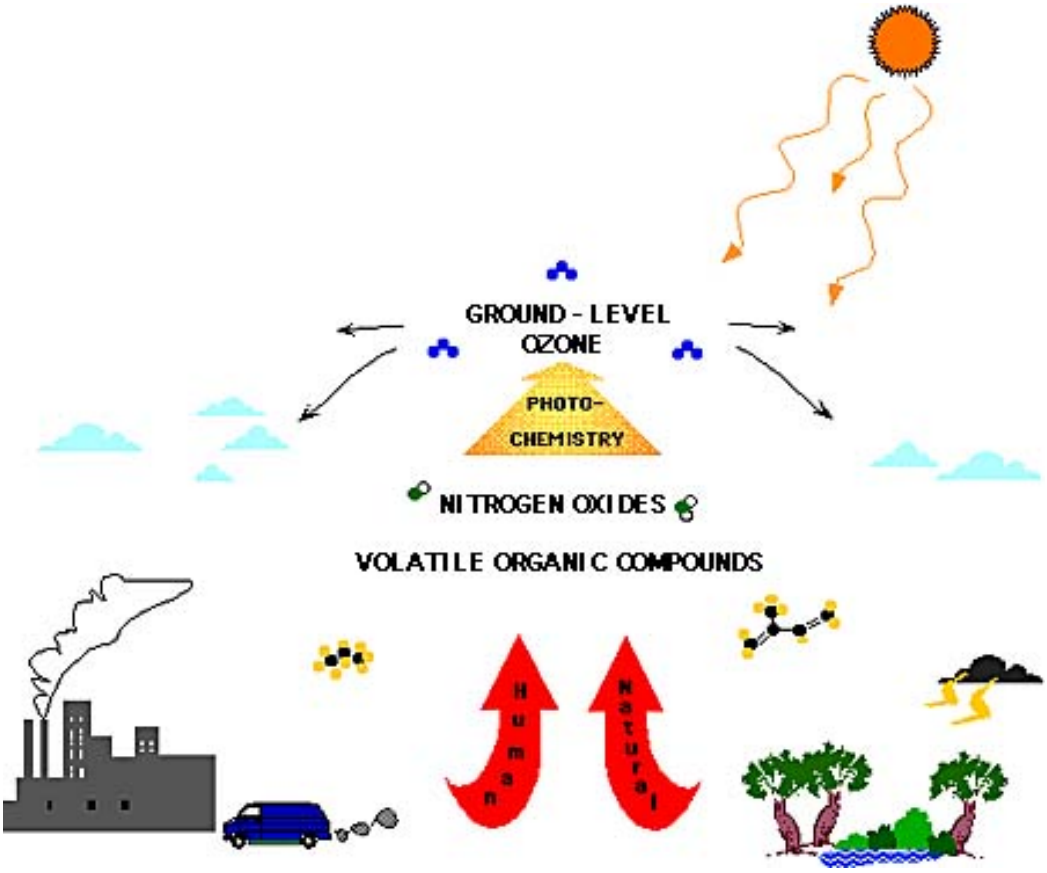
# Regional Air Quality
# (Urban and Rural Air Chemistry)
# NOAA ESRL Chemical Sciences Division

While ozone in the stratosphere has a beneficial role, the ozone close to the planet's surface, in the region known as the troposphere, displays a destructive side. Because it reacts strongly with other molecules, it can severely damage the living tissue of plants and animals. It is one of the key pollutants in "smog" that hangs over many cities around the world. Measurements have revealed that ozone can reach extremely high abundances in rural areas, where crop and forest damage are of concern. This phenomenon is being studied by CSD scientists, who have shown that volatile organic compounds (VOCs) emitted from vegetation and human-made sources are interacting with nitrogen compounds from power plants and automobile exhaust to produce the ozone. The current approach to improving air quality has been to control the amounts of human-made VOCs. However, scientists at CSD and from other institutions have discovered that in some regions of the country, the natural emissions of VOCs are far greater than the human-made ones. This may mean that in some cases, controls on human-produced nitrogen oxides would be a more effective way to reduce ozone. This important finding is of great interest to National, State, and industry policymakers, who are considering what approaches will work best to decrease the levels of ozone.

In a major effort to address the needs of the policymaking community, scientists at CSD played leading roles in launching the NARSTO (North American Research Strategy for Tropospheric Ozone) program in 1994. This interagency, international program is focusing the air quality research in the U.S., Canada, and Mexico so that it addresses key policy-relevant questions now faced by the U.S. and its neighbors. CSD worked with scientists from the Environmental Protection Agency, universities, industry, other NOAA labs, and other national and international organizations to develop the program.




**The Puzzle, the Pieces, and Now... the Picture Begins to Emerge.**

In the 1960s, with smog increasing in many cities, the United States launched an effort to improve air quality and, thereby, the health of its citizens. Passed in 1970, the Clean Air Act placed controls on human-caused volatile organic compound (VOC) emissions, one of the two primary ingredients that go into the production of ozone and other oxidants in the lower atmosphere. While some cities succeeded in "clearing the air," others had a puzzling result: no change. In cities like Atlanta, Georgia, of the southeastern U.S., ozone standards were frequently being violated. What was going on? In the 1980s, researchers from CSD and other institutions began to sort out the pieces of the puzzle, finding that with regard to ozone production, "all cities are not alike." In particular, some regions of the country have high natural levels of VOCs, coming from the trees and other vegetation of the area. Human activity adds to the amount of VOCs, but often is not the dominant contributor. So is high ozone just "natural" to these cities, then? Absolutely not– because of the other ingredient that is necessary to make ozone... nitrogen oxides. Natural levels of nitrogen oxides are quite low, and so natural ozone production is relatively small even in areas with high amounts of natural VOCs. Along come humans, with activities such as fuel combustion in cars and power plants causing large increases in nitrogen oxides. The largely human-produced nitrogen oxides react with the natural and human-made VOCs alike, producing the unnaturally high ozone. For scientists and policymakers, the picture is becoming clearer and new strategies for improving air quality are emerging. Backed by a more complete understanding of the science, the path to cleaner air is now coming into view for many cities.

**Studying the Fundamentals of Air Quality with the NOAA Aircraft Operations Center WP-3D Aircraft.**

In 1994, the NOAA WP-3D aircraft embarked on its first full-blown mission to study the atmospheric chemistry related to ozone in the troposphere. No stranger to research, the "P-3" has long been used by NOAA scientists to study hurricanes. But in the 1994 and subsequent missions, the P-3 has been loaded with a full complement of instrumentation for measuring the chemical composition of the atmosphere. Put to work in the 1994 and 1995 field experiments of the Southern Oxidants Study, the P-3 was used to study processes governing the formation of ozone and other oxidants in the region surrounding Nashville, Tennessee. The research has yielded valuable insights into the mechanisms whereby ozone is produced from the interaction of biologically and human-produced volatile organic compounds (VOCs) and nitrogen oxides from automobiles and power plants. The research has also shown that the amount of ozone in cities of the southeast U.S. often depends on processes that go far beyond that city's borders– in other words, that excessive ozone is a regional problem. Findings like these will form the scientific basis for decisions of State and local governments that aim to improve air quality.

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## Field Campaigns in Air Quality

- New England Air Quality Study (NEAQS) 2002
- New England Air Quality Study (NEAQS) 2004
- International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) 2004

For more information, visit NOAA ESRL CSD: http://www.esrl.noaa.gov/csd/