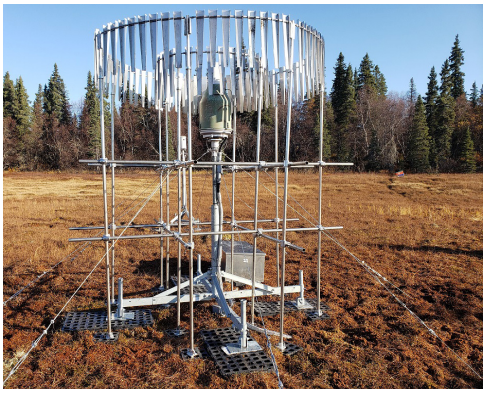
Air Resources Laboratory



NOAA's Air Resources Laboratory (ARL), conducts research on the lowest part of the atmosphere, the boundary layer, the area where we live and breathe. World-class research on the chemistry and physics of the boundary layer contributes to accurate regional and global predictions of weather and air quality, as well as climate variability. ARL also works to generate actionable information and highly localized forecasts to respond to a variety of emergencies efficiently. Scenarios may include chemical or nuclear-related industrial accidents, wildfires, volcanoes, and high-impact air pollution episodes; data from ARL informs local managers whether evacuations or stay- at- home orders may be necessary.

Emergency Management

The accidental or intentional release of chemical, biological, or nuclear agents, as well as ash associated with volcanic eruptions, may result in significant health, safety, national security, economic, and ecological implications. ARL's atmospheric transport and dispersion research provides critical modeling and observation data to understand how, where, and when chemicals and materials are dispersed through the atmosphere. This information can be quickly assembled to provide emergency responders, federal agencies or and the aviation industry with accurate and highly localized forecasts to guide actions to reduce the impacts to public health and property.

Weather forecasts and climate outlooks

Studies of the boundary layer improve subseasonal to seasonal weather forecasting and climate outlooks. ARL conducts long-term field studies to understand interactions between the atmosphere, the land surface and vegetation to improve climate and weather predictions. ARL also studies energy, water, and greenhouse gas flux measurements and analyzes their relationships to weather and climate variability.

ARL measures atmospheric composition changes at many locations across the US. Measurements of the boundary layer interactions with the weather are key to long term climate assessment and mitigation; in order to estimate greenhouse gas (GHG) emissions and verify commitments, localities will need access to measurements of current and past conditions and techniques.

Air Composition and Chemistry

While the past three decades have made significant advances in reducing emissions of harmful air pollutants into the atmosphere, many locations in the U. S. continue to experience poor air quality and some sensitive ecosystems remain highly stressed by exposure to elevated pollutant levels and deposition of harmful chemicals. ARL performs both measurements and computer modeling to advance our understanding of air composition and chemistry and partners with other NOAA laboratories and the National Weather Service (NWS) to provide the nation and its citizens with accurate air pollution forecasts. ARL's research in these areas also helps to improve weather and climate forecasts since the composition of the atmosphere has fundamental impacts on clouds, precipitation and solar radiation.

ARL's work includes:

- NOAA's HYSPLIT transport and dispersion model is developed for targeted forecasts and products as varied as volcanic ash, mercury deposition, or airborne hazardous materials emitted from industrial events.
- Locust swarms have struck the horn of Africa; in 2020 ARL quickly developed a web application product to model the behavior of the swarms and predict the next area they may infest.
- NOAA/NWS Weather Forecast Offices generate over 1100 HYSPLIT runs each year to inform local responders and decision makers of atmospheric dispersal of

smoke plumes or toxic chemicals. Special events, such as sporting events, balloon or air festivals, and NASA launches also use HYSPLIT to determine appropriate public safety measures.

- Contributions to national and international assessments of climate, including a supplement to the annual Bulletin of the American Meteorological Society (State of the Climate Report), that inform readers of the global climate for the previous year to support key environmental management decisions.
- Designed, installed, and maintains the 114 stations of the U.S. Climate Reference Network (USCRN) in the conterminous U.S. (CONUS), 23 stations in Alaska (with a plan for 29-30 stations by 2025), and two stations in Hawaii, that monitor air temperature, precipitation, and soil moisture and temperature (CONUS only) across the U.S. with a high degree of accuracy and reliability.
- ARL's fleet of Small Uncrewed Aerial Systems (SUAS), or drones, routinely samples how temperature, moisture, and wind evolve within the boundary layer under different weather conditions.
- ARL research supports the NWS National Air Quality Forecast Capability, which provides multi-day air quality forecasts to the U. S. ARL also provides emissions algorithms and datasets that are crucial components of next-generation sub-seasonal to seasonal weather forecast models.

ARL's scientists, engineers and technicians conduct research at four geographically distributed divisions:

- Atmospheric Sciences and Modeling Division (ASMD) in College Park, Maryland
- Atmospheric Turbulence and Diffusion Division (ATDD) in Oak Ridge, Tennessee
- Field Research Division (FRD) in Idaho Falls, Idaho
- Special Operations and Research Division (SORD) in Las Vegas, Nevada

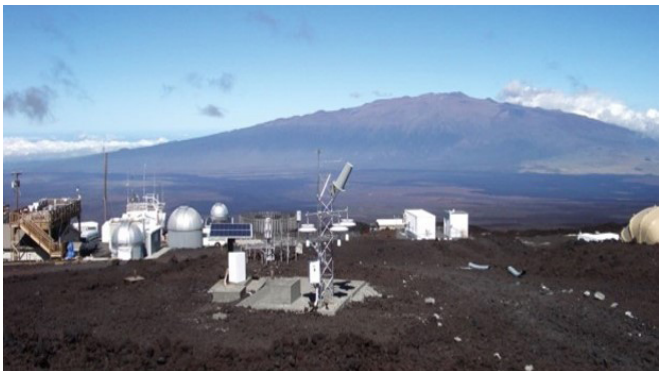


Image captions left to right, front: ARL researchers use instrumented small planes to sample air in the MidAtlantic states; SUAS operator in Oak Ridge, TN takes vertical profiles of the atmosphere; a close up of a U.S. Climate Reference Network station. Reverse: USCRN station in Mauna Loa, HI; Equipment for installation on the Mauna Loa Observatory; Dust storms from North Africa visible from the International Space Station (image credit: NASA); SUAS vehicle prepared for flight in Oak Ridge, TN.

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