this conclusion is supported by the the inter-hemisphere concentration gradient, with higher concentrations in the northern, more industrialized hemisphere. Currently,". [Daniel Metcalfe, Sweden]	Accepted - corrected in text
6-1769	6	33	5			change to 'concentrations', check grammar [Jeffrey Obbard, Singapore]	Accepted - corrected in text
6-1770	6	33	6	33	10	This is a very incomplete description of the current state of satellite observations of CH4. Although I understand that the purpose of the report is not to do a complete review, the description gives the impression that current capabilities are much more limited than they are in reality. There are presently 3 instruments that make observations of CH4 with middle to upper tropospheric sensitivity over both land and water: AIRS (launched in 2002), TES (launched in 2004) and IASI (launched in 2006, with copies to follow in 2012 and 2016). SCIAMACHY makes measurements of column-averaged CH4 over land (although sensitivity over ocean was sufficient up to 2005). GOSAT is a satellite mission that launched in 2009, not an “instrument” as stated. The GOSAT TANSO-FTS is the instrument that measures column-averaged CH4. Although the availability of AIRS, TES, IASI and SCIAMACHY data was just beginning around the time of AR4, their retrievals have continually improved to the point that the data are now very useful and complementary to the ground-based point measurements. The GOSAT TANSO-FTS observations are newest and potentially the most valuable of all of these measurements, and over time are expected to be useful for estimation of the spatial distribution of CH4 sources and sinks by inverse modeling. Furthermore, satellite profiles of CH4 in the upper troposphere and stratosphere are made by ACE-FTS and MIPAS. Publications to reference these CH4 measurements are almost too numerous to list, but I have selected 1-2 for each instrument below. AIRS Xiong, X., C. Barnet, E. Maddy, C. Sweeney, X. Liu, L. Zhou, and M. Goldberg (2008), Characterization and validation of methane products from the Atmospheric Infrared Sounder (AIRS), J. Geophys. Res., 113, G00A01, doi:10.1029/2007JG000500. TES Payne, V. H., S. A. Clough, M. W. Shephard, R. Nassar, and J. A. Logan (2009), Information-centered representation of retrievals with limited degrees of freedom for signal: Application to methane from the Tropospheric Emission Spectrometer, J. Geophys. Res., 114, D10307, doi:10.1029/2008JD010155. Wecht, K. J., D. J. Jacob, S. C. Wofsy, E. A. Kort, J. R. Worden, S. S. Kulawik, D. K. Henze, M. Kopacz, and V. H. Payne (2011), Validation of TES methane with HIPPO aircraft observations: implications for inverse modeling of methane sources, Atmos. Chem. Phys. Discuss., 11, 27887-27911.	Accepted - corrected in text

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						IASI Razavi, A., C. Clerbaux, C. Wespes, L. Clarisse, D. Hurtmans, S. Payan, C. Camy-Peyret and P. F. Coheur (2009), Characterization of methane retrievals from the IASI space-borne sounder, Atmos. Chem. Phys., 9, 7889–7899. SCIAMACHY Schneising, O., M. Buchwitz, M. Reuter, J. Heymann, H. Bovensmann, and J. P. Burrows (2011), Long-term analysis of carbon dioxide and methane column-averaged mole fractions retrieved from SCIAMACHY, Atmos. Chem. Phys., 11, 2863–2880, doi:10.5194/acp-11-2863-2011. GOSAT TANSO-FTS Yoshida, Y., Y. Ota, N. Eguchi, N. Kikuchi, K. Nobuta, H. Tran, I. Morino, and T. Yokota (2011), Retrieval algorithm for CO2 and CH4 column abundances from short-wavelength infrared spectral observations by the Greenhouse gases observing satellite, Atmos. Meas. Tech., 4, 717–734, doi:10.5194/amt-4-717-2011 Butz, A., et al. (2011), Toward accurate CO2 and CH4 observations from GOSAT, Geophys. Res. Lett., 38, L14812, doi:10.1029/2011GL047888. ACE-FTS De Mazière, M., C. Vigouroux, P. F. Bernath, P. Baron, T. Blumenstock, C. Boone, C. Brogniez, V. Catoire, M. Coffey, P. Duchatelet, D. Griffith, J. Hannigan, Y. Kasai, I. Kramer, N. Jones, E. Mahieu, G. L. Manney, C. Piccolo, C. Randall, C. Robert, C. Senten, K. Strong, J. Taylor, C. Tétard, K. A. Walker, and S. Wood (2008), Validation of ACE-FTS v2.2 methane profiles from the upper troposphere to the lower mesosphere, Atmos. Chem. Phys., 8, 2421-2435. R. Nassar, P.F. Bernath, C.D. Boone, G.L. Manney, S.D. McLeod, C.P. Rinsland, R. Skelton, K.A. Walker (2005), Stratospheric abundances of water and methane based on ACE-FTS measurements, Geophysical Research Letters, 32, L15S04, doi:10.1029/2005GL022383. MIPAS S. Payan, et al. (2009), Validation of version-4.61 methane and nitrous oxide observed by MIPAS, Atmos. Chem. Phys., 9, 413-442, doi:10.5194/acp-9-413-2009. [Ray Nassar, Canada]	
6-1771	6	33	7	33	7	Abbreviation: FTIR [Leticia Cotrim da Cunha, Germany]	Accepteed - added in tesxt
6-1772	6	33	8	33	8	Reference required for IASI and GOSAT details [Peter Burt, UK]	We have opted for not referencing any of the instruments to keep total number of refernece in check, unless a result a scientific result presented, such as the one for sciamachy
6-1773	6	33	8	33	8	Change to "2003, and IASI". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1774	6	33	8	33	11	A figure showing the intehemispheric gradient would be useful. Does the SCIAMACHY interhemispheric gradient agree with the surface flask samples? [William Collins, United Kingdom of Great Britain & Northern Ireland]	We have opted for not having an additional figure showing the interhemispheric gradient given there are already several atmospheric methane figures in the chapter (section before 6.3)
6-1775	6	33	8	33	11	Wetlands should be included in the list of sources from SE Asia. [Eric Davidson, USA]	accepted - text revised.
6-1776	6	33	11	33	11	Figure 6.1 should be 6.2 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepteed - text revised
6-1777	6	33	11			Should this be Figure 6.2? [Roger Gifford, Australia]	Accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1778	6	33	13	33	20	Reduced growth rate of CH4 has also been attributed to approach to steady state. Two papers mention this possibility. Khalil et al. (2007) and Dlugokencky et al. (20xx). [Christopher Butenhoff, USA]	Accepted - text revised
6-1779	6	33	13	33	26	Chen and Prinn, JGR, 2006 concluded that decreases in fossil-fuel related sources were a significant contributor to the decline in the CH4 growth rate before 2001 using inversions of both AGAGE and NOAA data. Also NOAA and AGAGE data show different growth rates in the earlier years. AGAGE data should be briefly discussed here and included in Fig. 6.17. [Ronald Prinn, USA]	Accepted - text revised
6-1780	6	33	14	33	14	insert ",which are" before "associated" [James Butler, United States of America]	Accepted - text revised.
6-1781	6	33	14			Please, add after the words "The reasons for this decline are still debated but different lines of evidence include:reduced emissions from" the words "the shrinking volume of the activities like coal mining, gas industry and animal husbandry in the countries of the former Soviet Union (Dlugokencky et al., 2003; Savolainen et al., 2009)".... Reference: Savolainen, I., Monni, S., Syri, S., The mitigation of methane emissions from the industrial-ised countries can explain the atmospheric concentration level-off. International Journal of Energy for a Clean Environment, 10(1–4), 193–201 (2009). [Ilkka Savolainen, Finland]	Accepted - text revised
6-1782	6	33	15	33	15	Aren't these potential causes, rather than "lines of evidence". I suggest change to "debated but possible causes include:" [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1783	6	33	16	33	16	Soviet Union instead of Soviet union. [Leticia Cotrim da Cunha, Germany]	Editorial - text revised.
6-1784	6	33	16			reduction in global related fossil fuel emissions seems hard to accept given increases in global consumption [Jeffrey Obbard, Singapore]	Agreed but the emphasis here is in the possibility that we have been overestimating the reporting of fossil fuel emissiosn in which case it could have contributed to a slower growth, along with other possible causes. The list of possibilities are not exclusives but likely to be a set of processes.
6-1785	6	33	19	33	19	Substitute "or" with "and/or". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1786	6	33	19		20	If CH4 emissions from rice paddies were reduced, what were factors leading to the reduction? In factor, CH4 emissions from rice paddies was overestimated in 1980-1990s. Estimated emissions reduced with the accumulation of field measurement and imporved understanding of CH4 emissions from rice paddies, particularly in the case of China (see Cai, 2012, Greenhouse gas budget for terrestrial ecosystems in China. SCIENCE CHINA-Earth Sciences, 55(2): 173–182). It shall be made clearly. [Zucong Cai, China]	Accepted - text revised
6-1787	6	33	20			I think there may be more recent papers on the effect of OH on CH4 that could also be used here. [Jan Fuglestvedt, NORWAY]	Montzka et al was added as a reference for only small changes in OH concentrations
6-1788	6	33	22	33	22	Table - see comments further [Leticia Cotrim da Cunha, Germany]	Checked comments further
6-1789	6	33	28	33	28	Change to "2007, the", and "CH4 has increased again". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1793) - text revised.
6-1790	6	33	28	33	29	not clear what the 21 and 18 Tg mean, also are these numbers Tg yr-1 or per 2 years? [Stefan Gerber, USA]	Accepted - text revised
6-1791	6	33	28	33	36	Need to begin this paragraph with Rigby et al, GRL, v35,L22805, 2008 who were the first to report and infer explanations for the post-2006 increase in the CH4 growth rate. [Ronald Prinn, USA]	Accepted - text revised
6-1792	6	33	28	35	40	Please refer to general comment 1 about the units used for CH4. [Leticia Cotrim da Cunha, Germany]	the chapter made the agreement to use C-CO2 for carbon dioxide and CH4 for methane; conssitent with the historical used of these species and units.
6-1793	6	33	28			change 'is' to 'has begun' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-1789) - text revised.
6-1794	6	33	30	33	30	Change to "found to be dominated", and "2011) with some" [Daniel Metcalfe, Sweden]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1795	6	33	34	33	36	More explanation would be useful here regarding the observed global trends in CH4 and 13C-CH4. [Eric Davidson, USA]	The chapter is already beyond the length acceptable and instructions are to reduced length by additional 2 pages.
6-1796	6	33	38			Figure 6.17: "a smooth line to guide the eye"? I think it needs to be stated what this line actually is. Running mean? Cubic spline? [James Christian, Canada]	Accepted - text corrected
6-1797	6	33	43	33	57	I suggest rewriting these two sentences along the lines of: "Each of these three processes is characterized by distinct ranges in the magnitude of isotopic fractionation against 13C-CH4: –55 to -70‰ for biogenic, –25 to -45% for thermogenic, and –13 to –25‰ for pyrogenic. These distinctions provide a basis to determine the relative contribution of different methane sources to a particular sample (references as cited)". The comment "if process disriminations are reasonably known" is not necessary as it seems from the prior sentence that the are known. [Nathaniel Ostrom, United States of America]	Accepted - text replaced
6-1798	6	33	44			Section 6.3.3.2: To keep symmetry with title of Section 6.3.3.3, simply call section “Sources”, esp since 6.3.3 deals with the components of the budget which typically are labeled burden, sources, and sinks. This labeling also connects better to labeling in Table 6.7. [Christopher Butenhoff, USA]	Accepted - text revised
6-1799	6	33	44			Section 6.3.3.2: The range of emission estimates for most CH4 sources quoted in this section are considerably smaller than the range of emission estimates given for the sources in AR4. These leaves the impression that our understanding of these sources has greatly improved since AR4. I am suspicious that our understanding has reduced the uncertainty this much. Instead these smaller estimate ranges seem to come from the use of the ensemble method to produce the global CH4 budget for this report. How should the reader interpret the quoted ranges? Do the authors feel that we have reduced the uncertainties by this much? Have estimates converged since AR4? Further explication of the ensemble method seems warranted. [Christopher Butenhoff, USA]	One major difference with AR4 is that we group the estimates per decade which means that, for sources with large interannual vatiability and trend estimates for the 1980s are not grouped with estimates for the 2000s or the 1990s unless they are climatolog
6-1800	6	33	46	33	46	I'm not sure what "are composed by" means here. Budgets are composed of more than sources, so I'm also not sure what "budgets" mean in this context either. [James Butler, United States of America]	Accepted - text revised
6-1801	6	33	46	33	46	Change to "composed of various". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-1802	6	33	46	33	47	"Regional CH4 budgets are composed by various methane sources around the globe, which are biogenic, thermogenic, or pyrogenic in origin (Neef et al., 2010), and they can be the direct result of either human activities or natural processes". As biogenic and pyrogenic processes are affected by anthropogenic factors, the term should be "human activities and/or natural processes" rather than "human activities or natural processes". [Andrew Glikson, Australia]	Accepted - text revised
6-1803	6	33	46	33	48	Again, the use of the terms "regional" and "global" together seems misleading. Also, it is not clear what the authors are trying to say here. In particular, budgets should refer to more than just emission sources. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-1804	6	33	46	34	11	Chen and Prinn, JGR, 2006 also deduced spatial distributions. [Ronald Prinn, USA]	Text rewritten and no longer referred to spatial distributions.
6-1805	6	33	46			: It is confusing to lead this section with “Regional budgets …” since this section simply describes CH4 sources and not specifically regional budgets of CH4. [Christopher Butenhoff, USA]	Accepted - text revised
6-1806	6	33	53	33	53	delete comma after 'volcanoes' [Peter Burt, UK]	Editorial - text revised.
6-1807	6	33	54	33	55	The use of hyphens is confusing, they look like minus signs! [Peter Burt, UK]	Accepted - text revised
6-1808	6	33	55	33	56	Change to "Measurements of 13CH4 can help to partition the different". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1809) - text revised.
6-1809	6	33	56			add 'in' before 'partitioning' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-1808) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1810	6	33				Figure 6.28. In figure caption line 7, change 2005-2100 to 2006-2100, and in line 12 change remission to emission. [Vivek Arora, Canada]	accepted - text revised
6-1811	6	33				The trends of methane over 30 years are discussed in: “Atmospheric methane: Trends and cycles of sources and sinks.” M.A.K. Khalil, C.L. Butenhoff, and R.A. Rasmussen. Environmental Science & Technology 41, 2131-2137, 2007. [Mohammad Aslam Khan Khalil, USA]	Reference was added in §6.3.3.1
6-1812	6	33				The reduced emissions from rice were published by us in: [Mohammad Aslam Khan Khalil, USA]	Noted - see the next comment (6-1813).
6-1813	6	33				“Decreasing emissions of methane from rice agriculture.” M.A.K. Khalil and M.J. Shearer. In: Greenhouse Gases and Animal Agriculture: An Update (C.R. Soliva, J. Takahashi, M. Kreuzer, eds.) International Congress Series 1293, Elsevier, The Netherlands, p. 33-41, 2006. [Mohammad Aslam Khan Khalil, USA]	Accepted - added in text
6-1814	6	34	1	34	1	The sentence "During the decade of the 2000s, natural sources of methane represent 244–368 TgCH4 yr–1 1 (Table 6.7)." is incomplete. I suggest the following "During 2000-2009, natural sources of methane account for 244-368 TgCH4/year of the total annual global emissions." [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-1815	6	34	1	34	1	Replace "represent" with "contributed". [Nathaniel Ostrom, United States of America]	Editorial - text revised.
6-1816	6	34	1	34	11	This is correct but it should be noted that process models and bottom-up approaches frequently underestimate source strength measured at the larger top-down scale. It is particularly the case for forested wetlands (~60% of all wetlands) where processes models based on measurements made using cuvettes at the wetland surface - traditionally consider only herbaceous transport, ebbulition and diffusion as emission pathways. The evidence is growing, however, that tree stems themselves are a major emission pathway. (see Gauci et al 2010; Rice et al 2010). There should be further information coming out within the next 6 months or so that shows that in SE Asian tropical peatlands, for example, tree stems can be the dominant contributor to ecosystem CH4 flux:. Gauci, V., Gowing, D.J., Hornibrook, E.R., Davis, J.M., Dise, N.B. (2010) Woody stem methane emission in mature wetland alder trees, Atmospheric Environment, doi: 10.1016/j.atmosenv.2010.02.034 (shows that mature trees can emit methane) ;Rice, A. L., C. L. Butenhoff, M. J. Shearer, D. Teama, T. N. Rosenstiel, and M. A. K. Khalil (2010), Emissions of anaerobically produced methane by trees, Geophys. Res. Lett., 37, L03807, doi:10.1029/2009GL041565. (they extrapolate pot sapling studies to the globe - although the scaling metric - LAI is not appropriate - see new work to come out soon by Pangala et al). [Vincent Gauci, United Kingdom]	Accepted - text revised
6-1817	6	34	1			I know it is standard practice to quote ranges like this, but if the range is over 120 Tg CH4, it doesn’t’ make sense to specify emissions with three sig figs. [Christopher Butenhoff, USA]	It was chosen to quote uncertainties as min-max because when few studies are available, sigma approach can be critisized as the normal law is not properly sampled. We clarified this in the introduction of §6.3.3
6-1818	6	34	1			add 'emissions' after 'methane' [Jeffrey Obbard, Singapore]	Accepted - text revised.
6-1819	6	34	4	34	6	Though CH4 emissions from wetlands are sensitive to temperature and precipitation, this relationship can only be indirectly inferred from the correlation between recent CH4 increases and anomalies. Direct plot-scale and ecoystem-scale experiments and Q10 studies provide more conclusive evidence. See e.g. Valentine, D.W., E.A. Holland, and D.S. Schimel. 1994. Ecosystem and physiological controls over methane production in a northern wetland. J. Geophys. Res. , 99:1563-1571 Whalen, S.C. 2005. Biogeochemistry of methane exchange between natural wetlands and the atmosphere, Environ. Eng. Sci. 22: 73-94. Christensen, T.R. et al. 2003. Factors controlling large scale variations in methane emissions from wetlands. Geophys. Res. Lett., 30: 1414, 10.1029/2002GL0116848.	At global scale, Spahni et al 2011 showed that simple regression based on temperature and precipitation can nicely represent interannual variability of global methane emissions from wetlands. Process-based studies are very important of course to refine t

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						[Christopher Butenhoff, USA]	
6-1820	6	34	8	34	11	References required! [Peter Burt, UK]	Accepted - text revised
6-1821	6	34	8	34	11	Models show significant discrepancies relative to what? I assume the authors mean there are discrepancies between models since real emissions are unknown. Authors should provide some discussion on how big these discrepancies are and the largest sources of uncertainties in the models. [Christopher Butenhoff, USA]	Accepted - revised text but no additional text provided due to restriction in increasing length; chapter needs to be shorten.
6-1822	6	34	8	34	11	Ito and Inatomi (in press) estimated net CH4 budget of the terrestrial biosphere as 308.3 ± 20.7 Tg CH4 yr–1 using a process-based terrestrial biogeochemical model including multiple CH4 uptake and release schemes. Ito, A., and M. Inatomi, in press: Use and uncertainty evaluation of a process-based model for assessing the methane budget of global terrestrial ecosystems. Biogeosciences. [Akihiko Ito, Japan]	If a paper is available it can be included in the text and table (if possible, depending on thez refinement and the time period covered) but should be transmitted asap to the lead authors.
6-1823	6	34	10	34	10	Change to "the difficulties of representing and quantifying the variety". [Daniel Metcalfe, Sweden]	Editorial suggestion - accepted.
6-1824	6	34	11	34	11	Is there a reference available for WETCHIMP? [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	To date, there is no peer-reviewed reference available for WETCHIMP but an abstract at EGU. A reference should appear before July 31st or the citation will be removed.
6-1825	6	34	14	34	16	Units should be consistently in TgCH4/year. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-1826	6	34	14	34	16	"Emissions from terrestrial (13–29 TgCH4) and marine (1–10 TgCH4) seepages, mud volcanoes (6–9 TgCH4), hydrates (5–10 TgCH4 yr–1), and geothermal and volcanic areas (3–6 TgCH4) may represent between 42 and 64 TgCH4 yr–1." The range of 42-64 TgCH4/year and the sum from the individual sources mentioned here (terrestrial and marine seepages, mud volcanoes, hydrates and geothermal and volcanic areas) are not consistent. Etiope et al. (2008) came up with the range of 42-64 TgCH4/year but did not include hydrates. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised.
6-1827	6	34	15	34	15	delete comma after second) [Peter Burt, UK]	Editorial - corrected in text.
6-1828	6	34	16			The estimate of 42 to 64 Tg CH4 should be compared to estimates made from AR4 since authors are saying that natural geological sources are contributing a larger fraction of the budget than previously thought. How much larger since AR4? [Christopher Butenhoff, USA]	It is stated that fossil contributions to the global CH4 budget are estimated to be around 30% instead of the previously thought 20%. The text has been modified to add a comparison with AR4 estimates.
6-1829	6	34	17	34	17	delete comma after 'fossil' [Peter Burt, UK]	Editorial - corrected in text.
6-1830	6	34	17	34	17	Change to "13CH4 re-analysis showing natural and". [Daniel Metcalfe, Sweden]	Rewording suggestion - accepted.
6-1831	6	34	17	34	19	If the sources of CH4 are neither natural nor anthropogenic, what are they then? [Göran Ågren, Sweden]	the text refer to the relative importance of the sources from natural and anthorpogenic activities. It is not invoking a new type of source actvity outside of the ones established.
6-1832	6	34	17	34	19	"This large contribution from natural, geological, and partly fossil, CH4 is consistent with a recent 13CH4 analysis re-evaluating that natural and anthropogenic fossil contributions to the global methane budget to be around 30% (Lassey et al., 2007) and not around 20% as previously thought." It will help to explain how can natural CH4 release be distinguished from anthropogenic factors in the case of biogenic and pyrogenic processes affected by global warming. [Andrew Glikson, Australia]	Unfortuantely, the text cannot be expanded beyond its current length given the chapter needs to be shorten by two pages, not expanded.
6-1833	6	34	21	34	23	This sentence needs a bit of re-writing. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-1834	6	34	21	34	30	I think the change in CH4 emission at high latitude of north hemisphere (e.g. Siberia to Arctic) and its interaction with climate change is very interesting and was suggested to add some discussion on this issue here, [Xuemei Wang, China]	Unfortuantely, the text cannot be expanded beyond its current length given the chapter needs to be shorten by two pages, not expanded. Additional text is provided in section 6.4

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1835	6	34	23			For a reference to permafrost C pools also cite: Zimov, S.A., Schuur, E.A., Chapin III, F.S., 2006. Permafrost and the global carbon budget, Science, 312, 1612. [Christopher Butenhoff, USA]	Accepted - included in the text
6-1836	6	34	24	34	25	Change to "demonstrate some CH4 activity across the region.". [Daniel Metcalfe, Sweden]	Editorial - corrected in text.
6-1837	6	34	25	34	25	sense of: 'net flux sea-air flux [Peter Burt, UK]	Accepted - revised text.
6-1838	6	34	25	34	25	Please provide clarity whether this flux is in terms of carbon or methane and whether it's an accumulated flux (net flux sea-air flux of 7.9 TgC-CH4). [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accetped - revised text
6-1839	6	34	25			net sea-air flux --- delete the extra “flux” [Richard Bourbonniere, Canada]	Accetped - revised text
6-1840	6	34	26	34	27	Change to "from decomposing, thawed lake", "with an estimated", and "region and its". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1841) - text revised.
6-1841	6	34	26			“thawed” not “thaw” [Richard Bourbonniere, Canada]	Editorial (combined with comment 6-1840) - text revised.
6-1842	6	34	26			add 'of methane' after 'ebullition' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1843	6	34	28	34	28	give dates for the 'last decades' [Peter Burt, UK]	Accepted - text revised
6-1844	6	34	28	34	29	Change to "however, no evidence of significant". [Daniel Metcalfe, Sweden]	Rewording suggestion (combined with comments 6-1849 to 6-1851) - copyedit to be completed prior to publication.
6-1845	6	34	28	34	30	Strange sentence. [Göran Ågren, Sweden]	Accepted -text revised
6-1846	6	34	28	34	30	This statement is misleading. There is evidence of enhanced CH4 emissions from thawing permafrost. See Schuur et al. 2011. Nature 480:32–33. [Eric Davidson, USA]	Schuur et al. show show the potential for future emissions from permafrost thaw based on survey of some of the leading permafrost carbon scientists. In IPCC we are discourage of using surveis as opposed to real observations or best practice modeling.
6-1847	6	34	28	34		"Over the past decades, however, there exist no evidence for significant emission of CH4 from permafrost and hydrates has been detected (Dlugokencky et al., 2009).". This is a surprising statement, in view of recent papers, for example (1) "Extensive Methane Venting to the Atmosphere from Sediments of the East Siberian Arctic Shelf" (Shakhova et al., 2010, Science 5 March 2010: Vol. 327 no. 5970 pp. 1246-1250) (2) "Large-Scale Controls of Methanogenesis Inferred from Methane and Gravity Spaceborne Data" (Bloom et al., 2010. Science 15 January 2010: Vol. 327 no. 5963 pp. 322-325) where it is stated "We estimate a 7% rise in wetland CH4 emissions over 2003–2007, due to warming of mid-latitude and Arctic wetland regions, which we find is consistent with recent changes in atmospheric CH4." [Andrew Glikson, Australia]	Dlugokencky et al provided an estimate of emissions from coastal sips of methane without any evidence that those emissions have been arising. In fact they talk about the possibility to be part of the dynamics of the last glacial period. Bloom shows increase in wetland emissions which is not necessarily a proof of increase emissions from the thawing of permafrost. It is well established that higher temperatures lead to higher methane emissions because higher microbial activity.
6-1848	6	34	28		30	Isn't it more accurate to say 'no increase' in emissions from permafrost and hydrates because there is still methane tricking out of northern systems -- but it hasn't apparently been increasing anytime recently [Edward Schuur, USA]	Accepted -text revised
6-1849	6	34	28			delete 'there exist' [Jeffrey Obbard, Singapore]	Rewording suggestion (combined with comments: 6-1844, 6-1850, 6-1851) - copyedit to be completed prior to publication.
6-1850	6	34	29	34	29	Delete "has been detected"; not needed. [Nathaniel Ostrom, United States of America]	Rewording suggestion (combined with comments: 6-1844, 6-1849 to 6-1851) - copyedit to be completed prior to publication.
6-1851	6	34	29			Change “for” to “that” OR keep “for” and delete “has been detected” [Richard Bourbonniere, Canada]	Rewording suggestion (combined with comments: 6-

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							1844, 6-1849, 6-1850) - copyedit to be completed prior to publication.
6-1852	6	34	32	34	32	"has" should be "have a" [James Butler, United States of America]	Editorial (combined with commens: 6-1854 to 6-1856) - text revised.
6-1853	6	34	32	34	32	"plays" should be "play" [James Butler, United States of America]	Editorial (same comment 6-1855) - text revised.
6-1854	6	34	32	34	32	"… of CH4 have a small…" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comments: 6-1852, 6-1855, 6-1856) - text revised.
6-1855	6	34	32	34	32	Change to "sources of CH4 make small contributions to the global", and "but play a role". [Daniel Metcalfe, Sweden]	Editorial (same comment 6-1853) - text revised.
6-1856	6	34	32			change 'has' to 'have a' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1852, 6-1854, 6-1855) - text revised.
6-1857	6	34	36	34	36	→ with occurrence of other fire emissions [Peter Burt, UK]	Editorial (combined with comments: 6-1858, 6-1859) - text revised.
6-1858	6	34	36	34	36	Change to "emissions observed". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1857, 6-1859) - text revised.
6-1859	6	34	36			change to 'emission occurences' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1857, 6-1858) - text revised.
6-1860	6	34	37	34	37	what does 'high fires' mean? [Peter Burt, UK]	Accepted - text revised
6-1861	6	34	41	34	41	delete 'and' [Peter Burt, UK]	Editorial (combined with comments: 6-1862, 6-1863, 6-1867) - text revised. Copyedit to be completed prior to publication.
6-1862	6	34	41	34	41	Delete "emissions"; not needed. Replace "and so adding" with "and suggested". [Nathaniel Ostrom, United States of America]	Editorial (combined with comments: 6-1861, 6-1863, 6-1867) - text revised.
6-1863	6	34	41	34	42	Change to "emissions, and thus potentially constitute a large additional emission". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1861, 6-1862, 6-1867) - text revised.
6-1864	6	34	41	34	48	The following study demonstrates that these aerobic emissions are negligible (1Tg): Bloom A.A., Lee-Taylor J., Madronich S., Messenger D.J., Palmer P.I., Reay D.S. & McLeod A.R. (2010) Global methane emission estimates from ultraviolet irradiation of terrestrial plant foliage. New Phytologist, 187, 417-425. I think AR5 should provide the last word on the whole aerobic emission of methane, an intriguing process but not significant from the point of view of climate or climate change. Certainly AR6 should avoid its mention. [Vincent Gauci, United Kingdom]	Accepted - text revised
6-1865	6	34	41	34	49	Another possible CH4 emission from plants are reported which the methane in the groundwater emitted through the stem of trees having aerenchyma tissue like ash and alder (Terazawa et al., 2007, Soil Biology & Biochemistry, Gauci et al., 2010 Atmospheric Environment). The amount of this emission could be quite large corresponding to 10 % of all sources (Rice et al., 2010 Geophysical Research Letters, Mascarelli, 2010, Nature 463, 7283). The estimation is rough one, but it is better to address the possibility of this kind of emissions from natural ecosystem. [Shigehiro Ishizuka, Japan]	Accepted - added in text
6-1866	6	34	41	34	49	Martinson et al. (2010) reported an additional CH4 emission from tank bromeliads, approximately, at a rate of 1.2 Tg CH4 yr–1. Martinson, G. O., and Coauthors, 2010: Methane emission from tank bromeliads in neotropical forests. Nature Geoscience, 3, 766–769. [Akihiko Ito, Japan]	These are not plants themselves emitting CH4, rather the CH4 is produced in the tanks these plants form, and then partly emitted through the leaves. Anyway it represents a very small flux.
6-1867	6	34	41			delete' emissions' change to 'and represent a large source' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1861 to 6-1863) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1868	6	34	45			“an order of magnitude lower than” . . . WHAT? [Richard Bourbonniere, Canada]	Accetped - revised text
6-1869	6	34	46	34	48	It seems there are bits of text missing here. [Leticia Cotrim da Cunha, Germany]	Accepted - revised text
6-1870	6	34	46	34	48	This sentence needs rewriting… it is not a complete sentence. [Nathaniel Ostrom, United States of America]	Accepted - revised text
6-1871	6	34	46			correct grammar [Jeffrey Obbard, Singapore]	Accepted - revised text
6-1872	6	34	49			delete 'the' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1873	6	34	51	34	51	"ranged", "included" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with comment 6-1874) - text revised.
6-1874	6	34	51			correct grammar of sentence [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-1873) - text revised.
6-1875	6	34	53	34	53	delete comma after) [Peter Burt, UK]	Editorial (combined with 6-1876, 6-1878, 6-1879) - text revised.
6-1876	6	34	53	34	53	Please start a new sentence at: "They are now…" [Leticia Cotrim da Cunha, Germany]	Editorial (combined with 6-1875, 6-1878, 6-1879) - text revised.
6-1877	6	34	53	34	54	Why do Anthropogenic sources dominate in the top-down, but not in the bottom-up? Which does the IPCC assess as being most likely? [William Collins, United Kingdom of Great Britain & Northern Ireland]	As mentioned in the introduction of §6.3.3, bottom-up approaches are more reliable for individual processes whereas top-down inversions are more reliable for total emissions (being constrained by atmospheric observations). Representing each process ind
6-1878	6	34	53	34	54	This sentence should be split up: "industry). Antropogenic sources are now", also change to "inversions but approximately equal for bottom-up". [Daniel Metcalfe, Sweden]	Editorial (combined with 6-1875, 6-1876, 6-1879) - text revised.
6-1879	6	34	54	34	54	but of the same magnitude for bottom-up models and inventories i.e. include the word "magnitude" [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Editorial (combined with 6-1875, 6-1876, 6-1878, 6-1880). Rewording suggestion - accepted.
6-1880	6	34	54	34	54	I'm not certain but I believe "magnitude" should be inserted between "of the same" and "for bottom-up models". [Nathaniel Ostrom, United States of America]	Editorial (combined with 6-1875, 6-1876, 6-1878, 6-1879). Rewording suggestion - accepted.
6-1881	6	34	55	34	56	While it is good to compare the continuously flooded paddies to these lower flux rice ecosystems, a more important comparison is to irrigated paddies that are drained mid-season. Perhaps change to “continuously flooded paddies having much higher emissions per square meter than drought-prone, rain-fed, or irrigated paddies that are intermittently drained.” [Christopher Butenhoff, USA]	Accepted - text revised
6-1882	6	34	55			Here is a good example of the point I made above (comment for Section 6.3.3.2). Only 2 of the 7 estimates of rice emissions from AR4 are within the quoted range here of 28-44 Tg CH4, some from AR4 are much higher. This gives the impression that the uncertainty of our estimates of this source has dramatically decreased. I doubt the uncertainties are really this low. Authors should discuss briefly this change from AR4. [Christopher Butenhoff, USA]	The range quoted for rice emissions is narrower than in the AR4 mostly because it stands for the decadal mean of the 2000s whereas AR4 studies were only repreesenting specific years from 1980 to 2005. Also, even estimates from the 1980s are smaller for re
6-1883	6	34	56	34	56	meter → metre [Peter Burt, UK]	Editorial - text revised.
6-1884	6	34	56	34	56	Please avoid starting a sentence with "90%". [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-1885	6	34				Figure 6.29. In figure caption please change CanESM to CanESM2 [Vivek Arora, Canada]	accepted - text revised
6-1886	6	34				Analysis of plant emissions missing reference: “Global methane emissions from terrestrial plants.” C.L. Butenhoff and M.A.K. Khalil. Environmental Science & Technology 41, 4032-4037, 2007. [Mohammad Aslam Khan Khalil, USA]	The section already cites more than six papers and in the interest of space we need to put a limit to the number of citations to support one single finding.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1887	6	34				Fig 29. Given the uncertainties in the carbon feedback, it would be valuable for the assessment to comment on the confidence that can be placed in any of these models and the utility of the comparisons. [Stephen E Schwartz, USA]	Taken into account - confidence statements added to the text
6-1888	6	34				fig 29. The attendant discussion does not appear to touch on the consequences of changes in emissions of aerosols and precursors that would likely accompany changes in CO2 emissions to achieve a given RCP. Resultant changes in aerosol forcing would likely exert a strong influence on temperature, the stabilization of which (and not CO2) would seem to be the ultimate objective. Suggest discuss. [Stephen E Schwartz, USA]	Rejected - out of remit of chapter to discuss the objective of the scenarios.
6-1889	6	34				In the top panel, there are at least three blue lines and red lines, what are they? [Zongbo Shi, United Kingdom]	taken into account - caption revsied to clarify the lines
6-1890	6	34				Bottom panel; there are two lines in this figure with same color? Add a lengend [Zongbo Shi, United Kingdom]	taken into account - caption revsied to clarify the lines
6-1891	6	35	1	35	1	delete comma after 'goats' [Peter Burt, UK]	Editorial - text revised.
6-1892	6	35	1	35	2	Replace "a total estimated between 73 and 94 TgCH4 yr–1" with "a total estimate of between 73 and 94 TgCH4 yr–1" [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Editorial - text revised.
6-1893	6	35	1	35	10	Point to the appropriate section of the Agriculture chapter in WG III [Robert Scholes, South Africa]	WGIII chapters not available as yet
6-1894	6	35	2	35	2	Rewrite as "Major regional contributions of this flux come from…" [Nathaniel Ostrom, United States of America]	Editorial - text revised.
6-1895	6	35	3	35	5	Substitute "Millions" with "Million", and "imcluding" for "comprising", "wasted" for "waste". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-1897) - text revised.
6-1896	6	35	4	35	4	Lack of consistency in units i.e. 11 Tg and 1 Tg [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-1897	6	35	5	35	5	wasted → waste [Peter Burt, UK]	Editorial (combined with comment 6-1895) - text revised.
6-1898	6	35	5	35	5	Correct units in "14 and 25 TgCH4 y-1" to be TgCH4 yr-1 [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Editorial - text revised.
6-1899	6	35	7	35	9	Fugitive emissions could be even higher than current estimates, as found in direct measurements of CH4 in urban areas. [Beverly Law, USA]	We agree with the point but to make this statement we need an peer review reference which we have not been able to find.
6-1900	6	35	8	35	8	What is meant by "Fugitive emissions"? [Daniel Metcalfe, Sweden]	Accepted - defined in text
6-1901	6	35	9			Why is the USA high? [Jeffrey Obbard, Singapore]	Because industrial processes; no space to extend paragraph as we need to shorten the chapter, not extended.
6-1902	6	35	10	35	10	Reference required for quantities given [Peter Burt, UK]	Accepted - reference provided
6-1903	6	35	10			change 'due to' to 'associated with' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1904	6	35	12	35	16	No supporting references! [Peter Burt, UK]	Accepted - text revised
6-1905	6	35	12	35	16	The statemnet shows a bias towards top-down inversions without giving an explanation why their results are less uncertain than those from bottom-up appraoches. The discrepancy should be reconciled by explaining why the different approaches deliver different results. [Nikolaus Josef Kuhn, Switzerland]	Top-down atmospheric inversion are constrained by the atmospheric signal (obs), and thus close the budget in a way that bottom-up approaches can't as they are not constrained by the atmosphere.
6-1906	6	35	14	35	14	Substitute "narrowed" with "narrow", and "closing" for "to close". Change to "as detailed a budget per". [Daniel Metcalfe, Sweden]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1907	6	35	15			“close” not “closing” . . .”provide” not “provided” . . . add “a” before “budget” [Richard Bourbonniere, Canada]	Accepted -text revised
6-1908	6	35	18	35	40	Section 6.3.3.3. could also mention the loss in the stratosphere by reactions with Cl and O(1D). [Jan Fuglestvedt, NORWAY]	Accepted - text revised
6-1909	6	35	18	35	40	Section 6.3.3.3. could also mention that the development of the OH sink is affected by NOx, CO, UV and H2O, as well as the development of CH4 emissions (the OH feedback). [Jan Fuglestvedt, NORWAY]	There is no space to extend paragraph so no additional text can be provided.
6-1910	6	35	18	35	40	There is no description about the second largest sink of soils. The following is the example for the description: The CH4 uptake by soils were estimated 30 TgCH4 y-1 in the previous report (IPCC AR4, Table 7.6), and the following reports almost agree with the previous estimation (ex. Dutar and Verchot, 2007, Global Biogeochemical Cycles, Curry, 2009, Biogeoscience, Ito and Inatomi, 2011, Biogeosciences Discuss, Spahni et al., 2011, Biogeosicence). [Shigehiro Ishizuka, Japan]	The soil sink is reported in the paragraph. A range is now provided
6-1911	6	35	18	35	40	Section 6.3.3.3: duplication of chapter 8. Better just refer to chapter 8, section 8.2.3.3 for methane lifetime discussion or import text from Chapter 8 here. [Michiel van Weele, The Netherlands]	We left text for completion but refer to chapter 8 as suggested.
6-1912	6	35	19	35	23	Again, there is no mention about stratospheric loss due to chlorine and oxygen (O1D) atoms in the stratosphere [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Already addressed in comment 6-1908.
6-1913	6	35	19			A review of the methane sink can be found in Shallcross, D.E., Khalil, M.A.K., and Butenhoff, C.L. (2007) The atmospheric methane sink, in Greenhouse Gas Sinks, ed. Reay, D., CABI Publishing, London. [Christopher Butenhoff, USA]	The text has been modified and the suggested reference added.
6-1914	6	35	20	35	20	insert comma after CH4 [Peter Burt, UK]	Editorial - text revised.
6-1915	6	35	20	35	20	delete "determining a"; insert ", yielding a partial atmospheric". BTW, is this correct or is 9 years the total lifetime? [James Butler, United States of America]	Accepted - text revised
6-1916	6	35	21	35	22	"OH removes about 90% of atmospheric CH4 determining a lifetime of about 9 years (7–11 years) for an atmospheric burden of 4800 TgCH4 (4700–4900 TgCH4) (ACCMIP intercomparison)." Does the longevity of methane vary much under different concentrations? [Andrew Glikson, Australia]	Yes, more CH4 in the atmosphere means less OH due to the oxidation process, which in turn means that less CH4 can be oxidised, impacting its life time.
6-1917	6	35	22	35	22	take → takes [Peter Burt, UK]	Editorial (combined with comment 6-1919) - text revised.
6-1918	6	35	22	35	22	Add appropriate citation(s) for the magnitude of dry soil CH4 oxidation. [Akihiko Ito, Japan]	Accepted - reference provided
6-1919	6	35	22			change 'take' to 'removes' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-1917) - text revised.
6-1920	6	35	23	35	23	Chlorine → chlorine [Peter Burt, UK]	Editorial (same comment 6-1921) - text revised.
6-1921	6	35	23			Chlorine - convert to L/C [Jeffrey Obbard, Singapore]	Editorial (same comment 6-1920) - text revised.
6-1922	6	35	25	35	25	have → has [Peter Burt, UK]	Editorial - text revised.
6-1923	6	35	25	35	40	Is it relevant to add recently published data on OH from the tropical marine boundary layer in the Atlantic? The lower tropical troposphere plays a key role in the loss of CH4. Suggested reference: Whalley, L. K., Furneaux, K. L., Goddard, A., Lee, J. D., Mahajan, A., Oetjen, H., Read, K. A., Kaaden, N., Carpenter, L. J., Lewis, A. C., Plane, J. M. C., Saltzman, E. S., Wiedensohler, A., and Heard, D. E.: The chemistry of OH and HO2 radicals in the boundary layer over the tropical Atlantic Ocean, Atmos. Chem. Phys., 10, 1555-1576, doi:10.5194/acp-10-1555-2010, 2010. [Leticia Cotrim da Cunha, Germany]	We agree as to the relevance of the tropical troposphere in terms of OH production/CH4 loss. However, there is no space to extend the paragraph.
6-1924	6	35	29	35	29	get → obtain [Peter Burt, UK]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1925	6	35	31	35	31	Move (MCF) before 'as' [Peter Burt, UK]	Editorial (same comment 6-1926) - text revised.
6-1926	6	35	31	35	31	In the phrase "Atmospheric inversions using methyl-chloroform as a proxy (MCF) find", place "(MCF)" after the word methyl-chloroform. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Editorial (same comment 6-1925) - text revised.
6-1927	6	35	31			change 'find' to 'indicate' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-1928	6	35	32	35	32	Change to "because of an oversensitivity to". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1929	6	35	34			protocol U/C, include date i.e. 1987 [Jeffrey Obbard, Singapore]	Accepted - text revised
6-1930	6	35	36	35	36	insert 'the need' after 'impose' [Peter Burt, UK]	Editorial (combined with comments: 6-1931 to 6-1936) - text revised.
6-1931	6	35	36	35	36	the next years → the near future [Peter Burt, UK]	Editorial (combined with comments: 6-1930 to 6-1936) - text revised.
6-1932	6	35	36	35	36	insert "the need" after "impose" [James Butler, United States of America]	Editorial (combined with comments: 6-1930 to 6-1936) - text revised.
6-1933	6	35	36	35	36	Change to "2010) make it necessary to find another". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1930 to 6-1936) - text revised.
6-1934	6	35	36	35	36	Replace "impose to find" with "highlight the need to find" [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Editorial (combined with comments: 6-1930 to 6-1936) - text revised.
6-1935	6	35	36	35	36	Rewrite "impose to find" with "impose the need to find". [Nathaniel Ostrom, United States of America]	Editorial (combined with comments: 6-1930 to 6-1936) - text revised.
6-1936	6	35	36			Reword: “imposes the requirement to find another OH proxy in the upcoming years” [Richard Bourbonniere, Canada]	Editorial (combined with comments: 6-1930 to 6-1935) - text revised.
6-1937	6	35	38	35	40	This sentence is constructed in a strange way, i suggest it is revised to the following "Finally, evidence for the role of changes in OH concentrations in explaining the increase in atmospheric methane since 2007 is variable, ranging from a significant contribution (Rigby et al., 2008) to only a small role (Bousquet et al., 2011).". [Daniel Metcalfe, Sweden]	Accepted -text revised
6-1938	6	35	38	35	40	The sentence "Finally, changes in OH concentrations are found to play a significant (Rigby et al., 2008) to only small role (Bousquet et al., 2011) in this increase of atmospheric methane since 2007" seems clumsy. It could be replaced with "Finally, there are differences in the extent to which changes in OH concentrations played a role in the atmospheric increase in methane since 2007, with Rigby et al., 2008 suggesting it played a significant role while Bousquet et al., 2011 find its role to be small". [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-1939	6	35	39	35	39	move 'role' to after Bousquet reference [Peter Burt, UK]	Editorial - text revised.
6-1940	6	35	42	36	11	It is suggested that not chemical fertilizer but afforestation of N2-fixing plants possbly increases the N2O emission from soils (Arai et al., 2008, Global Biogeochemical Cycles). [Shigehiro Ishizuka, Japan]	Rejected - the evidence of this paper is not compelling, given the long lasting increase in atm. N2O and the rather recent increase in Acacia plantation. The paper does not provide any evidence that the observed site-level phenomenon is of a scale that translates into global changes
6-1941	6	35	42			Section 6.3.4: The introduction to this section is good as it briefly discusses some studies that give reason to update the global N2O budget since the AR4, in particular changes to the IPCC Guidelines to estimate agriculture N2O emissions. The authors should strive to provide an equally compelling introduction to section 6.3.3 – the global CH4	Noted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						budget, and motivate the need to update the budget from AR4. [Christopher Butenhoff, USA]	
6-1942	6	35	42			The text in section 6.3.4 does not make it clear that agriculture is responsible for about 80% of the source of anthropogenic N2O. There is a lot of discussion about feedbacks and effects of soil moisture, which is fine, but the reader should understand very clearly that fertilizer and manure use and management trump everything else with respect to perturbation of the N2O budget. [Eric Davidson, USA]	Accepted - paragraph will be added as the first paragraph of 6.3.4.
6-1943	6	35	44	35	44	start sentence with AR4 [Peter Burt, UK]	Editorial - text revised.
6-1944	6	35	44			Overall, I think Section 6.3.4 could be balanced better. It overemphasizes some new budget items (soil sink and atmospheric source from NH4NO3) which are not well quantified and may not be important at all, while under-emphasizing some much more important points: 1) Agriculture is the dominant source of N2O (as evidenced, among other things, by observed Suess Effect in N2O) and, as such, future trends in N2O will be closely tied to future trends in Nr creation and food production. 2) N2O emissions may increase in the future as an unintended consequence of processes that sequester CO2 or offset fossil fuel emissions, e.g., biofuel production, ocean fertilization, N deposition. 3) The important Ravishankara et al. paper should at least be mentioned somewhere in this section or chapter: Ravishankara A. R., Daniel, J. S. and Portmann, R. W.: Nitrous Oxide (N2O): The dominant ozone depleting substance emitted in the 21st century, Science, 326,123-125, doi: 10.1126/science.1176985, 2009. [Cynthia Nevison, USA]	Accepted - New first paragraph will be added to Section 6.3.4 to address issues 1 & 3. Issue #2 is not in the scope of this section.
6-1945	6	35	49	35	49	If not here then somewhere there needs to be a very clear discussion of what emission factors are, how the are derived, and the error introduced in their use. [Nathaniel Ostrom, United States of America]	Accepted - sentence will be added.
6-1946	6	35	50	35	50	Change to "statistics results". [Daniel Metcalfe, Sweden]	Agreed & changed.
6-1947	6	35	52			The IPCC wetlands guidelines are currently revised, not sure if that can already be mentioned here [Christoph Mueller, Germany]	Noted, will ask if appropriate
6-1948	6	35	54	35	54	Table - see comments further [Leticia Cotrim da Cunha, Germany]	Noted
6-1949	6	35				Figure 6.30. This figure is suppose to help the reader understand that in concentration-driven simulations diagnosed emissions can be inconsistent because of LUC emissions (in context of lines 32-41 on page 6-49). However, I am afraid the figure confuses things even more. First, if the focus is on concentration driven runs than why even talk about emissions driven run in the figure caption. Second, the caption says F_LA and F_OA are diagnosed in concentration driven runs and interactive in emissions driven run. This is not exactly correct. Fluxes are calculated in both cases. The land and ocean carbon cycle components do not care if CO2 is prescribed or evolving. They use use the CO2. The use of diagnosed and interactive terms for fluxes is incorrect. The use of both F_LA and F_AL is confusing. If anything, F_LA = -F_AL but clearly this is not what is being intended here. The two arrows each for F_AL and F_AO is confusing. I have tried conveying the simple message (in red above) in a figure on Sheet 2, but this may need more work. [Vivek Arora, Canada]	taken into account - this figure and a new box to describe ESM and carbon cycle experiments/use will be revised
6-1950	6	35				I am sorry to say it again, but the number of significant digits is not right. Also in stating emissions as high as 706 Tg/yr, I believe some constraints would be violated, especially on OH. [Mohammad Aslam Khan Khalil, USA]	Uncertainty or maximum/minimum range has been provided for each quantity.
6-1951	6	35				On global OH here is a reference: “A new model of tropospheric hydroxyl radical concentrations.” K. Bahm and M.A.K. Khalil. Chemosphere 54, 143-166, 2004. [Mohammad Aslam Khan Khalil, USA]	Noted - The reference has not been included in SOD - but will be considered in TOD version of Chapter 6.
6-1952	6	35				There is a whole book on sinks that has not been referenced. . Greenhouse Gas Sinks (D. Reay, C.N. Hewitt, K. Smith and J. Grace, eds.), CABI, Cambridge, MA, p. 171-183, 2007. [Mohammad Aslam Khan Khalil, USA]	Rejected - this is a very vague refence to a whole book. We use references to support specific statements or attribute observations made.
6-1953	6	35				Fig. 6.30 does not add substantial new data or explanation and could be omitted without loss of information [Stefan Reis, United Kingdom of Great Britain & Northern Ireland]	taken into account - figure moved to box on earth system modelling
6-1954	6	35				The two plots are not readable; they are also not explained properly in the caption [Zongbo Shi, United Kingdom]	taken into account - figure redrawn and moved to a box

