Researchers to Scrutinize Megacity Pollution During Mexico City Field Campaign

March 2, 2006

BOULDER—A team of researchers from the National Center for Atmospheric Research (NCAR) and other institutions is heading to Mexico City to participate in one of the most complex field campaigns ever undertaken in atmospheric chemistry. From March 1 to 29, the team will make multiple research flights in the NSF/NCAR C-130 aircraft and operate ground instruments to investigate the chemical and physical transformation of air pollution as it flows downwind from Mexico City.

The team's goal is to assess the pollution's impact on regional and global air quality, climate, and ecosystems. The results are expected to be applicable to megacities (cities with 10 million or more inhabitants) in other locations around the world.

"Mexico City's pollution probably doesn't have a global impact, but all urban areas together do, and the world is urbanizing," explains NCAR scientist Sasha Madronich, one of the project's principal investigators. "If we can understand the pollution impacts of Mexico City, we can apply this new knowledge to other urban areas across the globe."

The project, called MIRAGE (Megacity Impacts on Regional and Global Environments), is led by NCAR in partnership with several U.S. universities and other organizations.

MIRAGE is one component of a set of simultaneous field campaigns collectively called Megacity Initiative: Local and Global Research Observations (MILAGRO). This international effort will observe and quantify air pollution emitted by Mexico City from multiple perspectives. Other components of MILAGRO are led by the U.S. Department of Energy, the Molina Center on Energy and the Environment, and NASA. As part of the broader effort, researchers from more than 60 institutions in the United States, Mexico, and several other nations will convene in Mexico City to coordinate aircraft and ground-based measurements, satellite observations, and computer modeling. The cost of the MILAGRO campaign is estimated to be more than $20 million, with the National Science Foundation contributing about $10 million. NSF is also NCAR’s primary sponsor.

NCAR researchers hope that data from MIRAGE will shed light on four broad questions:

- How far downwind does Mexico City's pollution plume extend?
- How are the pollutants transformed by chemical reactions occurring downwind of the city?
- How do the pollutants affect visibility, as well as regional and global climate?
- How do the urban pollutants interact with pollutants from other sources, such as agricultural and forest fires?

"We're not looking so much at pollution inside the city because that's already fairly well known," Madronich says. "We're looking at the outflow. For the first time we'll have an idea of how much pollution is outside the city and be able to understand its full life cycle."

Because air pollution is complicated, both chemically and physically, and evolves over time and distance, scientists have traditionally faced difficulty in quantifying its components. The MIRAGE team will use aircraft, ground stations, and satellite observations to gather data on how Mexico City's air pollution ages as it disperses in the first hours and days after emission.

Aircraft and instruments

Researchers based in Veracruz, located east of the capital on the Gulf of Mexico, will crisscross Mexico City's pollution plume in the C-130 aircraft. Using a complex package of instruments, they'll make multiple flights to sample the gases and aerosols that comprise the plume, which usually spreads northeast from the city toward the gulf.

Others will set up ground-based instruments at the Technical University of Tecamac, about 25 miles (40 kilometers) northeast of Mexico City. From there, they will also launch GPS radiosondes, which are instrument packages attached to helium balloons that send atmospheric measurements to the ground via radio. The radiosondes will make vertical profiles of winds, temperatures, and humidity from the ground through the lower stratosphere.

The NSF/NCAR C-130 will fly out of Veracruz, Mexico to intercept Mexico City's pollution plume downwind. A unique array of sensing instruments on board will sample the gases and aerosols in the plume. A four-engine turboprop, the NSF/NCAR C-130 was built for military transport and adapted for research missions in the mid-1990s. (©UCAR, photo by Carlye Calvin)

Two kinds of pollutants

MIRAGE is especially significant because it focuses on both aerosols (airborne particles of dust, soot, and other pollutants) and gaseous pollutants (including ozone, nitrogen oxides, carbon monoxide, sulfur dioxide, and hydrocarbons and their oxidation products).

"In the past there have been air campaigns during which researchers have made lots of aerosol measurements, and other ones during which they've emphasized gas measurements," Madronich says. "The uniqueness of MIRAGE is that it brings them together, allowing us to study interactions between gases and aerosols."

Why Mexico City?

The researchers chose Mexico City for MIRAGE because it is the world's third largest urban area, has some of the worst air quality in the world, and is situated in the tropics, as are most fast-growing megacities in developing nations.

Current computer models for studying air pollution were developed mainly for cities in industrialized nations, Madronich says. They don't transfer well to megacities in the developing world, where people are more likely to burn coal and wood and drive vehicles that emit more harmful chemicals.

The field campaign will also gather information about aerosols, such as how long they endure in the atmosphere and how they affect clouds. These insights are useful to scientists who make computer models of global climate.

"The lifetime of organic aerosols may be longer than climate modelers have thought, and this could have a huge effect on climate," Madronich says.

Mexico City, the world's third largest urban area, has some of the worst air quality in the world. (Photo courtesy Nancy A. Marley.)

Related sites on the World Wide Web

MIRAGE homepage
MILAGRO homepage
Educational resources pertaining to MILAGRO

Contacts for This Release

For Journalists
David Hosansky, head of Media Relations
303-497-8611, hosansky@ucar.edu

UCAR Communications
www.ucar.edu/news/contacts.shtml

General inquiries
Yvonne Mondragon, 303-497-8601, yvonnem@ucar.edu

Photo inquiries
Carlye Calvin, 303-497-8609, calvin@ucar.edu

Digital Image Library
www.ucar.edu/imagelibrary