State of the Science FACT SHEET

Air Quality

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION • UNITED STATES DEPARTMENT OF COMMERCE

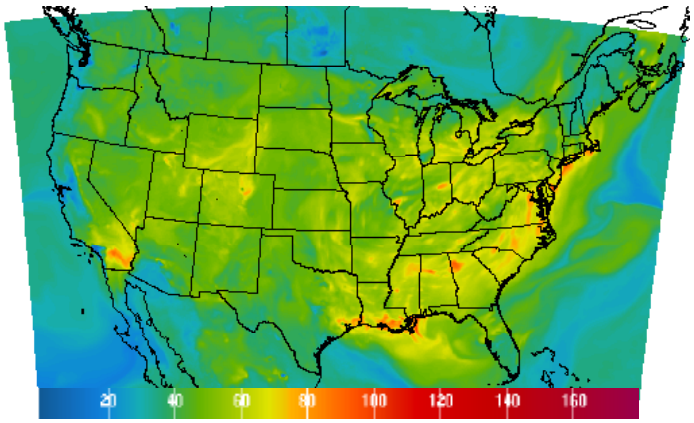
Air pollution has significant health, economic and ecological consequences. The U.S. spends tens of billions of dollars each year to reduce air pollution in order to protect public health and the environment. For more than 50 years, industrial nations have been reducing harmful air pollutants generated primarily by power plants, transportation, industry and agriculture. Despite significant improvements, poor air quality still contributes to tens of thousands of premature deaths from cardiovascular and respiratory diseases across the Nation annually. NOAA provides air quality forecasts and critical science that support development of effective policies and strategies for air quality management.

What Is Air Quality?

Air quality is determined by the quantities and types of gaseous and particle pollutants found in the air we breathe. Critical pollutants affecting U.S. air quality are:

Ground-level ozone: A gas typically produced from other air pollutants reacting in the presence of sunlight. Ozone is a major constituent of smog.

Fine particulate matter ($PM_{2.5}$): Small particles (with a diameter of 2.5 microns or less) emitted into the air or formed by atmospheric reactions of other pollutants. Because impacts are associated primarily with these small particles, NOAA's and EPA's focus is on $PM_{2.5}$.



Sample operational air quality forecast guidance. Predicted ground-level ozone concentrations, (averaged over 8 hours, in parts per billion) show unhealthy levels of ground-level ozone in warmer colors (orange, red). Current predictions available at: www.weather.gov/aq

Air pollutants, especially those containing mercury, sulfur, and nitrogen compounds, also impact ecosystems. These compounds are released into the air primarily from burning fossil fuels. Additional sources of nitrogen-bearing pollutants include fertilizers and animal waste.

What Are NOAA's Roles and the Benefits to the Nation in Improving Air Quality?

NOAA does not regulate air quality but instead serves as an "honest broker", providing objective scientific information to all stakeholders to support effective decisions. NOAA researchers collaborate with other government agencies, academia and the private sector.

Role: Deliver operational air quality predictions to the public, as the basis for health warnings and individual actions to limit exposure to poor air quality. Improve the accuracy of air quality predictions through research and development.
Benefit: The public can adjust their daily activities to limit exposure to poor air quality, responsible for as many as 60,000 premature deaths each year. People with access to air quality forecasts literally breathe easier, as documented in reductions of hospital admissions for asthma.

Role: Provide decision-makers with key science on the physical and chemical atmospheric processes that contribute to poor air quality.
Benefit: Federal and state agencies can develop and implement policies that will be most effective in improving air quality. For example, a NOAA-led air quality assessment in Texas in 2000 identified the most important air pollution sources, resulting in targeted industrial control strategies that will yield an estimated savings of $9 billion and 64,000 jobs by 2010.

Role: Quantify trends in air quality and deposition of pollutants.
Benefit: Air quality decision makers can assess whether policies and regulatory actions achieved the desired outcome and whether new approaches are needed to protect public health and the environment.

How Does Poor Air Quality Affect the Nation?