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1955	6	35				Section 6.3.3.3: consistency needed with chapter 2, section 2.4.2.4 and Chapter 8, section 8.2.3.3 [Michiel van Weele, The Netherlands]	Noted - numbers to be harmonized with other chapters
6-1956	6	36	9	36	11	Bits of sentences - needs re-writing. [Leticia Cotrim da Cunha, Germany]	Agreed, change made
6-1957	6	36	12			New research also includes the finding that rivers and streams may an important source of atmospheric N2O. The reference is; Beulieu, J.J. et al. 2010. Nitrous oxide emission from dentrification in stream and river networks, PNAS, 108, 214-219. [Christopher Butenhoff, USA]	Accepted - sentence will be added.
6-1958	6	36	14	36	14	years needed! [Peter Burt, UK]	Accepted - correction will be made.
6-1959	6	36	14	36	14	years missing [Leticia Cotrim da Cunha, Germany]	Accepted - correction will be made.
6-1960	6	36	14	36	29	The N2O 1978-2010 trends from AGAGE (Prinn, Weiss et al, JGR, v105, 2000, updated from AGAGE website 2012) should be included here and in Fig. 6.18. [Ronald Prinn, USA]	This figure was provided by Martin Heimann who will address the comment.
6-1961	6	36	14			note that dates are needed [Jeffrey Obbard, Singapore]	Accepted - correction will be made.
6-1962	6	36	15			Delete "," [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-1963	6	36	17	36	17	insert "the" before "concentration" [James Butler, United States of America]	Editorial (same comment 6-1967) - text revised.
6-1964	6	36	17	36	17	"Figure 6.18 shows concentration and annual growth rate …" I think it shows annual growth rate only, but not concentration. [David Pearson, United Kingdom]	Rejected - legend does not say 'concentration'
6-1965	6	36	17	36	18	Figure 6-18 shows only the growth rates, NOT the concentrations. [Richard Bourbonniere, Canada]	Rejected - legend does not say 'concentration'
6-1966	6	36	17	36	25	This section is a good example on how with a copuple of short sentences a results with high uncertainty can be explained and put in perspective. Such explanations should be added when possible to statements about the uncertainty of results. [Nikolaus Josef Kuhn, Switzerland]	Noted, no response needed
6-1967	6	36	17			add 'the' after 'shows' [Jeffrey Obbard, Singapore]	Editorial (same comment 6-1963) - text revised.
6-1968	6	36	18	36	18	program → programme [Peter Burt, UK]	Editorial - text revised.
6-1969	6	36	21	36	25	I don't agree that this is poorly understood. Interannual variability in the stratosphere backflux of N2O-depleted air probably drives much of the IAV in the growth rate. See (Nevison, C.D. E. Dlugokencky, G. Dutton, J.W. Elkins, P. Fraser, B. Hall, P.B. Krummel, R.L. Langenfelds, S. O'Doherty, R.G. Prinn, L.P. Steele, R.F. Weiss, Exploring causes of interannual variability in the seasonal cycles of tropospheric nitrous oxide, Atmospheric Chemistry and Physics, 11, doi:10.5194/acp-11-1-2011, 1-18, 2011.) for additional reference. [Cynthia Nevison, USA]	Accepted - text will be modified to take advantage of suggested references.
6-1970	6	36	22	36	22	soils → soil [Peter Burt, UK]	Editorial (same comment 6-1971) - text revised.
6-1971	6	36	22	36	22	Substitute "soils" with "soil". [Daniel Metcalfe, Sweden]	Editorial (same comment 6-1970) - text revised.
6-1972	6	36	24	36	24	Should the sentence be changed as following to follow from the "since" earlier: "exchange may also"? [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-1973	6	36	27			Figure 6.18: "a smooth line to guide the eye"? I think it needs to be stated what this line actually is. Running mean? Cubic spline? [James Christian, Canada]	Noted - text revised
6-1974	6	36	28			ppm should be ppb [Peter Rayner, Australia]	Accepted - text revised.
6-1975	6	36	31			This section is incomplete without more discussion specific sources of N2O including soils, estuaries, ocean,	Rejected - because emissions from aquatic systems

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						rivers, etc. There is no mention of N2O sinks. For a complete review of the atmospheric sink of N2O see : Butenhoff, C.L., and Khalil, M.A.K. (2007) Stratospheric sinks of nitrous oxide, in Greenhouse Gas Sinks, ed. Reay, D., CABI Publishing, London. [Christopher Butenhoff, USA]	are highly uncertain. Sinks are discussed on page 6-37, line 7.
6-1976	6	36	33	36	34	"Most N2O is produced during biological (bacterial) processes such as nitrification and denitrification in soils and sediments." What about the ocean? Ocean source is globally significant (see Fig 6.4). In the ocean at least, Archaea are at least as important in nitrification as Bacteria (Wuchter et al 2006 PNAS 103: 12317–12322). [James Christian, Canada]	Accepted - sentence will be modified.
6-1977	6	36	33	36	48	The post-AR4 3D regional (8 land, 4 ocean) and global inversions by Huang et al, JGR, v113, D17313, 2008 that use AGAGE, NOAA and CSIRO N2O data, ought to be used here and in Table 6.8. Also, the pre-AR4 Hirsch et al, GBC, v20, 2006 paper. Too much reliance here on just the Syakila et al, 2010 and 2011 papers. [Ronald Prinn, USA]	Accepted - material will be modified.
6-1978	6	36	39	36	40	Is there a name for this process? This sentence needs a bit of re-writing too. [Leticia Cotrim da Cunha, Germany]	Accepted - text will be modified
6-1979	6	36	39	36	42	The ammonium nitrate source will be related to emissions of NHx, which are largely agricultural. In this sense, it is probably not a completely new source that will radically alter the N2O budget, but rather may already be included in the uncertainty of the indirect agricultural N2O estimate. [Cynthia Nevison, USA]	Accepted - sentence will be added.
6-1980	6	36	44	36	44	delete "the" [James Butler, United States of America]	Editorial - text revised.
6-1981	6	36	46	36	46	1990's → 1990s [Peter Burt, UK]	Editorial - text revised.
6-1982	6	36	46			delete “since” [Richard Bourbonniere, Canada]	Editorial - text revised.
6-1983	6	36	48	36	48	Would be useful to mention at the end of this paragraph that trends in N2O isotopes confirm that agriculture is primarily responsible for historic increase in N2O. Some references include 1) Pérez, T. et al. Identifying the agricultural imprint on the global N2O budget using stable isotopes. J. Geophys. Res. 106, 9869–9878 (2001)., 2) Sutka, R. L. et al. Distinguishing nitrous oxide production from nitrification and denitrification on the basis of isotopomer abundances. Appl. Environ. Microbio. 72, 638- 644 (2006). Also, a new paper recently accepted by Nature by Park, Boering et al. is probably the best reference for this. Kristie Boering (UC Berkeley) is the corresponding author. [Cynthia Nevison, USA]	Accepted - sentence with reference will be added in.
6-1984	6	36	50	37	27	6.3.4.3 Feedbacks from N2O and Climate: While thawing permafrost and methane hydrates are mentioned in several different places a similar section for CH4 on feedbacks could be useful. [Jan Fuglestvedt, NORWAY]	Noted - section needs to be added - Canadell/Bousquet
6-1985	6	36	50			Section 6.3.4.3: This sub-section would better fit as part of Section 6.4.6 Future Trends in the Nitrogen Cycle and Impact on Carbon Fluxes. By removing this subsection the parent section becomes more symmetrical with Section 6.3.3, since that section does not include a separate subsection on CH4 climate feedbacks. [Christopher Butenhoff, USA]	Accepted in part - the portion of this section that relates to projections will be moved to Section 6.4.
6-1986	6	36	50			Section 6.3.4.3: Evidence of further feedback is provided in study by Khalil and Baggs (Khalil, M.I., and E.M. Baggs, 2005. CH4 oxidation and N2O emissions at varied soil water-filled pore spaces and headspace CH4 concentrations, Soil Biol. & Biochem. 37: 1785-1794) provided a link between future climate change, soil moisture, and N2O emissions, suggesting a possible feedback. [Christopher Butenhoff, USA]	Rejected - While this study shows that methane oxidation and denitrication are linked, there is no direct link towards climate change. The issues at hand are discussed in detail in the following paragraph (p37, l7ff), such that this study does not add any important information to the understanding of the N2O climate linkage
6-1987	6	36	54	36	58	It has recently been found that melting permafrost is a strong source of N2O(ref?) .Since nitrous oxide is a strong greenhouse gas with a GWP of 300 , this could represent a significant increase in the radiative forcing budget in the future. [Wayne Evans, USA]	Accepted - change will be made.
6-1988	6	36	57	36	57	Substitute "suggests" with "suggest" to agree with "Simulations". [Daniel Metcalfe, Sweden]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-1989	6	37	1	37	1	delete 2nd 'to' [Peter Burt, UK]	Editorial (combined with comments: 6-1990, 6-1992 to 6-1994) - typo corrected.
6-1990	6	37	1	37	1	Remove one "to" [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-1989, 6-1992 to 6-1994) - typo corrected.
6-1991	6	37	1	37	1	In addition to Zaehle and Dalmonech, the same has been found by: Xu-Ri, I.C. Prentice, R. Spahni and H.S. Niu, "Modelling terrestrial nitrous oxide emissions and implications for climate feedback", submitted to New Phytologist. We have estimated a feedback strength of 1 Tg N/yr per degree of warming. [Iain Colin Prentice, Australia]	Noted - paper has been requested.
6-1992	6	37	1	37	1	Typo 'However, most of the change in atmospheric N2O is attributed to to..' [Dave Reay, UK]	Editorial (combined with comments: 6-1989, 6-1990, and 6-1993, 6-1994) - typo corrected.
6-1993	6	37	1			remove extra “to” [Richard Bourbonniere, Canada]	Editorial (combined with comments: 6-1989, 6-1990, and 6-1992 to 6-1994) - typo corrected.
6-1994	6	37	1			delete 'to' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-1989, 6-1990, and 6-1992, 6-1993) - typo corrected.
6-1995	6	37	3	37	3	N2O → N2O [Peter Burt, UK]	Editorial (combined with 6-1996, 6-1997, and 6-2000, 6-2001) - corrected in text.
6-1996	6	37	3	37	3	Subscript 2 in N2O. [Daniel Metcalfe, Sweden]	Editorial (combined with 6-1995 to 6-1997, and 6-2000, 6-2001) - corrected in text.
6-1997	6	37	3			N2O?; similar issues throughout the chapter; CO2 as well [Zongbo Shi, United Kingdom]	Editorial (combined with 6-1995, 6-1996, and 6-2000, 6-2001) - corrected in text.
6-1998	6	37	4			"surface pH" should be "surface ocean pH"? Please also add a proper legend [Zongbo Shi, United Kingdom]	Accepted - text revised.
6-1999	6	37	8	37	8	"remain" appears 2x in the sentence. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-2000	6	37	9	37	9	Subscript 2 in N2O. [Daniel Metcalfe, Sweden]	Editorial (combined with 6-1995 to 6-1997, 6-2001) - corrected in text.
6-2001	6	37	9			correct 'N2O' [Jeffrey Obbard, Singapore]	Editorial (combined with 6-1995 to 6-1997, 6-2000) - corrected in text.
6-2002	6	37	11		12	There is a strong evidence of the effect of climate change on N2O emissions from soils. That is the good positive relationships established between N2O emission from non-fertilized forestlands and grasslands and precipitation (Cai, 2012, Greenhouse gas budget for terrestrial ecosystems in China. SCIENCE CHINA-Earth Sciences, 55(2): 173–182) and between N2O emission factor in croplands and precipitation in China (Lu YY, Huang Y, Zou J W, et al. An inventory of N2O emissions from agriculture in China using precipitation-rectied emission factor and background emission. Chemosphere, 2006, 65: 1915–1924). [Zucong Cai, China]	Rejected - The CAI 2012/Lu 2006 study shows a strong effect of precipitation on terrestrial N2O emissions on fertilised land. The way N2O for non fertilised land has been calculated cannot be reconstructed with the information given in the manuscript.
6-2003	6	37	12	37	17	One of the most important publications by Kammann et al. (2008) (Kammann, C., Müller, C., Grünhage, L., and Jäger, H.-J. (2008). Elevated CO2 stimulates N2O emissions in permanent grassland. Soil Biology & Biochemistry 40, 2194-2205.) should be quoted because it is currently the only long-term study spanning over more than 14 years (in 2011) from a FACE study on temperate grassland. THis is currently worldwide the only continuous N2O gas emission data set over such a long time period. All the other papers quote ususally very short-term studies and sometimes conflicing results. A general comment: if possible only results from long-term studies should be considered in this report and all other short-term studies sometimes only over several days of weeks should be quoted with the utmost caution. [Christoph Mueller, Germany]	Accepted - material will be added.
6-2004	6	37	15	37	15	CO2 → CO2 [Peter Burt, UK]	Editorial (combined with comments: 6-2005 to 6-2008)
6-2005	6	37	15	37	15	Subscript 2 in CO2. [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-2004 to 6-2008)

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2006	6	37	15			correct CO2 [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-2004 to 6-2008)
6-2007	6	37	18	37	18	CO2 → CO2 [Peter Burt, UK]	Editorial (combined with comments: 6-2004 to 6-2008)
6-2008	6	37	18	37	18	Subscript 2 in CO2. [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-2004 to 6-2007)
6-2009	6	37	21	37	21	application → appications [Peter Burt, UK]	Editorial - text revised.
6-2010	6	37	21	37	27	Again, while uncertainty is mentioned and commented, the reasons for the uncertainty (e.g. missing spatial data coverage or lack of understanding of ecosystem procesesses…) are not given. Such additional information would make the chapter and report a valuable tool to inform further research. [Nikolaus Josef Kuhn, Switzerland]	Rejected - This is a good comment but we are not aware of a paper that summarizes these factors: lack of long-term measurements; factorial experiments combining the factors driving the N2O response; limited geographical coverage of available relevant observations; upscaling of these factors to regional + global scales; modelling of these factors with biogeochemical models combining soil-vegetation proceses.
6-2011	6	37	21	37	27	It would seem appropriate to have the use of isotopes and isotopomers of N2O in global source modelling here as the use of isotopes was discussed in the context of the global methane budget [Nathaniel Ostrom, United States of America]	Accepted - This comment was addressed earlier.
6-2012	6	37	21			change to 'suggests' [Jeffrey Obbard, Singapore]	Editorial (combined to comment 6-2009) - text revised.
6-2013	6	37	23	37	23	This should either be "the responses of terrestrial" or "emissions on future", depending the direction of causality you're intending. Also, this is quite a long sentence that would benefit from being split up. [Daniel Metcalfe, Sweden]	Accepted - material will be added.
6-2014	6	37	24	37	24	Insert full stop after 'respsonse', Start new sentence with Kesik et al. (2006) found for [Peter Burt, UK]	Editorial suggestion (combined with comments: 6-2015 to 6-2018) - accepted.
6-2015	6	37	24	37	24	"… response. Kesik et al. (2006) …" [Leticia Cotrim da Cunha, Germany]	Editorial suggestion (combined with comments: 6-2014, 6-2016 to 6-2018) - accepted.
6-2016	6	37	24	37	27	This sentence is too long, and "that" appears 2x in the beginning. [Leticia Cotrim da Cunha, Germany]	Editorial suggestion (combined with comments: 6-2014 to 6-2018) - accepted.
6-2017	6	37	24	37	27	Place a period after "response" and start the next sentence with: "Kesick (et al., 2006) found…". I'm not certain what "increases of up to 20%" refers to. Kesik found emissions were reduced so it is not clear what is increasing. [Nathaniel Ostrom, United States of America]	Accepted - material will be added.
6-2018	6	37	24			Start new sentence after 'response' [Jeffrey Obbard, Singapore]	Editorial suggestion (combined with comments: 6-2014 to 6-2017) - accepted.
6-2019	6	37	26			Clarify: ['…despite increases of 20% in central Europe'] What does 'increases' refer to? To temperature? To overall N2O in central Europe? [Christina Tonitto, USA]	Accepted - material will be added.
6-2020	6	37	29	37	38	Maybe add some references for the statements here, especially about the atmospheric N inputs to the ocean vs. riverine N inputs. [Leticia Cotrim da Cunha, Germany]	Accepted - references will be added
6-2021	6	37	29	37	38	Section 6.3.4.4 seems out of place and repeats material already presented on page 6-10. Would perhaps be more useful to replace with a discussion of increased N2O emissions associated with biofuels, N deposition and ocean fertilization. The Zaehle and Dalmonech reference then could be moved here from p37 line 1 (where it doesn't really belong under the discussion of climate feedbacks). [Cynthia Nevison, USA]	Section was removed.
6-2022	6	37	29	37	38	6.3.4.4 Global N Sources' Inclusion of estimated N inputs to terrestrial, aquatic and marine ecosystems would be useful here. [Dave Reay, UK]	Section was removed.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2023	6	37	31	37	38	supporting references required for these vaues [Peter Burt, UK]	Section was removed.
6-2024	6	37	32			… - Haber-Bosch-derived N fertilizer and N fixation in cropping systems account for 170 g N … [Christina Tonitto, USA]	Accepted, change made.
6-2025	6	37	36			Drop the "is" in is becomes. [Peter Högberg, Sweden]	Editorial - text revised.
6-2026	6	37	37	37	38	"There is a net transfer of reactive N from the continental atmosphere to the marine atmosphere, resulting in N deposition to the oceans that is greater than riverine discharge." refs? [James Christian, Canada]	Agreed - reference will be added
6-2027	6	37	37		38	Reference is needed to support this assertion. [Zucong Cai, China]	Noted, references will be added
6-2028	6	37	38			Add a reference [Zongbo Shi, United Kingdom]	Noted - reference will be added
6-2029	6	37	40	37	40	Back again to concentrations [VINCENT GRAY, NEW ZEALAND]	Noted, comment is not understood.
6-2030	6	37	40	41	52	This section is lacking a summary that describes the lessons learned and limitations of the models. Such a summary is extremely important, as it sets the stage for the following discussion of model projections. The section suffers from confusion in its purpose. It includes both descriptions of new observations and evaluation of models, but the observations are not linked to the evaluation of the models. The model evaluation is limited to discussion of model sensitivities and of processes not represented in the models. The discussion of sensitivities is clouded by unstated dependencies on models, scenarios, and time scales. A more thorough discussion of sensitivities is needed. Much, much more could be gained from the C4MIP and CMIP5 simulations of historical fluxes. [Eric Sundquist, United States of America]	Accepted - the disconnected section on new observations has been deleted. New text has been added in the section on models but there is a limit on extending the section as requested as the overall section 6.3 needs to be shorten by 2 pages.
6-2031	6	37	41	37	43	Orr et al 2001: these are archaic models. Aren't there more recent estimates available for C4MIP models or OCMIP II models, if not the CMIP5 models? This Orr paper is for the OCMIP I models. [James Christian, Canada]	Accepted - new model results are discussed in Section 6.4
6-2032	6	37	42	38	38	In the section of new observations, it is strongly recommended including recent advancement of satellite observation of atmospheric column CO2 concentration and subsequent inversion estimation of surface CO2 fluxes. For example, Takagi et al. (2011) report the initial result of the Greenhouse gas Observation SATellite. Takagi, H., and Coauthors, 2011: On the benefit of GOSAT observations to the estimate of regional CO2 fluxes. SOLA, 7, 161–164. [Akihiko Ito, Japan]	Figure removed
6-2033	6	37	42			Section 6.3.5.1. I don't really see the interest of that long list of "new observations" (I uses " " as not all of these are pure obsevations", several do include some modelling component) . In any case, most of these data have been already presented ealier in the chapter, so not sure there is a need to repeat here what they are. If you really want to keep this, I would strongly reduce (in a 1 sentence for the ocean, 1 for the land and 1 for CH4 and move it at the very begining of each relevant section. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Figure removed
6-2034	6	37	44	37	44	are → is [Peter Burt, UK]	Editorial - corrected in text.
6-2035	6	37	44	37	45	These new observations are remarkable, I agree, but it should be mensioned that they may contain unspecified ranges of uncertainty. [Akihiko Ito, Japan]	Figure removed
6-2036	6	37	44			additional [Richard Bourbonniere, Canada]	Editorial - text revised.
6-2037	6	37	44			change 'there are' to 'there have been' [Jeffrey Obbard, Singapore]	Figure removed
6-2038	6	37	44			"addition" should be "additional"? [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-2039	6	37	47			Figure 6.19. Many of the panels are too small to be readable [Göran Ågren, Sweden]	figure removed
6-2040	6	37	47			Caption for Fig 6.19: Last entry labelled “g)” rather than “h)” [Richard Bourbonniere, Canada]	figure removed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2041	6	37	47			Figure 6.19: panel (b) has no units. [James Christian, Canada]	figure removed
6-2042	6	37	48	37	48	Figure 6.19: I suggest to delete it. There are already many figures in this chapter [Nicolas Gruber, Switzerland]	figure removed
6-2043	6	37	53			or caption of fig 6.19: You should be careful distinguishing observations from inferences. Beer 2010 is a wonderful paper but their GPP estimates are not observations, they are connected to observations by a fairly long chain of reasoning and inference. Frankenberg's 2011 observations of fluorescence are closer to a measurement of the distribution of photosynthesis. The Van der Werf fire estimates similarly involve models [Peter Rayner, Australia]	figure removed
6-2044	6	37				Section 6.3.5: I think one of the most important developments since AR4 is that CO2 flux in partial ice cover does not scale linearly with ice cover fraction, but rather the exchange coefficient for the open-water fraction of a partially ice covered ocean seems to be much larger than for ice-free conditions (Else B. G. T. , T. N. Papakyriakou, R. J. Galley, W. M. Drennan, L. A. Miller, and H. Thomas, 2011. Wintertime CO2 fluxes in an Arctic polynya using eddy covariance: Evidence for enhanced air-sea gas transfer during ice formation. J. Geophys. Res., 116, doi:10.1029/2010JC006760) And what about the “First direct observation of the atmospheric CO2 year-to-year increase from space” (Buchwitz et al 2007, Atmos. Chem. Phys. 7: 4249-4256). Groger and Mikolajewicz (2011, Ocean Modelling 39: 284) give a new formulation for the Schmidt number for CO2 to give better results at temperatures above 30 C, and showed that this has a significant effect on air-sea exchange under global warming scenarios. Other significant papers not cited although I can’t say exactly were they should be discussed include Matsumoto et al 2010 “Characterizing post-industrial changes in the ocean carbon cycle in an Earth system model” (Tellus 62B: 296-313) and Lachkar et al 2009 “Seasonal and mesoscale variability of oceanic transport of anthropogenic CO2” Biogeosciences 6: 2509-2523) (note: I think some sort of subheader is required after Box 6.3. The subject matter changes quite abruptly.) [James Christian, Canada]	Figure removed
6-2045	6	37				Fig. 19(b) requires a statement of what units are used. [David Pearson, United Kingdom]	Figure removed
6-2046	6	37				Fig. 19(g) requires a scale/legend. [David Pearson, United Kingdom]	Figure removed
6-2047	6	37				Figure 6.19 Reformat: Font in legend is too small in c,d,f at print scale. Legible in .pdf if zoom to 200%. [Christina Tonitto, USA]	Figure removed
6-2048	6	38	1	38	4	SOCAT database available : http://cdiac.esd.ornl.gov/oceans/SOCAT/ [Leticia Cotrim da Cunha, Germany]	Figure removed
6-2049	6	38	1	38	4	It is worth stressing that many of the new surface ocean pCO2 measurements have been made using 'ships of opportunity', i.e. commercial vessels fitted with pCO2 analysers, and not just due to more research cruises. [Ian Totterdell, United Kingdom]	Figure removed
6-2050	6	38	4			What "the ocean O2 cycle" is in italic? [Zongbo Shi, United Kingdom]	Figure removed
6-2051	6	38	6	38	9	I would be very careful here. I wouldn't categorize Khatiwala et al.'s estimate as an observation. It uses CFC observations to determine the parameters of a set of Green's functions, which are then used to COMPUTE the anthropogenic CO2 uptake. In the (mostly grey) spectrum ging from pure observations to pure models, the Khatiwala et al estimate is equivalent to an ECCO-model based anthropogenic CO2 uptake estimate. This latter model has also assimilated ocean observations to determine the 3-D ocean transport, which was then	Figure removed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						applied to determine the oceanic CO2 uptake. My suggestion is to remove Khatiwala et al.'s estimate from this list. It's a great contribution to our field, but it is NOT an observation. [Nicolas Gruber, Switzerland]	
6-2052	6	38	9	38	9	→ Khatiwala et al. (2009) [Peter Burt, UK]	Editorial - the reference corrected.
6-2053	6	38	11		34	Relying on just Pan et al. (2011) seems quite risky to me. [David Newbery, CH]	Section removed
6-2054	6	38	12	38	16	Baccini et al. (2012) have now produced a tropical forest biomass map that is higher resolution than Saatchi's and that was calibrated with field Lidar data from numerous countries in three continents. This citation should be included, and the biomass estimates added here. See Baccini et al. Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps.Nature Climate Change (published online 29 January 2012; doi 10.1038/NCLMIAT1354) [Eric Davidson, USA]	Accepted. Text to include this reference.
6-2055	6	38	12	38	16	The relative importance of tropical biomass needs to be linked with other sections on carbon gains and losses, human and natural. [Beverly Law, USA]	Accepted - section removed
6-2056	6	38	12			change to 'in-situ' [Jeffrey Obbard, Singapore]	Editorial - corrected in text.
6-2057	6	38	13	38	13	→ Saatchi et al. (2011) [Peter Burt, UK]	Accepted. Editorial changes.
6-2058	6	38	14	38	14	insert 'the' after 'over' [Peter Burt, UK]	Editorial - corrected in text.
6-2059	6	38	18	38	21	This section is also short compared with others (like the NDVI greening), yet it is a topic of significance if permafrost pools are reduced (fluxes increase). The section needs to be either linked with or placed in section on permafrost thaw and potential pulse of carbon to the atmosphere in the future. [Beverly Law, USA]	Accepted - section removed
6-2060	6	38	18		21	Maybe have the word 'organic carbon' as a descriptor somewhere in this inventory [Edward Schuur, USA]	Section removed
6-2061	6	38	23	38	28	Terrestrial GPP - please add to title and text. [Leticia Cotrim da Cunha, Germany]	Section removed
6-2062	6	38	23	38	38	This section also needs to be linked to the relative contribution of the terrestrial ecosystems to atmospheric CO2 (net carbon uptake), predictive model performance in predicting GPP (e.g. Schaeffer et al)., and potential future changes in GPP (does it concur with the NDVI record of apparent greening outweighing browning?) Maybe better organization of this section and the previous three sections into areas where the reader can understand the importance of these findings. [Beverly Law, USA]	NDVI changes reflect GPP changes. It is a stretch to relate NDVI changes to net terrestrial carbon changes. Authors to discuss at LA3 meeting on how to address this comment.
6-2063	6	38	27	38	27	Change to "size of the global GPP flux has". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2064	6	38	27	38	28	A higher value of gross primary production (GPP), 150 Pg C yr–1, was also attained by the previous stable oxigen isotope study of Farquhar et al. (1993). Farquhar, G. D., and Coauthors, 1993: Vegetation effects on the isotope composition of oxygen in atmospheric CO2. Nature, 363, 439-443. [Akihiko Ito, Japan]	Section removed
6-2065	6	38	30	38	34	<Forest carbon fluxes> Emission of BVOCs should be taken into consideration. [Yoko Yokouchi, Japan]	Section removed
6-2066	6	38	31	38	31	→ '..enabled estimation of the net..' [Peter Burt, UK]	Editorial (combined with comment 6-2067, 6-2070) - text revised.
6-2067	6	38	31	38	31	Change to "enabled estimation of the net". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-2066, 6-2070) - text revised.
6-2068	6	38	31	38	34	It should be pointed out that the Pan et al.(2011) estimates of tropical secondary forest C sink is very uncertain. For example, Davidson et al. (2012, The Amazon basin in transition. Nature, 481:321-328) point out that secondary forests in the Amazon are recut so frequently, that secondary forests are a negligible term in the regional C balance. It is difficult to understand exactly how Pan et al. calculated their sinks, but it appears that they project current regrowth rates with some assumptions of permanence of the regrowing forest. [Eric Davidson, USA]	Section removed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2069	6	38	31	38	34	This section needs to be linked with the previous ones (pools, gross photosynthesis, net uptake), and other sections to understand why this is important. Possibly move these three sections to an area that discusses current status and predictive model evaluation. [Beverly Law, USA]	Section removed
6-2070	6	38	31			. . . enabled an estimation of the net . . . [Richard Bourbonniere, Canada]	Editorial (combined with comment 6-2066, 6-2067) - text revised.
6-2071	6	38	32	38	34	It will help the non-specialist reader if the text explains the different factors affecting the GPP (123 ± 8 PgC yr–1) (line 25) and the intake of 1.1 ± 0.8 PgC yr–1 specified here. [Andrew Glikson, Australia]	Section removed
6-2072	6	38	32	38	34	Change to "of a 2.4", "forests, a 2.9", and "and a 1.6". [Daniel Metcalfe, Sweden]	Section removed
6-2073	6	38	36	38	38	The implication from this single sentence is that the only new satellite observations of gases pertinent to climate change are the SCIAMACHY CH4 observations, which have actually been around since before AR4, although have undergone recent improvements. I have provided some detailed comments reviewing the state of satellite observations of CO2 and CH4 above. While the SCIAMACHY data are good and now give a multi-year record, I think it would be a major misrepresentation to omit any mention of the other satellite CO2 and CH4 datasets, especially GOSAT. [Ray Nassar, Canada]	Section removed, add text used elsewhere
6-2074	6	38	37	38	37	delete 'of' [Peter Burt, UK]	Editorial - text revised.
6-2075	6	38	37	38	38	text missing [Peter Burt, UK]	section removed
6-2076	6	38	38	38	38	delete ; [Peter Burt, UK]	Editorial - text revised.
6-2077	6	38	39	38	39	Two other new datasets since AR4, which might deserve being mentioned are: 1) The HIPPO aircraft campaigns which provide fine-grained nearly pole-to-pole observations of CO2, CH4 and other parameters 2) The Total Carbon Column Observing Network (TCCON) [Ray Nassar, Canada]	Section removed
6-2078	6	38	41	39	20	Could not find BOX 6.3 described here [Richard Bourbonniere, Canada]	Box in place
6-2079	6	38	43	39	18	I would delete this entire box or radically revise it. It is partly a tutorial (lines 46-51), partly an advert (53- 39:5) and nowhere a properly balanced assessment. There are lots of these products, and lots of evaluations. They seldom agree with one another. Part of the problem is fundamental flaws in the sensors and the index (NDVI). The other part is varying assessment periods and inapproriate statistics (linear trend analysis). [Robert Scholes, South Africa]	Reject. The GIMMS NDVI is the longest satellite data based record. There are no other comparable data sets of such quality and length. Will replace the linear trend analysis with Vogelsang's statistical method in SOD.
6-2080	6	38	48			L48 and onwards: the detail on the NDVI record doesn't seem commensurate with that on the other new observations Check whether there's anything that should constrain climate/carbon-cycle feedbacks from obs, probably not and the climate sensitivity stuff is handled elsewhere. [Peter Rayner, Australia]	Reject. The NDVI data set is the only longest satellite data of vegetation activity (30 years in length as of now). Most other data sets are new (from the NASA EOS era). Hence the prominence given to results from analysis of NDVI data.
6-2081	6	38	53	39	18	This section seems overly long for the result reported compared with other sections. Balance of length and importance is needed. [Beverly Law, USA]	Reject.The NDVI results are in a box. Does not affect the flow of the manuscript. The reader can skip the box if he/she desires.
6-2082	6	38	56	38	56	AVHRR → AVHRRs [Peter Burt, UK]	Accept.
6-2083	6	38	57	38	57	space between numbers and units [Peter Burt, UK]	Accept.
6-2084	6	38				Add a brief paragraph 6.3.5.1.8 to describe Fig 6.19h regarding biomass burning [Richard Bourbonniere, Canada]	Figure removed
6-2085	6	38				Box 6.3. I fould it a bit too technical for a box What is GSI ? I was missing the box figures and tables. What I was hoping to also read in this box is something on the recent MODIS NPP trend (see page 6.32, line 41-43.	Accept. Expand GSI to Growing Season Integrated. A discussion on recent MODIS NDVI and NPP analysis

