

## BNL Plays Major Role in Air Pollution Studies

As we bid farewell to summer, alerts about poor air quality should become less frequent. But, scientists from BNL's Atmospheric Sciences Division in the Department of Environmental Sciences, won't let that stop their efforts to understand air pollution all around the U.S., so that better efforts may be made to control it.

"We have to understand these pollutants, where they come from, why their concentrations are so high, because they have very significant effects on people, especially older people who have health problems," said atmospheric chemist Peter Daum, who leads the group.

Recently, this group announced results from one of the most comprehensive U.S. air pollution studies ever conducted, in Houston, Texas. They also began another major air-sampling effort in the skies over upstate New York and New England.

### Texas Study Results

In the Texas 2000 Air Quality Study — a collaborative effort involving hundreds of researchers from more than 40 public, private, and academic institutions led by Daum and funded by DOE, the U.S. Environmental Protection Agency, and the Texas Natural Resource Conservation Commission — the scientists identified specific volatile organic compounds (VOCs) as key sources of excess ozone smog in industrial areas of Houston. These pollutants appear to be different from traditional sources of ozone pollution in typical urban areas around the country. The findings appeared in the May 28 on-line issue of *Geophysical Research Letters*.

"A clear understanding of the complex causes of ozone pollution will help to identify cost-effective ways to control smog and protect public health," said BNL's Larry



BNL scientists are working to understand the behavior of atmospheric pollutants. Pictured above (from left) are researchers from BNL's Atmospheric Sciences Division: Gunnar Senum; Peter Daum, Group Leader; Linda Nunnermacker; Stephen Springston; Xiao-Ying Yu; Larry Kleinman; and Yin-Nan Lee. Recently, this group announced results from one of the most comprehensive U.S. air pollution studies ever conducted, in Houston, Texas.

Kleinman, lead author of the paper.

Traditional efforts to control ozone have focused on limiting emissions of precursor chemicals such as nitrogen oxides (NO<sub>x</sub>) and/or VOCs. They are emitted from automobiles, power plants, and other industrial sources and form ozone when they react with sunlight in Earth's atmosphere. But, despite improvements in air quality due to more stringent emission standards, many areas still exceed ozone standards.

To get a better understanding of the ozone problem, the

Brookhaven team conducted air-sampling flights during August and September 2000 over the Houston-Galveston area — which experiences the country's highest ozone levels. The main research tool was a Grumman Gulfstream-1 aircraft operated by Pacific Northwest National Laboratory (PNNL), carrying sophisticated instrumentation developed at BNL.

"We use the plane because it has the ability to sample over a broad range of distances and to look vertically in the atmosphere so we can understand how pollutants are distributed in space and how they relate to relevant sources," said Daum.

The scientists flew over "clean" background areas and over urban and industrial areas with high emission rates of nitrogen oxides and volatile organic compounds, as well as downwind from these sources in regions where ozone is expected to form.

On each flight, the scientists measured levels of ozone, ozone precursors, and photochemical oxidation products. They were then able to calculate the ozone-production rate for each of the flight areas. For the *GRL* paper, they compared the Houston findings with data collected during several previous DOE-sponsored air quality studies

(continued on page 3)

### BNL's Role in Air Pollution Studies

(cont'd.)

over Nashville, Tennessee; New York, New York; Phoenix, Arizona; and Philadelphia, Pennsylvania.

"We found that most of Houston resembles other urban areas in its concentration of ozone precursors and ozone production rates," said Daum. "The industrial Houston Ship Channel region, however, the location of one of the largest petrochemical complexes in the world, has a distinctive chemistry," he said. There, very high concentrations of VOCs neither seen in the other cities, nor in the other parts of Houston — specifically ethene, propene, and butenes — lead to excessive production of ozone.

"Calculations based on the aircraft measurements show that the ozone production rate in the Houston Ship Channel region can be as much as five times higher than occurs in the other four cities or in nonindustrial parts of Houston," said Kleinman. "This extra kick in the photochemistry is a direct result of the high concentrations of VOCs emitted by industrial facilities."

### New England Study

In the new study over the Northeastern United States, known as the New England Air Quality Study, the Brookhaven team again used the G-1 aircraft in collaboration with PNNL, a ship operated by the National Oceanic and Atmospheric Administration (NOAA), and several universities to monitor air pollutants and their transport through the region. Sampling flights began in early July and ran through August.

"In addition to the usual air-quality sampling instruments carried aboard the G-1, this study included special instruments to measure aero-

sols, the tiny particles in the atmosphere that we perceive as haze," said Daum. "Together, this array of aerosol instrumentation will provide a characterization of ambient aerosol composition with unprecedented detail."

The team says the sampling flights were very successful and the data are now being analyzed.

In addition to Daum and Kleinman, Stephen Springston and Yin-Nan Lee of Atmospheric Sciences participated in both studies, along with Fred Brechtel who holds a guest appointment at the Lab. Atmospheric Sciences Linda Nunnermacker, Dan Imre, Alla Zelenyuk, and Zhiguang Song, who was a guest from China, also participated in the Texas study, along with postdoc Gintas Buzorius, Stony Brook University student Jun Zheng, Judy Weinstein-Lloyd, a guest appointee from The State University of New York at Old Westbury, and former guest appointees Barbara Hillery and Ali Alaouie, also from SUNY Old Westbury. Gunnar Senum of Atmospheric Sciences and postdoc Xiao-Ying Yu took part in the New England study.

— Karen McNulty Walsh

For more information on the Texas study, see: <http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr060302.htm>, <http://www.utexas.edu/research/coer/txaqs/>, and <http://www.bnl.gov/bnlweb/pubaf/pr/2000/bnlpr082400.html>.

For more information on the New England Air Quality Study, see: <http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr070802.htm> and <http://www.al.noaa.gov/neaqs/>