Solar simulation

Magneto-hydrodynamic activity near the surface of the Sun is the major source of Space weather that impacts space exploration, satellite operations, power grids, communications, and other aspects of modern life. Understanding the changing flow of energy and matter throughout the Sun has been established as one of the objectives in NASA's missions and goals. The three projects in the Solar group are representative of the efforts on developing a better understanding of the dynamics of our closest star, the Sun.

In the first project, Stein *et al.* are interested in the near surface region of the Sun. In this region, accurate simulation of radiation is critical because the domain of interest covers the nearly opaque region below the surface and the transparent solar atmosphere (photosphere). The accuracy of spatial quadrature for integration along a ray is found to be important. The angular quadrature, on the other hand, is found to be less critical. In addition, moment models were applied to compute radiative transfer in the solar atmosphere. They found that these alternative models overestimate absorption in the atmosphere. Finally, high-resolution fields were used to synthesize center-to-limb G-band images to provide a better understanding of the observations.

In the second project, Miesch *et al.* are interested in simulating the convection zone on a global scale (the entire solar sphere) without having to resolve the near surface region or the deep core region. Approximate boundary conditions are used at the inner and outer surface of the simulation domain. The sensitivity of convection simulations to these boundary conditions have been investigated. They found that the flow is surprisingly sensitive to the boundary conditions. In addition to these investigations, acoustic wave simulations on a sphere were intitated. The objective is to simulate acoustic wave propagation through the convection zone and provide essential theoretical support to ongoing observational efforts.

In the third project, Busse developed a theoretical model of thermal convection in a twisted magnetic field. The model aims at providing an interpretation of high resolution observations in the interior of sunspots. A relationship for the dependence of the wavelength of filaments on the strength and twist of the magnetic field has been derived.

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