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						[Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	is contained in the text. See Page 32, lines 38 to 43.
6-2086	6	38				There remains the unknown of root growth, turnover and biomass changes. [David Newbery, CH]	section removed
6-2087	6	38				Where are the Figures for Box 6.3? [Christina Tonitto, USA]	Good question. There seems to be a problem with boxes. The figures and tables referred to in the boxes are not to be found anywhere! Even I (the author) cannot find them.
6-2088	6	39	1	39	12	Figure 6.33 - Units are missing in the panels: colour scale, y- and x-axis. [Leticia Cotrim da Cunha, Germany]	taken into account - figure revised
6-2089	6	39	5	39	9	References to figures contain the text "rbm". This could be an error. If not, could an explanation be added? [David Pearson, United Kingdom]	Accept. Need to fix figure and table numbers of the box.
6-2090	6	39	7	39	18	This summary of "a greening planet" is misleading. While many areas are greening, especially the tundra, many areas are browning, particularly the boreal forest. See Goetz, S. J. et al. (Satellite-observed photosynthetic trends across boreal North America associated with climate and fire disturbance. Proc. Natl Acad. Sci. USA 102, 13521–13525. 2005) and see Beck, P. S. A., S. J. Goetz (2011 Satellite observations of high northern latitude vegetation productivity changes between 1982 and 2008: ecological variability and regional differences. Environmental Research Letters, 6: 045501, doi: 10.1088/1748-9326/6/4/045501) for evidence of widespread "browning" in boreal forests. These results are robust and should be included in this discussion. [Eric Davidson, USA]	Reject. The previous analyses are now updated. The proportions of greening and five to nine fold larger than browning. The cited articles refer to limited vegetated areas in the north. The box refers to global analysis with the updated 30 year NDVI data set.
6-2091	6	39	14	39	14	insert 'the' after 'from' [Peter Burt, UK]	Accept.
6-2092	6	39	15	37	18	This statement appears rather general and should at least comment on the role of reforestation, fire surpression, shrub encroachment etc. [Nikolaus Josef Kuhn, Switzerland]	Accept.
6-2093	6	39	15	39	18	"the percentage of global vegetation exhibiting greening is three times larger than the browning vegetation (31% vs. 10%) ". These comparisons are difficult to evaluate unless regions are specified where vegetation becomes gener or browner, i.e. since intensitifcation of the hydorlogical cycle results in heavier precipitation occurs in some regions whereas the shift in climate zones results in droughts and browning in other areas. [Andrew Glikson, Australia]	Reject. Can cite a paper reporting these results for details. That paper is currently in prepartion.
6-2094	6	39	16	39	16	suggests → suggest [Peter Burt, UK]	Accept.
6-2095	6	39	16	39	18	Although there is apparently 3x greening compared with browning globally, using NDVI for 30 yrs of record, what in situ evidence supports this analysis? Suggesting enhanced CO2 seems like a large leap without supporting information. [Beverly Law, USA]	Reject. Can cite a paper reporting the reults in support of these statements. That paper is currently in preparation.
6-2096	6	39	16			continuing realxation' stateemnt looks odd - just say 'warming'? [Jeffrey Obbard, Singapore]	Reject. Relaxation of climatic constraints implies not just warming, but also enhanced precipitation, less cloud cover (more sunshine), etc.
6-2097	6	39	23	39	23	Back again to fluxes and the impossible problem of "balancing" willdly inaccuirate figures. What have they got to do with emissions and budgets? [VINCENT GRAY, NEW ZEALAND]	the section present an analyses of the confidence we have on our models that are used for the carbon balance.
6-2098	6	39	23	39	23	Add "ocean* to subtitle [Nicolas Gruber, Switzerland]	accepted
6-2099	6	39	23	40	19	Maybe here add to the section title "… global and regional ocean carbon balance" [Leticia Cotrim da Cunha, Germany]	accepted
6-2100	6	39	23	40	19	Section head refers to "Model Evaluation of Global and Regional Carbon Balance" but text speaks only of ocean models. [Stephen E Schwartz, USA]	accepted
6-2101	6	39	29	39	29	"is" should be "are" [James Butler, United States of America]	Editorial (combined with comment 6-2102) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2102	6	39	29	39	29	What is meant by "model skills"? This should be either "skills are" or "skill is". [Daniel Metcalfe, Sweden]	sentence deleted
6-2103	6	39	33	39	46	I think it is confusing to coin the "beta-factor" phrase from Kelling and Bacastow's original use of beta for describing the magnitude of the CO2 fertilising factor on C-storage by vegeation. Their beta factor was a coefficient expressing the fractional change of C-storage by vegetation for a fractional change in atmospehric CO2 concentration. ie it was dimensionalees. As used here for the ocean, it is the absolute absorbtion of CO2 for a fractional increse in atmospheric CO2 concetration. Its use here muddies the waters. [Roger Gifford, Australia]	taken into account - section entirely revised
6-2104	6	39	33		46	In this paragraph, I did not see much discussion about "sensitivity". This paragraph seems to only list the results of several work [Zongbo Shi, United Kingdom]	taken into account - section entirely revised
6-2105	6	39	34	39	46	Related to my comment 51. I suggest to be careful in treating Khatiwala's estimate of the time-varying beta as independent of the model results. That the ocean uptake scales with atmospheric CO2 and its variations lies in the very nature of the ocean-atmosphere system, since it can be treated as a mostly linear three-box model with atmosphere, surface ocean, and deep ocean (this scaling was used already by Gloor et al, 2003, and was described and justified in more detail by Mikaloff Fletcher et al., 2006. The foundation of this argument goes back to the pulse respone function models developed in the 1990s, such as that by Joos et al, 1996)). The different methods (forward model, ocean inversion, ocean Green's functions by Khatiwala) then just difer in the way they determine the (constant) exchange coefficients between the reservoirs. I therefore suggest to rewrite this section and simply point out that the non-constant atm. CO2 growth rate has led to time variations in beta, which is captured by all methods given the fundamental nature of how the ocean is taking up anthropogenic CO2. [Nicolas Gruber, Switzerland]	taken into account - section entirely revised
6-2106	6	39	35			"can be evaluated…" or " have been evaluated…" [Zongbo Shi, United Kingdom]	taken into account - section entirely revised
6-2107	6	39	36	39	36	→ Over 1750-2010, the oceans..' [Peter Burt, UK]	Editorial - text revised.
6-2108	6	39	41	39	41	Helpfu to define 'Beta' [Peter Burt, UK]	taken into account - section entirely revised
6-2109	6	39	48	40	4	This is interesting but there is no mode evaluation in that section. The first sentence is misleading. It is not "more difficult", it seems impossible at the moment. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - section entirely revised
6-2110	6	39	51	39	53	How can the oceans take up more CO2 both when the world is warm and cold? [Göran Ågren, Sweden]	taken into account - section entirely revised
6-2111	6	39	51	39	53	need to add "…, as well as more CO2 during…"? [Leticia Cotrim da Cunha, Germany]	taken into account - section entirely revised
6-2112	6	39	51	39	53	"In general, the ocean takes up more CO2 during El Niño events when the world temperature is warm (see Section 6.3.6.4), and more CO2 during glacial periods when the world temperature was cold (see Section 6.2.2.1.1)." There is a contradiction here, i.e. suggesting CO2 is more strongly sequestered in warm water and then more in cold water. This needs to be corrected. [Andrew Glikson, Australia]	taken into account - section entirely revised
6-2113	6	39	51	39	53	These patterns seem to be conflicting, the ocean takes up more CO2 both when the world is warmer and colder than usual? [Daniel Metcalfe, Sweden]	taken into account - section entirely revised
6-2114	6	39	52	39	52	Temperature cannot be warm: '..world is warming..' [Peter Burt, UK]	Rewording suggestion (combined with comments: 6-2115 to 6-2116) - text revised.
6-2115	6	39	52	39	53	replace "world" with "Earth's" - two occurrences [Stefan Gerber, USA]	Rewording suggestion (combined with comments: 6-2114, 6-2116) - text revised.
6-2116	6	39	53	39	53	..world was cooler..' [Peter Burt, UK]	Rewording suggestion (combined with comments: 6-2114, 6-2115) - text revised.
6-2117	6	39	56	39	56	Do you mean "surface temperature" of the ocean or atmosphere? [Daniel Metcalfe, Sweden]	accepted
6-2118	6	39	57	39	57	→ LeQuere et al. (2009) [Peter Burt, UK]	Editorial - the reference corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2119	6	39	57	40	1	Change to "2009) simulate a decreased ocean" [Daniel Metcalfe, Sweden]	Rewording suggestion (combined with comment 6-2120) - text revised.
6-2120	6	39	57	40	1	This is badly worded. Maybe instead of 'give a decrease ocean CO2 uptake of 0-43 PgC during 1959-2008' it would be better as 'give a reduction in cummulative ocean CO2 uptake of 0-43 PgC over the period 1959-2008' [Ian Totterdell, United Kingdom]	Rewording suggestion (combined with comment 6-2119) - text revised.
6-2121	6	39				I suspect title for section 6.3.5.2 should be "Model evaluation of global and regional OCEAN carbon balance. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Editorial (combined with comments: 6-2098 to 2100) - ...
6-2122	6	39				Section 6.3.5.2. This section should also refer to chapter 10 where carbon cycle components of ESMs are also being evaluated. Also I was surprised not to find more (and a figure) on top down-bottom up approaches and how they agree. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - section entirely revised
6-2123	6	40	1	40	1	decrease → decreased [Peter Burt, UK]	Editorial (combined with comments: 6-2118 to 6-2120) - text revised.
6-2124	6	40	1	40	1	"0-43 Pg C" This seems a lot to me. I couldn't find this information in Le Quere et al. [Nicolas Gruber, Switzerland]	Taken into account - section entirely revised.
6-2125	6	40	1	40	11	Figure 6.34 - Please explain the dashed line "nitrogen boundary" (without …); x-axis units (year) are missing. [Leticia Cotrim da Cunha, Germany]	accepted - figure revised
6-2126	6	40	2	40	3	Why do the two estimates of gamma-ocean use opposite sign conventions? [James Christian, Canada]	accepted - sign corrected
6-2127	6	40	2	40	4	0-72, should this not be 0 to -72? [Göran Ågren, Sweden]	accepted
6-2128	6	40	2			Should the '0-72' be '-72 to 0'? [Ian Totterdell, United Kingdom]	accepted
6-2129	6	40	4	40	4	Change to "for the year". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2130	6	40	6	40	12	The basic problem of the carbon cycle is that the models actually ignore the climate, which is the global ensemble of all the small scale and lsrge scale sets of air and ocean movements and heat transfer exchanges. The models are misconceived and coiuld never work [VINCENT GRAY, NEW ZEALAND]	Noted - the carbon cycle models do consider climate in a detailed and physical way.
6-2131	6	40	6			Section 6.3.5.2.2 Title of section should include the word 'ocean', i.e. Processes missing in ocean carbon models [Beverly Law, USA]	accepted
6-2132	6	40	6			It is important to point out the processes missing in the modesl. However, it is also desirable to know what processes in the present models are still highly uncertain. This is important because it tells the way forward to improve the models. [Zongbo Shi, United Kingdom]	rejected - model evaluation is presented in the following section
6-2133	6	40	8	40	12	This statement is far too confident - you only have to read the penultimate paragraph of the cited paper to see that we still really do not know if this likely to be the dominant control. [Paul Halloran, UK]	accepted
6-2134	6	40	11	40	1	"underestimated". I would be more careful here. The impact of eddies can go both ways. [Nicolas Gruber, Switzerland]	partly taken into account - it is the sensitivity of models that is underestimated, not the signal itself. The text has been modified and broaden and should fit in a wider context
6-2135	6	40	12	40	12	Change to "to as much as ~20". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2136	6	40	14	40	19	I think this section on the role of biology should be substantially expanded and strengthened. There are a couple of important processes that we haven't really investigated yet, in particular associated with the remineralization of organic matter in the upper ocean (see e.g. Kwon et al. 2009) [Nicolas Gruber, Switzerland]	taken into account -section revised within the limits of the space constraints
6-2137	6	40	14	40	19	I think this describes the situation perfectly. [Ian Totterdell, United Kingdom]	noted
6-2138	6	40	15	40	16	Change to "Nevertheless, models reprduce to a first order the patterns". [Daniel Metcalfe, Sweden]	Editorial - text revised accordingly.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2139	6	40	17	40	17	Change to "that, up to now, changes". [Daniel Metcalfe, Sweden]	accepted
6-2140	6	40	18			what does 'top-down control by fisheries' mean? [Jeffrey Obbard, Singapore]	Accepted - text clarified.
6-2141	6	40	21	41	36	Evaluatioin is purely the opinion of the people who are paid to produce the models, and have therefore a conflict of interest. No model projection can be trusted unless it has been shown to be capable of future climate prediction to a satisfactory level of accuracy [VINCENT GRAY, NEW ZEALAND]	noted - the backcast evaluation performed in this section is a real test of the model performance.
6-2142	6	40	21			Section 6.3.5.3 should maybe include the information in sections 6.3.5.1.4 through 6.3.5.1.6 (or move these sections to 6.3.5.3 for a more diagnostic evaluation of predictive model performance when compared with observations. [Beverly Law, USA]	rejected - sections 6.3.5.1.4-6 have been deleted
6-2143	6	40	23			change 'done' to 'compared' [Jeffrey Obbard, Singapore]	Editorial - text revised accordingly.
6-2144	6	40	24			Should citation be Schwalm et al. 2010? [Christina Tonitto, USA]	Taken into account - section entirely revised.
6-2145	6	40	25	40	25	Abbreviation for LAI? [Leticia Cotrim da Cunha, Germany]	Accepted
6-2146	6	40	25			Define LAI. [Eric Sundquist, United States of America]	Accepted
6-2147	6	40	28	40	35	Poor grammar throughout this paragraph. The other sections mentioned above could be moved/summarized here for explaining weaknesses in the land models, and processes not included in the land models (similar to the ocean model section on processes that are missing or poorly represented). It is worth discussing the curious findings that atmospheric inversions tend to overestimate terrestrial fluxes compared with bottom-up models, and explain the discrepancies better. [Beverly Law, USA]	Taken into account- weaknesses in the land models were mentioned in the section of 6.3.5.3.2
6-2148	6	40	29	40	35	Figure 6.15 is confusingly described, but it seems to compare NEE simulated by models that do not include land use change to residual fluxes derived from calculations that include land use emissions. The comparison therefore seems to be fundamentally inconsistent. [Eric Sundquist, United States of America]	Rejected-the residual land sink did not include land use change caused C emission.
6-2149	6	40	29			For clarity for those who use the opposite sign convnetion adopted here, I suggest adding "(i.e a sink)" after the the number. [Roger Gifford, Australia]	Taken into account- text revised
6-2150	6	40	30	40	30	Change to "accounting for land". [Daniel Metcalfe, Sweden]	Editorial - text revised accordingly.
6-2151	6	40	31	40	31	You can remove both uses of "emission", since they are redundant here. [Daniel Metcalfe, Sweden]	Editorial - text revised accordingly.
6-2152	6	40	32	40	33	Change to "of the residual", and "despite the large". [Daniel Metcalfe, Sweden]	Accepted-text revised
6-2153	6	40	34	40	35	Finally, a lack of in-situ measurments is acknowledged as a problem. This should be done, when applicable, for all variables when uncertainty is high. [Nikolaus Josef Kuhn, Switzerland]	We are glad you like it. Incusing of the lack of data in other sections.
6-2154	6	40	34			change to 'in-situ' [Jeffrey Obbard, Singapore]	Editorial - corrected in text.
6-2155	6	40	37	40	37	" … are better constrained because of higher availability …". Include "of". [Vivek Arora, Canada]	Editorial (combined with comment 6-2158) - text revised.
6-2156	6	40	37	40	37	modeling → modelling [Peter Burt, UK]	Editorial (combined with comments: 2155 to 2159) - text revised.
6-2157	6	40	37	40	37	are → is [Peter Burt, UK]	Editorial (combined with comment 6-2159) - text revised.
6-2158	6	40	37	40	37	→ because of the higher..' [Peter Burt, UK]	Editorial (combined with comment 6-2155) - text revised.
6-2159	6	40	37	40	37	Replace "modeling" with "models of". Change to "because of the greater availability". [Daniel Metcalfe, Sweden]	Editorial (combined with comment s: 6-2155 to 6-2158) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2160	6	40	38	40	38	Current..' → The current…' [Peter Burt, UK]	Editorial (combined with comments: 6-2161, 6-2163) - text revised.
6-2161	6	40	38	40	38	Change to "inventory approaches show that the forest carbon". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-2160, 6-2163) - text revised.
6-2162	6	40	38	40	41	The inventory results are higher than the model results for both the forest carbon budget and vegetation productivity by about the same proportion; why is it necessary to use "however" in line 40? The more important issue that should be addressed, in the context of model evaluation, is why the models do not agree with the observations. [Eric Sundquist, United States of America]	Accepted-weaknesses in the land models were mentioned in the section of 6.3.5.3.2
6-2163	6	40	38			change to 'Using a current..' [Jeffrey Obbard, Singapore]	Editorial (combined with comment 6-2160, 6-2161) - text revised.
6-2164	6	40	40	40	40	Remove "substantially", you don't need this general descriptor since you then specifically report the magnitude of the difference. [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2165	6	40	41	40	41	→ Schwalm et al. (2010) [Peter Burt, UK]	Editorial (combined with comment 6-2167) - the reference corrected.
6-2166	6	40	41	40	42	Change to "simulate the seasonal". [Daniel Metcalfe, Sweden]	Editorial - corrected in text.
6-2167	6	40	41			Remove parentheses (here and similarly in many other places). [Roger Gifford, Australia]	Editorial (combined with comment 6-2165) - the reference corrected.
6-2168	6	40	43	40	43	delete 'of'' [Peter Burt, UK]	Accepted
6-2169	6	40	43			sentence nneds rewriting: grammar! [David Newbery, CH]	Taken into account
6-2170	6	40	44	40	44	insert 'the' after 'of' [Peter Burt, UK]	Editorial - text revised.
6-2171	6	40	44	40	44	Change to "magnitude of the carbon sink estimated by five". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2172	6	40	46	40	46	Replace "is" with "was". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2173	6	40	47	40	47	Replace "are" with "is". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2174	6	40	50	41	2	FACE experiments are of limited use: they mostly deal with samll tres in crops and pulses of Co2, which is not what happens in nature over decades under mature forest cover. [David Newbery, CH]	Taken into account-mentioned the limited use of FACE
6-2175	6	40	50	41	2	This is duplicative of 31:46-53, and both overlap with treatments in WGII ch 4 and ch 7 [Robert Scholes, South Africa]	Accepted - reduced duplication and made a new Box to concentrate information.
6-2176	6	40	51	40	51	Change to "sensitivity of the carbon" in both cases [Daniel Metcalfe, Sweden]	Accepted-text revised
6-2177	6	40	52	40	54	In summarizing the FACE results, it is very important to describe the results for NEE as well as NPP. [Eric Sundquist, United States of America]	Accepted - nex box on the CO2 fertilization provides more detail, although most FACE experiments do not report NEE
6-2178	6	40	53	40	53	Change to "show a sustained". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2179	6	40	55	40	55	What is meant by "co-located"? [Daniel Metcalfe, Sweden]	Taken into account
6-2180	6	40	56	40	57	This doesn't make clear sense, perhaps change to something like "studies question the universality". [Daniel Metcalfe, Sweden]	Accepted-text revised
6-2181	6	40		72		I have read the material quickly but have not had time to formulate any suggestions. If time permits I will send another set of comments before the deadline. However, I note that some of the projections seem to be for very long time scales, and the underlying principles that will cause future emissions do not seem to be spelled	We assume principles mean processes in this context. We have some additional information on the relative importnace of the modelled processes.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						out [Mohammad Aslam Khan Khalil, USA]	
6-2182	6	40				Section 6.3.5.3.1 Doesn't say anything about model evaluation. You should a) compare FACE beta with C4MIP and CMIP5 beta, and b) refer to papers having simulated FACE experiments with DGVMs (eg. Hckler et al., GCB, 2008; Zaehle et al., GRL, 2010) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account
6-2183	6	40				Figure 6.38 Please describe what is the "Nitrogen Boundary" in this figure. [Cynthia Nevison, USA]	Accepted - text revised
6-2184	6	41	1	41	2	Change to "2011) though these studies face other limitations, such as the difficulty of accounting for other interactive" [Daniel Metcalfe, Sweden]	Taken into account-text revised
6-2185	6	41	1	41	9	Figure 6.35 - Figure quality is not very good; axis units are missing (time and SO x and reactive N deposition). [Leticia Cotrim da Cunha, Germany]	taken into account - figure revised
6-2186	6	41	1	156	5	The rest of this chapter is devoted to the problem I have outlined: how to reconcile emissions with future scenatios and carbon cycles and I must admit that you make a huge meal of it. The problem in the pudding is in the eating and I await with interest any attempts that you make to find out whether any of the projections will coincide with what actually happens. The omens are bleak. It is clear that the extreme measures for cutting emissions which would be needed for the future of an acceptable climate are never going to be achueved, in which case you are projecting inevitable unmitigated disaster It is obvious from several of your diagrams that all this has depended on a pictuire of the earth's climate which is completely unrealistic. The earth is static, without a breath of wind, with sun all day and all night, with no variabilty, in other woirds the very opposite of the climate we all experience and is best projected by our weather forecasting service. who actually get it right most of the time. We can be assured that sooner or later you are going to have to admit this.truth.. [VINCENT GRAY, NEW ZEALAND]	Yes, we need to wait to find out if model projects are close to reality.
6-2187	6	41	4	41	9	This section is worrying because in the absence of data from the tropics, the implication is that warming generally will increase NPP. Is there no evidence at all that could be used to suggest the direction of change in NPP with warming in the tropics? If not, this should in any case be flagged as a major area of uncertainty. It is to be expected that warming increases NPP in climates with a cold winter, because the dominant effect is then the lengthening of the growing season. In the tropics here is no such effect and the direction of effect is not obvious a priori, and represented differently in models. [Iain Colin Prentice, Australia]	Taken into account-text revised
6-2188	6	41	7	41	7	aboveground → above ground [Peter Burt, UK]	Editorial - text revised.
6-2189	6	41	8	41	9	More caveats on the FACE results are needed - this was also dominated by young forests and grasslands, and relatively short term such that lagged responses in forests like changes in carbon allocation patterns with N limitations may not have been noticeable. [Beverly Law, USA]	Taken into account
6-2190	6	41	11	41	12	" … global terrestrial net carbon uptake in response to 1 C increase if global mean temperature could decrease by about 4 Pg C/yr C". First, it is not at all obvious to me how this can be inferred from Figure 6.15 which shows the land carbon sink as a function of time. Second, if we are saying that 1 degree increase in global mean temperature decreases the uptake by 4, then the units should be Pg C/yr and not Pg C/yr C. [Vivek Arora, Canada]	Taken into account- Figure 6.15 should be changed to Figure 6.20
6-2191	6	41	11	41	12	It is not clear how Fig 6.15 demonstrates this poiunt, or how any methodolgy involving estimation of the residual sink separates warming effects from CO2 fertilising effects. [Roger Gifford, Australia]	Taken into account- Figure 6.15 should be changed to Figure 6.20
6-2192	6	41	11	41	12	It is difficult from Figure 6.15 to find a relationship between temperature and land (or residual) CO2 budget. It may be better to add a curve of land average annual temperature in the figure. [Akihiko Ito, Japan]	Taken into account- Figure 6.15 should be changed to Figure 6.20
6-2193	6	41	13	41	15	Again, how can the range of this temperature sensitivity across models can be inferred from Figure 6.15. Seems like some additional references and cleaning up of the text is needed here. Also, I am currently analyzing carbon-concentration and carbon-feedback parameters in the 1% increasing CO2 runs from seven CMIP5 models and I get temperature sensitivities of around 1-2 Pg C/yr C. I will be forwarding this manuscript to Chris Jones. [Vivek Arora, Canada]	Taken into account- Figure 6.15 should be changed to Figure 6.20

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2194	6	41	15	41	15	space after) [Peter Burt, UK]	Editorial (same comment 6-2199) - corrected in text.
6-2195	6	41	15	41	15	inser 'the' after 'by' [Peter Burt, UK]	Editorial - text revised.
6-2196	6	41	15	41	15	Change to "C-1) is close" [Daniel Metcalfe, Sweden]	Accepted-text revised
6-2197	6	41	15	41	18	You should use the Frank et al range to give the likely range of C4MIP models, as done in Franck et al paper (and as also done in the last millenium section 6.2.4) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Taken into account-we mentioned that "The sensitivity of carbon cycle to climate change varies with different time scale. "
6-2198	6	41	15	41	18	This paragraph is confusing. The models produce decreasing NEP with increasing temperature. The absolute residual sink is increasing with time (and global avg temperature) so the residual sink is going in the opposite direction from the warming effect. The sentence seems to imply that they are of the same size and comparable magnitude. Reword perhaps. [Roger Gifford, Australia]	Taken into account-text revised
6-2199	6	41	15			space after ')' [Jeffrey Obbard, Singapore]	Editorial (same comment 6-2194) - corrected in text.
6-2200	6	41	16	41	16	as → at [Peter Burt, UK]	Editorial - text revised.
6-2201	6	41	16	41	16	Change to "estimated as 3.6-45.6" and "1.7-21.4". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2202	6	41	18	41	18	atmosphere → atmospheric [Peter Burt, UK]	Editorial - text revised.
6-2203	6	41	18	41	18	was → were [Peter Burt, UK]	Editorial (combined with comments: 6-2204, 6-2205) - text revised.
6-2204	6	41	18	41	18	Replace "was" with "were". [Daniel Metcalfe, Sweden]	Editorial (combined with comments: 6-2203, 6-2205) - text revised.
6-2205	6	41	18			change 'was' to 'where' [Jeffrey Obbard, Singapore]	Editorial (combined with comments: 6-2203, 6-2204) - text revised.
6-2206	6	41	20	41	21	"Previous model studies suggested that carbon release in response to future drying is one of the dominant contributors to the positive carbon cycle-climate feedback found in previous coupled models". Reword by removing one "previous". [Vivek Arora, Canada]	Accepted-text revised
6-2207	6	41	20	41	36	I think there needs to be some literature reference here for the experiment shown in the figure. The MLR approach used can not be identified from the information given. [James Christian, Canada]	Accepted
6-2208	6	41	20		27	precipitation is again a poor guide to what is available to trees in terms of soil water: and the adaptations involved inby species in different regios, Generalizations are not possible. [David Newbery, CH]	added sentence in caption
6-2209	6	41	20			insert 'have' after 'studies' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-2210	6	41	22	41	23	While indeed there are only a few studies on precipiation sensitivity, some are available and the number of precip-manipulation studies is increasing. Some should be cited here, e.g. work of Asmeret Berhe, UC Merced [Nikolaus Josef Kuhn, Switzerland]	Taken into account
6-2211	6	41	22	41	25	There are plenty of eddy covariance sites and long-term research sites where the sensitivity to precipitation has been evaluated, and changes in ET (Jung et al). Compared this to model sensitivity. [Beverly Law, USA]	Taken into account-information provided
6-2212	6	41	23	41	23	They are "very limited" but nevertheless the few that do exist provide important constraints to models. There were two in the Amazon, for example. What did they show, did they support model predictions? [Daniel Metcalfe, Sweden]	Taken into account-text revised
6-2213	6	41	25	41	25	Change to "based on the residual" [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2214	6	41	26	41	26	insert 'out' after eight [Peter Burt, UK]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2215	6	41	27	41	27	Is there any fundamental difference between NEP and "net carbon uptake"? It would be clearer if this terminology was consistently applied. [Daniel Metcalfe, Sweden]	Taken into account-text revised
6-2216	6	41	29	41	36	These are nothing more than pure speculation. [VINCENT GRAY, NEW ZEALAND]	Taken into account-text revised
6-2217	6	41	29			Figure 6.20. What is the meaning of the letters A – K? [Göran Ågren, Sweden]	Taken into account
6-2218	6	41	29			Caption to Fig 6-20: Explain the letter designations – 11 models? [Richard Bourbonniere, Canada]	Taken into account
6-2219	6	41	29			Can caption include description of sites/models represented by the letters in the graph? [Christina Tonitto, USA]	Taken into account
6-2220	6	41	30	41	30	Change to "and the residual". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2221	6	41	33	41	33	Change to "and the modeled". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2222	6	41	38	41	52	The main processes missing from the models are the ordinary major processes of the real climate, the wind and ocean movements, the energy exchanges by convection and evaporation/precipitation, the regions of high and low air pressure; namely the climate as understood by traditional meteorology. [VINCENT GRAY, NEW ZEALAND]	Taken into account-combined with other comments
6-2223	6	41	38			Section 6.3.5.2 ok, this is what I was looking for on the previous page. Clarify the title of the section by including "terrestrial" or "land surface" [Beverly Law, USA]	Taken into account
6-2224	6	41	38			similar comment to above [Zongbo Shi, United Kingdom]	Taken into account
6-2225	6	41	39	41	39	Change to "Currently, most". [Daniel Metcalfe, Sweden]	Editorial (same comment 6-2228) - text revised.
6-2226	6	41	39	41	52	Water table level is an important driver e.g. for CH4 fluxes from wetlands. Also, increasing frequency of heavy precipitation events and wet and dry periods might have significant feedbacks to C cycling. Water related processes are still missing from all these models, which might have direct links to the confidence level of statements. [Pirkko Kortelainen, Finland]	Taken into account-combined with other comments
6-2227	6	41	39	41	52	Somewhere in this paragraph, mention disturbance effects on albedo and the relative contribution to radiative forcing compared with carbon sources and sinks. It seems to be missing in most terrestrial models, and is important where snow cover increases albedo when forests burn or die from beetles. [Beverly Law, USA]	Rejected-this section only discuss carbon cycle but not radiative forcing
6-2228	6	41	39			insert ',' after 'currently' [Jeffrey Obbard, Singapore]	Editorial (same comment 6-2225) - text revised.
6-2229	6	41	41	41	42	Here is a direct statement confirming the lack of appreciation of forest mangement in most models (see comment no. 2). [Peter Högberg, Sweden]	Yes, address above.Thanks for the comment.
6-2230	6	41	42	41	42	"First, carbon cycle models usually simulate biomass and soil carbon contents directly, but most of them do not represent stand growth processes ". What does "stand growth processes" actually means here. I think it will help to be more explicit. Even as a terrestrial ecosystem modeller, I am unsure what this phrase actually means. You do say that models usually simulate biomass and soil carbon content directly. What does "directly" mean? There ARE physical processes that need to be modelled, even in the most simplest models, to simulate vegetation biomass and soil carbon. This sentence likely needs to be reworded. Looking at the next sentence which talks about forest age structure what probably needs to be said here is that most terrestrial ecosystem models do not explicitly take into account various forms of disturbances, including fire, logging, harvesting and the resulting variation in forest age structure which is known to affect the net carbon exchange. [Vivek Arora, Canada]	Taken into account-text revised
6-2231	6	41	44	41	44	"Second, processes relevant to feedbacks from organic soils are limited, including …". I would rather write this as - Second, the representation of physical process relevant to organic soils is limited …". "Processes relevant to feedbacks" seems quite vague. Again, it might be useful to be more explicit and actually say what these physical processes actually are. I am not an organic soils person so don't actually know but suspect these include different heat and soil moisture capacities of organic soils versus mineral soils which affect	Taken into account-text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						permafrost thawing. [Vivek Arora, Canada]	
6-2232	6	41	45			Personally I think it would be god to see the expansion of Section 6.4 to discuss the future evolution of specific ocean sink regions, and discussion the mechanisms controlling these - what changes impact the future modelled CO2 uptake in the N. Atlantic and S. Ocean? Do we believe these changes? What is controlling the regional beta and gamma terms? I'm looking into this in the N. Atlantic but I would have through exploring what is going on with the CMIP5 S. Ocean response would be really useful - certainly we see some interesting implications of stratification resulting from melting ice and increased precipitation in HadGEM2-ES. [Paul Halloran, UK]	rejected - no scientific evidence provided to support changes
6-2233	6	41	46	41	47	You mention several studies, but give one reference [Peter Burt, UK]	Accepted-text revised
6-2234	6	41	46	41	48	Another place where Table 6.6 should be discussed. [Eric Davidson, USA]	Accepted-text revised
6-2235	6	41	46	41	48	Third, despite several studies highlighted the important role of N cycle in regulating carbon cycle (Magnani et al., 2007), N dynamics has only coupled in a few carbon cycle models.' As suggested previously, though N interactions are not well represented in models yet, it would help the reader to have an idea of the potentail magnitude of this impact on net C fluxes. [Dave Reay, UK]	taken into account - sentence added summarizing the published model-based estimates of impact of C-N coupling on global scale carbon fluxes, carbon stocks, and carbon-climate feedbacks.
6-2236	6	41	47	41	47	highlighted → highlighting [Peter Burt, UK]	Editorial - text revised.
6-2237	6	41	47	41	49	Change to "studies highlighting the important role of the N cycle in regulating the carbon cycle", "only been coupled", and "pollution have also not been taken into account in most current carbon cycle models despite evidence that increases in the tropospheric" " [Daniel Metcalfe, Sweden]	Accepted-text revised
6-2238	6	41	47			In fact the Magnani et al. paper stirred up considerable debate. While many authors agreed that N deposition mostly increases forest growth and C sequestration, the actual quantitative relation between N depositon and forest C sequestration was stated to be an order of magnitude lower than that suggested by Magnani et al. (see, e.g., Högberg 2007 Nature, de Vries et al. 2008 Nature, Sutton et al. 2008 GCB, Högberg 2012 GCB). [Peter Högberg, Sweden]	Taken into account
6-2239	6	41	47			the study by Magnani et al has been heavily critizised, the references should be easy to find [Per Erik Karlsson, Sweden]	Taken into account
6-2240	6	41	47			Is P cycle important in regulating carbon cycle? [Zongbo Shi, United Kingdom]	taken into account - combined with comments 1686 and 1687
6-2241	6	41	47			Include this reference for N effect on soil C storage. (Janssens et al. 2010 Reduction in forest soil respiration in response to nitrogen deposition. Nature Geoscience 3:315-322) [Christina Tonitto, USA]	Taken into account
6-2242	6	41	48	41	48	text missing [Peter Burt, UK]	Taken into account
6-2243	6	41	48	41	48	I was surprised to see (surviving from the first draft) that there are "only … a few" carbon cycle models with N dynamics. I just counted eight (not all referenced here!) How many models do you need for it to me more than "a few"? [Iain Colin Prentice, Australia]	Taken into account-text revised
6-2244	6	41	50	41	52	The role of lateral surface processes, especially water and tillage erosion, should be mentioned here. [Nikolaus Josef Kuhn, Switzerland]	Taken into account-text revised
6-2245	6	41	51	41	52	Change to "human management activities including", "influence the carbon cycle", and "but it has not been considered in most". [Daniel Metcalfe, Sweden]	Accepted - text revised accordingly.
6-2246	6	41	54			"6.4 Future Projections of Carbon and other Biogeochemical Cycles" . "Future projections"; is this meant to distinguish from "past projections", that is projections that were made in the past? Or "present projections ", projections that are being made now? I think the title is meant to mean something like Projections of future biogeochemical cycles of carbon and other substances. [Stephen E Schwartz, USA]	Accepted - text revised accordingly.
6-2247	6	41	56	41	68	These are all merely your opinion. But you are biased because it is expected of you [VINCENT GRAY, NEW ZEALAND]	rejected - supported by peer-reviewed literature

