



Air Resources Laboratory

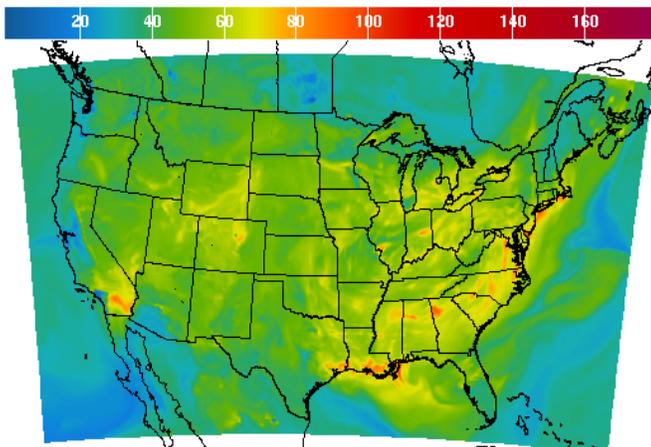
Research and Development for Improving Air Quality Forecast Products

What We Do

The Air Resources Laboratory (ARL) conducts world-class air quality research and development (R&D) that supports air quality planners and managers, air quality forecasters, and the research community. An important component of ARL's work is evaluating and improving computer models used by NOAA's National Weather Service (NWS) to operationally predict concentrations of ground-level ozone. ARL's work will also help NWS to predict concentrations of fine particulate matter in the future. ARL scientists evaluate air quality models by performing rigorous comparisons of model predictions with actual atmospheric measurements. Based on the knowledge gained from these evaluations, ARL adds or enhances specific model processes or input data sets to better represent emissions of air pollutants and the physical and chemical complexities that occur in the atmosphere. The continuous model evaluation and improvement cycle conducted by ARL scientists leads to better NWS operational air quality forecast products.



*Houston, Texas on a clear day and a smoggy day
Image Credit: The Batelle Institute*



1Hr Avg Ozone Concentration(PPB) Ending Wed Jul 16 2008 1PM EDT
(Wed Jul 16 2008 17Z)
National Digital Guidance Database
12z model run Graphic created-Jul 16 1:30PM EDT



An example map of ground-level ozone concentrations predicted for the continental U.S. NOAA's National Weather Service generates such maps twice daily using an ARL-developed modeling system.

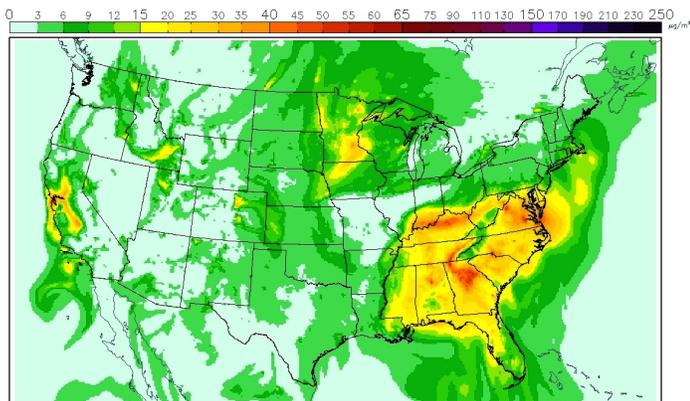
of fossil fuels, residential fireplaces, agricultural burning, and fires), volcanic emissions, and windblown dust, but can also form in the air as a result of chemical reactions. Although scientific understanding of the origin and fate of $PM_{2.5}$ has advanced rapidly over the last 20 years, the forecasting capabilities of these atmospheric constituents are not as advanced as that of ground-level ozone. This is largely because the physical and chemical processes that govern the concentration of fine particulates in air are much more complex than those that determine ozone concentrations.

