Air Resources Laboratory

Headquarters
College Park, Maryland

Conducting Research and Development in the Fields of Atmospheric Dispersion, Air Chemistry, and Climate

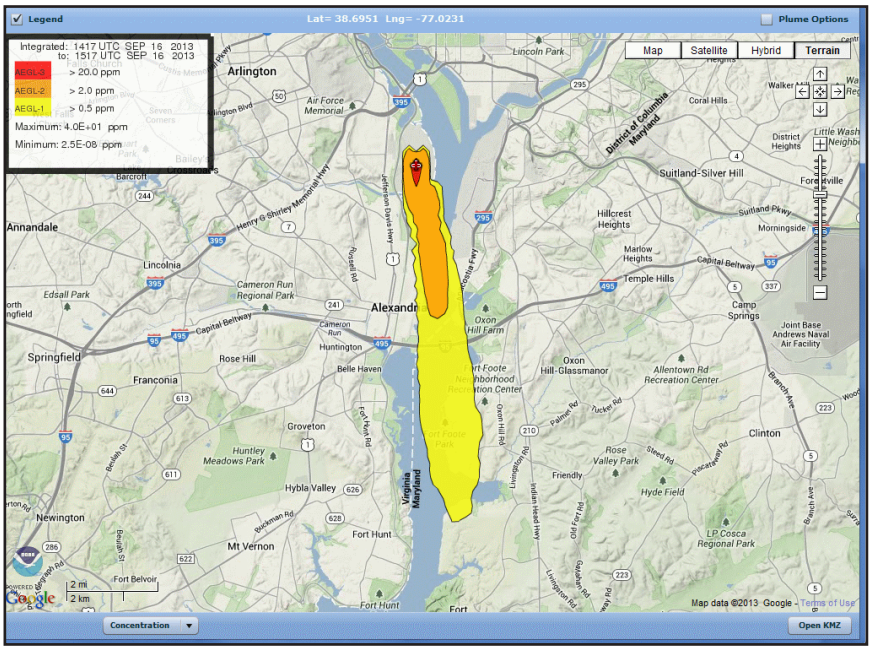
The Air Resources Laboratory's (ARL) Headquarters is located at the NOAA Center for Weather and Climate Prediction in College Park, MD. ARL also has other divisions in Idaho Falls, ID; Las Vegas, NV; and Oak Ridge, TN. ARL Headquarters has talented scientists and technicians who work in the areas of atmospheric dispersion, atmospheric chemistry, and climate analysis. The Laboratory traces its origins back to 1948 when it was headquartered in Washington, DC and known as the Special Projects Section of the U.S. Weather Bureau (now known as the National Weather Service).

Our Research

ARL Headquarters develops and improves atmospheric dispersion and air quality models; collects and analyzes air quality and deposition measurements; and provides climate-relevant datasets and assessments of climate variability and trends. Some products developed by ARL augment the operational products of NOAA's service-oriented offices, particularly the National Weather Service (NWS). Other products and services directly support air quality decision-makers, such as the U.S. Environmental Protection Agency (EPA), and the research community. Headquarters scientists also produce state-of-the art, web-based assessment tools that serve thousands of users, including university researchers, federal research agencies, and international partners. For example, the HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model is a very powerful and useful analytical tool developed and used by ARL and by many others at NOAA and throughout the world to investigate atmospheric dispersion of harmful materials.

Dispersion Modeling

The accidental or intentional release of chemical, biological or nuclear agents can have significant health, safety, economic, and national security implications. Headquarters scientists develop, improve, and conduct tests with the HYSPLIT model for emergency response applications, including volcanic eruptions, forest fires, nuclear accidents, and homeland security incidents. Having the understanding of how, where, and when chemicals and materials are atmospherically transported is essential for responding appropriately and preventing disaster. For instance, accurate predictions of the path of a chemical or nuclear radiation release help emergency managers evacuate people thought to be in harm's way. ARL dispersion products are used by other parts of NOAA, the U.S. EPA, the Federal Aviation Administration, the Volcanic Ash Advisory Centers, the U.S. Department of Energy, the International Atomic Energy Agency, and the World Meteorological Organization.



Results for a simulated chlorine spill near Washington, D.C. using the new HYSPLIT web-based modeling system developed by ARL in collaboration with NOAA's Office of Response and Restoration and the U.S. EPA. Colors depict decreasing concentrations of the chlorine plume as it disperses away from the source area (red color). Image credit: NOAA/ARL