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2248	6	41	57	41	57	Changes can easily be projected, i assume you're concerned with assessing how accurate these projections are? If so, i suggest change to "our ability to accurately project changes in". [Daniel Metcalfe, Sweden]	Accepted - text revised accordingly.
6-2249	6	41	57			remove 'we' and correct grammar [Jeffrey Obbard, Singapore]	rejected - grammar is OK
6-2250	6	41		42		it is very important to recognize that putative effects of raised CO2 cannot be separated from recent decades of forest regrowth, or enhance growth due to past major disturbances, succession and other recurrent events like ENSOs [David Newbery, CH]	noted.
6-2251	6	41		50		This section seems inconsistent in the perspective it takes for land and marine processes. It is very good that there are sections on ocean acidification and oxygen depletion - these are important for impacts. However, the land focus seems to be more on its importance as feedbacks to the atmosphere. Why not include discussion of the role of CO2 fertilization and increased plant water use efficiency, which (like ocean acidification and oxygen depletion) is important for impacts - eg: drought, crop productivity and biome change. Including ocean acidification but not CO2 fertilization or increased water use efficiency leaves the chapter open to te charge of bias, since the former is considered "bad" but the latter two may be considered "good". Moreover, CO2 effects on land ecosystems are mentioned in section 6.5.4 as an issue to consider for solar radiation management, so more context is needed for that. [Richard Betts, United Kingdom of Great Britain & Northern Ireland]	taken into account - text will be added to discuss ocean fertilization
6-2252	6	41				Section 6.4.1 seems very vague and unfinished, especially statements like: “As the complexity of Earth System Models continues to increase it is important to reflect any new findings in such policy relevant assessments.” (appears out of nowhere, doesn’t make much sense in the context of the paragraph it is tacked on the end of) “A recent review highlighted the complexity of terrestrial biogeochemical feedbacks (Arneth et al., 2010).” (what are the relevant results in this review? Should they be summarized here? If not does it really make sense to include this sentence?) Parts of 6.4.2.1 are also excessively vague. The paragraph at the bottom of p. 43 mostly just describes what each group of researchers did, rather than summarizing their conclusions. [James Christian, Canada]	taken into account - section shortened and clarified
6-2253	6	41				Figures are not readable [Zongbo Shi, United Kingdom]	reject - figures are readable
6-2254	6	42	1	42	1	delete IPCC [Peter Burt, UK]	Accepted - text revised.
6-2255	6	42	1	42	1	feedback → feed back [Peter Burt, UK]	Editorial - text revised accordingly.
6-2256	6	42	1	43	7	Figures 6.36 and 6.37: colour bar could be placed at the bottom of the three panels; panels could be labeled a), b), c) [Leticia Cotrim da Cunha, Germany]	Noted, figure will be reformatted.
6-2257	6	42	2		21	nearly all vegetation-climate models are too broad and general with no attention to nutrients (agree here) - but note no model involves phosphorus [David Newbery, CH]	taken into account - some models include P and this is discussed in section 6.4.8
6-2258	6	42	3	42	3	→ Cox et al. (2000) [Peter Burt, UK]	Editorial - the style of citation corrected.
6-2259	6	42	6	42	6	insert) after 2006 [Peter Burt, UK]	Editorial (same comment 6-2260) - the style of citation corrected.
6-2260	6	42	6	42	6	Change to "2006)) and" [Daniel Metcalfe, Sweden]	Editorial (same comment 6-2259) - the style of citation corrected.
6-2261	6	42	7	42	11	Yoshikawa et al. (2008), Journal of Geophysical Research, DOI:10.1029/2007JG000570, showed significant geographical variations of climate-carbon feedback can be found within a single model, and that the feedback can even be negative in some parts on the globe. This study should be cited together with Booth et al. [Michio Kawamiya, Japan]	taken into account - thank you, this study is relevant to regional beta/gamma analysis
6-2262	6	42	8	42	8	CO2 → CO2 [Peter Burt, UK]	Editorial - corrected in text.
6-2263	6	42	8	42	8	Change to "remains, both" [Daniel Metcalfe, Sweden]	Editorial - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2264	6	42	13	42	21	This paragraph discusses the impact of nutrient changes, such as nitrogen, on the terrestrial carbon cycle. There appears to be no analogous discussion of the impact of changes in nutrient inputs on the marine carbon cycle, although this is briefly mentioned in lines 38-39 on this page. See also my comments about page 6-30 above. [Robert Duce, USA]	Accepted - this is discussed later in the section but will be mention here.
6-2265	6	42	13	42	21	In this section the link to grey emissions should also be made, i.e. not only a link between C pools and fluxes and nutrients should be made, but also to the emissions associated with the fertilisation required for a particular land use. An example is the study of West and Marland (2002; Agr. Ecosyst. Environ. 91, 217–232). [Nikolaus Josef Kuhn, Switzerland]	taken into account - this paragraph discusses the presence or absence of nutrient cycles as a first-order effect in Earth system models. Including CO2 emissions associated with fertilizer production to accomplish a particular land management strategy is well beyond the scope of any current model, and cannot be properly addressed in this introductory material to the future projections section 6.4. The final sentence of the preceding paragraph provides a better connection to this topic, and we have included the West and Marland reference there as an additional example of known processes missing from current models.
6-2266	6	42	14	42	14	Change to "cycle, affecting". [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2267	6	42	15	42	15	chnages → change [Peter Burt, UK]	Editorial - text revised.
6-2268	6	42	16	42	16	Will "nitrogen" be abbreviated to N in this document or not? [Daniel Metcalfe, Sweden]	taken into account - We will use both "N" and "nitrogen" as appropriate for clarity
6-2269	6	42	16	42	21	This becomes a bit unclear. You state that inclusion of the N cycle in your C cycle models is necessary, but make only very vague predictions about the potential outcome. [Peter Högberg, Sweden]	taken into account - model uncertainty is discussed and quantitative CN results given in section 6.4.6
6-2270	6	42	17	42	18	When mentioning this point about the sign of the feedback changing, you should mention that this is known to be unrealistic because of the millennium-scale variations (see e.g. Friedlingstein and Prentice 2010, which is cited). [Iain Colin Prentice, Australia]	taken into account - the difficulty of interpretting feedbacks across different timescales is discussed and this prevents using one period to constrain another directly
6-2271	6	42	18	42	18	to limit → limiting [Peter Burt, UK]	Editorial and rewording suggestions (combined with 6-2272 to 6-2274) - text revised.
6-2272	6	42	18	42	18	delete second 'to' [Peter Burt, UK]	Editorial and rewording suggestions (combined with 6-2271 to 6-2274) - text revised.
6-2273	6	42	18	42	20	Change to "The capacity of nitrogen", and "change highlights the necessity of viewing the future". [Daniel Metcalfe, Sweden]	Editorial and rewording suggestions (combined with 6-2271 to 6-2274) - text revised.
6-2274	6	42	19	42	19	reduce → reducing [Peter Burt, UK]	Editorial and rewording suggestions (combined with 6-2271 to 6-2273) - text revised.
6-2275	6	42	20	42	20	What kind of competition. Please explain [Nicolas Gruber, Switzerland]	accepted - text revised
6-2276	6	42	20	42	20	This is not clear, what two effects are you referring to, carbon and nitrogen? [Daniel Metcalfe, Sweden]	accepted - text revised
6-2277	6	42	23	42	23	"predictive link" you say. What does it predict, and does this agree with what actually happens? [VINCENT GRAY, NEW ZEALAND]	rejected - what it predicts is presented in sec 6.4, model evaluation is covered in section 6.3 and also chapter 9
6-2278	6	42	23			Assuming that my interpretation of Figure 6.20 that the models exhibit spread of an order of magnitude is correct, one looks, in vain, it seems, for a statement in the text that speaks to the confidence that can be placed in these models. There is a statement	taken into account - model uncertainty is discussed and confidence statements made

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						"Coupled climate-carbon cycle models provide a predictive link between fossil fuel CO2 emissions and future CO2 concentrations and are an important component of the CMIP5 experiment design." Setting aside the nicety of the distinction between projections and predictions (discussed at length at Chapter 11, page 2, line 9), such a statement seems at total variance with the inability of the models to get within an order of magnitude of each other. The language continues: "The main conceptual advance of CMIP5 models analysed in this chapter, compared to the C4MIP first generation coupled carbon-climate models in AR4, is their treatment of land use change fluxes, as a perturbation of the carbon cycle driven by local land cover change, instead of an external prescribed emission." So it is clear that the models are attempting to simulate the response of flux to perturbations that is (it would appear) presented in Figure 6.20. So this may be a "conceptual advance" but it would appear that the models have little skill, so it would seem unjustified to go any further. Despite that, he para continues: "Simplified models calibrated against complex coupled carbon-climate models have been used to extrapolate findings to new or longer scenarios (House et al., 2008; Meehl et al., 2007; Plattner et al., 2008). As the complexity of Earth System Models continues to increase it is important to reflect any new findings in such policy relevant assessments." It would certainly seem necessary to support such a statement of utility of such models given their apparent failure to represent the observed sensitivities. And it would seem that an Assessment such as this is the place to point this out, rather than speak to the utility or importance of reflecting findings with such models in policy relevant assessments. Or at least, to attach an uncertainty estimate to the output of such models. [Stephen E Schwartz, USA]	
6-2279	6	42	30	42	31	Is that last sentnce "As the complexity …" really necessary. It doesn't bring any new information, and it's a subjective judgement. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted - text revised
6-2280	6	42	32			correct CH4 [Jeffrey Obbard, Singapore]	Editorial (with same comments: 6-2283 to 6-2285) - corrected in text.
6-2281	6	42	33	42	43	I suggest adding a comment on the interaction between N availability and methane oxidation. This is still an unresolved but question but could be of importance for the future methane budget. A discussion of this problem can be found in Gärdenäs A.I., Ågren G.I., Bird J.A., Clarholm M., Hallin S., Ineson P., Kätterer T., Knicker H., Nilsson S.I., Näsholm T., Ogle S., Paustian K., Persson T. and Stendahl J. (2011) Knowledge gaps in soil carbon and nitrogen interactions - From molecular to global scale. Soil Biol Biochem 43, 702-717. [Göran Ågren, Sweden]	Accepted - a comment will be added.
6-2282	6	42	33	42	57	This discussion and Figure 6.21 are incomplete with respect to climate-nitrogen interactions. I suggest citing the Butterbach-Ball et al. chapters in the European Nitrogen Assessment (Sutton et al., 2011, Cambridge Press). [Eric Davidson, USA]	accepted - acknowledgement of missing second-order interactions and citation to ENA added in the Figure 6.21 caption
6-2283	6	42	34	42	34	CH4 → CH4 [Peter Burt, UK]	Editorial (with same comments: 6-2280, 6-2284, 6-2285) - corrected in text.
6-2284	6	42	34	42	34	Subscript 4 in "CH4". [Daniel Metcalfe, Sweden]	Editorial (with same comments: 6-2280, 6-2283, 6-2285) - corrected in text.
6-2285	6	42	34			CH4? [Zongbo Shi, United Kingdom]	Editorial (with same comments: 6-2280, 6-2283, 6-2284) - corrected in text.
6-2286	6	42	35	42	37	Changes in the nitrogen cycle, in addition to interactions with CO2 sources and sinks, affect emissions of N2O both on land and from the ocean (Section 6.4.6).' This is an important point and a very useful section overall. If not mentioned elsewhere, the interaction the of the N cycle with CH4 fluxes (esp. soil CH4 oxidation) may also be worth mentioning [Dave Reay, UK]	Accepted, we will mention the interactions.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2287	6	42	42	42	42	insert comma after 'Therefore' [Peter Burt, UK]	Editorial (same comment 6-2288) - corrected in text.
6-2288	6	42	42			insert ',' after 'Therefore' [Jeffrey Obbard, Singapore]	Editorial (same comment 6-2287) - corrected in text.
6-2289	6	42	45	42	57	You have lots of "confidence" but where is the evidence that it actually works? [VINCENT GRAY, NEW ZEALAND]	reject - confidence is not mentioned in this section except to say it is low where evidence is limited. Model evaluation is presented in sectin 6.3 and chapter 9
6-2290	6	42	51			Collins et al., 2011a: this reference is exactly the same as Collins et al., 2011b in the reference list [Zongbo Shi, United Kingdom]	editorial - will be corrected
6-2291	6	42				Figure 6.36. This should show RCPs 4.5 and 8.5 in order to span the range of nitrate deposition. Reference should be to Lamarque et al. 2011, not 2010 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepted - in part: reference will be corrected; Rejected in part: Given general similarities, and space constraints, RCPs 4.5 and 8.5 will not be shown.
6-2292	6	42				Figures, page 42. The reference for Figure 6.36 is given as Lamarque et al. 2010, and in the reference list that paper is indicated to be Lamarque, J.-F., et al., 2010: Historical (1850-2000) gridded anthropogenic and biomass burning emissions of reactive gases and aerosols: methodology and application. Atmos. Chem. Phys., 10, 7017-7039. However, looking at that paper I cannot find anything similar to Figure 6.36. [Robert Duce, USA]	Accepted - reference will be corrected.
6-2293	6	43	1	43	57	All mere speculation. When are you going to provide proof that it is predictive? [VINCENT GRAY, NEW ZEALAND]	rejected - this discussion is about measuring feedback processes in the models and is supported by peer-reviewed literature
6-2294	6	43	1	50	18	Sections 6.4.2 and 6.4.3 are vital to the effectiveness of this chapter and to the overall success of AR5. These sections should show clearly, in language that is accessible by nonspecialists, the advances made by recent analyses of both C4MIP and CMIP5, and the utility (and difficulties) of using the RCP's. A text box explaining the background and comparing C4MIP and CMIP5 is warrented. Another text box explaining the RCP's -- in a specific carbon cycle context -- is also warranted. I also suggest that all of the chapter's sensitivity estimates -- past, present, and projected -- be gathered into a single section of the chapter, where methods and their dependencies can be more fully described and compared. In particular, sensitivities that refer to different models, scenarios, and time scales should not be compared without appropriate caveats. [Eric Sundquist, United States of America]	accepted - added box explaining carbon system design, background text briefly explaining RCP approach and added comparison of gammas; sensativity estimates for different time scales'
6-2295	6	43	5	43	15	The alpha, beta, gamma conceptual model is very useful, but very difficult to explain briefly to non-specialists. This paragraph fails to do so adequately. [Robert Scholes, South Africa]	taken into account - reworded for clarity. These metrics are also defined earlier in the chapter
6-2296	6	43	5	43	16	Units: Pg C K-1 [Leticia Cotrim da Cunha, Germany]	accepted - text revised
6-2297	6	43	5	43	16	By pertubing 12 parameters selected by experts opinion and leteratures, we identified some significant parameters controlling beta_L and gamma_L for 1% increase and RCP4.5 scenarios (Tachiiri, K., Ito, A., Hajima, T., Hargreaves, J. C., Annan, J. D. and Kawamiya, M (in print) Nonlinearity of land carbon sensitivities in climate change simulations, Journal of the Meteorological Society of Japan, 90A, 261-276.). [Kaoru Tachiiri, Japan]	noted - thank you
6-2298	6	43	5		16	The quantities alpha beta and gamma and g are not defined well enough for this to be useful. "g" should not be referred to as "gain factor" but simply "gain"; Friedlingstein, J Clim 06, just after eq 1 of that paper. If, as it appears, this feedback analysis is going to be discussed in detail here, a box would seem necessary to define the several quantities. [Stephen E Schwartz, USA]	taken into account - reworded for clarity and defined earlier in the chapter
6-2299	6	43	5		16	The conclusion is very powerful: "the concentration-carbon response is very uncertain, and there is no suitable observation against which to evaluate accurately the climate-carbon cycle gain factor."	rejected - models can be evaluated at a process level even if the feedback gain factor cannot be observed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						This is the sort of forthright language that is needed more in the present assessment. A logical conclusion would be that it is premature to represent these quantities (or the governing processes) in coupled climate models and the attendant effort in conducting, interpreting, and comparing climate model runs that represent these processes. A corollary is that the discussion that follows could be eliminated from the report. [Stephen E Schwartz, USA]	
6-2300	6	43	5			kg N ha-1 should be Kg S ha-1 [Zongbo Shi, United Kingdom]	accepted - text revised (I believe this comment referred to the caption for Figure 6.37, which was corrected under comment 2575)
6-2301	6	43	7	43	8	Replace "cycle" with "cycles", in both cases. [Daniel Metcalfe, Sweden]	Editorial - text revised.
6-2302	6	43	9	43	9	→ Friedlingstein et al. (2006) [Peter Burt, UK]	Editorial - the style of citation corrected.
6-2303	6	43	10	43	10	delete 'g' [Peter Burt, UK]	accepted - text revised
6-2304	6	43	10	43	10	Replace "discuss" with "argue" or "suggest". [Daniel Metcalfe, Sweden]	Rewording suggestion (combined with comment 6-2306) - accepted.
6-2305	6	43	10			I note that the use of reference in sentences encloses the author. Should it not be Gregory et al. (2009)? If so this should be corrected for all such use of references in Chapter 6. [Jeffrey Obbard, Singapore]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2306	6	43	10			discuss to discussed [Zongbo Shi, United Kingdom]	Rewording suggestion (combined with comment 6-2304) - text revised.
6-2307	6	43	12	43	12	Change to "climate, and". [Daniel Metcalfe, Sweden]	Editorial - accepted.
6-2308	6	43	13	43	14	This is not clear, at least to me. What "well known black-body response"? [Daniel Metcalfe, Sweden]	taken into account - reworded for clarity
6-2309	6	43	14			delete "," [Zongbo Shi, United Kingdom]	Editorial - corrected in text.
6-2310	6	43	31			Table 6.9. The columns need to be better explained. What is for example Group? [Göran Ågren, Sweden]	taken into account - reworded for clarity
6-2311	6	43	35	43	35	There is a "g" lost in the text. [Leticia Cotrim da Cunha, Germany]	accepted - text revised
6-2312	6	43	37	43	37	insert 'the' after 'for' [Peter Burt, UK]	Editorial - corrected in text.
6-2313	6	43	38	43	38	ocean → oceans [Peter Burt, UK]	Editorial - corrected in text.
6-2314	6	43	42			or nearby - remind the reader what alpha, beta and gamma are (from previous chapters..?) [David Newbery, CH]	taken into account - reworded for clarity
6-2315	6	43	47	43	47	→ Boer and Arora (2010) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2316	6	43	47	43	56	Another vry dense paragraph, hard for non-specialists to follow. [Robert Scholes, South Africa]	taken into account - reworded for clarity
6-2317	6	43	47	53	50	Sentence is too long. [Leticia Cotrim da Cunha, Germany]	taken into account - reworded for clarity
6-2318	6	43	47			analyse to analysed [Zongbo Shi, United Kingdom]	Editorial - corrected in text.
6-2319	6	43	49	43	49	al → al. [Peter Burt, UK]	Typo - corrected.
6-2320	6	43	49	43	49	Yoshikawa et al. (2008) is not included in the reference list. [Akihiko Ito, Japan]	Editorial - accepted.
6-2321	6	43	49			change 'present' to 'presents' [Jeffrey Obbard, Singapore]	Editorial - text revised.
6-2322	6	43	51	43	56	Units: Pg C K-1 or Pg C ppm-1 [Leticia Cotrim da Cunha, Germany]	accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2323	6	43	52	43	54	"In an exactly linear framework these metrics would be equivalent, but given non-linearities in the system, these approaches yield different quantitative results." - Chris, this is not exactly true. As you will see in the paper I will send you the Friedlinfgstein et al.'s feedback parameters are temperature and concentration weighted forms of Boer and Arora's feedback parameters. [Vivek Arora, Canada]	taken into account - reworded for clarity
6-2324	6	43	52		56	linearity, nonlinearity. The linear term may be thought of as the leading term in a taylor series expansion about the present (or any other) climate state. The nonlinearities come to play only when the departure from the initial state is substantial enough to make the second derivative of a system quantity times (T-T_0)^2 (or whatever is the independent variable) becomes appreciable to the first order term. Thus in the limit of small perturbation the system is linear. The community cannot hide behind nonlinearities as an excuse for not agreeing on the first order term. Given that understanding the first derivative quantities are indeed intrinsic properties of the system, contrary to the statement here. The problem is not that the first derivative terms are not well defined or that second derivative terms are important; the problem is that the first derivative terms are not well known. This seems to be a fundamental misunderstanding on the part of the present author(s), not of Friedlingstein et al, who got it right. [Stephen E Schwartz, USA]	taken into account - reworded for clarity
6-2325	6	43	53		54	"different quantitative results". There are many reasons for different quantitative results in different models. The analysis of Friedlingstein J Clim 06 is very valuable in showing why. Attn is called to Eq 7 of that paper which shows the strong dependence of the gain term (which has to be measured relative to unity) on the transient climate sensitivity to CO2, alpha (other forcings not considered). Given the spread in climate sensitivity characterizing current climate models it is not surprising the spread in g and other quantities dependent on alpha. The present assessment would be greatly strengthened by pointing this out. [Stephen E Schwartz, USA]	taken into account - alpha is indeed important as acknowledged on page 43 line 36
6-2326	6	43	54	43	54	comma after 'Hence' [Peter Burt, UK]	Editorial - text revised.
6-2327	6	43				Figure 6.37. This should show RCPs 6.0 and 8.5 in order to span the range of sulphate deposition. Reference should be to Lamarque et al. 2011, not 2010 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepted - in part: reference will be corrected; Rejected in part: Given general similarities, and space constraints, RCPs 4.5 and 8.5 will not be shown.
6-2328	6	43				Figures, page 43. The same comment as that above for Figure 6.36 can be made for Figure 6.37. That figure is not in Lamarque et al. (2010). [Robert Duce, USA]	Accepted - reference will be corrected.
6-2329	6	43				Section 6.4.2.1. The introduction of what are beta and gamma should come ealier as these quantities are already discussed in 6.3.5.2 and in 6.4.1. The same applies for the description of Gregory et al(2009) here, already introduced in the previous figure [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - reworded for clarity
6-2330	6	43				Fig. 23, bottom-left graph has a spelling mistake in its title: "Temperatrue". [David Pearson, United Kingdom]	Editorial - text revised.
6-2331	6	44	5	44	5	→ Gregory et al. (2009) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2332	6	44	5			demonstrate to demonstrated [Zongbo Shi, United Kingdom]	Editorial - text revised.
6-2333	6	44	15	44	15	→ Friedlingstein et al. (2006) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2334	6	44	20			"1% idealized simulations"; jargon. specify what that means. 1% of what? 1% of ideal? [Stephen E Schwartz, USA]	taken into account - reworded for clarity
6-2335	6	44	26	44	26	insert 'such' after 'area' [Peter Burt, UK]	Editorial (same comment 6-2336) - text revised.
6-2336	6	44	26	44	26	Change to "areas such as". [Daniel Metcalfe, Sweden]	Editorial (same comment 6-2335) - text revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2337	6	44	26	44	26	Change to "with the (Roy". [Daniel Metcalfe, Sweden]	Editorial (combined with comment 6-2341) - text revised.
6-2338	6	44	26	44	43	These 2 paragraphs should be combined with section 6.3.5.2 [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	reject. This is part of the feedback analysis not the model evaluation section.
6-2339	6	44	26	44	43	it would be nice if some additional information was given on how ocean biology responded to these changes. [Nicolas Gruber, Switzerland]	Accepted - changes in export production will be mentionned briefly.
6-2340	6	44	26			Betao: if first time appears, please define [Zongbo Shi, United Kingdom]	accepted - text revised
6-2341	6	44	28	44	28	→ Roy et al's. (2011) [Peter Burt, UK]	Editorial (combined with comment 6-2337) - the style of citation corrected (copyedit to be completed prior to publication).
6-2342	6	44	30	44	31	I don't see how you estimate the distribution of "historical" anthropogenic CO2 flux. Gruber et al estimated the "contemporary" flux (a quasi-mean for the last few decades). Methods for estimating the anthropogenic fraction of ocean DIC give inventory, and Khatiwala's method gives a time-dependent global integral flux, but I don't see how you can estimate the geographic distribution of the historical fluxes. [James Christian, Canada]	Rejected - using the ocean inversion method, Gruber et al. estimate both a contemporary flux and a natural component in the air-sea flux. Substracting the natural from the contemporary gives them what they refer to as the anthropogenic component.
6-2343	6	44	34	44	34	→ Roy et al's. (2011) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2344	6	44	34	44	34	I don't see how you can assert that "The spatial distributions of γ are also broadly consistent between the models" when the spatial distribution is only shown for the ensemble mean (Figure 6.24). [James Christian, Canada]	reject - the zonal mean panel shows model spread
6-2345	6	44	34	44	34	Change to "with the (Roy". [Daniel Metcalfe, Sweden]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2346	6	44	35	44	35	pacific → Pacific [Peter Burt, UK]	Editorial - text revised.
6-2347	6	44	41	44	41	are → is [Peter Burt, UK]	Editorial - text revised.
6-2348	6	44	46	44	47	The physiology of the CO2 fertilising effect leads to the opposite conclusion: the relative magnitude of the response increases with aridity because stomatal restriction of CO2 entry to leaves is the price that plants pay for restricting water loss. In tropical forests where water is close to non-limiting but N supply is a co-limiting factor one would expect lesser CO2 sensitivity. So for a global total it is not to do with the effect of rainfall on CO2 sensitivity per unit standing biomass, but to do with the large baseline mass of the tropical forests despite the lower relative response to CO2. This needs to be clarified. The para sounds as if there is something mechanistically special about the result that the biggest absolute responses come from the biggest compartmentrs. (ie in lines 49-50) [Roger Gifford, Australia]	taken into account - this is completely true - text revised to make it clearer
6-2349	6	44	55	44	55	insert comma after 'region' [Peter Burt, UK]	Editorial - text revised.
6-2350	6	44	57	44	57	→ Jones and Falloon (2009) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2351	6	44	57	45	3	This statement is misleading. Productivity is very important in all ecosystems, but this statement ignores the importance of soil processes in determining rates of decomposition in wetlands and permafrost. If wetlands drain and if permafrost thaws, soil processes will trump plant productivity as the determiniant of carbon releases and feedback to climate change. Generalizations that apply mostly to upland mineral soils are dangerous, because the largest soil feedbacks to climate change are in wetlands and permafrost, which are also "soils." See Davidson and Janssens (2006. Temperature sensitivity of soil carbon decomposition and feedbacks to climate change. Nature 440:165-173.) [Eric Davidson, USA]	taken into account - the statement is true of the models it discusses but not the real world. Text revised to reflect this
6-2352	6	44				Fig. 24, bottom two graphs. Their titles include "kgC/m/ppm". Should this be "kgC/m2/ppm"? [David Pearson,	rejected - units now different in revised figure

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						United Kingdom]	
6-2353	6	45	2	45	2	→ Matthews et al. (2005) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2354	6	45	7	45	7	Section 6.4.3 overall needs some coherency. I appreciate it is very difficult to write this section because results from CMIP5 simulations are still being analyzed. But just like the earlier parts of this chapter report existing science, this section should do the same. However, in its current form the need to summarize results and info from new simulations dilutes the effectiveness of this section. Plus, the section appears to be written for people in the business and not the general audience. [Vivek Arora, Canada]	taken into account - text revised to use simpler language
6-2355	6	45	7	45	11	Chapter 1 does not have details of these scenarios. Perhaps they are in Chapter 8. Please give the details somewhere and include a scheme for checking their relationaship with reality as the future unfolds [VINCENT GRAY, NEW ZEALAND]	taken into account - chapter 1 will cover this in second order draft
6-2356	6	45	7	45	24	For each RCP scenario, it is highly recommended that appropriate papers in the special issue of Climatic Change are cited to show data source; a representative paper is as below. Meinshausen, M., and Coauthors, 2011: The RCP greenhouse gas concentrations and their extensions from 1765 to 2300. Clim.Chan., 109, 213–241. [Akihiko Ito, Japan]	taken into account - chapter 1 will cover this in second order draft
6-2357	6	45	8	45	8	RCP 2.6 is mentioned on line 8 but Scenario 3PD is mentioned in Table 6.10. These need to be made consistent. [Vivek Arora, Canada]	taken into account - we use RCP2.6 throughout
6-2358	6	45	10	45	10	chapter → Chapter [Peter Burt, UK]	Editorial - text revised.
6-2359	6	45	11	45	11	on → of [Peter Burt, UK]	Editorial - text revised.
6-2360	6	45	13	45	15	Abbreviation for ESMs [Leticia Cotrim da Cunha, Germany]	accepted - text revised
6-2361	6	45	15	45	24	True, but it is worth mentionng that the CMIP5 CO2 for each RCP was calculated fusing each IAM emissions, BUT using the same (latest) version of MAGICC, to ensure consistency between emissions and concentrations (see Meinshausen et al, Climate Change 2011) [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - text revised
6-2362	6	45	16	45	16	→ van Vuuren et al. (2011) [Peter Burt, UK]	Editorial - the style of citation corrected (copyedit to be completed prior to publication).
6-2363	6	45	17	45	17	Change to "cycle responses from". [Daniel Metcalfe, Sweden]	Editorial - text revised accordingly.
6-2364	6	45	19	45	19	"For the RCPs 3 of the 4 IAMs (GCAM, RCP4.5; AIM, RCP6.0; MESSAGE, RCP8.5) …". I have not read the whole Chapter 6 so this comment may be redundant. Does the reader know at this point that different IAMs were used to generate different RCP scenarios. [Vivek Arora, Canada]	reject - this is explicitly mentioned earlier on this page
6-2365	6	45	19	45	19	Change to "RCPs, 3". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2366	6	45	21	45	21	insert comma after 'Hence' [Peter Burt, UK]	Editorial (same comment 6-2367) - corrected in text.
6-2367	6	45	21	45	21	Change to "Hence, for". [Daniel Metcalfe, Sweden]	Editorial (same comment 6-2366) - corrected in text.
6-2368	6	45	34	45	34	" … including different land-use classifications, parameter settings, allocation rules, and geographical scales …". Only people in the business would know what this sentence exactly means. I for sure even don't exactly know what does "allocation rules" imply. Allocation of what?. [Vivek Arora, Canada]	taken into account - text revised for clarity
6-2369	6	45	34	45	34	delete comma after 'rules' [Peter Burt, UK]	Editorial - text revised.
6-2370	6	45	35	45	35	" To meet the challenge of tracking gridded land-use effects in ESMs …". It might be more appropriate to say something like "To implemement LUC in a relatively consistent manner in ESMs …". [Vivek Arora, Canada]	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2371	6	45	37	45	38	"Land use transitions describe …". This is the first time the term "land use transitions" is being used. First, the reader must be told more clearly what this term means. The current description is somewhat difficult to follow. Second, the reader must be told that these "land use transitions" are provided as part of the harmonized data set. It is probably also worthwhile telling that some ESM groups use this info and some do not. [Vivek Arora, Canada]	taken into account - sentence removed
6-2372	6	45	42	45	42	Table 6.11. Please consider spelling out IAMS and ESMS, or at least write these as IAMs and ESMs. When I saw the table the first time I thought IAMS is a model itself. Also, please considering putting space between the two sections (IAMs and ESMs). Please consider including references for each model.. . Also, can we please add CanESM2 to this table with " Y N N Y N" values with the Arora and Boer (2010) reference. [Vivek Arora, Canada]	taken into account - text revised and table updated with more ESMs
6-2373	6	45	42	45	42	Table 6.11. Can we safely expect a reader to know what the five terms in the columns mean. Again, while people in the business know these terms our expected reader may not. [Vivek Arora, Canada]	taken into account - more details included in caption
6-2374	6	46	1	47	8	I appreciate the candid discussion of uncertainties, as land use change is of high importance but doesn't seem to be represented well. [Beverly Law, USA]	noted.
6-2375	6	46	6	46	6	delete comma after 'harvesting' [Peter Burt, UK]	editorial - text revised
6-2376	6	46	7	46	9	"For most metrics, the choice of RCP had a smaller impact than the inclusion of wood harvest, shifting cultivation and choice of start date". What metrics and impact on what? [Vivek Arora, Canada]	taken into account - text revised for clarity
6-2377	6	46	11	46	11	Land-use → Land use [Peter Burt, UK]	taken into account - text revised
6-2378	6	46	11	46	20	These lines appear to be written by an ESM person rather than a IAM person and essentially convey the message that IAM's LUC scenarios are meaningless as implied here " … appear to be driven more by the assumptions of the individual modelling teams than by the radiative forcing levels ...". Land use change is a very complex process so we would not expect it to be driven by radiative forcing as the caption for Figure 6.25 says " There is no logical relationship (nor is there intended to be) between the land use calculated by IAMs for the RCPs and the radiative forcing level of each RCP". So why even talk about this. What probably needs to be said here is that land use change is driven by very complex processes and the assumptions in IAMs themselves may not be consistent. [Vivek Arora, Canada]	taken into account - text revised for clarity
6-2379	6	46	12	46	12	Remove ",". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2380	6	46	14	46	14	→ Wise et al. (2009) and Thomson et al. (2010) [Peter Burt, UK]	taken into account - text revised
6-2381	6	46	17	46	17	→ '..population, but cropland area..' [Peter Burt, UK]	taken into account - text revised
6-2382	6	46	19	46	19	"RCP 4.5 shows a clear turning point in global land use change …". I couldn't figure out what does "turning point" refers to. Please consider rewording this sentence. [Vivek Arora, Canada]	taken into account - text revised for clarity
6-2383	6	46	22	46	22	"Within the IAMs land use change is translated into carbon emissions as shown in Figure 6.25". Please consider including "change" because it is the change (I think) that eventually yields LUC emissions. [Vivek Arora, Canada]	taken into account - text revised for clarity
6-2384	6	46	22	46	22	insert comma after 'IAMs' [Peter Burt, UK]	taken into account - text revised
6-2385	6	46	22	46	22	Change to "IAMS, land". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2386	6	46	22	46	30	Kato et al. (2011, Journal of Land Use Science, doi:10.1080/1747423X.2011.628705) estimates the land-use change carbon emission for each RCPs scenario using a process based model and the land-use change transition date by Hurtt et al. (2011). This study may show the differences in the amount of carbon emissions between IAMs and a process based model. [Michio Kawamiya, Japan]	noted - thank you

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2387	6	46	24	46	24	"feed" = food? [Leticia Cotrim da Cunha, Germany]	rejected - no this means "feed" as a noun
6-2388	6	46	26	46	26	– → : [Peter Burt, UK]	taken into account - text revised
6-2389	6	46	26	46	26	Change to "regional level or". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2390	6	46	29	46	30	Do you mean "population level to", if the rate of positive growth stabilizes to a fairly constant level this still means that agricultural production will need to increase. [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2391	6	46	34	46	37	"There is not presently explicit reconciliation of the carbon cycle models intrinsic to IAMs, the harmonization model (GLM, (Hurtt et al., 2011)), and ESMs, and so the land use fluxes prescribed for the RCP scenarios differ from fluxes estimated by the subset of ESMs which represent land use processes explicitly". Please consider rewording this long unclear sentence. [Vivek Arora, Canada]	taken into account - text revised
6-2392	6	46	34	46	37	Without further discussion, this sentence seems to call into question the use of the ESMs in RCP simulations. Please clarify the value and limitations of the ESM RCP simulations. [Eric Sundquist, United States of America]	reject - there is much more to the RCPs than just land-use.
6-2393	6	46	41	46	42	Again, a short explanation on what the inconsistencies are would be helpful. [Nikolaus Josef Kuhn, Switzerland]	rejected - this whole section has been describing exactly that
6-2394	6	46	42	46	42	" … that inconsistencies between carbon cycle models in IAMs and ESMs are still significant." How about saying that " ...that differences between representation of LUC related processes in IAMs and ESMs are still significant". [Vivek Arora, Canada]	taken into account - text revised
6-2395	6	46	45	46	45	Units for the fluxes are missing [Leticia Cotrim da Cunha, Germany]	taken into account - units added in table heading
6-2396	6	46	45	47	1	Table 6.12. This table has a lot of info and I am unable to follow it completely and appreciate its usefulness. First, shouldn't the "Net LULCC flux" be the sum of all other columns. This brings us back to definitions of these terms. These terms should be defined clearly some where. Second, the footnotes a and b are not included. Third, under historical what does GLM mean. All these acronyms must be defined. Again, it seems that this section is written for people in the business. Also, under Historical shouldn't we include Houghton's LUC emissions. That's our best observation-based estimate. How do we make Table 6.12 consistent with Table 6.2. A few groups who have contributed results to Table 6.2 have done simulations with ESMs and their cumulative estimates for the 1850-2005 period can go in Table 6.12. In addition, LUCID CMIP5 participants (CCCma, MPI and JAMSTEC and may be more) have done 2006-2100 simulations with and without LUC and they can provide numbers for Table 6.12. Victor Brovkin (MPI) is leading LUCID CMIP5 simulations. [Vivek Arora, Canada]	taken into account - missing notes have been included in table footer, which includes definition of acronyms. The table is intended to illustrate the differences between integrated assessment models and Earth system models in their representation of components of the land use flux. A new row under the historical section has been added to link back to Table 6.2.
6-2397	6	46				Table 6.11: For MIROC-ESM, deforestation is Y, wood harvest is N, explicit age classes is Y and N (vegetation dynamics is simulated by the individual based model), crop management is Y (harvest), explicit biofuels is N. [Michio Kawamiya, Japan]	taken into account - text revised
6-2398	6	47	12	47	12	move (i) and (ii) to before the simulation definitions. [Peter Burt, UK]	taken into account - text revised
6-2399	6	47	12	47	12	CO2 → CO2 [Peter Burt, UK]	taken into account - text revised
6-2400	6	47	22	47	22	What is implied by placing speechmarks around "freely"? [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2401	6	47	22	47	25	The sentences describing the differences between emissions and concentration driven runs need to be worded in a better way. [Vivek Arora, Canada]	taken into account - text revised
6-2402	6	47	27	47	27	"The dominant driver of changes in AF is the emissions scenario and not carbon cycle feedbacks". Consider rewording as "The dominant driver of changes in AF is the emissions scenario and not the differences in carbon cycle feedbacks between models". [Vivek Arora, Canada]	reject - we mean change in time, not between models
6-2403	6	47	28	47	28	"increasing CO2 rise" doesn't make clear sense. [Daniel Metcalfe, Sweden]	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2404	6	47				Figure 6.26. I wonder whether the large spread in the land uptake could come from the land use flux ? Wouldn't it be better to also show the "natural" changes in land carbon (i.e. NEP as opposed to NBP). I guess the model agreement would be much better. Hard to believe models don't even agree on the sign otherwise (especially for low scenarios). Also if models have a nitrogen cycle this should be mentioned as this would lead to different response for a know reason. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - this figure is required as it gives the total response of each model. We agree more understanding is required of the underlying processes but this does not yet exist in the literature. Mention of N is important
6-2405	6	47				Figure 6.27. I have the same issue : how much of the spread comes from the land use term. But I don't really have an easy solution here. Plotting the Land-borne fraction as cumulated NEP only and use the IAM land use emissions, combined to the fossil fuel emissions to calculate total anthrpogenic emissions (hence having an AF consistent with the one discussed in the rest of the chapter. May be showing both calculations would be even better. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - as comment 6-2404 - if such analysis exists in the literature it can be assessed here, but outside remit of chapter to do this new analysis
6-2406	6	47				Figure 6.41. I don't agree with the permafrost effect showing only starting centuries to millennia. I think the green lines should extend into the decadal time scale as well. Mabe the emissions are low like 500 Tg cumulative, in that range, but I think it is a mistake saying there is not any effect until the century time scales. See Schuur et al. 2011 Nature (I realize this is a modified figure and you can't cite this new paper, but you might get some insight from it for your modification). Based on observations of the polar ice cap melting, current warming of permafrost temperatures, as well as model forecasts, degradation of permafrost, especially surface (2-3m) permafrost is expected to occur on a decadal time scale, perhaps continuing for more centuries depending on overall warming trajectory [Edward Schuur, USA]	taken into account - figure revised
6-2407	6	48	7			Figure 6.27: The description doesn't make sense. Why should one of the three axes have a different convention than the others? Don't all three fractions increase along lines parallel to their respective axes? [James Christian, Canada]	taken into account - caption revised for clarity
6-2408	6	48	14	48	14	Change to "difficulty of estimating" [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2409	6	48	18			The term "compatible fossil fuel emissions" is a misnomer. Please refer to "compatible emissions" here and throughout the text. [Eric Sundquist, United States of America]	reject - we explicitly mean fossil fuel emissions here and not the contribution from land-use
6-2410	6	48	21	48	23	see also Arora et al 2011 [James Christian, Canada]	reject - this work is relevant and cited later but nt required in this sentence
6-2411	6	48	27	48	27	I suggest you change to "classed as a CO2 capture method under the definition" for compatibility with section 6.5. [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2412	6	48	28	48	28	→ Rogelj et al. (2011) [Peter Burt, UK]	taken into account - text revised
6-2413	6	48	31	48	31	Change to "achieved, but merely compute the global" [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2414	6	48	40			Figure 6.28: As I interpret this figure, there is one model where the net land + ocean (I am assuming land dominates) carbon cycle response to CO2 + climate change is greater uptake, i.e., the allowable emissions for RCP's 4.5 and 8.5 are larger than they would be without an interactive carbon cycle. Is this consistent with assertions elsewhere in the text that the carbon cycle feedback from terrestrial ecosystems is consistently positive? [James Christian, Canada]	reject - this figure does not show any models without feedback so such an inference cannot be made - all the models in this figure exhibit a positive feedback
6-2415	6	48				Table 6.13 - The linear extrapolation of the slope of 0.46 % of yearly increase of CO2 in the atmosphere measured at Mauna Loa from 2010 to 2012 would give 390 x 1.4 = 546 ppm in 2100. The mean values retained in the scenarios RCP4.5, RCP6.0, RCP8.5 indicated in Table 6.13 appear by 41 % to 294 % above the linear extrapolation of these experimental results. Is it realistic ? Max values are even in excess of 76 % to 334 % above the extrapolation of present experimental data. Why ? [François GERVAIS, France]	reject - beyond remit of WG1 to evaluate scenarios which include much more than just linear extrapolation of trends
6-2416	6	48				Two red lines. What are they? Similar for other colors [Zongbo Shi, United Kingdom]	taken into account - not clear which figure this comment refers to, but captions will be checked to make sure they describe the lines contained in the figures

