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Tracking 'America's tailpipe'

By MEREDITH GOAD, Portland Press Herald Writer

NEWINGTON, N.H. — On board the DC-8 that serves as NASA's flying laboratory, researchers hunker down behind scientific instruments that fill the plane from nose to tail. The windows have been pulled out of the fuselage, replaced by probes that suck air into the plane during nine-hour flights. The parcels of air are analyzed in-flight for the pollutants that blanket Acadia National Park in haze and can make it difficult to breathe there on hot summer days.

Staff photo by Herb Swanson
Data collection instruments protrude from the side of a DC-8 at Pease Tradeport in Portsmouth, N.H. The plane is being used in the largest and most complex air-quality study ever.

"They're measuring a large number of chemicals, the products that they form, and ultimately what happens to them," said Hanwant Singh, the lead scientist on the plane.

The 35 scientists who are flying on the plane this summer are taking part in the largest and most complex air-quality study ever. This time of year, plumes of pollution drift over New England from the Midwest, then are transported almost directly to western Europe. U.S. and Canadian researchers are tracking the plumes as far as they can, then, as the polluted air arrives in Europe, it is picked up by British, French and German scientists who are studying how it has changed in its journey across the Atlantic.

Based at the University of New Hampshire, the six-week project involves a dozen aircraft, three satellites, a 274-foot research vessel, a "smart balloon" and a network of more than 50 ground-based observation sites in places ranging from Appledore Island and Mount Washington to Nova Scotia and the Azores.

The study is known as the International Consortium for Atmospheric Research on Transport and Transformation, or ICARTT. Organizers held a press conference on the study last Monday at the Pease International Tradeport.

The data scientists gather from land, sea and air will be used to advance knowledge of climate change and improve scientists' understanding of how "America's tailpipe" works. The information will be used to develop new, daily air-quality forecasts that will be

launched in New England this September. It will improve computer models so that they are better able to track where the region's pollution comes from and how it changes over time.

"Better models lead to better science," said James Meagher of the National Oceanic and Atmospheric Administration's Aeronomy Laboratory in Boulder, Colo. "Better science means better decisions, better policies."

OZONE LEVEL HIGH OFF COAST

This rainy summer may seem like bad luck for a project that's intent on studying summer smog, but the scientists say they have had some successes. On July 22, the smart balloon recorded an "exceedingly high" ozone level of 200 parts per billion, said Robert Talbot, director of UNH's Airmap Cooperative Institute.

"You need sunlight to produce ozone," Talbot said. "We haven't had a lot of it here, but it's been pretty clear out over the Atlantic, actually, and we're seeing a lot of ozone generated just off the coast that normally occurs over the continent."

The balloon, 12 feet in diameter, has two bladders inside. One of them is filled with air, the other helium, which allows the scientists to adjust its altitude to follow the ozone. The measurements the balloon is taking are the first of their kind.

"It's the difference between a movie and a snapshot," said Berrien Moore III, director of UNH's Institute for the Study of Earth, Oceans and Space. "You're going with the air, and seeing the chemistry and physics change in real time."

The first balloon launch occurred July 15, just off the tip of Rhode Island. The balloon traveled just west of Boston and came down 21 hours later at the Maine-New Brunswick border. The second flight, out over Nova Scotia, left July 20 and lasted 49 hours.

Researchers on board NOAA's research vessel Ronald H. Brown have been able to track two pollution plumes as they passed over the ocean, and smaller plumes within those plumes. The ship sniffs the air through a mast that sticks up about 20 feet above the vessel.

The plumes haven't been as big as previous years, but the scientists are being patient - the study doesn't end until mid-August.

'HURRICANE HUNTER' USED

"We have another three weeks to find bigger ones," said Timothy Bates, the lead scientist on the vessel. "But even the smaller ones, we've been able to track clear across to the Bay of Fundy. We sort of weave our way back and forth through these plumes and try to see how the chemistry is changing as it is transported across the Gulf of Maine."