Air Pollutant Measurements

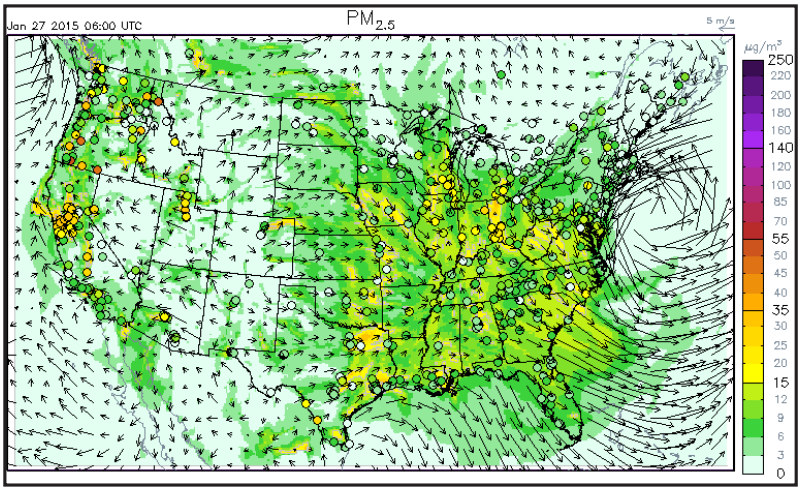
Pollutants released into the air can lead to significant impacts to both human and environmental health. Headquarters scientists are leaders on improving methods for measuring concentrations of these pollutants in the air, as well as concentrations in rain and snow. The primary pollutants of concern are mercury; sulfur compounds (such as sulfates and sulfur dioxide); and nitrogen compounds (such as nitrate and ammonium). Headquarters scientists also coordinate with national programs, such as the National Atmospheric Deposition Program, and international programs, such as the World Meteorological Organization Global Atmosphere Watch, to provide the highest quality atmospheric chemistry and meteorological data to the research community.

Mercury Modeling System

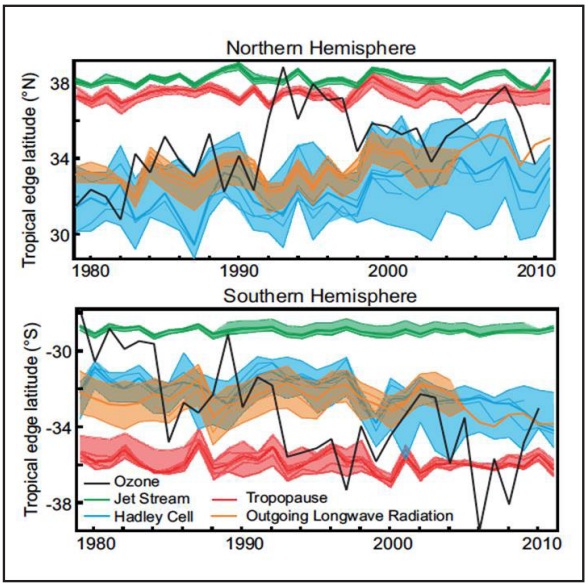
Headquarters modelers developed and use a special version of the HYSPLIT model to simulate the atmospheric fate and transport of mercury. A key feature of this modeling system is that it can estimate the overall atmospheric concentrations and deposition arising from emissions of mercury to the air and at the same time keep track of the individual contributions of each source to the overall totals. ARL evaluates the model by comparing its predictions against ambient measurements carried out by ARL and other scientists. Results of the modeling are used to support air quality and water quality decision-makers and forecasters in protecting human and ecosystem health. For example, ARL's mercury modeling is contributing to the Great Lakes Restoration Initiative, a partnership program of federal agencies in cooperation with states, tribes, municipalities, universities and other organizations to accelerate efforts to protect and restore the Great Lakes, with assessments of atmospheric sources of mercury deposition to the Great Lakes.

Air Quality Forecasting Support

Poor air quality contributes to tens of thousands of premature deaths annually from cardiovascular and respiratory diseases. The air pollutants most critically affecting human health are ground-level ozone (O_3), also known as smog, and 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. ARL's Air Quality Forecasting Group evaluates and improves computer models used by the NWS to operationally predict concentrations of O_3 and $PM_{2.5}$. This valuable work supports air quality planners and managers, air quality forecasters, and the research community.



Example of an official modeled forecast of $PM_{2.5}$ concentrations and near real-time verification using collocated measurements (depicted as color-filled circles under the same color scheme). Across the map colors match up nicely, demonstrating a high level of forecasting skill. Source: NOAA



Changes in the locations of the edges of the tropical belt in the Northern and Southern Hemispheres 1979–2012. An example of research using contemporary satellite and reanalysis datasets. The shifting of the dry zones associated with the belt can have dramatic local consequences for climate, ecosystems, water resources, economies, and agriculture. Birner et al. (Physics Today 2014).

Climate Analysis

Changes in our climate can affect water availability, ecosystems, air quality and weather. Headquarters climate scientists contribute to improved understanding of climate change and variability through:

- Characterizations of daily to multi-decadal climate variations based on analysis of observations;
- Development of climate monitoring methods and data products to understand multi-decadal variations in the climate system, including temperature, water vapor, ozone, heat waves, and clouds, and their response to natural and man-made climate changes;
- Evaluation and development of the climate models to support more reliable projections and better informed public policy; and
- Participation in national and international climate assessments, such as those conducted by the U.S. Global Change Research Program, the Intergovernmental Panel on Climate Change, and the international stratospheric ozone community.

Our Partners

- NOAA service offices and other research groups
- U.S. Environmental Protection Agency, U.S. Department of Agriculture, and other federal agencies
- National Center for Atmospheric Research
- NASA Jet Propulsion Lab
- Wide range of academic institutions
- International scientists

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