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2417	6	49	1	49	3	Consider rewording to - "Several studies (Jones et al., 2006; Matthews, 2006; Miyama and Kawamiya, 2009; Plattner et al., 2008) have shown that carbon cycle feedbacks affect the compatible anthropogenic emissions that are consistent with a given CO2 concentration pathway". [Vivek Arora, Canada]	taken into account - text revised
6-2418	6	49	4	49	4	" … to quantify the direct effects of climate and carbon feedbacks on compatible emissions ..". Change "climate and carbon feedbacks" to "carbon-climate feedback" because that is what Figure 6.29 shows. [Vivek Arora, Canada]	taken into account - text revised
6-2419	6	49	18	49	18	"Simulated land-use emissions cannot be deduced by this method …". What does this refers to. Was there suppose to be some text before this sentence. [Vivek Arora, Canada]	taken into account - text revised
6-2420	6	49	18	49	18	land-use → land use [Peter Burt, UK]	taken into account - text revised
6-2421	6	49	20	49	20	→ Arora and Boer (2010) [Peter Burt, UK]	taken into account - text revised
6-2422	6	49	21	49	21	insert 'such' after 'reconstructions' [Peter Burt, UK]	taken into account - text revised
6-2423	6	49	21	49	21	Change to "reconstructions such as Houghton". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2424	6	49	24	49	24	land-use → land use [Peter Burt, UK]	taken into account - text revised
6-2425	6	49	25	49	25	insert comma after 'models' [Peter Burt, UK]	taken into account - text revised
6-2426	6	49	27	49	27	CO2 → CO2 [Peter Burt, UK]	taken into account - text revised
6-2427	6	49	27	49	27	land-use → land use [Peter Burt, UK]	taken into account - text revised
6-2428	6	49	27	49	27	Subscript 2 in "CO2" [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2429	6	49	29	49	30	LU = ? [Peter Burt, UK]	taken into account - text revised
6-2430	6	49	36	49	36	→ to accurately quantify [Peter Burt, UK]	reject - we choose not to split an infinitive
6-2431	6	49	36	49	36	Change to "to accurately quantify LU" [Daniel Metcalfe, Sweden]	reject - we choose not to split an infinitive
6-2432	6	49	39	49	39	→ Rose et al. (2011) [Peter Burt, UK]	taken into account - text revised
6-2433	6	49	39			Kato et al. (2011, Journal of Land Use Science, doi:10.1080/1747423X.2011.628705) denotes the cumulative reduction of emission for 2006-2100 in RCP-3PD by the biomass-based CCS (BECS) as 160 Pg C, however, the cumulative emission by land-use change in the scenario is estimated as 114.8 Pg C using a process-based model. This may be the example of such inability of representing the IAMs assumption by ESMs and/or process based model. [Michio Kawamiya, Japan]	noted - thank you
6-2434	6	49	41	49	41	Briefly mention how this better representation could be achieved. [Nikolaus Josef Kuhn, Switzerland]	reject - beyond remit of WG1 to advise on model development
6-2435	6	49	54	49	54	straight forward → straightforward [Peter Burt, UK]	taken into account - text revised
6-2436	6	49	54	49	54	→ Huntingford et al. (2009) [Peter Burt, UK]	taken into account - text revised
6-2437	6	49				Figure 6.30. Shouldn't thisfigure comes earlier somewhere in 6.4.1 when describing the CMIP5 rationale for climate-carbon models ? [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - box added to describe ESM process and rationale
6-2438	6	49				Fig. 6.29. It would be helpful here if the curves were labelled. In the top graph, it is not clear which blue goes with which red. In the bottom graph, it is difficult to separate the curves by eye, so it would be nice if two different kinds or colours of lines could be used. [David Pearson, United Kingdom]	taken into account - more models added and presenteation revised
6-2439	6	50	4	50	4	Should this be "shows how the". [Daniel Metcalfe, Sweden]	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2440	6	50	5	50	5	Can we expect our reader to know/remember what A1B SRES is? [Vivek Arora, Canada]	taken into account - text revised
6-2441	6	50	5	50	7	"The same ensemble shows that the range of atmospheric CO2 in the land carbon cycle ensemble is wider than the range of business as usual concentrations when carbon cycle uncertainties are neglected". I am unable to follow this sentence in the context of Figure 6.31 and not sure what does the phrase in bold exactly means. Does it mean that the "range in simulated atmospheric CO2 concentration at the end of the simulation in experiments with an interactive land carbon cycle is wider than the experiments which don't have an interactive land carbon cycle". [Vivek Arora, Canada]	taken into account - this discussion now moved to Ch.12
6-2442	6	50	6	50	7	"the range of business as usual concentrations" vague. Not sure this term has any well-defined meaning. [James Christian, Canada]	taken into account - this discussion now moved to Ch.12
6-2443	6	50	10	50	18	Again, the reasons for the uncertainty should be explained in more detail to inform research and decision makers on the relevance of the uncertainties. [Nikolaus Josef Kuhn, Switzerland]	taken into account - this discussion now moved to Ch.12
6-2444	6	50	20	51	26	For many readers, sections 6.4.4 and 6.4.5 will appear to be disproportionately brief in comparison to the seriousness of the projected effects. At the very least, please explain why these effects are important concerns. [Eric Sundquist, United States of America]	taken into account - each section length will be considered when meeting the final length requirement
6-2445	6	50	22	50	32	In my opinion, the coastal ocean should to be discussed here as well. For example, we submitted a paper where we show that the California Current System is on a path to become undersaturated at the same time as the Arctic. Papers from other coastal settings similarly suggest that it is more than just the Arctic and Southern Ocean that we need to be concerned about. [Nicolas Gruber, Switzerland]	Accepted - some text and some references will be added on the coastal perspective.
6-2446	6	50	22	51	13	General comment on section 6.4.4. The coastal perspective is missing here pretty much throughout. Please add, since this will be very important for WGII. [Nicolas Gruber, Switzerland]	Accepted - some text and some references will be added on the coastal perspective.
6-2447	6	50	22	51	13	A 2100 calculation of the vertical profile of pH and DIC based on highly-detailed ocean chemistry as well as a time series of surface ocean pH versus time from 1751-2004, calculated consistently with observed CO2 changes in the atmosphere, are given in Figures 3 and 2, respectively, of Jacobson, M.Z., Studying ocean acidification with conservative, stable numerical schemes for nonequilibrium air-ocean exchange and ocean equilibrium chemistry, J. Geophys. Res., 110, D07302, doi:10.1029/2004JD005220, 2005. [Mark Z. Jacobson, U.S.A.]	Noted
6-2448	6	50	23	50	23	"… is not debated…" = "… is now debated…"? [Leticia Cotrim da Cunha, Germany]	reject - the chemistry is not debated
6-2449	6	50	24	50	24	time-series → time series [Peter Burt, UK]	taken into account - text revised
6-2450	6	50	26	50	26	Replace "world" with "worlds". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2451	6	50	26	50	27	"The largest changes in surface [CO3 2–] occur in the warmer low and mid-latitudes, which are naturally rich in this ion;" Is this correct or is the CO3 2–] ion more common in cold water? [Andrew Glikson, Australia]	Noted - this is correct. A reference to Orr et al. 2005 will be added.
6-2452	6	50	26	50	30	reference(s) required [Peter Burt, UK]	Accepted - see response to 6-2451
6-2453	6	50	27	50	27	Sentence could be splitted and the semi-colon avoided. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-2454	6	50	37	50	40	This statement is true for the open ocean, but not for the ocean margins, where changes in upwelling, for example, will have a first order effect on ocean acidification. I suggest to be [Nicolas Gruber, Switzerland]	Accepted - text will be revised to mention upwelling.
6-2455	6	50	41	50	44	From this sentence, the future projections of pH and CaCO3 saturation in the Arctic Ocean will be affected by how rapidly the reduction in sea ice occurs. Current observations show that recent Arctic sea ice loss may be more rapid than projected with CMIP3 AOGCMs. Yamamoto et al (2011) show that the Earth System Model with higher sea ice reduction rate (summer sea-ice free condition by 2040) projects significantly lower pH and CaCO3 saturation of Arctic surface water than the other model (that by 2090). Please discuss that in this paragraph. [Reference]	Accepted - reference to Yamamoto et al. will be added.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						A.Yamamoto., M. Kawamiya., A. Ishida., Y. Yamanaka., and S. Watanabe, 2011: Impact of rapid sea-ice reduction in the Arctic Ocean on the rate of ocean acidification. Biogeosciences Discussions, 8, 10617-10644. [Michio Kawamiya, Japan]	
6-2456	6	50	44	50	46	see also M. Chierici and A. Fransson, 2009. Calcium carbonate saturation in the surface water of the Arctic Ocean: undersaturation in freshwater influenced shelves. Biogeosciences, 6, 2421-2431 [James Christian, Canada]	Accepted - reference will be added.
6-2457	6	50	45	50	46	"and lower pH values near river mouths and in areas under substantial fresh-water influence". Explain why freshwater have lower pH. [Andrew Glikson, Australia]	Rejected - due to strong constrain on available space, the reader is refered to the listed publications for more explanations.
6-2458	6	50	46	50	46	Change to "2008; Yamamoto". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-2459	6	50	49	50	49	author list out of alphabetical order [Peter Burt, UK]	Accepted - text revised.
6-2460	6	50	56	50	56	delete 'i' [Peter Burt, UK]	Accepted - text revised.
6-2461	6	50	56	50	56	"i" [Leticia Cotrim da Cunha, Germany]	Accepted - text revised.
6-2462	6	50	56	50	56	"at the surface, i the greatest pH". Delete the "I" [Andrew Glikson, Australia]	Accepted - text revised.
6-2463	6	50	56	50	56	Remove the stray "i". [Daniel Metcalfe, Sweden]	Accepted - text revised.
6-2464	6	50	56	50	56	Delete "i" between "surface," and "the greatest" [Nathaniel Ostrom, United States of America]	Accepted - text revised.
6-2465	6	50	56	50	56	Contains a non-sequitur "i" in "… the surface, i the greatest …" [David Pearson, United Kingdom]	Accepted - text revised.
6-2466	6	50	56			remove 'I' [Jeffrey Obbard, Singapore]	Accepted - text revised.
6-2467	6	50				Figure 6.31. This figure is about climate prohjection, I suggest moving it to chapter 12, where a section describes the impacts of biogeochemical feedbacks on climate projections. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted. Figure will be moved to the projection chapter.
6-2468	6	51	15			Figure 6.32: The symbols (Omega) should be defined, and it should be stated what assumptions are required to give a constant value (presumably a fixed reference temperature and salinity). [James Christian, Canada]	Accepted - caption will be revised.
6-2469	6	51	26	51	26	al. → al., [Peter Burt, UK]	Accepted - text revised.
6-2470	6	51	34	51	34	th' as superscript [Peter Burt, UK]	Accepted - text revised.
6-2471	6	51	34	51	34	delete) after 2011 [Peter Burt, UK]	Accepted - text revised.
6-2472	6	51	42	51	50	The role of ventilation temperature is downplayed here, but if you look at Table 6.14 the most up-to-date models give by far the highest solubility contribution. The models that give it a lower value are mostly old, with low resolution and highly simplified biology. That "the observed signal could be caused by natural variability in the climate system" is true in the narrow sense that available data records are short and unambiguous attribution to anthropogenic factors is not yet possible. But a priori we expect there to be an anthropogenic component because on average ventilation temperature is increasing globally (see Figure 6.33). [James Christian, Canada]	Accepted - this will be discussed with the inclusion of new material (Cocco et al. ref, CMIP5 simulations)
6-2473	6	51	42	51	50	In aquatic systems oxygen might be an important driver for greenhouse gas fluxes. In randomly selected Finnish lake data oxygen was the best predictor for CO2 concentrations and fluxes (among all water quality variables, catchment characteristics, catchment land use data, lake morphometry etc.). Generally, CO2 and CH4 in boreal freshwater systems are more closely linked to oxygen than N2O. Kortelainen, P., Rantakari, M., Huttunen, J.T., Mattsson, T., Alm, J., Juutinen, S., Larmola, T., Silvola, J. &	Noted - but due to space constrain, we limit the paragraph here to open- and coastal ocean.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Martikainen, P.J. 2006. Sediment respiration and lake trophic state are important predictors of large CO2 evasion from small boreal lakes. Global Change Biology 12, 1554-1567. [Pirkko Kortelainen, Finland]	
6-2474	6	51	43	51	43	insert comma after 'Thus' [Peter Burt, UK]	Accepted - text revised
6-2475	6	51	43	51	43	Change to "provide important insights into" or "provide an important insight into". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2476	6	51	44	51	44	its → their [Peter Burt, UK]	Accepted - text revised
6-2477	6	51	45	51	45	Change to "times greater than those" [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2478	6	51	46	51	47	"be caused by decreases in biological productivity" may be "be caused by increases in biological productivity"? [AKIHIKO MURATA, Japan]	Accepted - text revised
6-2479	6	51	47	51	49	I think this is very much true. In order to attribute the observed deoxygenation, we have to investigate deeper this issue by developing the ocean biogeochemical observation network and by combining the data with the ocean biogeochemical modelings. [Masao Ishii, Japan]	Noted
6-2480	6	51	49	51	49	insert 'in' after 'increases' [Peter Burt, UK]	Accepted - text revised
6-2481	6	51	49	51	49	Change to "deoxygenation also leads to increases in oceanic". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2482	6	51	49	51	50	explain why de-oxygenation leads to emission of N2O. [Andrew Glikson, Australia]	Accepted - a clearer explanation wil be given.
6-2483	6	51	49			insert 'in' after 'increases' [Jeffrey Obbard, Singapore]	Accepted - text revised
6-2484	6	51	52			Box 6.4 Figure 1: This does not make sense: what appears to be POC is labelled as DOC and POC is not considered at all. DOC doesn't "rain" down. Also why would the ventilation age affect the O2 concentration independently of remineralization? [O2] is a function of ventilation age because of cumulatve remineralization (and sometimes minor contributions from abiotic oxidation of reduced inorganic compounds like H2S). I don't see how age can be considered an independent factor here. [James Christian, Canada]	Noted - to be discussed with CLQ
6-2485	6	51	54	51	54	Change to "interior, a". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2486	6	51				The caption of figure 6.45 mentions only degassing from the atmosphere and the oceans, and is therefore inconsistent with the text on p. 34, l. 32-34 [Pierre Bernier, Canada]	Accepted - caption will be revised
6-2487	6	51				Fig 6.45. This figure is highly misleading in that it assumes (tacitly; if the figure is to be retained in the final, the assumption must be explicitly stated) that forcing by tropospheric aerosols is to be maintained at roughly current levels, artificially, as much of the aerosol derives from emissions of precursors associated with fossil fuel combustion. For a more realistic picture of what would ensue when emissions of aerosol precursors are halted together with CO2 emissions, see Brasseur and Roeckner, 2005; Knutti and Plattner, 2011. Brasseur GP, Roeckner E (2005) Impact of improved air quality on the future evolution of climate. Geophys Res Lett 32:L23704. doi:10.1029/2005GL023902 Knutti R., and G.-K. Plattner, 2012: Comment on “Why Hasn't Earth Warmed as Much as Expected?” by Schwartz et al. 2010. J. Climate. In press, http://dx.doi.org/10.1175/2011JCLI4038.1 [Stephen E Schwartz, USA]	taken into account - caption is revised with the addition of "Idealized experiments to illustrate…" The main purpose is to demonstrate the "rebound effect". We find it not necessary to cite the suggested literature on air quality in this context. Caption will be revised to mention that the goal of the figure is just to provide a thought experiment
6-2488	6	52	3	52	3	Abbreviation for EMICs? [Leticia Cotrim da Cunha, Germany]	Rejected - abbreviation has been introduced earlier in the chapter and will belong to the glossary.
6-2489	6	52	3	52	16	I would emphasize here much more strongly that the oxygen decrease is strongly related to ocean heat	Accepted - Add Keeling ratios

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						uptake. This is mentioned indirectly here, but I think that this argument should be made very clearly. It connects ocean deoxygenation with the well studied problem of ocean heat uptake and storage. Furthermore, first observationally based estimate of this ratio are coming online (e.g. Stendardo and Gruber, submitted) which strongly support the so-far largely model based findings. [Nicolas Gruber, Switzerland]	
6-2490	6	52	4	52	4	delete) after first 2008 [Peter Burt, UK]	Accepted - text revised
6-2491	6	52	4	52	4	Change to "2008; Oschlies". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2492	6	52	4	52	5	not all of these are ESMs (ocean-only biogeochemical models) [James Christian, Canada]	Accepted - text revised.
6-2493	6	52	7	52	7	insert 'the' after 'for' [Peter Burt, UK]	Accepted - text revised
6-2494	6	52	7	52	7	Change to "kg-1 by the year 2100". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2495	6	52	14	52	14	"(~20–100 µmol µmol kg–1)" delete one of the "µmol"expressions. [Andrew Glikson, Australia]	Accepted - text revised
6-2496	6	52	15	52	15	delete (after 2002; [Peter Burt, UK]	Accepted - text revised
6-2497	6	52	19	52	26	I suggest to add the heat uptake to oxygen loss number here as was given by Keeling et al. (see my comment above). This gives a clear quantitative connection to the ocean heatt uptake question. [Nicolas Gruber, Switzerland]	Accept - see response to comment 2489
6-2498	6	52	21	52	21	Ocean mass -> format the 10E21 to superscript [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-2499	6	52	29	52	33	Surely much of the local change in suboxic waters is due to stratification-driven changes in primary productivity - I'm pretty sure that is the dominant control in the HadGEM2-ES equatorial Pacific. [Paul Halloran, UK]	Noted - but no clear quantification yet published. New materail will be added based on new publications and CMIP5 simulations.
6-2500	6	52	36	52	37	"a pCO2-sensitive C:N drawdown in primary production, as established by mesocosm experiments". This based on very limited data and is not necessarily a robust result. [James Christian, Canada]	Noted - we agree with the expert reviewer. We will mention the large uncertainty regarding this assumption which is discussed in the cited reference (Tagliabue et al. 2011).
6-2501	6	53	1	53	7	(Page number is for figures); FAQ 6.1, Figure 1. Can land-use change be shown? [James Butler, United States of America]	noted - the revised graph might have land use change included, however, the figure really intends to illustrate the time scales of carbon transfers through the different reservoirs, hence land use change is not central to this argument.
6-2502	6	53	2	53	2	"the Particulate Organic Carbon - CaCO3 export ratio" POC has already been defined and the "rain ratio" referred to if not exactly defined. [James Christian, Canada]	Accepted - text revised
6-2503	6	53	10	53	10	"Hypoxia in the shallow coastal ocean is largely eutrophication-driven". No. Continental shelves under eastern boundary currents are part of the " shallow coastal ocean", and in these environments hypoxia is not caused by terrestrially-derived nutrients. [James Christian, Canada]	Accepted - text revised
6-2504	6	53	15	53	15	Does "de-oxygenation" need a hyphen or not? [Daniel Metcalfe, Sweden]	Accepted - deoxygenation withouth hyphen. Text revised.
6-2505	6	53	21	53	21	Seems that a bit of text is missing here. [Leticia Cotrim da Cunha, Germany]	Accepted - text revised
6-2506	6	53	22	53	24	This is not entirely correct as written. N2O yields from nitrification are enhanced under low O2 conditions, but nitrification itself is not inhibited by oxic conditions (in fact nitrifiers need oxygen!). Denitrification can both produce and consume N2O, but the net effect of denitrification is to increase oceanic N2O production, due to very high yields of N2O in the suboxic margins of the anoxic zones. [Cynthia Nevison, USA]	Accepted - text has been revised
6-2507	6	53	23	53	24	Only denitrification is inhibited by oxic conditions, nitrification requires oxic conditions. [Göran Ågren, Sweden]	Accepted - text has been revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2508	6	53	23	53	24	Certainly denitrification is inhibited by oxic waters, but I am not certain that this is true for nitrification. [Richard Bourbonniere, Canada]	Accepted - text has been revised
6-2509	6	53	23	53	24	"nitrification and denitrification, which provide the main pathways for N2O production, are inhibited by oxic conditions" True for denitrification, not nitrification. This appears to have been copied from Schmittner who attributes it to Nevison, but he is misinterpreting her text. N2O yield from nitrification does depend on oxygen concentration, but this effect is only strong at very low [O2]. [James Christian, Canada]	Accepted - text has been revised
6-2510	6	53	27	53	27	"a doubling in marine N2O flux by the year 4000" this is N2O production, not air-sea flux [James Christian, Canada]	Accepted - text revised
6-2511	6	53	34			change O2 [Jeffrey Obbard, Singapore]	Accepted - text revised
6-2512	6	53	36			change O2 [Jeffrey Obbard, Singapore]	Accepted - text revised
6-2513	6	53	37	53	37	Subscript 2 for "O2". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2514	6	53	38			Note Placeholder [Jeffrey Obbard, Singapore]	Accepted - text revised
6-2515	6	53	41	56	29	This section considers mainly anthropogenic N inputs affecting biological C fixation. Fixation of atmospheric N in the tropical and subtropical occeans, however, will likely gain more importance in warmer and stratified oceans (e.g. Sohm et al., 2011). Recent field studies point also to a growing fraction of primary production derived from atmospheric N in large ocean basins (e.g. Mouriño-Carballido et al., 2011). [Antonio Bode, Spain]	Noted - Including a reference to discuss potential changes to N-fixation will be discussed. Due to space constrain, it may not be the case.
6-2516	6	53	41	56	29	References from comment above: Mouriño-Carballido, B., R. Graña, A. Fernández, A. Bode, M. Varela, J. F. Domínguez, J. Escánez, D. De Armas, and E. Marañón, 2011: Importance of N2 fixation vs. nitrate eddy diffusion along a latitudinal transect in the Atlantic Ocean. . Limnol. Oceanogr., 56, 999-1007. Sohm, J. A., E. A. Webb, and D. G. Capone, 2011: Emerging patterns of marine nitrogen fixation. Nat. Rev. Microbiol., 9, 499-508. [Antonio Bode, Spain]	Noted - see response to comment above.
6-2517	6	53	45	53	47	Repeat of statements made earlier. [Robert Scholes, South Africa]	Accepted - text will be shortened.
6-2518	6	53	50	53	51	Include the year 2100 as reference for roughly doubling N demands with respect to 2005. [Marcelo Galdos, Brazil]	Accepted - text revised
6-2519	6	53	51	53	52	I'd recommend 'lack' rather than the cumbersome 'non-inclusion'. [Drew Shindell, USA]	Accepted - text revised
6-2520	6	53	53			Note Placeholder [Jeffrey Obbard, Singapore]	Accepted - text revised
6-2521	6	53	56			perhaps elaborate here. [Jeffrey Obbard, Singapore]	Rejected - due to severe space constrain, we keep the text as short as possible.
6-2522	6	53				FAQ 6.1 Figure 1: The figure also misses an arrow representing the carbon liberated fromt he lithosphere by carbonate weathering and also by oxidation of fossil fuels due to weathering. [Nils Moosdorf, Germany]	Noted - this Figure is not a copy of the main carbon cycle graph, but displays only the main turnover times.
6-2523	6	54	1			Figure 6.34. What is meant by “Nitrogen boundary”? [Göran Ågren, Sweden]	Accepted - N Boundary will be defined.
6-2524	6	54	3	54	3	Change to "right). Net consumption is always" [Daniel Metcalfe, Sweden]	Accepted - change will be made.
6-2525	6	54	9	54	11	This statement doesn’t clearly make the distinction between Nr loss to the atmosphere as N2 vs. as another N gas. Nr simply returning to the atmosphere isn’t the problem, it is returning as a gas other than N2 that is the problem. [Christina Tonitto, USA]	Rejected - N2 is not included in Nr definition.
6-2526	6	54	9	54	11	Possible rewording: “Projected increases in anthropogenic Nr production will result in the transformation of Nr to aqueous forms, impacting freshwater and marine ecosystems, and ultimately to gaseous Nr forms including the potent greenhouse gas N2O.” [Christina Tonitto, USA]	Rejected - statement is confusing.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2527	6	54	10			Most N is sequestered by soils and vegetation. Hence: "...reservoirs, especially soils, terrestrial vegetation, ..." [Peter Högberg, Sweden]	Accept, change made.
6-2528	6	54	18	54	21	sentence does not make sense [Peter Burt, UK]	Accept, change made.
6-2529	6	54	19	54	19	Change to "in the understanding", and "changes leading to". [Daniel Metcalfe, Sweden]	Noted, change made in response to previous comment.
6-2530	6	54	19			nisert 'the' before ' understanding' [Jeffrey Obbard, Singapore]	Noted, change made in response to previous comment.
6-2531	6	54	21	54	23	This is a very dense sentence, could it be clarified. [Daniel Metcalfe, Sweden]	Noted, change made in response to previous comment.
6-2532	6	54	26	54	26	but → except [Peter Burt, UK]	Accept, change made.
6-2533	6	54	27	54	27	insert comma after emissions [Peter Burt, UK]	Accept, change made.
6-2534	6	54	30	54	30	a → an [Peter Burt, UK]	Accept, change made.
6-2535	6	54	34	54	40	There needs to be more discussion here about other emission scenarios, or at least a recognition that the RCPs are tightly bunched and do not explore the range of possible future SO2 emissions (e.g. POLES). [William Collins, United Kingdom of Great Britain & Northern Ireland]	Rejected - due to space limitations we are not able to expand this discussion.
6-2536	6	54	34	54	40	This paragraph seems a bit lost in the text: maybe briefly explain the relevance of SOx deposition and ist coupling to the C and N cycles? [Leticia Cotrim da Cunha, Germany]	Accepted - sentence will be added
6-2537	6	54	34	54	40	Yes there is variabitlity in the temperal and spatial deposition of SOx but perhaps the consequences for other feedbacks - direct and indirect - within the remit of this chapter should be explored in more detail. E.g. mobility of fluvial DOC, suppression of methane. [Vincent Gauci, United Kingdom]	Rejected - due to space limitations we are not able to expand this disussion.
6-2538	6	54	34		40	Are there any connections between N2O emissions and SOx deposition? If not, why should SOx deposition be presented here? [Zucong Cai, China]	Noted - they are pesented because of the connection between aresols in the atmosphere and climate impacts.
6-2539	6	54	34			state what Sox is projected to decrease. [Jeffrey Obbard, Singapore]	Rejected - comment is not understood.
6-2540	6	54	39	54	39	delete comma after 'regions' [Peter Burt, UK]	Accept, change made.
6-2541	6	54	43		45	For most systems, total N input is less than 1000 kg ha-1. Why could the discharge of DIN be larger than 1000 kg N ha-1? [Zucong Cai, China]	Accepted - statement will be clarified.
6-2542	6	54	44	54	44	insert 'the' after > [Peter Burt, UK]	Noted, but comment not understood.
6-2543	6	54	50	54	50	What is the fundamental difference between "differences" and "variations", can one of them be removed? [Daniel Metcalfe, Sweden]	Accepted, change made.
6-2544	6	54	55			Figure 6-35 needs font improvement throughout [Richard Bourbonniere, Canada]	Accepted - figure will be improved
6-2545	6	54	55			Figure 6.35 axes and legends are not legible. [Christina Tonitto, USA]	Accepted - figure will be improved
6-2546	6	54				Faq 6.1, Fig 2. This figure is one view of this profile but should note that there is strong lack of concensus on CO2 remaining in the atmosphere in recent papers examining consequences of hypothetical abrupt cessation of CO2 emissions, below (Note overlapping authorship). For a comparison of the decay profiles of these several papers following a hypothetical cessation of CO2 emissions see Schwartz, S. E. Well Known . . . to a Few People: Attribution of Excess Atmospheric CO2 and Resulting Global Temperature Change to Fossil Fuel and Land Use Change Emissions. American Geophysical Union	Rejected - this discussion is not appropriate for the FAQ, but is dealt with in Box 6.2

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						Fall Meeting, San Francisco CA, December, 2010. Poster A21A-0018. http://www.ecd.bnl.gov/steve/pres/WellKnownAGU10vgphs.pdf viewgraph 7. I submit that a figure of this sort belongs in the present assessment or any assessment of the state of understanding of the carbon cycle. Disagreement of current models to this extent on this modeled quantity should inform any discussion of the degree of understanding of the processes controlling CO2 feedbacks. Solomon S, Plattner GK, Knutti R, Friedlingstein P. Proc Natl Acad Sci U S A. 2009 Feb 10;106(6):1704-9 J A Lowe, C Huntingford, S C B Raper, C D Jones, S K Liddicoat and L K Gohar Environ. Res. Lett. 4 (2009) 014012 (9pp) doi:10.1088/1748-9326/4/1/014012 How difficult is it to recover from dangerous levels of global warming? BILL HARE and MALTE MEINSHAUSEN HOW MUCH WARMING ARE WE COMMITTED TO AND HOW MUCH CAN BE AVOIDED? Climatic Change (2006) 75: 111–149 DOI: 10.1007/s10584-005-9027-9 Matthews, H. D., and K. Caldeira (2008), Stabilizing climate requires near-zero emissions, Geophys. Res. Lett., 35, L04705, doi:10.1029/2007GL032388. M. EBY, K. ZICKFELD, AND A. MONTENEGRO D. ARCHER K. J. MEISSNER AND A. J. WEAVER Lifetime of Anthropogenic Climate Change: Millennial Time Scales of Potential CO2 and Surface Temperature Perturbations VOLUME 22 JOURNAL OF CLIMATE 15 MAY 2009 Thomas L. Fro¨licher • Fortunat Joos Reversible and irreversible impacts of greenhouse gas emissions in multi-century projections with the NCAR global coupled carbon cycle-climate model Clim Dyn DOI 10.1007/s00382-009-0727-0 Myles R. Allen, David J. Frame, Chris Huntingford, Chris D. Jones, Jason A. Lowe, Malte Meinshausen & Nicolai Meinshausen Warming caused by cumulative carbon emissions towards the trillionth tonne Nature Vol 45830 April 2009 doi:10.1038/nature0801 [Stephen E Schwartz, USA]	
6-2547	6	55	2			"reduction air pollutant controls"???? [Zongbo Shi, United Kingdom]	Accept, change made.
6-2548	6	55	15			delete "," after Assessment [Zongbo Shi, United Kingdom]	Accept, change made.
6-2549	6	55	18	55	18	insert 'in' after 'changes' [Peter Burt, UK]	Accept, change made.
6-2550	6	55	18	55	19	First sentence is not very clear, needs re-writing. [Leticia Cotrim da Cunha, Germany]	Accept, change made via response to previous comment.
6-2551	6	55	18	55	21	I have submitted a manuscript for publication which evaluates the RCPs for N2O and the mitigation steps that would be needed to achieve concentration pathways consistent with the RCPs. I would be happy to provide this manuscript and to keep the chapter authors informed if and when it is accepted for publication [Eric Davidson, USA]	Accept, author has been contacted.
6-2552	6	55	18	55	28	I think this needs to be much more specific about which scenarios and assumptions these numbers are associated with. [James Christian, Canada]	Space limitation do not allow this change.
6-2553	6	55	19	55	19	Change to "illustrated by the". [Daniel Metcalfe, Sweden]	Accept, change made.
6-2554	6	55	19			…with by…???? [Zongbo Shi, United Kingdom]	Accept, change made.
6-2555	6	55	20	55	21	Change to "6.39), (Note", and "scenarios). A comprehensive" [Daniel Metcalfe, Sweden]	Accept, change made.
6-2556	6	55	21	55	21	→ . [Peter Burt, UK]	Accept, change made.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2557	6	55	21			Change "," to ".) after scenarios [Zongbo Shi, United Kingdom]	Accept, change made.
6-2558	6	55	22	55	22	show → shows [Peter Burt, UK]	Accept, change made.
6-2559	6	55	30			Figure 6.39: upper left panel mislabelled as 1990 [James Christian, Canada]	Noted, correction will be made.
6-2560	6	55	33			Section 6.4.6.2, Impact of Future N on Carbon Uptake and Storage. As mentioned relative to a discussion above, this section only discusses the impact of changes of nitrogen input on terrestrial carbon uptake - there is no discussion of the impact of increasing nitrogen inputs to the oceanic biosphere and the resulting carbon uptake there. [Robert Duce, USA]	accepted - sentence added summarizing current and projected future impact of nitrogen deposition on ocean carbon sink, citing Reay et al., 2008
6-2561	6	55	33			The section 6.4.6.2 begins with two clearly written paragraphs that do a good job of making the point that future availability of N matters for C cycle and climate, but the clarity of logic and meaning deteriorates in the third paragraph (beginning "In response to climate warming, increased decomposition..."). The important point that needs to be made clear at the beginning of the third paragraph is that the future availability of N will depend on BOTH (1) exogenous additions, i.e., the addition of new/anthropogenic Nr to ecosystems and (2) endogenous "additions", i.e., changes in internal ecosystem processes that tend to transfer N from relatively protected, slowly cycling forms (such as recalcitrant soil organic matter) to available inorganic forms. [Jennifer Johnson, United States of America]	accepted - sentences revised to clarify the distinction between changes in Nr inputs and N mineralization from soil organic matter
6-2562	6	55	42	55	42	→ '..Friend, 2010)) (Figure..' [Peter Burt, UK]	accepted - text revised
6-2563	6	55	44	55	52	This papragraph is very brief and does not spell out the processes and feed-backs alluded to. Consider rewriting in simpler language. Maybe the second language could simply tell that "When the nitrogen limitation of growth of many forests is considered, the projected increase in their C uptake due to increased [CO2] becomes reduced by 50-70%". [Peter Högberg, Sweden]	accepted - text revised
6-2564	6	55	47	55	47	carbon-cyle only → carbon-cycle-only [Peter Burt, UK]	taken into account - combined with comment 2563
6-2565	6	55	48	55	48	delete comma after 6.21 [Peter Burt, UK]	accepted - text revised
6-2566	6	55	48	55	48	→ Thornton et al. (2007) [Peter Burt, UK]	accepted - text revised
6-2567	6	55	50	55	50	"st" should be superscript.Should carbon be abbreviated or not? [Daniel Metcalfe, Sweden]	accepted - text revised
6-2568	6	55	50	55	51	"N limitation on 21st…" Maybe re-write the beginning of the sentence to "Nitrogen limitation…"? [Leticia Cotrim da Cunha, Germany]	accepted - text revised
6-2569	6	55	54	55	56	The first sentence in this paragraph is good, but the second sentence does not clearly convey the stoichiometric argument of the Melillo et al. 2011 paper. The main result in that paper is that the redistribution of N from soils to vegetation can cause a NET increase in C storage because the C:N ratio of woody vegetation is typically much wider than that of soils; i.e., each unit of N in vegetation holds more C than it would in soil. Thus, while warming-induced mineralization of soil organic matter releases CO2 to the atmosphere, in some ecosystems the transfer of the newly-mineralized N to vegetation enables photosynthetic uptake ofCO2 that, over time, can partially or completely offset the soil C releases. [Jennifer Johnson, United States of America]	taken into account - combined with comment 2561
6-2570	6	55	54	55	56	Needs clarification. Higher C:N ratio doesn't increase plant N uptake. Higher C:N tissue growth may be favored under increased CO2 conditions as it requires less N. Is this statement attempting to discuss higher C:N ratio of woody detritus resulting in higher N immobilization during decomposition? In my reading, Melillo et al. (2011) suggest the increased C storage in trees results from an acceleration of N-cycling that results from warming, though increased growing season could also have an effect. [Christina Tonitto, USA]	taken into account - combined with comment 2561
6-2571	6	55	54	55	56	Possible rewording: "In a climate warming experiment Melillo et al. (2001) conclude climate warming increased SOM decomposition and N mineralization. This increase in soil inorganic N availability led to increased tree growth and ultimately to increased ecosystem carbon storage." [Christina Tonitto, USA]	taken into account - combined with comment 2561

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2572	6	55	55	55	55	→ Generally, a higher..' [Peter Burt, UK]	taken into account - combined with comment 2561
6-2573	6	55	58	56	3	Part of the differences among models is whether they allow soil and litter layer C:N ratios to change. As soils warm and decomposition of organic matter increases, some of the C is lost as CO2, but is the N also lost from the system or retained? If it is taken up by plants, there will be a gain in plant biomass and a net C gain for the ecosystem, but if the N is retained in the soil, then the C:N ratio of the soil simply decreases, and there is no gain and only loss of C. The models that predict a negative feedback tend to posit a constant C:N ratio, which is probably wrong. We know that C:N ratios in soils can change. This can be a key shortcoming of models that attempt to include C-N linkages but that do not do it correctly. [Eric Davidson, USA]	accepted - text revised to add reference to constant vs. variable litter and soil C:N ratios.
6-2574	6	55	58			In two models, (….: this sentence needs re-written [Zongbo Shi, United Kingdom]	taken into account - combined with comment 2561
6-2575	6	55				Fig. 6.37. The caption of the figure has the units as "kg N ha-1 yr-1". I think it should be "kg S ha-1 yr-1", because this figure is about sulfur, not nitrogen. [David Pearson, United Kingdom]	accepted - text revised
6-2576	6	55				FAQ 6,2 Figure 1 Caption. Typo in Tarnocai et al. 2009 [Edward Schuur, USA]	Noted - text revised
6-2577	6	56	1	56	3	Replace "the other" with "Zaehle et al., 2010" to improve the clarity of this sentence. [Cynthia Nevison, USA]	taken into account - text revised
6-2578	6	56	2	56	2	→ Sokolov et al. (2008) [Peter Burt, UK]	taken into account - text revised
6-2579	6	56	4			I don't understand how positive beta and gamma are consistent with the biosphere becoming a source [Peter Rayner, Australia]	taken into account - text revised to clarify
6-2580	6	56	5			it should be stressed that the change in beta is overall more important than the change in gamma [Peter Rayner, Australia]	taken into account - is already mentioned in lines 28-29.
6-2581	6	56	6	56	6	interacts → interact [Peter Burt, UK]	taken into account - text revised
6-2582	6	56	14	56	14	→ Zaehle et al. (2010b) [Peter Burt, UK]	taken into account - text revised
6-2583	6	56	15	56	16	Change to "the potential usefulness of ecosystem", and possibly "responses. However, the methods whereby observational data may be used to constrain carbon-nitrogen" [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2584	6	56	16	56	16	delete comma after 'evaluate' [Peter Burt, UK]	taken into account - text revised
6-2585	6	56	16	56	16	→ Wang and Houlton (2009) [Peter Burt, UK]	taken into account - text revised
6-2586	6	56	16	56	16	comma is not needed after "evaluate" [Leticia Cotrim da Cunha, Germany]	taken into account - text revised
6-2587	6	56	17	56	18	Change to "fixation under altered". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2588	6	56	18	56	18	→ Esser et al. (2011) [Peter Burt, UK]	taken into account - text revised
6-2589	6	56	18			change 'find' to 'found' [Jeffrey Obbard, Singapore]	taken into account - text revised
6-2590	6	56	22	56	26	In the light of the limited capabilities of the models and scenarios used in this section, the statement on CO2 concentrations in 2100, should be qualified by pointing out the risks of the unknowns in current assessments and the most pressing research needs. [Nikolaus Josef Kuhn, Switzerland]	rejected - The text indicated in this comment does not mention CO2 concentration in 2100. This paragraph already indicates the sensitivity to choice of model, and choice of scenario. Uncertainties in models due to poor representation of processes has been highlighted in several places already in section 6.4. .
6-2591	6	56	35	56	35	Where is "b)"? [Daniel Metcalfe, Sweden]	taken into account - the panels are labelled. (b) is bottom left. This figure will be revised.
6-2592	6	56	41			Section 6.4.7 needs to be expanded to include removal as well as emissions - e.g. methane loss rate (OH reaction, stratospheric removal) [William Collins, United Kingdom of Great Britain & Northern Ireland]	taken into account - mention that sinks are important too, but not dealt with in detail here - atmospheric