As the Brown plies the seas, the research aircraft that fly out of the Pease International Tradeport conduct similar experiments in the skies.

NOAA's WP-3D "Hurricane Hunter" is normally used to barrel into huge storms. Last Sunday, in a typical flight for the air-quality study, the plane flew over Cape Cod and traveled down to Long Island and New York City. From there, it flew over power plants in Pennsylvania, dipped into West Virginia, and covered Philadelphia and other points north of Washington, D.C., before heading back to New Hampshire.

The scientists watch what their instruments are doing, then talk to the flight director about where they'd like to go next.

Joost Degouw, a NOAA scientist on board, measures hydrocarbons that are emitted by cars and vegetation. "This graph, the color represents toluene," he said, showing the results of a recent flight. "Toluene comes from cars, and you can see that there is a plume of polluted air coming off New York City."

This year, for the first time, scientists on the plane are examining how nitrogen oxides - compounds emitted from tailpipes and smokestacks - are transformed during the evening hours before becoming part of the soup of chemicals that form smog.

"If you want to know what they're going to do the following day, you need to know what's happening to them overnight," said Steve Brown, a NOAA researcher.

DC-8 TRAVELS MORE WIDELY

The DC-8 can travel twice as fast as the Hurricane Hunter and is airborne every other day, at a cost of about $500,000 per flight. On the same day the smaller plane was flying over power plants in Pennsylvania, the DC-8 flew over the open ocean, traveled all the way down to Cape Kennedy in Florida, then across to Atlanta. The plane then headed up to New York and crossed New Hampshire to the Canadian border.

Occasionally pilot Dick Ewers takes the DC-8 up to 35,000 feet and puts it on autopilot, bringing it down in a slow spiral so scientists can take extensive measurements of a single column of air.

Communications during the DC-8's flights are managed at a large mission-control station near the front of the plane. Flight time is precious, and there's no down time. Jim Podolske, from NASA's Ames Research Center in California, said it's important to maintain awareness of what the scientific instruments are "seeing" just outside the plane.

"We try to keep in communication with the rest of the science team," he said, "and when we see something interesting happening, to tell them what's going on so we can really try to get a first-cut understanding of what's happening in real time."

Podolske's equipment measures water vapor at a rate of 100 times per second throughout the entire flight. Other scientists record levels of peroxides and gases such as carbon monoxide, methane and nitrous oxide.

"All these instruments are extremely sensitive," Singh said. "They're all making measurements at the parts-per-trillion level."

Stephanie Vay, a scientist from NASA's Langley Research Center in Virginia, is focusing her efforts on carbon dioxide and other gases that are linked to climate change. This is the first study using a heavy-lift aircraft to measure carbon dioxide levels over North America, Vay said, and this is the perfect time of year for such a study.

"This is the time of year when the vegetation is really sucking up the carbon dioxide the greatest in the Northern Hemisphere at these latitudes," she said.

Across the aisle from Vay is Cam McNaughton, a graduate student from the University of Hawaii, and Edward Winstead, a chemist from NASA Langley. Winstead and McNaughton are studying the air particles that cause summer haze over Acadia National Park.

Their instruments measure light-scattering by particles that range in

size from sea salt and wind-blown dust to tiny aerosols that are 10,000 to 100,000 times smaller than a period at the end of a sentence.

The researchers also use wing-mounted probes to collect and study cloud aerosols up to the size of raindrops.

"When a cloud starts to form," Winstead said, "there's a theory that says there's going to be an interaction there, and that the pollution is actually starting to change the rain cycles because of the particles that are going into the atmosphere."

McNaughton and Winstead have flown all over the world doing this kind of work.

"A lot of this is global-based because some of these air parcels we're measuring here have been traced back to forest fires in Alaska and pollution from Asia," Winstead said.

Staff Writer Meredith Goad can be contacted at 791-6332 or at:

mgoad@pressherald.com

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