Southeast Focus of Large, Coordinated Air Quality Study

The Southeast United States, a heavily forested area with urban populations, has become the focus of a large, multi-agency study coordinated and funded by the U.S. Environmental Protection Agency (EPA) and other agencies to better understand the regional atmospheric chemistry as man-made emissions interact with those emitted naturally from trees. Scientists want to resolve why there is an unexplained cooling trend in this region while average temperatures are rising in the rest of the country. This cooling may be the result of the profile of emissions, along with complex chemistry and physics that are not well understood.

Scientists have many questions about the atmospheric processes in the Southeast, including the formation and concentration of particle pollution and the consequences to public health. The evidence so far suggests that tiny airborne particles are blanketing parts of the Southeast and blocking some solar radiation from reaching the earth’s surface. Known as secondary organic aerosols (SOA), these particles are formed when carbon-containing gases (volatile organic compounds or VOCs) emitted naturally by forests interact with other gases, including man-made pollution emissions. Learning more about the formation and the radiative properties of these particles may be the key to understanding the regional cooling.

More than 100 scientists from EPA, the National Science Foundation, the National Oceanic and Atmospheric Administration, and other agencies along with academic scientists funded by these organizations converged at selected research sites.
in the Southeast during the summer of 2013 for the Southern Oxidant and Aerosol Study (SOAS). EPA supported the study with research funding from the agency’s Science to Achieve Results (STAR) program to 14 academic and research institutions that took part in the work.

“The real focus for EPA is to understand the way in which man-made emissions interact with emissions from the natural environment to impact air quality,” says Sherri Hunt, an EPA chemist who coordinates research by grant recipients. “We need to understand these interactions so that we can develop models that accurately predict changes in pollutant levels that will arise from changing emissions, changing climate, or air quality management strategies.”

The atmospheric chemistry knowledge gleaned from this complex study will support further enhancements to air quality models, such as the Community Multi-scale Air Quality (CMAQ) Model, which is used by researchers and air quality managers to implement the air quality standards under the U.S. Clean Air Act.

The Southern Oxidant and Aerosol Study

SOAS is one of the most detailed characterizations of the region’s air quality ever conducted, with measurement sites in Alabama, North Carolina, and Tennessee. Over a six-week period, scientists at the primary site in the town of Brent, AL, near the Talladega National Forest, took air samples at ground level; they also used towers, balloons, and planes outfitted with specialized instruments to collect samples at altitudes as high as 7,500 feet. Recent advances in instrumentation enable measurement of numerous new compounds at lower concentrations with extremely high time resolution.

At the same time, EPA researchers took air measurements at the Duke University Forest, NC, and Look Rock, TN, in addition to the primary Brent study site. The collected data from all of the researchers is being used to evaluate modeled predictions of SOA formation and speciation and many other gaseous chemical species in the atmosphere. The scientists measured chemical components of particulate matter in the air and how these various particle types absorb and scatter light.

In addition, EPA researchers used a technique that relies on determining the presence of select chemical isotopes in particles to distinguish between naturally occurring and man-made emissions. This provides insight into the contribution of human activity to the pollution levels. With this information, scientists can learn what proportion of the particulate matter burden in the atmosphere is controllable by changing man-made emissions.

Hunt says these field measurements give scientists more confidence in how well models represent true atmospheric conditions. Additionally, a series of laboratory chamber studies have been conducted to help with interpretation of findings from the field and to understand the intercomparison of multiple instruments from multiple groups.

Scientists continue to analyze the vast amounts of data generated during the field measurements. Data became publically available in summer 2015 and can be accessed at http://www.esrl.noaa.gov/csd/groups/csd7/measurements/2013senex/.

One recently published study by Georgia Tech researchers provides evidence for the magnitude of man-made emissions’ influence on SOA formation in the Southeast. The study found that sulfur dioxide and nitrogen oxides emitted from motor vehicles and coal-fired power plants directly and substantially mediate the transformation of naturally occurring emissions from trees into SOA.1

The discoveries that come from SOAS are helping scientists gain a better understanding of SOA contributions to air pollution and how they may be contributing to a changing climate in the Southeast. This new knowledge and the rich dataset will lead to improvements in understanding and air quality models for many years to come. em

Learn more about SOA research at: http://www2.epa.gov/air-research/secondary-organic-aerosol-soas-research

Reference