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EPA scientists collaborate with NASA on multi-year DISCOVER-AQ study to improve ability to measure and forecast air quality from space

EPA exposure scientists are collaborating with NASA on a multiyear study to help scientists better understand how to measure and forecast air quality globally from space. The NASA-led mission — known as "DISCOVER-AQ" — stands for Deriving Information on Surface conditions from COlumn and VERtically resolved observations relevant to Air Quality.

The third of four DISCOVER-AQ field missions takes place September 2013 in Houston. Two NASA aircraft equipped with scientific instruments will make daily flights over the Houston area to measure air pollution.

EPA scientists Jim Szykman (left) and Russell Long (right) with NASA scientist Jim Crawford (center) on the NASA P-3B Orion aircraft being used in the DISCOVER-AQ study in Houston.

During the DISCOVER-AQ study, researchers are working to improve their knowledge of how satellite measurements observe air quality in the atmosphere, focusing on the lowest part of the atmosphere where air quality can impact human health.

Study results could lead to better air quality forecasts – specifically under the AirNow program - a web-based clearinghouse that offers daily air quality index forecasts for approximately 300 of the largest metropolitan areas of the United States. DISCOVER-AQ study results are also anticipated to help scientists develop more accurate determinations of where pollution is coming from and why emissions vary. Because many countries, including the United States, have large gaps in ground-based networks of air pollution monitors, experts look to satellites to provide a more complete geographic perspective on the distribution of pollutants — similar to how weather satellites image large-scale weather events.

Gathering pollutant data

A challenge for space-based instruments monitoring air quality is to distinguish between pollution high in the atmosphere and pollution near the surface where people live. To address this issue, DISCOVER-AQ is employing NASA aircraft to make a series of flights equipped with air monitoring devices to simulate existing satellite instruments. The data collected will be compared to data being gathered at ground-based monitoring sites, as well as data from a fleet of NASA-operated satellites that will pass daily over the DISCOVER-AQ study area.

About the Houston field study

Multiple daily flights will take place during the Houston mission. During each flight, one plane will fly at approximately 26,000-feet using remote sensing technology to sample a column of air beneath it. A second plane will fly at approximately 1,000 feet sampling the surrounding air. This plane will also make spiral flights over four surface air quality monitoring sites located in the Houston area. One of these sites,

located at La Porte Airport, will be run by EPA scientists where they will install and operate equipment to measure ozone, nitrogen dioxide, and water-soluble organic carbon – a component of airborne particulate matter that can impact climate, visibility and human health.

The ground-based instruments operated by EPA will complement ground data being gathered by the other DISCOVER-AQ collaborators. During the Houston mission, EPA scientists will evaluate new, state-of-the-science methods for measuring nitrogen dioxide. Scientists will also test and make final evaluations for a new Federal Reference Method for measuring ozone.

In addition to ozone and nitrogen dioxide, EPA scientists will also measure water-soluble organic carbon in collaboration with researchers from Baylor University and the University of Texas at Austin. Filter samples collected will be used to develop laboratory methods for measuring water-soluble organic carbon.

Citizen scientists help gather data in Houston

During the Houston field study, EPA is employing the help of citizen scientists to test new compact sensor technologies that can fit into one's hand for measuring ozone and nitrogen dioxide at the earth's surface. This will involve training teachers and students at eight Houston-area schools to operate the sensors. The flight path is designed to pass over the schools. This activity will provide outreach and educational opportunities for the schools to learn about air quality monitoring and air quality in general.

Data from the school-based sensors will be compared to measurements taken from EPA's national monitoring network in Houston and other ground based sites supporting DISCOVER-AQ including EPA's ground-based site at the LaPorte Airport. The purpose is to test the accuracy of the new compact sensor technologies compared to more traditional methods currently used to monitor air quality.

Previous and future DISCOVER-AQ missions

The five-year DISCOVER-AQ study involves four field research campaigns. During each field campaign, air pollutants, unique to each location, are being measured via air sensors in airplanes and on the ground. The role of EPA scientists is to provide equipment and expertise for measuring pollutants at ground-based monitoring sites. The DISCOVER-AQ site locations are:

- Baltimore-Washington D.C. area: Air quality data was collected during July 2011;
- San Joaquin Valley, Calif.: Data was collected during January-February 2013;
- Houston, Texas: Data is being collected during September 2013; and
- A fourth location to be determined for 2014.

New satellite instrument for air quality monitoring

EPA exposure scientists expect to use the DISCOVER-AQ data they collect in the four field studies to help plan for their participation in a newly selected NASA satellite mission called TEMPO, or Troposheric Emissions: Monitoring of Pollution, expected to launch in 2017.

The TEMPO project involves building the first space-based instrument to monitor major air pollutants across the North American continent hourly during daytime. The instrument, to be completed by September 2017, will share a ride on a commercial satellite that will orbit about 22,000 miles above Earth's equator. Current methods utilize satellites orbiting much closer to the earth's surface, allowing for observations of atmospheric pollutants to be made only once a day.

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