Ground-level Ozone

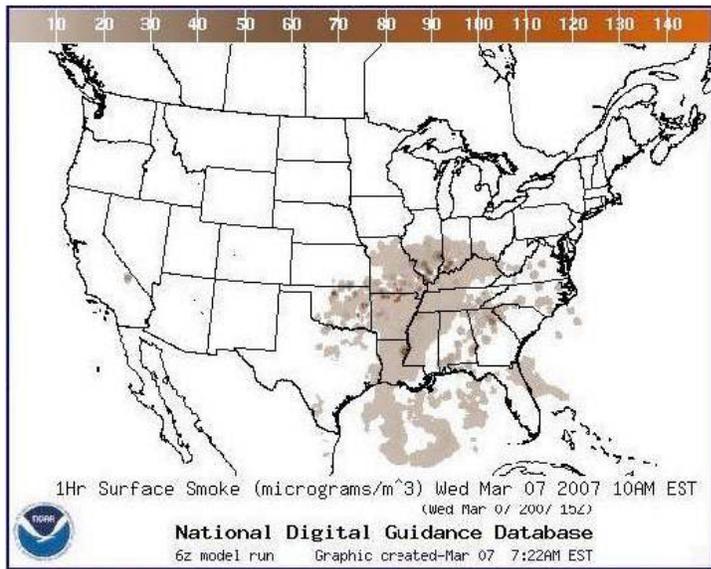
ARL's R&D improves the NWS's operational modeling system for short-term (1-2 day) prediction of ground-level ozone (O_3), a major constituent of smog. Motor vehicle exhaust, power plant and industrial emissions, gasoline vapors, and chemical solvents, as well as natural processes, are sources of the compounds that act to form ground-level O_3 . ARL works with scientists in other NOAA laboratories, other federal agencies, and at universities to improve air quality forecast models and to generate data that are necessary to model all of the significant processes that control the concentrations of ground-level O_3 .

Particulate Matter

ARL also supports NOAA's goal of predicting atmospheric concentrations of fine particulate matter ($PM_{2.5}$). These tiny particles, which are 2.5 micrometers in diameter or less (or less than 1/30th the width of a human hair), are especially dangerous to human health because they can be inhaled into and accumulate in the respiratory system. $PM_{2.5}$ is emitted directly into the air from combustion processes (burning



Forecast daily mean surface concentrations of $PM_{2.5}$ in $\mu g/m^3$ for November 17, 2009, from the developmental forecast system. Red, orange, and yellow show the highest concentrations. ARL scientists are working to improve the capabilities of this system in order to provide accurate forecasts of this important atmospheric pollutant.



An example map of surface smoke predicted for the Continental United States. The NWS generates such maps twice daily using an ARL-developed modeling system.

ARL is working to improve NOAA's forecast models for $PM_{2.5}$ by incorporating the latest scientific understanding of these processes obtained from field and laboratory measurements and other modeling efforts across the air quality scientific community. An example of this work is the NOAA Smoke Forecasting System (SFS), which integrates NOAA's satellite imagery of the location and extent of the fires, estimates of emissions from fires, and the dispersion simulations from ARL's Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model to produce a daily 48-hour prediction of smoke concentrations. The SFS serves as guidance to air quality forecasters and the public for $PM_{2.5}$ emitted from large wildfires and agricultural burning. In addition, ARL is developing a similar capability for windblown dust. To support a future capability to predict all forms of $PM_{2.5}$, ARL is also working on an advanced PM modeling system that will include particles formed in the atmosphere through chemical reactions.

Why It Is Important

Air pollution has significant health, ecological, and economic consequences. Elevated levels of ground-level ozone and particulate matter cause respiratory and cardiovascular problems and annually lead to tens of thousands of premature deaths, with costs in the United States of more than \$100 billion. 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. Environmental Protection Agency. NOAA's air quality model results inform forecasts and alerts (e.g., code red) issued by state and local air quality forecasters. The public also uses NOAA's air quality predictions to obtain information (e.g., hourly predictions) that is not included in state/local forecasts. Accurate air quality forecasts enable communities to take actions that can reduce the severity of episodes of poor air quality (e.g., encourage people to telecommute or take buses instead of driving). Predictions also enable individuals to take protective actions that limit their own exposure to poor air quality (e.g., limit exercise, stay indoors). ARL's R&D helps to ensure that the operational forecast models provide consistently high quality forecast products.

For More Information

Operational Air Quality Predictions

www.weather.gov/aq

ARL Air Quality R&D

www.arl.noaa.gov/AirQual.php

NOAA Smoke Forecasting System

www.arl.noaa.gov/smoke.php

NOAA's State of the Science Air Quality Fact Sheet

www.arl.noaa.gov/documents/Summaries/AQSOSFactSheetFINAL.pdf

NOAA, Air Resources Laboratory
1315 East West Highway, R/ARL
SSMC #3, Rm. 3316
Silver Spring, MD 20910
Phone: 301.713.0295 ext. 100
FAX: 301.713.0119
Email: arl.webmaster@noaa.gov