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
							chemistry is a different chapter?
6-2593	6	56	43	56	52	The authors should also consider feedbacks where there is considerable uncertainty. This includes the responses of wetland methane emissions to increasing reactive nitrogen deposition and the suppressive effects of acid rain sulfate deposition. E.g. Gauci, V., Matthews, E., Dise, N., Walter, B., Koch, D., Granberg, G., Vile, M., 2004. Sulfate suppression of the wetland methane source in the 20th and 21st centuries. Proceedings of the National Academy of Sciences USA, 101, 12583-12587. [Vincent Gauci, United Kingdom]	taken into account - wider range of processes will be assessed
6-2594	6	56	46	46	49	It should be acknowledged that permafrost thaw in some ares may lead to DRYING such that methane emissions could decrease. All the mechanisms discussed with permafrost here talk about increases in methane. There are of course issues of time scale and spatial scale, but at some point there could be a drier permafrost zone, thus reducing methane. Ok I do see this in the next section, but I still think you should point out the effect to possibly decrease methane here because that leads better into the following sections [Edward Schuur, USA]	taken into account - text revised
6-2595	6	56	46	56	46	CH4 → CH4 [Peter Burt, UK]	taken into account - text revised
6-2596	6	56	46	56	46	Subscript 4 for "CH4". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2597	6	56	46			change CH4 [Jeffrey Obbard, Singapore]	taken into account - text revised
6-2598	6	56	48	56	48	insert 'and' after , [Peter Burt, UK]	"," on this line for such an insertion
6-2599	6	56	49	56	51	Methane hydrate deposits are found in permafrost soils, in subsea permafrost, and in ocean sediments. Although there are large uncertainties in the size of these reservoirs, the amount of methane in ocean sediments is the largest reservoir and has been omitted here. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	taken into account - covered in sec. 6.4.7.2
6-2600	6	56	51	56	51	insert full stop after 'known' [Peter Burt, UK]	taken into account - text revised
6-2601	6	56	51	56	51	Change to "known, Methane" [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2602	6	56	51	56	52	Seems that a bit of text is missing here. [Leticia Cotrim da Cunha, Germany]	taken into account - text revised
6-2603	6	56	51			insert '.' after 'known' [Jeffrey Obbard, Singapore]	taken into account - text revised
6-2604	6	56				Fig. 41. The caption ends with this sentence: "Atmospheric chemistry is not discussed further in this chapter.". This seems to me to be an error, and perhaps that sentence should be removed? [David Pearson, United Kingdom]	rejected - this is true
6-2605	6	57	1	58	3	Little is written about the future emission from paddy field. As shown by Kai et al. (2011) and Yan (2009), CH4 emission from paddy field may change as a result of human management and have a large mitigation potential. Both references apper in the reference list of the FOD. [Akihiko Ito, Japan]	taken into account. Mitigation is outside remit of WG1, but the importance of paddy field emissions can be mentioned here.
6-2606	6	57	2	58	3	You may want to consider citing "O'Connor, F. M, O. Boucher, N. Gedney, C.D. Jones, G. A. Folberth, R. Coppell, P. Friedlingstein, W.J. Collins, J. Chappellaz, J. Ridley, and C.E. Johnson, The possible role of wetlands, permafrost and methane hydrates in the future methane cycle: A review, Reviews of Geophysics, 48, RG4005, doi:10.1029/2010RG000326, 2010." in this section. [Olivier Boucher, France]	taken into account - text revised
6-2607	6	57	2			Section 6.4.7.1: Another reference on feedback between permafrost on CH4 emissions Christensen T.R., et al. 2004. Thawing sub-arctic permafrost: Effects on vegetation and methane emissions, Geophys. Res. Lett., 31, L0401, doi:10.1029/2003GL018680. [Christopher Butenhoff, USA]	taken into account - text revised
6-2608	6	57	15	57	15	"st" in "21st" should be superscript. [Daniel Metcalfe, Sweden]	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2609	6	57	17	57	17	→ Lawrence and Slater (2005) [Peter Burt, UK]	taken into account - text revised
6-2610	6	57	18	57	18	3m → 3 m [Peter Burt, UK]	taken into account - text revised
6-2611	6	57	18	57	18	→ Burn and Nelson (2006) [Peter Burt, UK]	taken into account - text revised
6-2612	6	57	22	57	22	→ Marchenko et al. (2008) [Peter Burt, UK]	taken into account - text revised
6-2613	6	57	23	57	23	2m → 2 m [Peter Burt, UK]	taken into account - text revised
6-2614	6	57	26	57	32	methane → CH4 [Peter Burt, UK]	taken into account - text revised
6-2615	6	57	30	57	30	Replace "less strong" with "weaker". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2616	6	57	32	57	33	Replace "increase" by "increase globally" [Charles Curry, Canada]	taken into account - text revised
6-2617	6	57	32	57	33	Show the time frame of methan oxidation change estimated by Curry (2009). [Akihiko Ito, Japan]	taken into account - text revised
6-2618	6	57	35	57	39	Maybe give a brief introduction to Yedoma deposits, i.e. located on northeast Siberia, high amounts of organic carbon, or the corresponding carbon reservoir in Pg C (+/- 500 Pg C, is that correct?). [Leticia Cotrim da Cunha, Germany]	taken into account - text revised
6-2619	6	57	39	57	39	; → and [Peter Burt, UK]	taken into account - text revised
6-2620	6	57	43	57	43	Abbreviation for ET? [Leticia Cotrim da Cunha, Germany]	taken into account - text revised
6-2621	6	57	46	57	47	The first two studies on this were both in 2004, Gedney et al and Shindell et al. Probably worth having both. [Drew Shindell, USA]	taken into account - text revised
6-2622	6	57	48	57	48	order and formattingof references wrong [Peter Burt, UK]	taken into account - text revised
6-2623	6	57	48	57	48	Change to "2011; Ringeval" [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2624	6	57	49			again use 'permafrost thaw' in this context [Edward Schuur, USA]	taken into account - text revised
6-2625	6	57	52	58	2	methane → CH4 [Peter Burt, UK]	taken into account - text revised
6-2626	6	57	52	58	3	Are climate effects on wetland methane available from CMIP5? I know HadGEM2 produced this (as shown in figure 6.21). Gedney et al. 2004 also calculated the climate feedback on wetlands. [William Collins, United Kingdom of Great Britain & Northern Ireland]	reject. Unfortunately this is not a standard CMIP5 output variable
6-2627	6	57	55	57	57	Mention of large wet mineral soil source here is largely unsupported; only one study has claimed such a large value, and it is entirely model-based. This source doesn't appear in Table 6.7, I think for good reason. Perhaps retain mention of this source and reference, but remove estimated magnitiude. [Charles Curry, Canada]	taken into account - text revised according to evidence
6-2628	6	58	5	58	36	You should consider citing "O'Connor, F. M, O. Boucher, N. Gedney, C.D. Jones, G. A. Folberth, R. Coppell, P. Friedlingstein, W.J. Collins, J. Chappellaz, J. Ridley, and C.E. Johnson, The possible role of wetlands, permafrost and methane hydrates in the future methane cycle: A review, Reviews of Geophysics, 48, RG4005, doi:10.1029/2010RG000326, 2010.", which does a much more comprehensive job at reviewing/assessing relevant processes than this section. [Olivier Boucher, France]	reject - already cited in the introduction paragraph for this section
6-2629	6	58	7	58	7	gasses → gases [Peter Burt, UK]	taken into account - text revised
6-2630	6	58	7	58	10	methane → CH4 [Peter Burt, UK]	taken into account - text revised
6-2631	6	58	8	58	8	Change to "deposits at continental". [Daniel Metcalfe, Sweden]	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2632	6	58	9	58	9	Sentence could be splitted and the semi-colon avoided. [Leticia Cotrim da Cunha, Germany]	taken into account - text revised
6-2633	6	58	13	58	13	bottom-waters → bottom waters [Peter Burt, UK]	taken into account - text revised
6-2634	6	58	13	58	25	see also Fyke JG and AJ Weaver, 2009. The effect of potential future climate change on the marine methane hydrate stability zone. J Clim 19: 5903-5917. [James Christian, Canada]	taken into account - text revised
6-2635	6	58	16	58	16	methane → CH4 (x2) [Peter Burt, UK]	taken into account - text revised
6-2636	6	58	16	58	18	But in a typical cold-shallow Arctic setting (0.4°C and 320 m) these scenarios resulted in methane fluxes that exceeded rates of benthic sediment depletion.' As mentioned previously, net CH4 emission to the atmosphere are likley to be small due to oxidation in the ater column. [Dave Reay, UK]	taken into account - text revised
6-2637	6	58	17	58	17	→ '..sediments, but in..' [Peter Burt, UK]	taken into account - text revised
6-2638	6	58	18	58	18	"methane fluxes that exceeded rates of benthic sediment depletion" I can't tell what this means. [James Christian, Canada]	taken into account - text revised
6-2639	6	58	18	58	21	methane → CH4 [Peter Burt, UK]	taken into account - text revised
6-2640	6	58	18	58	21	One point to note is that Westbrook et al reported that the northward-flowing West Spitsbergen current warmed by 1degC over the past 30 years i.e. 0.03degC/year. However, in the Reagan and Moridis study, they applied the same temperature trend over a timescale of 100 years. Is there any observational evidence that such a sustained temperature trend has occurred? If not, then I would argue that their modelling study is not entirely consistent with the Westbrook et al. observations. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	taken into account - text revised
6-2641	6	58	23	58	23	Replace "is" with "was". [Daniel Metcalfe, Sweden]	taken into account - text revised
6-2642	6	58	23	58	24	→ (Biastoch et al., 2011) → Biastoch et al. (2011) [Peter Burt, UK]	taken into account - text revised
6-2643	6	58	24	58	25	(Lamarque, 2008) → Lamarques (2008) [Peter Burt, UK]	taken into account - text revised
6-2644	6	58	27	58	27	(Archer, 2007) → Archer (2007) [Peter Burt, UK]	taken into account - text revised
6-2645	6	58	27	58	28	methane → CH4 [Peter Burt, UK]	taken into account - text revised
6-2646	6	58	29	58	29	→ Archer et al. (2009a) [Peter Burt, UK]	taken into account - text revised
6-2647	6	58	29	58	30	replace hyphens with commas [Peter Burt, UK]	taken into account - text revised
6-2648	6	58	32	58	32	Undersea landslides initiated by earthquakes could potentially release several Gt of methane in a single event causing a rapid increase in atmospheric methane and consequent changes in radiative forcing and atmospheric chemistry (Shakova et al,2010?). [Wayne Evans, USA]	taken into account - text revised
6-2649	6	58	33	58	33	hydrates; recent..' → ..hydrates. Recent.. [Peter Burt, UK]	taken into account - text revised
6-2650	6	58	33	58	33	Sentence could be splitted and the semi-colon avoided. [Leticia Cotrim da Cunha, Germany]	taken into account - text revised
6-2651	6	58	34			Same comment as earlier. If you look closely at Shakova paper, they sort of imply that their methane flux is hydrates, but it does not say this in the paper anywhere, and there is no data distinguishing hydrates from the breakdown of organic C in permafrost. The shelf is inundated terrestrial yedoma, so the flux they observe could be from organic C NOT hydrates. They show no isotope data in that paper that could potenially help resolve this, if hydrates are from deep natural gas reservoirs [Edward Schuur, USA]	taken into account - text revised
6-2652	6	58	39	58	44	There is a reference tos ection 6.8.1 which doesn't exist. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	taken into account - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2653	6	58	40	58	40	Estimates for fire emissions of methane in Table 6.7 are 1-4TgCH4/year. At least for the present day, they are a very small source relative to wetlands and/or anthropogenic sources. However, fires have the potential to increase in a future climate, thereby potentially increasing in importance. I think that line 58 could be re-worded accordingly and in particular, the word "significant" removed. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	taken into account - text revised
6-2654	6	58	42	58	44	In my opinion, the former is much more likely than the latter. [Olivier Boucher, France]	taken into account - text revised
6-2655	6	58	50		53	The seven citations in the first half of the sentence did not specifically deal with Canadian forest. It is better if the sentence is split. The second half of the sentence should then become "Kurz et al. (2008b) indicated that increased fire activity in Canadian forest has the potential to turn from a caron sink into a carbon source. [Zongbo Shi, United Kingdom]	taken into account - text revised
6-2656	6	58	54	58	54	→ '...so far focused mainly ..' [Peter Burt, UK]	taken into account - text revised
6-2657	6	58	54	58	56	This sentence describes how the models have opposite signed responses in different areas. It would be useful for the reader to describe the extent to which the models are consistent in projected areas with decreases and increases in fires rather than simply saying results are different in different regions. [Drew Shindell, USA]	accepted - text revised to include not only description of geographic variability, but also extent to which models agree on the process-level controls.
6-2658	6	58	57	58	57	Replace "in" with "of". [Daniel Metcalfe, Sweden]	accepted - text revised
6-2659	6	59	1	59	2	This should be reworded. Mesic forests, such as those of the NW US and British Columbia, have long fire return intervals (hundreds of years between fires), and have the potential to reach high biomass and ages (e.g. 800+ years). In forests with mixed- and high-severity fire regimes, such as the Pacific Northwest, US, intervals between standreplacing fires are typically several decades to several centuries (Agee 1993). Agee, J.K. (1993) Fire Ecology of Pacific Northwest Forests. Island Press, Washington, DC. [Beverly Law, USA]	taken into account - text revised to indicate that this is not an either/or dependency, but that both fuel availability and fuel mositure condition contribute to fire activity
6-2660	6	59	4			Kato et al. (2011, Journal of Land Use Science, doi:10.1080/1747423X.2011.628705) also estimates fire emission for each RCPs scenario and shows 1.1 to 1.4 times of the amount of emissions compared to that of 2000s even without the effect of climate change. The result only considers vegetation carbon change by CO2 fertilization effect, and deforestation fires. Further more, if changes in soil moisture caused by CO2 fertilization is included, the study shows fire emission increases 1.3 to 1.7 times of the amount compared to that of 2000s. [Michio Kawamiya, Japan]	accepted - text revised to include Kato et al. citation.
6-2661	6	59	7	59	7	→ change continues ..' [Peter Burt, UK]	accepted - text revised
6-2662	6	59	10	59	17	The recent review of change in the Amazon notes that while rates of deforestation have declined, the incidence of fires has not declined (Davidson et al.,, 2012. The Amazon basin in transition. Nature, 481:321-328). It also cites literature for the megadroughts of 2005 and 2010 in the Amazon, where dense moist tropical forest caught fire. [Eric Davidson, USA]	accepted - text revised to include information from Davidson et al. review.
6-2663	6	59	16			Highlight to highlighted [Zongbo Shi, United Kingdom]	taken into account - text revised
6-2664	6	59	19	59	21	Is this true for all ESMs ? [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	rejected - text accurately reflects expert view that no models currently include the natural-anthropogenic interaction terms that are likely to drive future fire behavior
6-2665	6	59	25	59	36	This overlaps with 32:4-7, and does a better job. [Robert Scholes, South Africa]	taken into account - link to this section added in 6.3.
6-2666	6	59	27	59	27	→ Anav et al. (2011) [Peter Burt, UK]	accepted - text revised
6-2667	6	59	28	59	28	→ Tian et al. (2011) [Peter Burt, UK]	accepted - text revised
6-2668	6	59	28	59	28	O3 → O3 [Peter Burt, UK]	accepted - text revised
6-2669	6	59	28			change O3 [Jeffrey Obbard, Singapore]	accepted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2670	6	59	31	59	31	→ Felzer et al. (2005) [Peter Burt, UK]	accepted - text revised
6-2671	6	59	33	59	33	→ Sitch et al. (2007) [Peter Burt, UK]	accepted - text revised
6-2672	6	59	38		46	The statement regarding Tagliabue et al. (2008) is not very accurate. "varying aeolian Fe supply" is indeed misleading. What if aeolian Fe input doubled? What if 99% of the aeolian Fe supply is gone? Did the paper explore such variatioons as well? In addition, aeolian Fe supply does not capture the full picture. What is really matters is the bioavailable Fe supply rather than the total aeolian Fe supply. The bioavailability of Fe in dust and in combustion aerosols is highly uncertain (Jickells et al., 2005, Science). [Zongbo Shi, United Kingdom]	Accepted - the text will be made more precise. In Tagliabue et al. (2008), large variation sin aeolian Fe (and/or bioavailable) were investigated.
6-2673	6	59	38		46	Furthermore, our understanding of the Fe supply to the ocean has changed to some extent over the last five years. For example, we realized that combustion Fe might be important (Luo et al., 2008; GBC; Sedwick et al., 2007). It is possible that combustion iron can contribute more dissolved Fe (not necessarily bioavailable althoug it is often assumed to be bioavailable) than dust in some parts of the ocean at the present. A recent study by OLGUN Et al. (2011, GBC) suggested that volcanic ash contribute more soluble Fe than dust globally over 1000s years time scale; therefore, it is too simple to say desert dust carries iron.....; it is better to say "desert dust, combustion aerosols and volacanic ash" or simply "atmospheric aerosol"; [Zongbo Shi, United Kingdom]	Accepted - text will be revised.
6-2674	6	59	39			…iron, which is an essential micronutrients for marine biogeochemistry: this sentence does not read well. Iron could not be a micronutrient for marine biogeochemistry; iron can only be a nutirent for marine organisms (which might include algae and cynobacteria, nitregen fixing bacteria....). [Zongbo Shi, United Kingdom]	Accepted - text revised.
6-2675	6	59	39			Is atmospheric P depositon not important at all? Or is it because our understanding is too little to allow for some insightful discussion? See Mahowald et al. 2008, GBC review paper [Zongbo Shi, United Kingdom]	Noted
6-2676	6	59	42	59	42	→ Tagliabue et al. (2008) [Peter Burt, UK]	Accepted - text revised.
6-2677	6	59	42			after "are largely uncertain, even about the sign of the changes...", there should be a sentence either just after this sentence or at the end of the paragraph mentioning that "the impact of the change in fugure iron supply on the cumulative CO2 fluxes and atmospheric CO2 is even more uncertain". it is desirable to mention why the two studies gave very different results. [Zongbo Shi, United Kingdom]	Accepted - some details will be added.
6-2678	6	59	44	59	44	→ Mahowald et al. (2011) [Peter Burt, UK]	accepted - text revised
6-2679	6	59	47	57	57	Potential overlap with WGII ch 4, which also discusses this issue. [Robert Scholes, South Africa]	noted
6-2680	6	59	47	59	57	Should this important factor (diffuse radiation effect) not be included in discussion of the causes of the increasing global terrestrial CO2 (residual) sink (remaining at a constant fraction of the increasing global CO2 annual emission), along with CO2 fertilisation, N-deposition, warming and changing age profile of mid-latitudinal forests? [Roger Gifford, Australia]	accepted - link made between this section and 6.3.2.7.2
6-2681	6	59	49	59	49	insert 'the' after 'in' [Peter Burt, UK]	accepted - text revised
6-2682	6	59	49			define 'diffuse fraction' [Jeffrey Obbard, Singapore]	taken into account - combined with comment 2681
6-2683	6	59	52	59	52	insert comma after 'However' [Peter Burt, UK]	accepted - text revised
6-2684	6	59	53	59	53	→ '..light conditions. Under heavily..' [Peter Burt, UK]	accepted - text revised
6-2685	6	59	53	59	53	Sentence could be splitted and the semi-colon avoided. [Leticia Cotrim da Cunha, Germany]	accepted - text revised
6-2686	6	59	56	59	56	insert 'that' after 'implies' [Peter Burt, UK]	accepted - text revised
6-2687	6	59	56	59	57	Can the magnitude of these "steeper GHG emission cuts" be quantified by assuming the 25% enhancement is reversed? [William Collins, United Kingdom of Great Britain & Northern Ireland]	rejected - the Mercado et al. 2009 paper provides the relevant details, but space prevents getting into them in this section.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2688	6	59	56		57	Not clear why reduction in diffuse irradiance requires greater reduction in CO2 emissions to stabilize climate if anthropogenic aerosols decrease. [Stephen E Schwartz, USA]	rejected - the Mercado et al. 2009 paper provides the relevant details, but space prevents getting into them in this section.
6-2689	6	60	2	60	31	A major point missing from this section is that anthropogenic CO2 is a perturbation of the carbon cycle that will extend for geologic time scales. This is illustrated in the figures for Box 6.2 and FAQ 6.1, and discussed briefly in Section 6.5.1.1, p. 62, lines 19-29. This point has been made for quite some time; to my knowledge, it was first articulated by [Sundquist, E.T., 1986, Geologic analogs: their value and limitations in carbon dioxide research, in Trabalka, J.R., and Reichle, D.E., eds., The Changing Carbon Cycle: A Global Analysis: New York, Springer-Verlag, p. 371-402]. A copy of this paper can be provided on request. [Eric Sundquist, United States of America]	accepted - text revised to include this point.
6-2690	6	60	4	60	4	Spelling of abruptly [Leticia Cotrim da Cunha, Germany]	accepted - text revised
6-2691	6	60	4	60	4	Replace "abrupty" with "abruptly". [Daniel Metcalfe, Sweden]	accepted - text revised
6-2692	6	60	4	60	4	Replace "abrupty" with "abruptly". [Nathaniel Ostrom, United States of America]	accepted - text revised
6-2693	6	60	4	60	13	This paragraph is problematic because it strays into complex and contentious areas that may not be relevant. It would be worth considering removing some of these topics. (1) The "Green Sahara" and abrupt climate change… Claussen et al. (1999) appeared to be a neat result at the time but now the evidence for an abrupt change is disputed, and the mechanism for it happening in the model is also disputed. There is quite a large literature about this. Furthermore, these two references seem antiquqted, as they are based on asynchronous coupling, while generally dynamically coupled OAVGCMs don't show such strong feedbacks. (2) There are many more references than Bertrand et al. dealing with the question of whether (or not) ecosystems are showing, or would be expected to show, lagged responses to climate change -- again a huge area, replete with confusion, that doesn't seem to be crucially relevant to a chapter on the carbon cycle. [Iain Colin Prentice, Australia]	taken into account - first paragraph of this section revised to eliminate the parts that are not central to the future projections focus of section 6.4
6-2694	6	60	4	60	13	WGII ch 4 is built around issues of abrupt change. It would be better to be brief here and point to that fuller treatment. [Robert Scholes, South Africa]	taken into account - combined with comment 2693
6-2695	6	60	4	60	46	I suggest to mention here also the fact that ocean acidification is also bound to stay for a long time. See work by Joos et al. (2011) for example. [Nicolas Gruber, Switzerland]	Accepted - text revised.
6-2696	6	60	4			typo in 'abruptly' [Edward Schuur, USA]	accepted - text revised
6-2697	6	60	5	60	5	insert comma after 'climate' [Peter Burt, UK]	taken into account - combined with comment 2693
6-2698	6	60	5	60	5	Change to "climate, and are especially" [Daniel Metcalfe, Sweden]	taken into account - combined with comment 2693
6-2699	6	60	5	60	6	The biophysical feedbacks on climate discussed here seem to be presented in more of a general or global context; why the emphasis on North Africa? If you choose to keep the comment on North Africa it would be good to know why this region is sucha good case example. [Nathaniel Ostrom, United States of America]	taken into account - combined with comment 2693
6-2700	6	60	6	60	6	insert comma after 'Amazonia' [Peter Burt, UK]	accepted - text revised
6-2701	6	60	6	60	6	Change to "Amazonia, increased" [Daniel Metcalfe, Sweden]	accepted - text revised
6-2702	6	60	6	60	7	This sentence structure does not work. Break into 2 sentences to convey trends for increasing and decreasing forest cover. [Christina Tonitto, USA]	taken into account - combined with comment 2693
6-2703	6	60	6	60	8	This discussion of the relationship between forest cover and precipitation is rather simplistic. See Davidson et al.,, 2012. The Amazon basin in transition. Nature, 481:321-328) for a more analytical approach to this topic as a function of the scale of distrubances in the Amazon. This review article also contains references to specific processes if still more detail is desired. At small scales, clearings can result in greater precipitation due to "vegetation breezes" that brinig in moist air from the surrounding forest. At larger scales disturbances,	taken into account - combined with comment 2693

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						regional precipitation may decline, but it has been difficult to quanitfy. Smoke, which often accompanies deforestation and subsequent pasture management, plays a very important role, often inhibiting the formation of raindrops. [Eric Davidson, USA]	
6-2704	6	60	7	60	7	What is the purpose of "(decreased)"? I suggest that both instances can be removed. [Daniel Metcalfe, Sweden]	taken into account - combined with comment 2693
6-2705	6	60	11	60	11	Do you mean land ecosystems? [Peter Burt, UK]	taken into account - combined with comment 2693
6-2706	6	60	11	60	12	This sentence doesn't quite make sense, i suggest "1995). Early observations show that ecosystem shifts are already lagging behind changes in climate regimes" [Daniel Metcalfe, Sweden]	taken into account - combined with comment 2693
6-2707	6	60	15	60	16	As it is currently phrased, this point seems a bit obvious/trivial. Obviously, changes over longer periods of time will tend to be greater than those over a shorter period of time. [Daniel Metcalfe, Sweden]	accepted - text revised to indicate that this refers to long-term stabilization scenarios.
6-2708	6	60	15	60	17	First sentence in the paragraph is too long and could be splitted. [Leticia Cotrim da Cunha, Germany]	taken into account - combined with comment 2707
6-2709	6	60	15			insert 'will' after 'potentially' [Jeffrey Obbard, Singapore]	taken into account - combined with comment 2707
6-2710	6	60	22		24	"Changes in temperate forests and the southern boundary of the boreal forest are especially uncertain both across vegetation models and climate scenarios (Figure 6.42) with models showing either an increase or decrease in tree cover depending on scenario." Good language for an assessment. The figure might use a line code to distinguish the two models. [Stephen E Schwartz, USA]	noted - thank you for the comment. regarding figure: rejected, model identification not essential to the point being made.
6-2711	6	60	24			insert 'the' before 'scenario [Jeffrey Obbard, Singapore]	accepted - text revised
6-2712	6	60	26	60	26	insert 'for' after 'accounted' [Peter Burt, UK]	accepted - text revised
6-2713	6	60	28	60	28	delete 'here' [Peter Burt, UK]	accepted - text revised
6-2714	6	60	29	60	29	Why do the models not work well? [Nikolaus Josef Kuhn, Switzerland]	taken into account - text revised to clarify time scales where models do poorly, and to include relevant citations
6-2715	6	60	30	60	30	savanna (not savannah) [Robert Scholes, South Africa]	accepted - text revised
6-2716	6	60	35	60	35	Replace "tropics" with "tropical" for consistency with the other biome terms. [Daniel Metcalfe, Sweden]	accepted - text revised
6-2717	6	60	40	60	40	What is meant by "commitments"? [Daniel Metcalfe, Sweden]	taken into account - text revised to clarify commitments to changes in ecosystems
6-2718	6	60	44	60	46	I suspect the long term compatible emissions will also very much dependent on the commited changes in the ocean. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	accepted - text ammended to include mention of commited ocean changes
6-2719	6	60	48			Section 6.5: Overall I think this section spends too much effort on technologies of negligible importance. Some of these approaches (especially enhanced upwelling and downwelling) are largely fanciful and there isn't much point in discussing their potential side effects at length (I am thinking particularly of 6.5.2.4, 6.5.2.6.2 and 6.5.6.4 here). It also helps to be clear about what is potentially a partially offsetting effect and what is an effect that could completely negate the proposed gains or a side effect that could have completely unforeseen consequences (see e.g. 6.5.2.6). I find the paragraph on 69/5-16 particularly vague and confusing. [James Christian, Canada]	taken into account - sections are shortened and clarified.
6-2720	6	60	48			entire section on CDR: The text needs to be better connected to the available literature. It currently contains too few references. The text should also be better integrated into the rest of the chapter, as there are a few redundancies that could be avoided by simply refering to a section earlier in the chapter (e.g. long-term fate of ant. CO2) [Nicolas Gruber, Switzerland]	accepted - references added

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2721	6	60	48			Section 6.5: This section focuses entirely on carbon dioxide removal methods and altering solar radiation as a means of mitigating against climate change. There is no discussion about methane removal methods e.g. Boucher and Folberth, Atmospheric Environment, 2010. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	accepted - sentence added describing method for removal of CH4
6-2722	6	60	53	60	53	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - text revised
6-2723	6	60	56	60	56	CDR: Although the name implies that this is only about CO2, I suggest to widen this definition here a bit to include all greenhouse gases and especially CH4 and N2O. [Nicolas Gruber, Switzerland]	accepted - sentence added describing method for removal of CH4
6-2724	6	60		69		CO2 Removal and other geoengineering approaches. I question whether this section is within the mandate of the WG1. The material in this section, plus other approaches to geoengineering might better be in a special report rather than in the AR5. Even considering geoengineering might be taken as an endorsement and might redound negatively on IPCC as taking a position rather than assessing scientific understanding of climate change. [Stephen E Schwartz, USA]	reject - mandate to chapter to discuss geoengineering
6-2725	6	61	6			change to 'on land' and 'in oceans' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2726	6	61	12	61	12	"blue carbon" is a form of "industrialized capture"? [James Christian, Canada]	Taken into account - "Blue carbon" is explained in Table 1. It is not industrialized capture
6-2727	6	61	13	61	13	Replace "alkalinity" with "alkalis". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2728	6	61	15	61	15	Replace "alkalinity" with "alkalis", change to "minerals are added". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2729	6	61	19	61	19	insert (CDR) after 'Removal' and lower case for Carbon Dioxide Removal [Peter Burt, UK]	Editorial - text revised
6-2730	6	61	21	61	21	lower case for CCS in full [Peter Burt, UK]	Editorial - text revised
6-2731	6	61	22	61	22	lower case for REDD in full [Peter Burt, UK]	Editorial - text revised
6-2732	6	61	24	61	24	Change to "respectively, but they do not" [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2733	6	61	25	61	25	IPCC has several definitions across WG, so it would be good to provide a reference. Note that we may want to change that definition in AR5. [Olivier Boucher, France]	Accepted - text revised
6-2734	6	61	29	61	31	I think this statement on root cause and risk is a bit controversial. The root cause is the emission of CO2 not its presence in the atmosphere and CDR does not address the problem of emission. Possibly less risk for the climate itself, but maybe more risk for the Earth System as a whole depending on where and how the C is stored. I suggest to specify what is meant by unintended side effects here (I assume unintended side effects on climate change). [Olivier Boucher, France]	Accepted - text revised
6-2735	6	61	33	62	2	I agree that CDR cannot be fast, but this is not very well substantiated here. In particular you need to say why DAC and others cannot be fast. [Olivier Boucher, France]	Accepted - text revised
6-2736	6	61				There are no footnotes in the table, but there are some terms with lowercase letters [Marcelo Galdos, Brazil]	Accepted - added a sentence below the table
6-2737	6	62	4	62	4	Remove "time". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2738	6	62	6	62	36	Entire section 6.5.1.1: This could be substantially shortened because many of these arguments were presented and discussed earlier in the chapter [Nicolas Gruber, Switzerland]	Noted - text shortened
6-2739	6	62	8	62	8	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - text revised
6-2740	6	62	8	62	8	Should this be something like "preindustrial levels."? [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2741	6	62	8	62	14	"an additional of only 500 PgC can be emitted if climate change is to be stabilized at 2°C above preindustrial levels." Given present temprature rise is masked by the emission of anthropogenic sulphur aerosols,	Accepted - Text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						estimated by the AR4 at -1.2 Watt/m2 (direct effects and cloud albedo effects), the potential rise in mean global tempratures is near to 2 degrees C if and when this short-lived aerosol effect dissipates. [Andrew Glikson, Australia]	
6-2742	6	62	8	62	17	I suggest you double check that with relevant chapters of AR5. Are you talking CO2 eq or CO2 here? Or remove that bit as it is not very relevant. [Olivier Boucher, France]	Accepted - text removed
6-2743	6	62	9	62	9	modeling → modelling [Peter Burt, UK]	Editorial - text revised
6-2744	6	62	10	62	10	"have" instead of "has". [Leticia Cotrim da Cunha, Germany]	Editorial - text revised
6-2745	6	62	11	62	11	Change to "times, only PgC more can be emitted". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2746	6	62	11	62	12	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - text revised
6-2747	6	62	11			change 'additional' to 'addition' [Jeffrey Obbard, Singapore]	Taken into account - combined with another comment
6-2748	6	62	12			insert 'at' after 'estimated' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2749	6	62	14	62	14	Change to "rates have increased in the recent". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2750	6	62	15	62	15	modeling → modelling [Peter Burt, UK]	Editorial - text revised
6-2751	6	62	19	62	29	This paragraph might be used to expand Section 6.4.9 to emphasize the point that long-term stabilization of anthropogenic CO2 will extend to geologic time scales. This point has been made for quite some time; to my knowledge, it was first articulated by [Sundquist, E.T., 1986, Geologic analogs: their value and limitations in carbon dioxide research, in Trabalka, J.R., and Reichle, D.E., eds., The Changing Carbon Cycle: A Global Analysis: New York, Springer-Verlag, p. 371-402]. A copy of this paper can be provided on request. [Eric Sundquist, United States of America]	taken into account - reference has been added
6-2752	6	62	22	62	23	Change to "atmosphere for several". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2753	6	62	23			check '10000' if correct write as '10,000 [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2754	6	62	28	62	28	Replace "operates" with "operate". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2755	6	62	32	62	32	insert 'to' after 'relative' [Peter Burt, UK]	Editorial - text revised
6-2756	6	62	32	62	32	preindustrial → pre-industrial [Peter Burt, UK]	Editorial - text revised
6-2757	6	62	32	62	32	Sentence could be splitted and the semi-colon avoided. [Leticia Cotrim da Cunha, Germany]	Noted
6-2758	6	62	32	62	32	Change to "relative to preindustrial". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2759	6	62	32			insert 'to' after 'relative' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2760	6	62	33	62	4	Simplify this sentence to read: "Therefore, it may not be possible to reverse climate change on decadal to centennial timescales..." [Nathaniel Ostrom, United States of America]	Editorial - text revised
6-2761	6	62	34	62	34	I'm not sure what "time scales relevant to" something means, would it be simpler to change to "climate change within decadal". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2762	6	62	41	62	42	carbon dioxide → CO2 [Peter Burt, UK]	Editorial - text revised
6-2763	6	62	45	62	45	This a meaningless (tautological) statement. [James Christian, Canada]	Editorial - text revised
6-2764	6	62	45	62	51	This paragraph on the storage capacity deserves more thought and detail. E.g. a statement such as "oceans may also be able to store a few thousand Pg of ant. CO2" can be quantified more exactly. Model simulations	Accepted - Quantitative statement is made for ocean carbon storage and Archer et al. (2009) cited.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						by Archer and others can provide detailed estimates of what the storage capacity is and what fraction of the injected CO2 will actually stay in the ocean [Nicolas Gruber, Switzerland]	
6-2765	6	62	47	62	47	Change to "However, the terrestrial". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2766	6	62	47			insert 'the' after 'However,' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2767	6	62	49	62	49	insert comma ftre 'However' [Peter Burt, UK]	Editorial - text revised
6-2768	6	62	49	62	49	Change to "However, it is". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2769	6	63	1	63	5	This depends strongly on the rate of leakage and whether this leakage stems from the ocean or land. In the case of the ocean, only a fraction of the injected CO2 will leak out so. I suggest to be more specific here. [Nicolas Gruber, Switzerland]	Accepted - text revised
6-2770	6	63	2	63	5	This sentence "Nevertheless, …" is too long and confusing, maybe it could be re-written. [Leticia Cotrim da Cunha, Germany]	Editorial - text revised
6-2771	6	63	4	63	4	time → term [Peter Burt, UK]	Editorial - text revised
6-2772	6	63	4	63	5	Change to "short term while". Could this be better expressed as "while allowing time for existing options to improve and/or new options to emerge in the long term". [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2773	6	63	11			Statement is arguable - if non-permanent reservoirs were to leak CO2 back to the atmosphere the impact may be lesser than the eqivalent for a non-sequestration scenario if 'business as usual' emissions have been reduced in the meantime. [Jeffrey Obbard, Singapore]	Accepted -text revised
6-2774	6	63	14		21	should it not be mentioned that increasing wetlands will also raise CH4 output? [David Newbery, CH]	Accepted - text revised
6-2775	6	63	18			insert 'the' after 'in' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2776	6	63	19	63	19	Change to "storage in the terrestrial". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2777	6	63	20			alter grammer - remove 'we' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2778	6	63	21	63	21	Change to "light of possible future climate change, not under". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2779	6	63	24	63	26	see 6/9-11 [James Christian, Canada]	Noted
6-2780	6	63	25			should 'reduced' be 'increased'? [Jeffrey Obbard, Singapore]	Rejected - sequestration would lead to reduction in atmospheric CO2
6-2781	6	63	26	63	29	The magnitude of the "rebound effect" depends completely on the time scale, and the condition of constant airborne fraction is not appropriate. [Eric Sundquist, United States of America]	Accepted - text revised - "exactly the same" removed
6-2782	6	63	32	63	34	I am not certain I understand how CO2 taken up by terrestrial sinks could be outgased back to the atmosphere if the atmospheric CO2 concentration were to decrease. Has here been a clear demonstration that terrestrial C stores are gradient-driven? If not, how can we assume that they should be affected by a drop in atmospheric CO2. [Pierre Bernier, Canada]	Accepted - text revised with the addition of one sentence and a reference.
6-2783	6	63	34	63	34	I suggest change to "when it eventually outgases" to emphasise that this could take a long time! [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2784	6	63	42			(and the areas around this) This section is one of the important new contributions so it needs to be clear. I suggest a boxed text or diagram to describe the rebound effect [Peter Rayner, Australia]	Rejected - It is felt that the "rebound effect" is adequately discussed in the main text with the help of an illustration (Fig. 6.45). There is also an FAQ on geoengineering that discusses CDR.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2785	6	63	45	67	29	Section 6.5.2 does not adequately represent some important differences in the feasibility of the CDR methods discussed. Management of biological carbon production over land is a practice that extends throughout human history; its capacity as a CDR method is limited by available land area and competition with other resources. The other described methods depend on practices that have never been implemented on any meaningful scale, and their potential is extremely uncertain. For all the described methods, energy costs and environmental or resource tradeoffs should be fully described. [Eric Sundquist, United States of America]	Rejected - Beyond the mandate of WG1.
6-2786	6	63	47	63	49	Text requires editing for consistency with previous style [Peter Burt, UK]	Noted
6-2787	6	63	47	63	52	I can't tell what the numbers mean here. [James Christian, Canada]	Editorial - text revised
6-2788	6	63	47	64	3	enhanced biological production. Strictly speaking, Biochar etc do not require enhanced biological production on land. This is because they reduce the return flow of carbon from land by effectively reducing terrestrial respiration. I therefore suggest to rephrase this a discuss this in terms of enhanced NET uptake by land. [Nicolas Gruber, Switzerland]	Agreed - text revised
6-2789	6	63	48	63	49	It's confusing that there are two "(3)" categories. [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2790	6	63	51	63	51	→ over land, in the oceans or in geological formations. Carbon storage over land is in.. [Peter Burt, UK]	Editorial - text revised
6-2791	6	63	51	63	52	Change to "land is in organic forms but". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2792	6	63	51			add 'is' before 'in' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2793	6	63	57			This figure of 120PgC pa formation of biomass by global vegetation is incorrect. It is gross photosynthesis that is 120 Pg (as described for Fig 6.1). Concurrently plants are respiring about half of that (ie autotrophic respiration) with the result that net primary production (NPP) is about 50-60 PgC pa. NPP is the same thing as "new biomass production". This is in turn dissipated by heterotrophic respiration of about 50-60 Pg pa such that overall annual net biosphere C exchange is close to zero (except for the relatively small anthropogenic stimulus from CO2 fertilisation, N-deposition, warming etc.). As I mentioned in relation to Figure 6.1, there needs to be more information included in the Figure to avoid this major misunderstanding. This is well-established text book ecology and plant physiology. [Roger Gifford, Australia]	Accepted - text revised
6-2794	6	64	8	64	8	delete comma after 'urbanization [Peter Burt, UK]	Editorial - text revised
6-2795	6	64	9	64	9	Replace "to" with "of". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2796	6	64	13	64	20	In discussing the potential to sink carbon into vegetation and especially soils, it is essential to relate it to the source of the other mineral elements (especially N, P and S) that are an integral part of biomass and soil organic matter. The mineral elements that were part of the now lost pre-industrial stocks of soil organic matter are long since dissipated in ocean (and atmosphere as N2). For the soil organic matter to be recoverd requires the minerals involved in the organic molecules to be replaced. This is very expensive compared with the prices for C trading being discussed by policy people and C-markets. See pp48-49 in Gifford RM (2010) Carbon sequestration in Australian Grasslands: Policy and technical issues. Integrated Crop Management 11:33-56 (available online at http://www.fao.org/docrep/013/i1880e/i1880e.pdf). It is a major global biogeochemcial issue (as well as cost issue) if to be implemented globally on the scale discussed in this section. Biochar also contains minerals (I don't think it is pure C by any means) that will need to be supplied as fertiliser to form the residues that are converted into long lived biochar. [Roger Gifford, Australia]	Accepted - added a sentence 6.5.3.1
6-2797	6	64	13	64	20	This treatment inexplicably omits the "bounding" analysis by House, J.I., I.C. Prentice and C. Le Quéré (2002). Maximum impacts of future reforestation or deforestation on atmospheric CO2. Global Change Biology 8 : 1047-1052. As far as I know this basic calculation has not been seriously challenged. [Iain Colin Prentice, Australia]	Accepted - Text revised and literature cited
6-2798	6	64	17	64	20	You should perhaps also note here that there is potential for biochar to actually decrease soil C sequestration in some systems, see Wardle et al. Science, 2008, vol. 320, pp. 629. [Daniel Metcalfe, Sweden]	Accepted -text revised and literature cited in section 6.5.3.1

