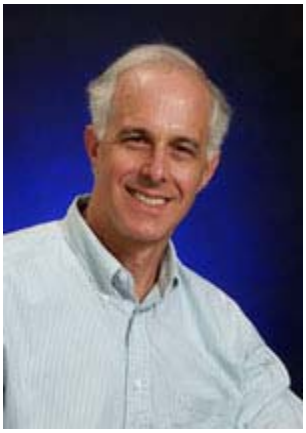
The Houston Triangle: Where air quality, not a ship, disappears

Field campaign investigates hydrocarbons and aerosol concentrations in industrialized environment

Hydrocarbons are a key ingredient in the production of ozone, a colorless, odorless gas that corrodes not only the rubber on windshield wipers, but also affects the health of human lungs. Aerosols are tiny particles suspended in the atmosphere. Though they can adversely affect human health, they are also believed to offset the warming known to be associated with greenhouse gases, such as carbon dioxide.



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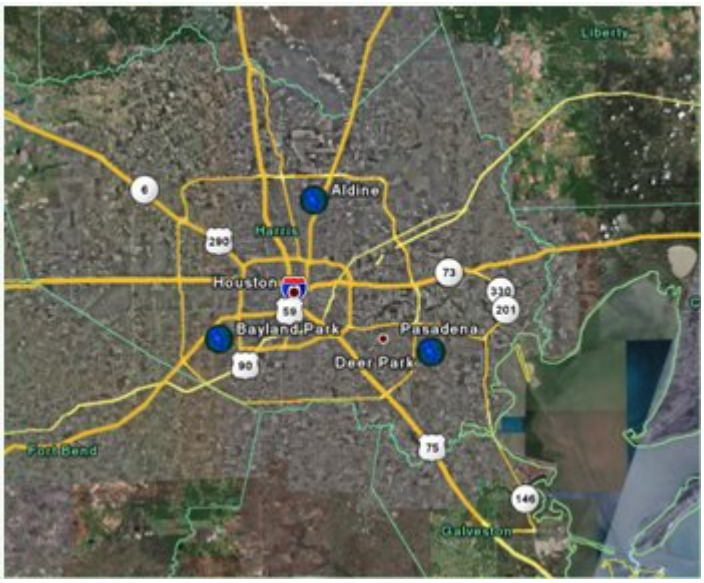
For nearly four weeks in September, a team of research scientists from the Pacific Northwest National Laboratory (PNNL) joined colleagues from around the world in a large air quality study in southeast Texas. The objective of the campaign was to examine the distribution of hydrocarbons and aerosols within the greater Houston area. New air quality guidelines issued by the World Health Organization (WHO) have called for lowering the daily allowed limits of ozone. The WHO estimates that reducing pollution from particles that are too small to be filtered in the nose and throat and that settle in the lungs could save as many as 300,000 lives every year.

"Past studies have linked specific hydrocarbons with the production of ozone, and more recently, we think that other hydrocarbons play an important role in the production of aerosols. Complicating this picture is the possibility that particulates can affect the concentration of gas-phase pollutants, including ozone," explained Carl Berkowitz, PNNL principle investigator for the Texas campaign. "These interactions are only one part of a complicated puzzle that policy makers must understand if emission control scenarios are to be effective in improving air quality, not only in Texas, but many parts of the world," he added.

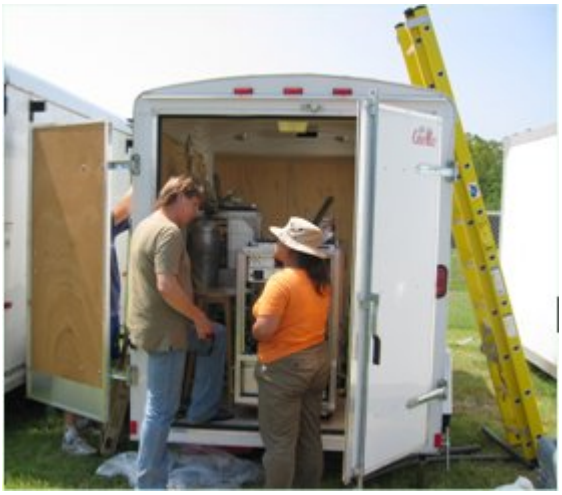


Three sites bounding the greater Houston area include Bayland Park, Aldine, and Deer Park, located near the Houston Ship Channel. Air monitoring stations at these sites record some of the highest ozone concentrations in Houston.

The PNNL scientists made side-by-side measurements at three locations associated with elevated ozone levels in Houston. One site, in the southeast part of Houston, was located very close to the Houston Ship Channel, home to the largest complex of petrochemical and oil refineries in the world, and the starting point for

many emissions in Houston. Another field laboratory site was set up in southwest Houston, where nitrogen emissions from automobiles dominate the air quality. The mixing of nitrogen emissions with hydrocarbons is thought to generate high ozone levels. The third site, to the north of Houston, was selected based on its proximity to natural sources of hydrocarbons, thus offering a contrast to the manmade hydrocarbons abundant in the southeast part of Houston.

To obtain the measurements, they used advanced mass spectrometers—an Aerosol Mass Spectrometer and a Proton Transfer Reaction–Mass Spectrometer, to measure aerosols and hydrocarbons, respectively—plus commercially available instruments to measure sulfur dioxide, ozone, carbon monoxide, and nitrogen oxides. The collocation of the two different mass spectrometers at each site resulted in a one-of-a-kind data set that can be used to answer many questions about hydrocarbon/aerosol interactions.



PNNL researchers Liz Alexander (left) and Xiao-Ying Yu (right) discuss sampling strategies for two mass spectrometers ready for deployment as part of the Texas Air Quality Study in September 2006. PNNL scientists deployed and maintained instrumentation at three sites over the greater Houston area throughout the campaign.

The Texas Air Quality Study of 2006 is a follow up to another large campaign conducted in 2000. That campaign was driven by a need to understand how ozone levels in Houston far exceeded those found anywhere else in the United States, and how they amassed in such a short time. Rather than building up over the better part of a day, the air in Houston could produce ozone concentrations in excess of 200 ppb in less than hour. Ongoing research by PNNL scientists and other investigators has shed light on how this process occurs, and data from the 2006 study will help answer the question of how effective emissions controls have been in reducing the occurrence of high ozone episodes.

In addition to Berkowitz, PNNL scientists involved in this field campaign included Xiao-Ying Yu and Vic Morris from the Atmospheric Sciences and Global Change Division, and Liz Alexander, John Ortega and Matt Newburn from the Environmental Molecular Science Laboratory (EMSL), a U.S. Department of Energy national user facility located at the Pacific Northwest National Laboratory.

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