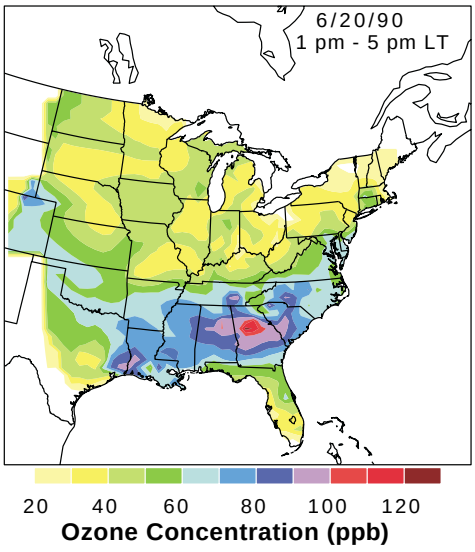
NOAA: Helping to Clear the Air About Ozone and Fine Particles...

The National Oceanic and Atmospheric Administration's (NOAA's) Health of the Atmosphere research is playing a key role in collaborative efforts that will lead to a better understanding of ozone and fine particle pollution in the United States.

Ozone is found throughout the atmosphere. But its effect on humans depends on where it is.

Ozone is mainly found in two regions of the Earth's atmosphere. Most ozone (about 90%) resides in the ozone layer approximately 10-50 kilometers (6-30 miles) above the Earth's surface. This ozone plays a beneficial role by absorbing most of the biologically damaging ultraviolet sunlight (called UV-B), allowing only a small amount to reach the Earth's surface. Thus, stratospheric ozone is often referred to as "good ozone". The remaining ozone is near the Earth's surface where it comes into direct contact with life-forms and displays its destructive side (hence, it is often called "bad ozone"). Several studies have documented the harmful effects of ground-level ozone on human health, crop production, forest growth, and materials (paints, rubber, and plastics exposed to the weather).



Ozone levels in the eastern U.S. during a typical summer episode. During these periods, ozone is often elevated over large regions for several consecutive days.

Ozone pollution at ground level is produced by the combination of oxides of nitrogen (NO_X), volatile organic compounds (VOCs), and sunlight. Human activities, primarily involving the burning of fossil fuels, add to the natural amount NO_X and VOCs in the atmosphere and increase the ozone at ground-level. Transportation and power generation are major human activities that affect ozone in the lower atmosphere.

The concentration of ozone in the lower atmosphere is determined not only by the amounts of NO_X and VOCs, but also by weather and climate factors. Warm temperatures, lots of sunlight, and stagnant high-pressure weather systems with low wind speeds contribute to harmful ozone accumulation.

Fine particles are a complex and ever-changing mixture of chemicals that affect human health and visibility.

Analysis of public health statistics suggests that exposure to high levels of fine particulates is responsible for tens of thousands of deaths each year in the U.S. (Science, July 7, 2000). Fine particles also contribute to deteriorating visibility in pristine areas of the country.

Fine particles may have many sources and contain hundreds of inorganic and thousands of organic components. They result primarily from the combustion of fossil fuels in industrial boilers, automobiles, and residential heating systems. A significant fraction is produced in the atmosphere through chemical conversion of anthropogenic and natural precursor emissions (SO_2, NO_X, reactive organics, ammonia, etc.). By mass, fine particles are primarily sulfate, nitrate, ammonium ions, carbon soot, and organics, as well as mineral dust in some locations. Fine particles can remain suspended for long periods (days to weeks) and contribute to ambient particle levels hundreds of kilometers away from where they were formed.

Research Goal

NOAA's Health of the Atmosphere research is focused on the atmospheric science that underlies regional air quality with the goal of improving our ability to predict and monitor future changes, leading to improved scientific input to decisionmaking. The series of intensive field campaigns that is planned will lead to a more complete understanding of the processes that control the formation and distribution of ozone and fine particles. This knowledge will help decisionmakers in the management of air quality in the U.S.

The Research Team

The foundation of the research program is a NOAA interlaboratory collaboration in creative partnership with other federal agencies, industry and the university community.

Participating NOAA Laboratories

Aeronomy Laboratory
Air Resources Laboratory
Climate Monitoring and Diagnostics Laboratory
Environmental Technology Laboratory
Forecast Systems Laboratory
NOAA Joint Institute - CIRES

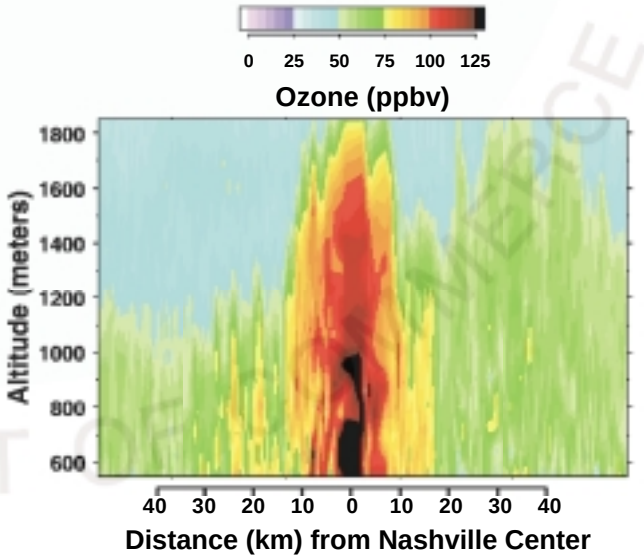
Collaborators

NARSTO
Southern Oxidants Study
University Community
Federal and State Agencies
Industry

Tools of the Trade

The NOAA WP3-D Orion. Most of the intensive field studies conducted to date have employed this aircraft equipped with state-of-the-art instruments to measure a variety of chemical species and meteorological parameters. This flying laboratory has an extensive range making it the ideal platform to study air quality on a regional and continental scale.

The NOAA Airborne LIDAR. This laser-based instrument is capable of measuring the vertical distribution of ozone and fine particles beneath a research aircraft in flight. The figure to the right shows the distribution of ozone over Nashville Tennessee on July 12, 1995. The ozone plume (as depicted by the orange/red colors in the figure) is very localized and is hanging directly over the city (the part of the flight track with elevated ozone is about 20 km or 13 miles). With this capability NOAA is able to track the formation and transport of ozone and fine particles with a spatial resolution that has not been previously possible.



Why NOAA?

NOAA has a proven track record in conducting atmospheric research that forms the scientific basis for effective decisionmaking. NOAA has been a national and international scientific leader on issues that are of great importance to the well-being of the Nation, such as ozone depletion, climate, and air quality. NOAA's scientific expertise, combined with its leadership in assessing the "state of the science" in user-friendly terms, are the foundation of its prediction and assessment mission.

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