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2799	6	64	20			is 'Report' reference correct? [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2800	6	64	22	65	8	Negative effects should also be mentioned in the Chapter" 6.5.2.2 Enhanced Biological Production over Oceans". I would suggest to also include risk of changes in biodiversity by enhancing growth of specific algae. [Birgit Nabbefeld, Germany]	Taken into account in section 6.5.3.2
6-2801	6	64	22			Section 6.5.2.2: The discussion of ocean fertilization omits some of the most relevant and up to date literature. Wingenter et al 2004 "Changing concentrations of CO, CH4, C5H8, CH3Br, CH3I, and dimethyl sulfide during the Southern Ocean Iron Enrichment Experiments" (PNAS 101: 8537-8541) show that fertilization enhances (or in some cases decreases) outgassing of non-CO2 climate-active gases, whose potential ofsetting effects need to be considered. There was some speculation that natural (sustained) iron fertilization led to much higher export efficiencies than mesoscale experiments. This is discussed by Pollard et al 2009 "Southern Ocean deep-water carbon export enhanced by natural iron fertilization" (Nature 457: 577-580). The global modelling study of Zahariev et al 2008 "Preindustrial, historical, and fertilization simulations using a global ocean carbon model with new parameterizations of iron limitation, calcification, and N2 fixation" (Progress in Oceanography 77: 56-82) showed that even "perfect" fertilization (complete elimination of iron limitation) does not lead to widespread NO3 drawdown and that peak uptake rates of excess CO2 are small and short lived. I am generally of the opinion that CH4 is implausible as an offsetting effect, because it is only produced in shelf and slope sediments (whereas N2O is produced in the water column). Perhaps a scenario where Nr was added in large quantities at the shelfbreak (as advocated by Prof Ian Jones but not discussed in this report) could lead to a small increase in CH4 production, but open ocean Fe or Fe/P fertilization would not. This is discussed in DFO, 2009."Ocean Fertilization: Mitigating Environmental Impacts of Future Scientific Research" (CSAS Science Advisory Report 2010/012, available at http://www.dfo-mpo.gc.ca/csas-sccs/publications/sar-as/2010/2010_012-eng.htm). These reports go through a fairly rigorous review process but are not peer-reviewed literature in the usual sense. The discussion of artificial upwelling should explicitly state that the a priori expectation is that it will lead to CO2 outgassing, not uptake, because the ratio of DIC/NO3 will normally be larger than the ratio in phytoplankton biomass. This can only be negated by the unusual stoichiometries discussed by Karl and Letelier or in some cases by excess alkalinity as discussed by Dutreuil, S., L. Bopp, and A. Tagliabue (2009), Impact of enhanced vertical mixing on marine biogeochemistry: lessons for geo-engineering and natural variability, Biogeosciences, 6, 901–912. Lovelock and Rapley did not address this issue, and the whole idea is based on a very naive understanding of the ocean. The field test of a pumping system by White et al 2010 An Open Ocean Trial of Controlled Upwelling Using Wave Pump Technology. J. Atmos. Oceanic Technol. 27: 385–396 could also be mentioned here. (see also 67/12-20) [James Christian, Canada]	Accepted - Pollard et al 2009 cited in section 6.5.2.2. Wingener etal. 2004 cited in section 6.5.2.6.2, and Zahariev et al. 2008 is cited in Table 6.16
6-2802	6	64	28			insert ' the' before 'deep' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2803	6	64	30	64	30	Biological pump. To be consistent with the terminology elsewhere in this chapter, one would have to use the term "soft-tissue pump" or "organic carbon pump" here. An enhancement of the other part of the biological pump, i.e. the carbonate pump, would actually cause an outgassing of CO2 [Nicolas Gruber, Switzerland]	Accepted - text revised
6-2804	6	64	35	64	35	delete second 'ocean' [Peter Burt, UK]	Editorial - text revised
6-2805	6	64	35			Correct grammar of sentence. [Jeffrey Obbard, Singapore]	editorial - text revised
6-2806	6	64	36			sequestrated -> sequestered [Peter Rayner, Australia]	Editorial - text revised
6-2807	6	64	40			"in the last 15 years" is not accurate; it is better to say "from 1990 to 1997" or similar. [Zongbo Shi, United Kingdom]	Accepted - text revised
6-2808	6	64	43	64	43	Change to "respiration by zooplankton grazing". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2809	6	64	43	64	43	Modify the phrase "…or by grazing by zooplankton." to "… or grazing by zooplankton." [Nathaniel Ostrom,	Editorial - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						United States of America]	
6-2810	6	64	53	64	53	potential → potentials [Peter Burt, UK]	Editorial - text revised
6-2811	6	64	53	64	53	Jin and Gruber (2003) obtained an atmospheric drawdown of more than 60 ppm over 100 years (idealized Fe fertilization over the entire Southern Ocean) [Nicolas Gruber, Switzerland]	Accepted - text revised
6-2812	6	64	53			add removal rates' after 'potential' [Jeffrey Obbard, Singapore]	Taken into account
6-2813	6	64	54	64	55	The writing is confusing here because the sentence specifies a "carbon sink" but provides values in ppm that are concentrations; concentration is not a unit for sinks. Perhaps rewrite to indicate an expected drawdown of atmospheric CO2 concentration by 15 to 33 ppm. [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-2814	6	64	55	64	55	Change to "in global oceans or only". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2815	6	65	1	65	1	Change to "than 100". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2816	6	65	2			change ' for perfect' to 'under ideal' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2817	6	65	4	65	4	be also → also be [Peter Burt, UK]	Editorial - text revised
6-2818	6	65	8			People will tend to take the figure of 0.9 PgCpa and forget about the "under most optimistic assumptions". I would be inclined to finish with a moderating clause such as "but under realistic conditions could be an order of maginitude lower than that." [Roger Gifford, Australia]	Accepted - text revised
6-2819	6	65	10	65	42	It would be worth explaining why, with the accumulation of extra Ca(HCO3)2 in the ocean by this accelerated weathering, re-equilibration via the reverse reaction Ca(HCO3)2 > CaCO3 + CO2 + H20 would not release some or all the CO2 captured back to atmosphere over time while accelerating the formation of carbonate shells. ie why over time, the net effect of enhanced weathering is not to increase calcium carbonate formation in the sea while leaving atmospheric CO2 concentration unchanged? [Roger Gifford, Australia]	Agreed - No space for details. The key process is the dissolution of carbonate minerals to achieve a new geochemical equilibrium for the removal of fossil fuels. This is now discussed in the first two sentences of the second paragraph of section 6.5.2.3
6-2820	6	65	14	65	14	The citation "Archer et al 2009" for the removal of atmospheric CO2 by silicate and carbonate weathering is not fitting. This was shown quite some time before, e.g. by Kempe, 1979 or Berner et al. 1983. References: Kempe, S., 1979. Carbon in the Freshwater Cycle. In: B. Bolin, E.T. Degens, S. Kempe and P. Ketner (Eds.), The Global Carbon Cycle. Scientific Committee On Problems of the Environment (SCOPE), Old Woking, 322-343. Berner, R.A., Lasaga, A.C. and Garrels, R.M., 1983. The carbonate-silicate geochemical cycle and its effect on atmospheric carbon-dioxide over the past 100 million years. American Journal of Science 283 (7), 641-683. [Nils Moosdorf, Germany]	Accepted - Reference Berner et al. 1983 cited
6-2821	6	65	19	65	43	6.5.2.3 Accelerated Weathering: I would suggest to include risk of alkalinity-changes for biodiversity. [Birgit Nabbefeld, Germany]	Taken into account - in section 6.5.3.3
6-2822	6	65	20	65	20	Based on empirical data the CO2-consumption by chemical weathering is estimated to be 0.2 to 2.8 Gt C yr-1 . Please compare references Gaillardet et al. (1999) and Hartmann et al., (2009) and references therein. The 0.1 Gt C yr-1 estimate seems to be too low if comparing the river data of the largest rivers of the world. If considering the increased fluxes from island arcs, the number is higher. Please compare: Hartmann, J., , Jansen, N., Kempe, S, Dürr, H.H., Köhler, P. (2009) Global CO2-consumption by chemical weathering: What is the contribution of highly active weathering regions? Global and Planetary Change, 69, 185-194. doi: 10.1016/j.gloplacha.2009.07.007 AND Gaillardet, J., Dupre, B., Louvat, P., Allegre, C.J., 1999. Global silicate weathering and CO2 consumption rates deduced from the chemistry of large rivers. Chemical Geology 159 (1–4), 3–30. Please note that I am an author of one of the publications. Probably another Reference should be found. [Jens Hartmann, Germany]	Accepted - Weathering rate changed to 0.25 PgC per year and the relevant literature for global scale weathering rate is cited
6-2823	6	65	20	65	21	Actually, the CO2 consumption by natural chemical weathering is quite well constrained by recent studies. Hartmann et al. 2009 reported an annual CO2 consumption of 237 Pg C, of which 63% are consumed by silicate weathering. These results are supported by my own results from North America (Moosdorf et al. 2011).	Accepted -See the response to 2822

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						References: Hartmann, J., Jansen, N., Dürr, H.H., Kempe, S. and Köhler, P., 2009. Global CO2-consumption by chemical weathering: What is the contribution of highly active weathering regions? Global and Planetary Change 69 (4), 185-194. Moosdorf, N., Hartmann, J., Lauerwald, R., Hagedorn, B. and Kempe, S., 2011. Atmospheric CO2 consumption by chemical weathering in North America. Geochimica et Cosmochimica Acta 75 (24), 7829-7854 [Nils Moosdorf, Germany]	
6-2824	6	65	22	65	22	insert 'the' after 'remove' [Peter Burt, UK]	Editorial - text revised
6-2825	6	65	22			change grammar - remove 'we' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2826	6	65	27	65	34	This reference could be added: "Kohler, P., Hartmann, J., & Wolf-Gladrow, D. A. (2010). Geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences of the United States of America, 107, 20228-20233 ST - Geoengineering potential of arti. doi:10.1073/pnas.1000545107". The authors estimate (direct quote from the article) a "potential to sequestrate up to 1 Pg of C per year directly, if olivine is distributed as fine powder over land areas of the humid tropics, but this rate is limited by the saturation concentration of silicic acid.". However, one of the associated impacts would be the increase in river pH (alkalinization). This could have negative impacts on the distribution of the Anopheles mosquito larvae (Malaria vector) in the region. A study has shown that mosquito larvae are more abundant in less acidic rivers and agricultured areas in the Amazon region, according to (Tadei, W. P., Thatcher, B. D., Santos, J. M., Scarpassa, V. M., Rodrigues, I. B., & Rafael, M. S. (1998). Ecologic observations on anopheline vectors of malaria in the Brazilian Amazon. . The American Journal of Tropical Medicine and Hygiene , 59 (2), 325-335. Retrieved from http://www.ajtmh.org/content/59/2/325.abstract)). [Leticia Cotrim da Cunha, Germany]	Accepted - text revised and literature cited. However, the other comment relating to impact on mosquito is rejected because it is beyond the mandate of WG1.
6-2827	6	65	31	65	32	Please be aware that although it is true that Schuiling and Krijgsman proposed the large-scale application of olivine to reduce atmospheric CO2, but their approach is quite uncritical of their very optimistic results. Some of their approximations e.g. result from global extrapolation of two samples from a mine-waste region. More recent publications (e.g. Köhler et al. 2010) draw a more realistic picture of the CO2 consumption potential of olivine powder weathering. Reference: Köhler, P., Hartmann, J. and Wolf-Gladrow, D.A., 2010. Geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences of the United States of America 107 (47), 20228-20233. [Nils Moosdorf, Germany]	Accepted - text revised and literature cited
6-2828	6	65	33	65	33	→ In these land-based weather processes..' [Peter Burt, UK]	Editorial - text revised
6-2829	6	65	33	65	34	Change to "weathering proposals, some". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2830	6	65	33			add 'scenarios' after 'weathering' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2831	6	65	35	65	34	May be it can be considered that there exists an upper limit due to dissolution kinetics. Due to the limitation of runoff (water mass itself) only a certain amount of the considered minerals can be dissolved, because saturation is reached. This upper limit has been investigated in natural systems (e.g. van Cappelen et al., 1999) and applied in Köhler et al. (2010). Ref.: VanCappellen, P., Qiu, L.Q.: Biogenic silica dissolution in sediments of the Southern Ocean .1. Solubility. Deep-Sea Res Pt Ii 44(5), 1109-1128 (1997a) VanCappellen, P., Qiu, L.Q.: Biogenic silica dissolution in sediments of the Southern Ocean .2. Kinetics. Deep-Sea Res Pt Ii 44(5), 1129-1149 (1997b) Pokrovsky, O.S., Schott, J.: Kinetics and mechanism of forsterite dissolution at 25C and pH from 1 to 12. Geochimica et Cosmochimica Acta 64(19), 3313-3325 (2000). doi:10.1016/s0016-7037(00)00434-8 Köhler, P., Hartmann, J., Wolf-Gladrow, D.A. (2010) The geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences. doi: 10.1073/pnas.1000545107 Please note that I am an author of one of the publications. Probably another Reference should be found. [Jens Hartmann, Germany]	Accepted - Text revised and Kohler et al. (2010) is cited.
6-2832	6	65	36	65	43	This section begs for some caveats about the unintended consequences, such as disruption of biological activity, impacts on marine ecosystems. [Beverly Law, USA]	Taken into account - addressed in section 6.5.3.3

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2833	6	65	42	65	42	insert 'the' after 'increase' [Peter Burt, UK]	Editorial - text revised
6-2834	6	65	48	65	48	Change to "from the surface ocean in high latitudes to the deep ocean (Zhou". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2835	6	65	48	65	50	In Sarmiento and Gruber (2006), there are figures which show distributions of CO2 transported by biological and solubility pumps, although the pumps are classified more in details. According to the figure (Fig. 8.4.3), CO2 in deep oceans is largely contributed by a soft-tissue pump, a kind of biological pump. Is it contradicted to what is described here? [AKIHIKO MURATA, Japan]	Rejected - Fig. 7.3 in WG1 AR4 report, a modified figure from Sarmiento and Gruber (2006) shows that the downward transport by solubility pump is ~ 90 PgC but it is only ~ 10 PgC by the biological pump
6-2836	6	65	49	65	50	Change to "not by the biological". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2837	6	65	50	65	50	Is "chemistry" a "process"? [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2838	6	65	50	65	50	Change to "by 1 million". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2839	6	65	50			add 'the' beofre 'biological' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2840	6	65	51	65	51	saturated in → saturated with [Peter Burt, UK]	Editorial - text revised
6-2841	6	65	51	65	53	"already saturated in CO2" is misleading. From this, readers may think that surface waters do not occur air-sea exchanges of CO2 any more. In reality, under- or super-saturations of CO2 in surface waters are often observed, implying exchanges of CO2. [AKIHIKO MURATA, Japan]	Accepted - text revised
6-2842	6	65	53	65	53	by1 → by 1 [Peter Burt, UK]	Editorial - text revised
6-2843	6	65	53	65	54	This proposed enhancement of the AMOC is much less than the projected decline due to anthropogenic climate change. [James Christian, Canada]	Noted - text revised
6-2844	6	65	53			add space after 'by' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2845	6	66	4	66	4	insert 'a' after 'which' [Peter Burt, UK]	Editorial - text revised
6-2846	6	66	4	66	4	Change to "which a pure". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2847	6	66	5	66	5	"Which "Commercial purposes"? Ones that don't involve emitting the condensed CO2 to the atmosphere ever, i assume? [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2848	6	66	5	66	5	Change to "or the deep-ocean". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2849	6	66	6	66	6	→ '..reservoirs or the deep ocean.' [Peter Burt, UK]	Editorial - text revised
6-2850	6	66	6	66	6	"At least three methods" only 2 listed [James Christian, Canada]	Accepted - text revised
6-2851	6	66	6	66	7	What is the third method alluded to? [Roger Gifford, Australia]	Accepted - text revised
6-2852	6	66	6	66	7	This sentence indicates there are three methods for direct air capture but only two are presented. What is the third? [Nathaniel Ostrom, United States of America]	Accepted - text revised
6-2853	6	66	6	66	8	You note three methods, but mention two [Peter Burt, UK]	Accepted - text revised
6-2854	6	66	6	66	8	Where's the third method? [Daniel Metcalfe, Sweden]	Accepted - text revised
6-2855	6	66	9	66	9	insert 'the' aftre 'is' [Peter Burt, UK]	Editorial - text revised
6-2856	6	66	9			add 'the' after 'is' revise sentence - bad grammar. [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2857	6	66	13			Section 6.5.2.6: I think concerns about both the hysteresis effect and reduced plant productivity are overstated here. Figure 6.46 shows a very idealized experiment where atmospheric CO2 attains extremely high levels	Accepted - added a sentence

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						and is then rapidly removed. If CDR is used e.g. to achieve a mitigation scenario like RCP2.6, the effects on terrestrial and ocean ecosystems will be small. The climate will not go back to exactly the way it was, but as noted above (5/37-40) the surface ocean at least responds very rapidly to a levelling off and subsequent decline of atmospheric CO2. [James Christian, Canada]	
6-2858	6	66	16	66	16	earth system → Earth System [Peter Burt, UK]	Editorial - text revised
6-2859	6	66	16	66	16	Earth System (capital letters?) [Leticia Cotrim da Cunha, Germany]	Editorial - text revised
6-2860	6	66	17	66	18	If you start lowering atm. CO2, surface temperature does not lag very much at all - Boucher et al. ERL submitted, or Froelicher and Joos 2010 [Paul Halloran, UK]	Accepted - text revised and literature cited.
6-2861	6	66	19	66	19	Change to "respect to temperature". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2862	6	66	19			change "on" to "to" [Roger Gifford, Australia]	Editorial - text revised
6-2863	6	66	19			revise sentence - bad grammar [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2864	6	66	21	66	21	modeling → modelling [Peter Burt, UK]	Editorial - text revised
6-2865	6	66	21	66	21	insert 'have' after) [Peter Burt, UK]	Editorial - text revised
6-2866	6	66	21	66	21	Replace "shown" with "show". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2867	6	66	21	66	21	Replace "shown" with "show" [Nathaniel Ostrom, United States of America]	Editorial - text revised
6-2868	6	66	21	66	23	The statements here about the impacts of CDR on the hydrological cycle do not appropriately reflect the true uncertainty that exists within the scientific community. In particular, it is very difficult to ascertain whether the so-called "fast" response of the hydrological cycle that is observed in the cited modeling studies (1) simply teaches us about how climate models work or (2) truly illustrates the probable response of the climate system to implementation of CDR.It would be appropriate to present the modeliing results with a statement that indicates the relative infancy of efforts to predict geoengineering impacts on climate. [Jennifer Johnson, United States of America]	Accepted - text revised
6-2869	6	66	21			Please change "…For instance, modeling studies (Cao et al., 2011; Wu et al., 2010) shown that there will…" to "…For instance, modeling studies (Cao et al., 2011; Wu et al., 2010) have shown that there will…" [Birgit Nabbefeld, Germany]	Editorial - text revised
6-2870	6	66	27			It would make the figures easier to understand if arrows indicating the time directions were added. [Göran Ågren, Sweden]	Accepted - figure includes arrows
6-2871	6	66	40	66	56	As in my discussion above of the mineral nutrient requirement for C sequestration into soil, so too for enhanced C storage in whole terrestrial ecosystems there is a mineral penalty to be paid (just as with the ocean biological production). In the case of terrestrial productivity that mineral supply cannot come from the soil since it has been depleted by man and sent to the ocean already (in erosion-sediments and sewage) and must come from factories at a price in both $ and fossil CO2 emissions. With "peak (high grade) phosphorus" looming for current uses of P, the huge increase in P-fertiliser demand would be problematic especially with regard to dealing with the polluting toxic Cadmium that contaminates low grade phosphorus resources. [Roger Gifford, Australia]	Accepted - text added
6-2872	6	66	41	66	41	carries → carry [Peter Burt, UK]	Editorial - text revised
6-2873	6	66	41	66	41	Replace "carries" with "carry". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2874	6	66	41			"…CDR methods that enhance biomass in forests carries the risk…" needs to be changed to "…CDR methods that enhance biomass in forests carry the risk…" [Birgit Nabbefeld, Germany]	Editorial - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2875	6	66	44	66	44	reforestation appears 2x [Leticia Cotrim da Cunha, Germany]	Editorial - text revised
6-2876	6	66	45	66	45	like → such as [Peter Burt, UK]	Editorial - text revised
6-2877	6	66	45	66	48	May I suggest adding a reference based on actual measurements of albedo and of forest biomass across a range of forest cover densities in the coniferous boreal forest in Canada. "Bernier, P.Y., R. L. Desjardins, Y. Karimi-Zindashty, D. Worth, A. Beaudoin, Y. Luo, S. Wang. 2011. Boreal lichen woodlands: a possible negative feedback to climate change in Eastern North America. Ag. For. Met. 151: 521–528 doi:10.1016/j.agrformet.2010.12.013" [Pierre Bernier, Canada]	Accepted - new papers cited
6-2878	6	66	51	66	56	A recent synthesis of FLUXNET data provides an evidence of the biosphysical feedback, i.e., cooling at deforestated areas in northern ecosystems. Lee, X., and Coauthors, 2011: Observed increase in local cooling effect of deforestation at higher latitudes. Nature, 479, 384–387. [Akihiko Ito, Japan]	Accepted - new papers cited
6-2879	6	66	53	66	56	This is a good example of how a statement on change in C stocks is explained in a short sentence. [Nikolaus Josef Kuhn, Switzerland]	Noted
6-2880	6	67	3	67	3	"a decrease in production "downstream" from the fertilized region" see also Zahariev et al 2008 op cit [James Christian, Canada]	Accepted - text revised and suggested literature cited
6-2881	6	67	7	67	10	Other environmental risks associated with ocean fertilization include expanded regions with low oxygen concentration (Oschlies et al., 2010a), increased production of N2O and CH4 (Jin and Gruber, 2003; Oschlies et al., 2010a), and possible disruptions to marine ecosystems (Denman, 2008).).' May be worth mentioning the potential increases in DMS emissions - these represent an important uncertainty in the net radiative forcing effect [Dave Reay, UK]	Accepted - text added
6-2882	6	67	13	67	13	insert 'the' after 'to' [Peter Burt, UK]	Editorial - text revised
6-2883	6	67	13	67	13	Replace "balance" with "balances". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2884	6	67	14	67	14	will → with [Peter Burt, UK]	Editorial - text revised
6-2885	6	67	14	67	14	Replace "will" with "with". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2886	6	67	14			“Along will growth-supporting nutrients…“ needs to be changed to “Along with growth-supporting nutrients…” [Birgit Nabbefeld, Germany]	Editorial - text revised
6-2887	6	67	14			change 'will' to 'with' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2888	6	67	18	67	19	Change to "from the atmosphere", and "soils due to land cooling caused by" [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2889	6	67	22	67	22	Please c.f. Köhler et al. : Köhler, P., Hartmann, J., Wolf-Gladrow, D.A. (2010) The geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences. doi: 10.1073/pnas.1000545107 Please note that I am an author of one of the publications. Probably another Reference should be found. [Jens Hartmann, Germany]	Accepted - literature cited.
6-2890	6	67	22	67	25	This will affect phytoplankton community structure locally. It's hard to say what the net effect on ocean CO2 uptake will be but most likely it will partially offset the abiotic effect because it will favour calcifying species. [James Christian, Canada]	Accepted - text added
6-2891	6	67	22	67	25	Chapter 6.5.2.6.3 Accelerated weathering: Please include risks of change in alkalinity, such as disturbance of ecosystems… [Birgit Nabbefeld, Germany]	Accepted - text added
6-2892	6	67	23	67	23	The effect of dissolution of up to 5 Pg of Olivine annually on ocean surface pH was shown nicely by Köhler et al. 2010. Referene: Köhler, P., Hartmann, J. and Wolf-Gladrow, D.A., 2010. Geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences of the	Accepted - text added and literature cited

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						United States of America 107 (47), 20228-20233. [Nils Moosdorf, Germany]	
6-2893	6	67	23	67	24	Change to "raised locally by accelerated terrestrial weathering. In the", and "could potentially counteract". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2894	6	67	31			Why is there a specific summary of 6.5 when there isn't for most other sections? [Peter Rayner, Australia]	Accepted - All sections will now have a brief synthesis
6-2895	6	67	33	68	9	I would like to encourage the author team to be more quantitative about the side effects and unintended consequences. The whole discussion is rather qualitative. There are detailed studies of certain CDR options that could be used to put more weight behind this section. [Nicolas Gruber, Switzerland]	Noted - Available literature on the side effects are cited. Quantitative information provided where available in peer-reviewed literature
6-2896	6	67	44	67	44	Change to "form on land and in inorganic". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2897	6	67	46	67	46	insert comma after 6.15 [Peter Burt, UK]	Editorial - text revised
6-2898	6	67	48	67	49	This sounds really odd. An integral aspect of the greenhouse effect theory is that increasing CO2 in the atmosphere accelerates the hydrological cycle thereby increasing absolute atmospehric humidity (and hence greenhouse forcing) and rainfall. Therefore decreasing atmospheric CO2 should do the opposite. Your claim needs detailed explanation to justify it. [Roger Gifford, Australia]	Accepted - literature cited.
6-2899	6	67	48	67	54	style issues [Peter Burt, UK]	Editorial - text revised
6-2900	6	67	49	67	49	Change to "in the global". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2901	6	67	49			change to 'the global hydrological cycle' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2902	6	67	54	67	55	"could potentially disturb the regional carbon balance" vague [James Christian, Canada]	Accepted - text revosed
6-2903	6	67	54	67	55	Change to "carbon cycles. 4)"", and "disturb regional carbon balances." [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2904	6	68	1	68	9	Table 6.16: I suggest to add a column that lists some of the known side effects/unintended consequences [Nicolas Gruber, Switzerland]	Accepted - a new column on "unintended side effects" added
6-2905	6	68	1	68	9	Table 6.16 should have an additional column (or columns) indicating general economic, energy, and environmental constraints. In the column for physical potential, the values for BECS and biochar are highly speculative and should reported as such. (These values are less well vetted than the values for forest activities and ocean fertilization.) In the same column, the entries that say "No obvious limit" should be replaced by "Not determined" to avoid the interpretation that these CDR methods offer limitless potential. [Eric Sundquist, United States of America]	Rejected - Discussion of Economic, energy and environmental constrants are Beyond the mandate of WG1. Text revised. "No obvious limit" replaced by "not determined"
6-2906	6	68	2	68	2	Table: in the table section: Accelerated weathering over land. Considering the limitations in dissolution kinetics and the saturation issue, there exists a limit. This would hold if plants as temporary reservoir would take up some of the released cations and dissolved silica. Please see comments 2 to 3 and references there. For example olovine is a silicate with one of the highest dissolution rates (Prokovsky & Schott, 2000). However, if a certain concentration plateaue in the soil or groundwater is reached, dissolution sopts until undersaturation is reached again. [Jens Hartmann, Germany]	Taken into account - combined with another comment
6-2907	6	68	2	68	2	There is an obvious limit for accelerated olivine weathering: the saturation concentration of silicic acid. This limits the annual potential of olivine dissolution to a consumption of 1 Pg C per year (Köhler et al. 2010). Reference: Köhler, P., Hartmann, J. and Wolf-Gladrow, D.A., 2010. Geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences of the United States of America 107 (47), 20228-20233. [Nils Moosdorf, Germany]	Taken into account - combined with another comment
6-2908	6	68	8	68	8	Replace "BECS" to "BECCS". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2909	6	68	12	69	32	A cross-reference to chapter 7, section 7.5 would be appropriate here. The first two paragraphs could be shortened as a result. Overall the section could be shortened a bit by avoiding repetitions. Whether SRM through stratospheric aerosols will enhance or suppress C uptake by terrestrial ecosystems is a matter of	Accepted - reference to section 7.5 made

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						magnitude I believe, and this is not very well expressed in the section. [Olivier Boucher, France]	
6-2910	6	68	14	68	14	define SRM [Peter Burt, UK]	Taken into account - combined with another comment
6-2911	6	68	14	68	14	Change to "techniques, could". [Daniel Metcalfe, Sweden]	Taken into account - combined with another comment
6-2912	6	68	14	68	16	I suggest swapping the order of the first two sentences around. [Peter Burt, UK]	Accepted - text revised
6-2913	6	68	16	68	16	earth surface → Earth's surface [Peter Burt, UK]	Editorial - text revised
6-2914	6	68	16	68	19	This is a run-on sentence. Perhaps delete the first "and" and replace it with a comma. [Nathaniel Ostrom, United States of America]	Taken into account - combined with another comment
6-2915	6	68	16			change to 'the Earth's surface' [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2916	6	68	18	68	19	"may not completely cancel regional changes in temperature or precipitation" or may create new ones (see also A. Robock, L. Oman, and G. L. Stenchikov 2008 Regional climate responses to geoengineering with tropical and Arctic SO injections J. Geophys. Res., 113, doi:10.1029/2008JD010050) [James Christian, Canada]	Accepted - text revised
6-2917	6	68	19	68	19	Remove "the". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2918	6	68	20			The comments on regional impacts of SRM don't seem logical to me, if SRM doesn't completely cancel the impact of regional climate change it doesn't mean the SRM caused it in the first place, and one should probably compare the regional changes with those engendered by climate change anyway. [Peter Rayner, Australia]	Accepted - text revised
6-2919	6	68	24	68	24	→ Jones et al. (2009a) and Jones et al.(2010a) [Peter Burt, UK]	Editorial - text revised
6-2920	6	68	24	68	24	Did the Jones study really investigated the impact on the carbon cycle ? [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Accepted - "carbon cycle" changed to "terrestrial ecosystem productivity"
6-2921	6	68	26	68	26	Change to "schemes, global". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2922	6	68				Table 6.16.: Line 5 “Accelerated weathering over land” says in column 5 “no obvious limit”. Based on my on research (Koehler, P., Hartmann, J., & Wolf-Gladrow, D. A. 2010. Geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Science, 107, 20228–20233.) I believe this is not true for silicate weathering. Once silicate weathering leads to a rise in silicic acid at or above the saturation concentration of silicic acid of about 2000 mmol per m^3 further dissolution of silicate minerals will be delayed or stopped. In the paper cited above we therefore calculated an upper limit for accelerated silicate weathering of 1PgC per year, thus 100 Pg per century. [Peter Koehler, Germany]	Accepted - text revised
6-2923	6	68				The row after Ocean fertilisation: which one or two of the references are "b"? The last row: Is Zhou and Flynn, 2005 "b"? Or should a note "c" is used? [Zongbo Shi, United Kingdom]	Accepted - text revised
6-2924	6	69	1	69	2	move 'negatively' to after 'carbon' [Peter Burt, UK]	Editorial - text revised
6-2925	6	69	2	69	2	To acknowledge the existence of several potential mechanisms i suggest change to "by, for example, altering". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2926	6	69	3	69	3	Change "this particular effect is". [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2927	6	69	3			Ref to Vaughan and Lenton is missing from the reference list. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Technical issue. The work on citations/references will be completed for Ch6 Second Order Draft.
6-2928	6	69	5	69	16	This is rather speculative at this point in time. I suggest to shorten this discussion here substantially to the benefit of better established consequences of CDR. [Nicolas Gruber, Switzerland]	Accepted - 3 lines deleted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2929	6	69	13	69	13	insert comma after 'somewhat' [Peter Burt, UK]	Editorial - text revised
6-2930	6	69	15	69	15	Should it be "modelling" or "modeling" in this document? [Daniel Metcalfe, Sweden]	Accepted - "modelling" is used
6-2931	6	69	20	69	20	cooler → lower [Peter Burt, UK]	Editorial - text revised
6-2932	6	69	22	69	23	"shown to affect land temperatures, evapotranspiration and hence runoff" isn't the temperature effect an indirect effect of evapotranspiration? I have difficulty envisioning how else a stomatal response could affect temperature. [James Christian, Canada]	Accepted - text revised
6-2933	6	69	22	69	25	It would be good if this chapter could assess the physiological effect, ie is what in the models realistic? And how does it relates to the CO2 fertilisation effect which is discussed elsewhere in the chapter. [Olivier Boucher, France]	Rejected - Outside the scope of this chapter
6-2934	6	69	25			add 'the' before climate [Jeffrey Obbard, Singapore]	Editorial - text revised
6-2935	6	69	28	69	39	This section repeats text on direct/diffuse impacts and 'global dimming' earlier in the chapter (6.4.8.4). [William Collins, United Kingdom of Great Britain & Northern Ireland]	Accepted - text revised
6-2936	6	69	34	69	34	space after 1999 [Peter Burt, UK]	Editorial - text revised
6-2937	6	69	34	69	35	Change "1999 (Mercado", and "injection) have the potential" [Daniel Metcalfe, Sweden]	Editorial - text revised
6-2938	6	69	35	69	35	has → have [Peter Burt, UK]	Editorial - text revised
6-2939	6	69	35	69	36	This sentence should be removed because it stands between a comment about efficiency from the caveat ("However,..."), and could be misinterpreted as the final determination of the net effect. This needs to be revised to be consistent with the earlier section that describes the effect of increasing the diffuse radiation, as it comes at the expense of decreasing total incident radiation. For plants, this is problematic, as incident radiation sets the upper limits to photosynthesis. [Beverly Law, USA]	Accepted - text revised
6-2940	6	69	36	69	36	lower case for PAR in full [Peter Burt, UK]	Editorial - text revised
6-2941	6	69	42	71	27	FAQ 6.1: I think this FAQ does a pretty good job of explaining some concepts that can be difficult to get across to a general reader, and the figures are very helpful. [David Wratt, New Zealand]	Noted - thanks for the compliments
6-2942	6	69	44	71	27	The relation to Impulse Response Functions could be mentioned. FAQ 6.1 Figure 2 is very useful and the relation to Box 6.2 Figure 1 could be mentioned. [Jan Fuglestvedt, NORWAY]	noted in revised text
6-2943	6	69	46	69	52	FAQ6.1 Make sure the numbers here (20-40% for up to 2000 years) are consistant with theones give page 19 [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	noted in revised text
6-2944	6	69	48	69	49	FAQ 6.1. is very useful. But the statement that "20-40% will remain in the atmosphere...." may cause confusion. I think it is important to explain that 20-40% of the change (or disturbance) will last and that this change is not the same molecules as those emitted. The difference between adjustment time (or response time) and residence time should be explained and stressed. (Alternativeley, one could write "emission signal" or "effect of emssion" remains.) [Jan Fuglestvedt, NORWAY]	noted in revised text
6-2945	6	69	50	69	51	Change "take tens to hundreds of thousands of years, perhaps longer. Enhanced" [Daniel Metcalfe, Sweden]	noted in revised text
6-2946	6	69	54	69	54	carbon dioxide is not an inert gas! [Peter Burt, UK]	noted in revised text
6-2947	6	69	54	69	54	"Carbon dioxide is an inert gas". No. How about "carbon dioxide is largely nonreactive in the atmosphere"? In aquatic systems it is highly reactive and even in the atmosphere these reactions still take place to some extent. Inert gases are specifically the noble gases on the far right of the periodic table. [James Christian, Canada]	noted in revised text
6-2948	6	69	55	69	55	Consider another term then "destroyed" eg. "broken down". [Øyvind Christophersen, Norway]	noted in revised text