Air pollution affects human health, the economy and the environment through multiple pathways. People inhale pollutants. Crops and forests are also exposed to air pollution. Some air pollutants make their way into the aquatic and terrestrial food chains and ultimately into humans. The impacts of air pollutants include:

- Ground-level ozone and $PM_{2.5}$ cause respiratory and cardiovascular problems and lead to tens of thousands of premature deaths, with costs of more than **$100 billion**, each year. **More than half of the people in the U.S.** live in areas that do not meet the health-based air quality standards established by the U.S. EPA.

- Ground-level ozone damages crops and forests, causing billions of dollars of losses annually.
- $PM_{2.5}$ reduces visibility, posing risks to aviation safety and limiting vistas in national parks and other protected areas, impacting tourism.
- Consuming seafood contaminated with high levels of mercury can harm the brain and other organs, especially during in-utero and early childhood development.
- Acidic and nitrogen compounds deposit onto watersheds and water surfaces. These compounds can degrade water quality, impair ecosystem health and reduce commercial and recreational use of these areas.
- Air pollutants, including ground-level ozone and $PM_{2.5}$, can contribute to global warming and cooling. Air quality is also influenced by climate change.

NOAA's Research and Development Capabilities:

NOAA employs a comprehensive set of capabilities to advance understanding of air quality.

Laboratory investigations characterize and quantify fundamental properties of atmospheric chemical reactions.

Field studies use advanced instrumentation– deployed at fixed observing stations, on aircraft, aboard ships and on satellites– to gather data on atmospheric processes. These data support model evaluation and enhancement, focus follow-up laboratory investigations, and inform effective policies and strategies for air quality management.

Numerical model enhancement leads to improved predictions.

What Are the Priorities for NOAA Research?

Effective air pollution management and prediction depends on knowing the sources, transport, transformation and fate of air pollutants. NOAA's research and development is required to address a number of key issues that limit the Nation's ability to improve air quality and mitigate the impacts of poor air quality. NOAA's priorities include:

- Improving understanding of $PM_{2.5}$ processes, including atmospheric reactions—especially involving organic compounds, sources of $PM_{2.5}$ and its chemical precursors.
- Improving capabilities to accurately predict air quality This includes quantitative predictions for next-day $PM_{2.5}$ and ozone and maintaining accuracy in multi-day predictions.
- Resolving significant gaps in understanding which sources of mercury lead to high levels of mercury in fish.
- Reducing uncertainties in sources of airborne nitrogen compounds and their rates of air-surface exchange.
- Improving information on the roles of distant (regional to intercontinental) air pollution sources on U.S. air quality.
- Enhancing understanding of interactions between air quality and climate, including the influence of $PM_{2.5}$ on climate change and the mutual air quality and climate impacts of potential management strategies.

Participating NOAA Organizations

Office of Oceanic and Atmospheric Research (OAR) Air Resources Laboratory – Investigates the exchange of pollutants between the air and surface; improves air quality forecast models; and enhances the understanding of mercury observation techniques, models and sources. www.arl.noaa.gov

OAR/Earth System Research Laboratory – Investigates the chemical processes that form and transform air pollutants, improves regional and global predictive models for air quality and pollutant transport, and develops fast-response and compound-specific sensors for the study of air quality. www.esrl.noaa.gov

OAR/Geophysical Fluid Dynamics Laboratory – Provides modeling analysis on the linkages between climate and air quality. www.gfdl.noaa.gov

OAR/Pacific Marine Environmental Laboratory – Researches aerosol processes and their contribution to air quality in coastal areas. saga.pmel.noaa.gov

National Environmental Satellite, Data, and Information Service (NESDIS) Center for Satellite Applications and Research (STAR) – Transfers satellite observations of air quality from scientific research and development into routine operations, and provides state-of-the-art data, products and services to decision-makers. www.star.nesdis.noaa.gov/star

National Weather Service (NWS) – Develops, tests and implements NOAA's operational air quality predictions. Development and testing is conducted by a team made up of scientists in the Office of Science and Technology, in the National Centers for Environmental Prediction (NCEP), in OAR, and NESDIS. www.nws.noaa.gov/ost/air_quality