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2949	6	69	56	69	56	"carbon is not lost" - do you mean carbon dioxide? The example you gave before is methane, a compound that also contains carbon in ist molecule. [Leticia Cotrim da Cunha, Germany]	noted in revised text
6-2950	6	69				FAQ 6.1: Avoid sub-questions as titles. In general, FAQs should aim to minimize the use of sub-headings, and particularly avoid stating these as questions. [Thomas Stocker/ WGI TSU, Switzerland]	noted in revised text
6-2951	6	69				FAQ 6.1, Fig 1: See general comment regarding schematic figures. We suggest using the style of schematics used in Chapter 7 of the AR4 (Fig 7.3). [Thomas Stocker/ WGI TSU, Switzerland]	noted - to be changed in line with the new carbon cycle graph
6-2952	6	69				FAQ 6.1, Fig 2: Please replace PRF with multi model EMIC results if possible. We propose to indicate the 3 different phases with shading. [Thomas Stocker/ WGI TSU, Switzerland]	noted - revised graph may include multi-model results if possible
6-2953	6	70	8	70	8	it's more than "molecular diffusion". Can this be said more simply, e.g., leave out the mechanism and simply state that the gas is exchanged between the two? [James Butler, United States of America]	Noted - text revised
6-2954	6	70	8	70	8	Change to "surface, CO2" [Daniel Metcalfe, Sweden]	Noted - text revised
6-2955	6	70	8	70	10	Perhaps rewrite to indicate that the "invading CO2 reacts with water to form carbonic acid". The phrase "reacts chemically very fast with…" is not well written; perhaps change to "which exchanges quickly with the large pool…". [Nathaniel Ostrom, United States of America]	Noted - text revised
6-2956	6	70	8			insert ',' after 'surface' [Jeffrey Obbard, Singapore]	Noted - text revised
6-2957	6	70	9	70	9	"invading" sounds strange in this context. [Daniel Metcalfe, Sweden]	Noted - text revised
6-2958	6	70	12	70	12	Delete "The" and rewrite as "Marine biota also redistribute carbon…" [Nathaniel Ostrom, United States of America]	Noted - text revised
6-2959	6	70	12	70	14	"The marine biota also redistributes carbon: marine organisms grow organic tissue and calcareous shells in surface waters, which after death sink to depth where it is transformed back to inorganic forms by microbes. A small fraction reaches the sea floor and forms sediments." how about "The marine biota also redistribute carbon: marine organisms grow organic tissue and calcareous shells in surface waters, which sink to depth where they are returned to the dissolved pool by dissolution and microbial decomposition. A small fraction reaches the sea floor and is incorporated into the sediments."? [James Christian, Canada]	Noted - text revised
6-2960	6	70	16	70	19	FAQ6.1 Mention disturbance such as fire that also release carbon to the atmosphere [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Noted - text revised
6-2961	6	70	16			insert ',' after 'land' [Jeffrey Obbard, Singapore]	Noted - text revised
6-2962	6	70	18	70	19	"Dead plant material forms soils, which are eventually decomposed by microbes and respired back into the atmosphere as CO2." how about "Dead plant material is incorporated into soils, and is eventually decomposed by microorganisms and respired back into the atmosphere as CO2."? [James Christian, Canada]	Noted - text revised
6-2963	6	70	18			Disagree, not all carbon in dead plant material is returned to the atmosphere - highly variable depending on factors related to vegetation composition and soil e.g. level of water saturation. [Jeffrey Obbard, Singapore]	Rejected - soil is a very small long-term sink if at all. In FAQ only the major processes are described.
6-2964	6	70	21			See above - soil is a net sink over time. [Jeffrey Obbard, Singapore]	Rejected - soil is a very small long-term sink if at all. In FAQ only the major processes are described.
6-2965	6	70	21			"steady, equilibrium state." No, not strictly. The situation is steady state (constant fluxes) but NOT equilibrium (equal and opposite fluxes on all paths). The term equilibrium is frequently (mis)used to describe this situation. It would seem important for an assessment of this sort to draw the distinction, or at least not confuse. [Stephen E Schwartz, USA]	Noted - text revised
6-2966	6	70	22	70	22	"net emission", while technically correct, obfuscates the point. Humans are pumping CO2 into the atmosphere and the Earth system responds. That is what is happening today. Since this is a FAQ and likely to be viewed by many not so well versed in this subject, language should be simpler and clearer. [James Butler, United States of America]	Noted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2967	6	70	23	70	23	Delete "Firstly" and replace with "First". [Nathaniel Ostrom, United States of America]	Noted - text revised
6-2968	6	70	30	70	37	Why isn't the temperature dependence of the solubility of CO2 in water mentioned or recalled in this paragraph ? As a result, cold waters near the Arctic show a much lower pH, 7.7, and contains, therefore, three times more CO2 than tropical waters with a larger pH of 8.2 (Byrne R.H., S. Mecking, R.A. Feely, X. Liu, Geophys. Res. Lett. 37 (2010) L02601). [François GERVAIS, France]	rejected - this is covered in the climate feedback pp in this FAQ
6-2969	6	70	32	70	32	Change to "ocean, the" [Daniel Metcalfe, Sweden]	Noted - text revised
6-2970	6	70	34	70	34	Change to "consequence, areas" [Daniel Metcalfe, Sweden]	Noted - text revised
6-2971	6	70	34	70	34	Change to "scales, acidification" [Daniel Metcalfe, Sweden]	Noted - text revised
6-2972	6	70	34			add ',' after 'consequence' [Jeffrey Obbard, Singapore]	Noted - text revised
6-2973	6	70	35	70	36	Ocean uptake is not really set by mixing with the deep waters, but rather with the ocean circulation and ventilation process (as discussed more correctly in Chapter 3-5) [Richard G Williams, UK]	Noted - text revised, but "ventilation" is a too technical term for a FAQ
6-2974	6	70	36			add ',' after 'time' [Jeffrey Obbard, Singapore]	Noted - text revised
6-2975	6	70	36			I suggest replacing "acidification of the invading CO2" to "acidification by the invading CO2". [David Wratt, New Zealand]	Noted - text revised
6-2976	6	70	37	70	37	delete "still" [James Butler, United States of America]	Noted - text revised
6-2977	6	70	37			How important is the "biological pump" compared to mixing with deep sea water? Can this be completely ignored? [Zongbo Shi, United Kingdom]	rejected - the major proces of transferring anthropogenic CO2 do the ocean interior is the transport of DIC by ocean circulation and mixing
6-2978	6	70	41	70	41	delete one 'however' [Peter Burt, UK]	Noted - text revised
6-2979	6	70	41	70	41	Remove one "however,". [Daniel Metcalfe, Sweden]	Noted - text revised
6-2980	6	70	41	70	44	Yes, but need to define what is "modest" and temporary". Present day budget shows that over the last 150 years, the land sink is comparable to the ocean sink. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Noted - text revised
6-2981	6	70	41	70	44	This is totally unclear, and a "modest and relatively temporary uptake capacity" is quite meaningless. This is an important section to get right! Please decide what you are trying to say, do not give the wrong impression that storage of carbon on land is "temporary", and do not forget that the residence time of slower soil fractions is on the order of 5000 years! [Iain Colin Prentice, Australia]	Noted - text revised
6-2982	6	70	41			delete 'hoever' [Jeffrey Obbard, Singapore]	Noted - text revised
6-2983	6	70	41			Delete the repeated "however". [David Wratt, New Zealand]	Noted - text revised
6-2984	6	70	42	70	42	Water and nutrient availability, in truth, are MUCH more important, not similarly important, as this sentence implies. [James Butler, United States of America]	Noted - text revised
6-2985	6	70	48	70	48	Delete "Firstly" and replace with "First". [Nathaniel Ostrom, United States of America]	Noted - text revised
6-2986	6	70	48	71	21	The amount of carbon staying in the atmosphere depends on the cumulative addition of carbon to the atmosphere from carbon emissions and land use changes. The amount of carbon remaining in the atmosphere after 2000 years can be analytically solved for based on this cumulative emissions: CO(t)=CO(t_preindustrial)exp(Iemission/IB) where Iemission is the cumulative carbon emissions and IB is the buffered carbon inventory; reference is Goodwin, P., R.G. Williams, M.J. Follows and S. Dutkiewicz, 2007: Ocean-atmosphere partitioning of anthropogenic carbon dioxide on centennial timescales. Global Biogeochemical Cycles, 21, GB1014, doi:10.1029/GB002810. [Richard G Williams, UK]	rejected - the analytical approximate solution of Goodwin et al neglects complications with the land biosphere storage and is too complex to be used in this FAQ

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-2987	6	70	50	70	50	delete colon, insert ", e.g.," [James Butler, United States of America]	Noted - text revised
6-2988	6	70	50	70	51	what about weathering of silicate rocks? [James Christian, Canada]	Noted - text revised
6-2989	6	70	54			I think you also need to say something about methane entering the atmosphere, is the interplay of absorption cross-section and chemical lifetime on the overall impact (embodied in some measure of GWP) described somewhere else in the report? [Peter Rayner, Australia]	rejected - the FAQ is about CO2
6-2990	6	71	10	71	10	"for example" instead of "E.g.2 in the beginning of the sentence. [Leticia Cotrim da Cunha, Germany]	Noted - text revised
6-2991	6	71	11	71	11	I am not certain what is meant by "shifted chemical carbon reactions"… do you mean "changes in the carbonate equilibirum"? [Nathaniel Ostrom, United States of America]	Noted - text revised
6-2992	6	71	12	71	12	Change to "land, higher". What is meant by "longer vegetation periods"? [Daniel Metcalfe, Sweden]	Noted - text revised
6-2993	6	71	14	71	16	Start paragraph with this sentence (i.e., answer the question right away). Note: in this and the other FAQ, keep in mind a less scientifically literate audience. I'm only making a few changes, but there are other things that can be done. [James Butler, United States of America]	Noted - text revised
6-2994	6	71	18			"forever"; forever is infinite; better "at long times in the future" or such. [Stephen E Schwartz, USA]	Noted - text revised
6-2995	6	71	20	71	25	The text doesn't really answer the question. It doesn't say how much is left over 10-100,000 years and if this would stay airborne "forever". Also it might be useful to mention that future glaciation would most reset the CO2 to a glacial level. There are a couple of studies that investigated this, but I can't find them on top of my head. Sorry. So the 100,000 year time scle of weathering might not be relevant. [Pierre Friedlingstein, United Kingdom of Great Britain & Northern Ireland]	Noted - text revised
6-2996	6	71	20	71	25	As noted above: the statement that "20-40% will remain in the atmosphere..." may cause confusion. I think it is important to explain that 20-40% of the change (or disturbance) will last and that this change is the same molecules as those emitted. The difference between adjustment time (or response time) and residence time should be explained and stressed. (Alternativeley, one could write "emission signal" or "effect of emssion" remains.) [Jan Fuglestvedt, NORWAY]	Noted - text revised
6-2997	6	71	22			correct 'a.o' [Jeffrey Obbard, Singapore]	Noted - text revised
6-2998	6	71	23	71	24	Change to "tens to hundreds of thousands of years and longer. Enhanced" [Daniel Metcalfe, Sweden]	Noted - text revised
6-2999	6	71	30	72	55	FAQ 6.2: I think this FAQ does a good job of covering the desirable scope. However, there are some places where the language could usefully be simplified and / or technical terms expanded or explained, for the benefit of the non-specialist reader. [David Wratt, New Zealand]	Noted - text revised
6-3000	6	71	35	71	35	"are" should be "is" and "soils" should be singular. Or make "Permafrost" plural at the beginning of the sentence. [James Butler, United States of America]	Noted - text revised
6-3001	6	71	35	71	35	"permafrost soils" is redundant, especially since it was defined that way in the previous sentence. [James Butler, United States of America]	Noted - text revised
6-3002	6	71	35	71	37	Maybe re-write the sentence and eliminate the semi-colon? [Leticia Cotrim da Cunha, Germany]	Noted - text revised
6-3003	6	71	35			change 'are' to 'is' [Jeffrey Obbard, Singapore]	Noted - text revised
6-3004	6	71	35			Permafrost is permanently frozen ground (or Earth materials), and soil is but one component of permafrost ground [Edward Schuur, USA]	Noted - text revised
6-3005	6	71	35			Change "Permafrost are" to "Permafrost soils are" or "Permafrost describes" ? [David Wratt, New Zealand]	Noted - text revised
6-3006	6	71	37	71	40	As well as explaining that release of a sizeable fraction of this carbon would lead to warmer temperatures, causing more methane and CO2 to be released, it would be useful to state in this "introductory" paragraph	Noted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						whether you assess such a release to be likely, and if so over what time scales it might occur. [David Wratt, New Zealand]	
6-3007	6	71	38			Replace “warmer” with “higher” [Christopher Butenhoff, USA]	Noted - text revised
6-3008	6	71	44			Citation is Tarnocai et al. 2009. typo in year [Edward Schuur, USA]	rejected - no citations allowed in the text
6-3009	6	71	49	71	49	delete "also" [James Butler, United States of America]	Noted - text revised
6-3010	6	71	49	71	49	Is this (organic form storage) true for CH4 hydrates? I don't think so . . . [James Butler, United States of America]	rejected - the CH4 hydrates are described separately
6-3011	6	71	49			This is not quite accurate -- there are huge pools of inorganic carbon in carbonate rocks in permafrost, so you would want to change this sentence to say there are large pools of organic carbon stored frozen in permafrost soils [Edward Schuur, USA]	Noted - text revised
6-3012	6	71	51			or as carbon dioxide AND methane under anaerobic conditions' [Edward Schuur, USA]	Noted - text revised
6-3013	6	71	54	71	54	delete "time" [James Butler, United States of America]	Noted - text revised
6-3014	6	71	56	71	56	What is meant by "extended vegetation periods"? [Daniel Metcalfe, Sweden]	Noted - text revised
6-3015	6	71	57	71	57	replace "is" with "results from" [James Butler, United States of America]	Noted - text revised
6-3016	6	71				FAQ 6.2: Need to incorporate the quantitative numbers from the figure into the text, discuss uncertainties, and consider time-frames. [Thomas Stocker/ WGI TSU, Switzerland]	Noted - text revised
6-3017	6	72	1	72	2	Change to "depressions, anaerobic" [Daniel Metcalfe, Sweden]	Noted - text revised
6-3018	6	72	5	72	6	Rewrite "in fact present Arctic permafrost can be seen as a relict of the last glaciation, which is still slowly eroding" as "in fact the present Arctic permafrost is a relict of the last glaciation and is still slowly eroding." [Nathaniel Ostrom, United States of America]	Noted - text revised
6-3019	6	72	5			Needs to say 'thawing' permafrost not 'melting' [Edward Schuur, USA]	Noted - text revised
6-3020	6	72	5			Could you please specify here what you mean by "relatively large" timescales (hundreds to thousands of years?). [David Wratt, New Zealand]	Noted - text revised
6-3021	6	72	6	72	6	move 'which is slowly eroding' to after 'pemafrost' [Peter Burt, UK]	Noted - text revised
6-3022	6	72	6			I do not think this is a true statement that current permafrost is still equilibrated to Pleistocene temperatures. Equilibration is more rapid that this and what we see now is more in equilibration with Holocene conditions, pre industrial. There was some formation and thawing of Little Ice Age permafrost, but it is not accurate to say that if Holocene conditions were held constant into the future that we would see large changes in permafrost extent. See papers by Romanovsky .. [Edward Schuur, USA]	Noted - text revised
6-3023	6	72	8			I suggest you define or explain the meaning of "aerobic" for the general reader. [David Wratt, New Zealand]	Noted - text revised
6-3024	6	72	9	72	11	sentence does not make sense [Peter Burt, UK]	Noted - text revised
6-3025	6	72	9			Needs to say 'thawing' permafrost not 'melting' [Edward Schuur, USA]	Noted - text revised
6-3026	6	72	10	72	10	Remove "under warming". [Daniel Metcalfe, Sweden]	Noted - text revised
6-3027	6	72	10			delete 'under warming' [Jeffrey Obbard, Singapore]	Noted - text revised
6-3028	6	72	14	72	14	insert 'centennial' after 'on' and delete 'of 100 years' [Peter Burt, UK]	Noted - text revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-3029	6	72	14			change '100' to 'hundreds' [Jeffrey Obbard, Singapore]	Noted - text revised
6-3030	6	72	21			I suggest you define or explain the meaning of "anaerobic" for the general reader. [David Wratt, New Zealand]	Noted - text revised
6-3031	6	72	24	72	25	Change to "large, in the Arctic alone the amount". [Daniel Metcalfe, Sweden]	Noted - text revised
6-3032	6	72	25			place 'alone' after 'Arctic' [Jeffrey Obbard, Singapore]	Noted - text revised
6-3033	6	72	30			Needs to say 'thawing' permafrost not 'melting' [Edward Schuur, USA]	Noted - text revised
6-3034	6	72	31			Should say decadal to centennial time scales [Edward Schuur, USA]	Noted - text revised
6-3035	6	72	32	72	32	Change to "become sufficiently warmed". [Daniel Metcalfe, Sweden]	Noted - text revised
6-3036	6	72	33	72	35	The last two sentences of this paragraph, though technically correct, tend to give the impression that there may be nothing to worry about. Given our current state of understanding, I would not want to transmit that message. Perhaps the issue would be helped by noting how much carbon is stored in these two zones relative to how much we've added already to the atmosphere. [James Butler, United States of America]	Noted - text revised
6-3037	6	72	34	72	36	Do we really know that destabilised deep ocean clathrates could not release methane to the atmosphere? Has the idea that release of methane may destabilise the sediments causing slumping, removal of overpressure, and large scale methane release (enough to reach the surface) been show to be false? [Paul Halloran, UK]	Noted - text revised
6-3038	6	72	41	72	41	arctic → Arctic [Peter Burt, UK]	Noted - text revised
6-3039	6	72	41	72	41	Maybe re-write the sentence and eliminate the semi-colon? [Leticia Cotrim da Cunha, Germany]	Noted - text revised
6-3040	6	72	41	72	41	Change to "studies have recently documented". [Daniel Metcalfe, Sweden]	Noted - text revised
6-3041	6	72	41	72	41	Remove ",". [Daniel Metcalfe, Sweden]	Noted - text revised
6-3042	6	72	43	72	43	insert comma after 'Hence' [Peter Burt, UK]	Noted - text revised
6-3043	6	72	43	72	43	delete comma after 'possible' [Peter Burt, UK]	Noted - text revised
6-3044	6	72	45	72	45	Change to "are a very small contribution to the global". [Daniel Metcalfe, Sweden]	Noted - text revised
6-3045	6	72	49	72	51	What is the evidence that the feedback from Arctic warming will be moderate? No citations are given here. The summary by Schuur et al. (2011. Nature 480:32–33) regarding the threat to permafrost calls this conclusion into question. A statement like this certainly needs to be better supported or modified/removed. [Eric Davidson, USA]	rejected - no citations allowed in the text
6-3046	6	72	50	72	50	Do we really know it will be moderate? Maybe one could state "possibly will be moderate" or something? I don't think we're doing much more than arm-waving with this right now. [James Butler, United States of America]	Noted - text revised
6-3047	6	72		72		On the whole it is a very through and complete chapter and will serve the AR5 well. [Mohammad Aslam Khan Khalil, USA]	We thank the reviewer
6-3048	6	73	1			Consistency in reference style [Zongbo Shi, United Kingdom]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3049	6	73	25	73	26	Reference information is incomplete. Collect reference information is as follows: Amiro, B. D., et al. (2010), Ecosystem carbon dioxide fluxes after disturbance in forests of North America, Journal of Geophysical Research, 115, G00K02, doi:10.1029/2010JG001390. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3050	6	73	61	73	62	This reference (Aydin et al. 2011) is duplicate of the above one. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-3051	6	74	46	74	46	Insert reference Betts et al (2007) Nature 448, 1037-1041| doi:10.1038/nature06045. This is cited on page 69 line 24 but not included in the reference list. [Richard Betts, United Kingdom of Great Britain & Northern Ireland]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3052	6	74	59	74	60	Boden citation for web link doesn't work. The correct web link as of Jan 2012 is: http://cdiac.ornl.gov/ftp/trends/emissions/ [Beverly Law, USA]	to be corrected
6-3053	6	75	46	75	48	Reference information is incomplete. Collect reference information is as follows: Brovkin, V., J. Bendtsen, M. Claussen, A. Ganopolski, C. Kubatzki, V. Petoukhov, and A. Andreev (2002), Carbon cycle, vegetation, and climate dynamics in the Holocene: Experiments with the CLIMBER-2 model, Global Biogeochem. Cycles, 16, 1139, doi:10.1029/2001GB001662. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3054	6	75	59	75	60	Reference information is incomplete. Collect reference information is as follows: Cadule, P., P. Friedlingstein, L. Bopp, S. Sitch, C. D. Jones, P. Ciais, S. L. Piao, and P. Peylin (2010), Benchmarking coupled climate-carbon models against long-term atmospheric CO2 measurements, Global Biogeochem. Cycles, 24, GB2010, doi:10.1029/2009GB003556. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3055	6	76	44	76	45	This reference (Collins et al. 2011b) is duplicate of the above one. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3056	6	76	59	76	60	This reference (Cox et al. 2001b) is duplicate of the above one. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3057	6	77	36	77	37	Reference information is incomplete. Collect reference information is as follows: Dlugokencky, E. J., S. Houweling, L. Bruhwiler, K. A. Masarie, P. M. Lang, and P. P. Tans (2003), Atmospheric methane levels off: Temporary pause or a new steady-state?, Geophys.Res.Lett., 30, 1992, 10.1029/2003GL018126. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3058	6	78	14	78	15	Reference information is incomplete. Collect reference information is as follows: Falloon, P., C. D. Jones, M. Ades, and K. Paul (2011), Direct soil moisture controls of future global soil carbon changes: An important source of uncertainty, Global Biogeochem. Cycles, 25, GB3010, doi:10.1029/2010GB003938. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3059	6	79	43	79	44	Reference information is incomplete. Collect reference information is as follows: Golding, N., and R. Betts (2008), Fire risk in Amazonia due to climate change in the HadCM3 climate model: Potential interactions with deforestation, Global Biogeochem. Cycles, 22, GB4007, doi:10.1029/2007GB003166. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3060	6	80	39	80	39	Reference information for Houghton (2008) is incomplete or incorrect. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3061	6	82	58	82	59	Reference information is incomplete. Collect reference information is as follows: Kleinen, T., V. Brovkin, W. von Bloh, D. Archer, and G. Munhoven (2010), Holocene carbon cycle dynamics, Geophys.Res.Lett., 37, L02705, doi:10.1029/2009GL041391. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3062	6	83	18	83	19	Reference should read 'Kroeze, C., L. Bouwman, and C. P. Slomp, 2007: Sinks for N2O at the Earth's surface. Greenhouse Gas Sinks, Reay D.S., J. Grace and K.A. Smith, Ed., CAB International, 227-243. [Dave Reay, UK]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3063	6	86	28	86	29	Reference information is incomplete. Collect reference information is as follows: Miyama, T., and M. Kawamiya (2009), Estimating allowable carbon emission for CO2 concentration stabilization using a GCM-based Earth system model, Geophys.Res.Lett., 36, L19709, doi:10.1029/2009GL039678. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3064	6	86				References in this table are obscure. [Charles Curry, Canada]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3065	6	91	40	91	41	Reference should read: Singh, B. K., R. D. Bardgett, P. Smith, and D. S. Reay, 2010: Microorganisms and climate change: terrestrial feedbacks and mitigation options. Nature Microbiology, 8, 779-790. [Dave Reay,	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						UK]	
6-3066	6	95	31	95	32	Reference information is incomplete. Collect reference information is as follows: Zhuang, Q., J. M. Melillo, M. C. Sarofim, D. W. Kicklighter, A. D. McGuire, B. S. Felzer, A. Sokolov, R. G. Prinn, P. A. Steudler, and S. Hu (2006), CO2 and CH4 exchanges between land ecosystems and the atmosphere in northern latitudes over the 21st century, Geophys.Res.Lett., 33, L17403, doi:10.1029/2006GL026972. [Akihiko Ito, Japan]	Technical issue. The work on citations/references to be completed for Ch6 Second Order Draft.
6-3067	6	96	1	96	1	Table 6.7 needs to be re-organised, and the references need formatting. It is very difficult to read. [Leticia Cotrim da Cunha, Germany]	Accepted - table reformatted and references included
6-3068	6	96	6	96	6	Table 6.7: According to table caption, column heading is incorrect: should be '2000-2009' [Charles Curry, Canada]	Accepted - text revised
6-3069	6	96		96		Table 6.7: Please enter the units in the table caption [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	accepted - text revised
6-3070	6	96		97		Table 6.7: It would be very useful to include a full reference list in the table's caption. For example, it could take a reader unfamiliar with the field some time to find C&P06 in the main reference list. The table itself could also be made less cluttered if the references in the table were referred to as [1], [2], with a key in the caption. Furthermore, the table itself is incomplete - it doesn't contain an estimate for the stratospheric sink term by chlorine and O1D. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	Accepted - table reformatted and references included
6-3071	6	96		97		Reference E]08 needs to be corrected. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	to be corrected in Second Order Draft
6-3072	6	96		97		Table 6.7: Reference Rhe09 in the table has not been included in the reference list. [Fiona O'Connor, United Kingdom of Great Britain & Northern Ireland]	The work on citations/references to be completed for Ch6 Second Order Draft.
6-3073	6	96		98		Table 6.7: typo in column label – assume this should be 2000-2009 and not 2000-2099 [Haroon Kheshgi, United States of America]	accepted - text revised
6-3074	6	96		98		Table 6.7: could not find references for this table or interpret what is meant by, e.g., Den04 in the 2000-2009 column; and if this is indeed a 2004 reference I do not understand how it tells us what are the emissions from a bottom up perspective since they have not yet occurred? Suggest careful assessment of these references be made. For example, do these references all rely on a common estimate of emissions (e.g. from national inventories such as those from the US EPA) to break down the aggregate methane source into its components. If this is so, then the ranges given are not representative of uncertainty – they result from a common analysis – whereas the list of references gives the misimpression that these estimates are more certain than actually known. Suggest that uncertainty be assessed, or if it is not know that that be stated. [Haroon Kheshgi, United States of America]	Taken into account - References in Table 6.7. to be clarified in Second Order Draft.
6-3075	6	96				Table 6.7: Notes of table. Stars did not appear in the table. References in this table are difficult to follow. [Zucong Cai, China]	Taken into account - References in Table 6.7. to be clarified in Second Order Draft.
6-3076	6	96				Table 6.7 is very complex. It presents essential information but it is difficult to see the wood for the trees. One way to simplify it would be to use footnotes for the references or to reformat it more like table 6.8 [William Collins, United Kingdom of Great Britain & Northern Ireland]	Taken into account - References in Table 6.7. to be clarified in Second Order Draft.
6-3077	6	98	1			try to include all notes on page 97 [Jeffrey Obbard, Singapore]	Taken into account for Second Order Draft
6-3078	6	99	1	99	1	Table 6.8 - not sure if it is possible, but this table could be splitted in 2 separate ones. 'It can be very confusing because the columns in section 2 do not correspond to the ones in section 1. [Leticia Cotrim da Cunha, Germany]	Noted, will investigate.
6-3079	6	99				Table 6.8, Section 1, part c, Deposition from the atmosphere. The numbers in this table for deposition to the ocean of NOy and NHx (20 and 17 TgN/yr respectively) are very close to the numbers of 23 and 24 TgN/yr respectively in Duce et al. “Impacts of atmospheric anthropogenic nitrogen on the open ocean”, Science, 320, 893 (2008). However, completely left out of Table 6.8, part c, is an estimate of the deposition of water soluble	Noted, will investigate.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						organic nitrogen species, which Duce et al. (2008) found to be ~ 20 TgN/yr, or about 1/3 of the total input of atmospheric Nr to the ocean - and the majority of this organic N is apparently anthropogenic in origin. Organic nitrogen species are an important part of the input of water-soluble N to the ocean and should not be ignored in this table. [Robert Duce, USA]	
6-3080	6	99				Table 6.8, Section 2. Would be good to clarify that this is the N2O budget by putting N2O in boldface somewhere in the Table (as is done for NO_y and NO_x) [Cynthia Nevison, USA]	Noted, will investigate.
6-3081	6	100				Table 6.8 entry for deep ocean N2O production associated with atmospheric deposition should be changed to 0.08-0.34 TgN/yr based on Suntharalingam et al., "Quantifying the Impact of Anthropogenic Nitrogen Deposition on Oceanic Nitrous Oxide," Geophysical Research Letters, accepted and in press. As described in this new paper, there is a major conceptual error in the back-of-the-envelope calculation in the Duce et al., 2008 paper that leads to a big overestimate of this N2O source. [Cynthia Nevison, USA]	Noted, will investigate.
6-3082	6	101	1	101	1	Table 6.9 - Maybe explain "Plant/plankton functional types" (for the land and ocean components), "Land Use Change", and that DMS parameterization is relevant for the sulphur cycle. [Leticia Cotrim da Cunha, Germany]	Taken into account - Table caption revised.
6-3083	6	103		103		Fig. 6.1: Arrows in figure not defined: "Numbers represent reservoir sizes (in PgC), while arrows represent carbon exchange fluxes (in PgC yr–1; blue for natural, red for anthropogenic),…" Instead of blue, perhaps use green for natural fluxes as in Figure 6.2? And same in Fig. 6.4 for N-cycle. [Charles Curry, Canada]	Figure revised.
6-3084	6	103				Fig 6.1 and other schematics are not very effective or optically attractive. For example, arrows and numbers are not clear. We suggest using the style of schematics used in chapter 7 of the AR4 (fig 7.3). More explanation is also required in the captions. [Thomas Stocker/ WGI TSU, Switzerland]	Figure revised.
6-3085	6	103				Fig 6.3: Add data from more stations, eg, to highlight the inter-hemispheric gradients [Thomas Stocker/ WGI TSU, Switzerland]	Rejected.
6-3086	6	103				Box 6.1, Fig 1: What are the sources for data in these figures? More explanation needed. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - additional information will be provided
6-3087	6	103				Box 6.1, Fig 2: A general improvement in schematic figure layout and quality needed. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - additional information will be provided
6-3088	6	103				Fig 6.4: See earlier comments concerning schematic figures. In additions, why does the box for atmospheric molecular nitrogen sit below the ground in this instance? [Thomas Stocker/ WGI TSU, Switzerland]	Accepted - additional information will be provided
6-3089	6	103				Fig 6.5: Not clear what 'H - ML' etc are indicating. Confidence? Clarify reference period and value used. Unclear what the open ended arrowhead for the yellow ice-core record indicates. We suggest you use whiskers to indicate the uncertainty associated with the ice-core record. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - figure revised
6-3090	6	103				Fig 6.6: Clarify what the dashed lines are indicating in these plots, and if these dashed lines use the same 200-year moving average. Furthermore, we recommend the more standard approach of a spline fit is used instead of the moving average. [Thomas Stocker/ WGI TSU, Switzerland]	Accepted. Figure 6.6 will be revised using spline fit.
6-3091	6	103				Fig 6.8: Graphically, the different quality of information should be made clear in the figure, i.e., direct measurement, emission statistics, vs. residual (land). Suggest to show land as being transparent. Furthermore, not clear what is indicated by the error bars. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account
6-3092	6	103				Box 6.2, Fig 1: Suggest a much clearer identification of phases 1-3 on the time axis. Consider highlighting as areas with shadings. Replacing these data with multi-EMIC range would also allow uncertainty to be added. It could also be better to only plot upper and lower bound runs. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised
6-3093	6	103				Fig 6.10: Provide and illustrate uncertainties, consider to show after Fig 6.8 [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised ; as a second panel with fig 6.8
6-3094	6	103				Fig 6.12: Explanation of the uncertainties needed - currently not clear to interpret what is shown. We also	taken into account - figure revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
						recommend Cape Grim should use a different colour to highlight this as data coming from direct measurements. [Thomas Stocker/ WGI TSU, Switzerland]	
6-3095	6	103				Fig 6.13: Careful coordination required with Chapter 2 (e.g. Fig 2.20) which seems to show lower values. The citation to older references suggests the figure could be updated. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised
6-3096	6	103				Fig 6.15: note grey shading -> pink. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised
6-3097	6	103				Fig 6.16: Could this information be more effectively displayed on a world map? i.e., using individual panels for each region displayed on a map, with different shading for source/sink regions. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account -- figure revised
6-3098	6	103				Fig 6.17: - 6.18 Careful coordination with Chapter 2 (Fig 2.21 - 2.22) to ensure consistency with results given there. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised to account for chapter 2
6-3099	6	103				Fig 6.19: We suggest removal of this figure - There are no key messages supported by this figure and no relevant discussion in the chapter. [Thomas Stocker/ WGI TSU, Switzerland]	rejected - keep the figure, but add simple titles and refers to it in different places of the report
6-3100	6	103				Fig 6.20: Please provide more explanation of what is shown in this figure. Include an indication of uncertainties. A legend is needed which provides the details for the model abbreviations. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised
6-3101	6	103				Fig 6.21: We note inconsistency in the way in which feedback figures are plotted in the different chapters (i.e., swapping of the X and Y axis) See for example chapters 7 and 8. We suggest chapters coordinate and use a consistent layout. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account
6-3102	6	103				Fig 6.22: Please provide notification about the different scenarios used or use different symbols distinguishing C4MIP from CMIP5; Give units in brackets. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - more explanation added
6-3103	6	103				Fig 6.23: Replace 'reconstructions' with 'inferred' or 'calculated'. This then avoids misusing the specific term of 'reconstruction'. Further explanation required regarding what is illustrated by the colour bar, whisker etc. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure revised
6-3104	6	103				Fig 6.24: Need to explain/highlight what the implications are of a negative or positive gamma/beta. A more extensive formal definition of these terms should be provided in Section 6.4.2.1. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account -metrics will be defined
6-3105	6	103				Fig 6.25: Clarify what is meant by 'agric fraction'. We suggest you repeat the colour legend in all figures given there is space available and this will aid interpretation, include small labels in right panels indicating start year '2000' and end year '2100' [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure and caption revised for clarity
6-3106	6	103				Fig 6.26: When speaking of RCPs and "model projected CO2 concentrations" it is unclear where these come from. MAGICC? What CO2 is used to force the models? [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - chapter 1 will cover this in second order draft
6-3107	6	103				Fig 6.27: Propose to redesign figure by transferring data to Cartesian system, x-axis: OF, y-axis: LF, and include grid for negative values . This would allow easier interpretation. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - figure design is being re-thought
6-3108	6	103				Fig 6.28: See general comment regarding Fig 6.26, regarding prescribed CO2 [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - chapter 1 will cover this in second order draft
6-3109	6	103				Fig 6.30: Suggest removal. Figure not necessary. See Fig 12.1. [Thomas Stocker/ WGI TSU, Switzerland]	taken into account - this figure and a new box to describe ESM and carbon cycle experiments/use will be revised
6-3110	6	103				Fig 6.33: Please specify the relevance of the Tagliabue et al. study, which is currently not clear from the caption, or related discussion in the text. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - fig. 6-33 modified to have CMIP5 models
6-3111	6	103				Fig 6.34: Please explain what is indicated by the 'Nitrogen boundary'. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - figure revised (nitrigen boundary mention is removed)

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-3112	6	103				Fig 6.36 and 6.37: Clarify if white is no data, or low flux. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - revievised fig. 6-36 to 6-39 use same color palette
6-3113	6	103				Fig 6.39: Clarify what white indicates in these projections. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - figure revised
6-3114	6	103				Fig 6.43: Note that this figure duplicates with Chapter 7 FAQ 7.3, Fig 1. Suggest removal and simply referring to the chapter 7 figure instead. [Thomas Stocker/ WGI TSU, Switzerland]	Taken into account - figure removed from this chapter and shown in CH7 ; FAQ7.3
6-3115	6	103				Fig 6.46: This figure overlaps with Chapter12 material. Coordinate with Chapter 12. [Thomas Stocker/ WGI TSU, Switzerland]	Noted
6-3116	6	103				<Figure 6-1> Biogenic volatile organic compounds (BVOCs) emitted from vegetation amount to 1 Pg/yr, which is exceeding the fluxes from "volcano" or "change in land use". Therefore, BVOCs emissions should be included in this figure and in its corresponding paragraphs. [Yoko Yokouchi, Japan]	Taken into account - figure revised (arrows)
6-3117	6	105	4			figure 6.3, oxygen: on the axes, it's not a concentration but probably an anomaly... [Francois DANIS, France]	Accepted
6-3118	6	106	4	106	5	I believe that "reactive creation" should be "creation of active nitrogen". [Nathaniel Ostrom, United States of America]	Accepted 'creation of reactive nitrogen'
6-3119	6	106	4			the word “nitrogen” is missing near “reactive”. [Francois DANIS, France]	Accepted, see reply 6-3118.
6-3120	6	114	11			The legend doesn't say what is the lower graph. Emission? No title either. [Francois DANIS, France]	These light-red bars represent a number of TRANSCOM models used for calculation of the ansembled mean - to be mentioned in the Figure caption.
6-3121	6	114		114		Fig. 6.9, caption: "back bars" should be "black horizontal bars"(actually they are darker grey)? The bottom panel of the figure is not described at all. [Charles Curry, Canada]	Figure revised for better representation. See also response to previos comment: 6-3120.
6-3122	6	115	1			on the graph, the unit of emission must be in yr-1 and not in a-1 [Francois DANIS, France]	Accepted - caption changed and merged with 6.8
6-3123	6	117	4			insert 'gaseous' aftter 'Atmospheric' [Jeffrey Obbard, Singapore]	Rejected - atmospheric measurements is clear enough
6-3124	6	118	1	118	2	Would it be possible to shift the bottom panel lower so that the years on the x-axis for the upper panel are not covered? [Nathaniel Ostrom, United States of America]	Accepted - fig changed
6-3125	6	120		120		Fig. 6.15: shading is pink, not grey. [Charles Curry, Canada]	Accepted - fig changed
6-3126	6	122	4			correct 'CH4' [Jeffrey Obbard, Singapore]	Accepted - subscript added
6-3127	6	122		122		Fig. 6.17: Aren't data on CH4 growth rate available prior to 1985? If so, why not show full record in upper panel as in Fig.6-13 for CO2? [Charles Curry, Canada]	Taken into account ****
6-3128	6	124	1			figures look too clustered and small - increase page space? [Jeffrey Obbard, Singapore]	Taken into account - considerable revision
6-3129	6	126		126		Fig. 6.20: Models corresponding to symbols marked A through J need to be identified somewhere. [Charles Curry, Canada]	Accepted - models names added
6-3130	6	130	1			figures look too clustered and small - increase page space? [Jeffrey Obbard, Singapore]	Taken into account - figure revised
6-3131	6	132		132		Fig. 6.26: Model CanESM1 is incorrectly named; should be CanESM2. [Charles Curry, Canada]	Accepted - figure revised
6-3132	6	133		133		Fig. 6.27: In order to estimate values falling outside the triangle, perhaps consider extending dotted lines into exterior region. [Charles Curry, Canada]	Taken into account - figure revised
6-3133	6	135	1			correct 'impacct' on figure title [Jeffrey Obbard, Singapore]	Accepted - figure revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
6-3134	6	135		135		Fig. 6.29, top: This figure is cluttered and different curves cannot be distinguished. According to the caption, results from two models are shown, but there is no indication of which is which. Visibility might be improved by using 4 colours instead of two, and by "fading" the annual (monthly?) curves relative to the running means. Two(?) curves are also not distinguishable in bottom panel. [Charles Curry, Canada]	Accepted - figure revised
6-3135	6	135		135		Figure 6.29 bottom panel - spelling mistake in title [Dave Reay, UK]	accepted - title revised
6-3136	6	138	8			note 'placeholder' and need to update [Jeffrey Obbard, Singapore]	Accepted - figure revised
6-3137	6	149	1			add 'cover' after 'tree'; change 'Terrest' to 'terrest' [Jeffrey Obbard, Singapore]	Taken into account - figure revised
6-3138	6	156	1			Correct 'CH4' on Arctic ocean floor [Jeffrey Obbard, Singapore]	Accepted
6-3139	6	156	22	156	24	Section FAQ 6.2: Mention that hydrate destabilization may pose a potential threat to continental slope sediment stability (e.g. Maslin M. et al., Gas hydrates: past and future geohazard?, Phil. Trans. R. Soc. A, 2010). [Christian Reiner Boehm, Germany]	Noted - text revised