Air Resources Laboratory

Milestone Moments in 2024

Message from the Director:

The Air Resources Laboratory (ARL) has a long history of studying the Earth's boundary layer. As an applied sciences lab within NOAA's Office of Oceanic and Atmospheric Research, we measure and model meteorological variables to recognize changes in atmospheric composition and employ personnel with the expertise to measure those changes accurately.

There were many accomplishments in 2024. We took time to celebrate our 75th anniversary, were a key participant in several collaborative field campaigns, and made some big updates to some of our models. I look forward to our lab continuing the important and exciting work in 2025.

Ariel Stein climbing ARL's tower in Chestnut Ridge, Tennessee. Photo courtesy of Ariel Stein

In 2024 ARL:

▪ Celebrated 75 years of research

ARL engaged in a number of activities in honor of its 75th anniversary

Events began by hosting several sessions at the American Meteorological Society Annual Conference in January where we featured a historical perspective of our research from the beginning in 1948 to the exciting work of today. ARL opened its doors at both the Atmospheric Turbulence and Diffusion Division in Oak Ridge, TN and the Special Operations Research Division in Idaho Falls, ID to congressional staffers, city government officials, partners and NOAA leadership at two Open House events. Additionally, in honor of 75 years, ARL established a Scientist-in-Residence program in 2024. This opportunity connects NOAA's Cooperative Institute faculty with the NOAA science community and supports professional development.

ARL scientist Rick Lantrip showing Charlene Rosenlund, staffer for Idaho Representative Mike Simpson, how to launch a weather balloon at the Special Operations and Research Division in Idaho Falls, ID. Credit: Tracey Bien-Aimé (NOAA/ERT)

Top cover image: ARL's set up at the SCALES campaign (pg 5). Credit: David Senn (NOAA/ORAU)
Lower cover image: EPA prescribed burn campaign (pg 6). Credit: Charley Fite (NOAA/CISESS)

▪ Signed inter-agency agreements

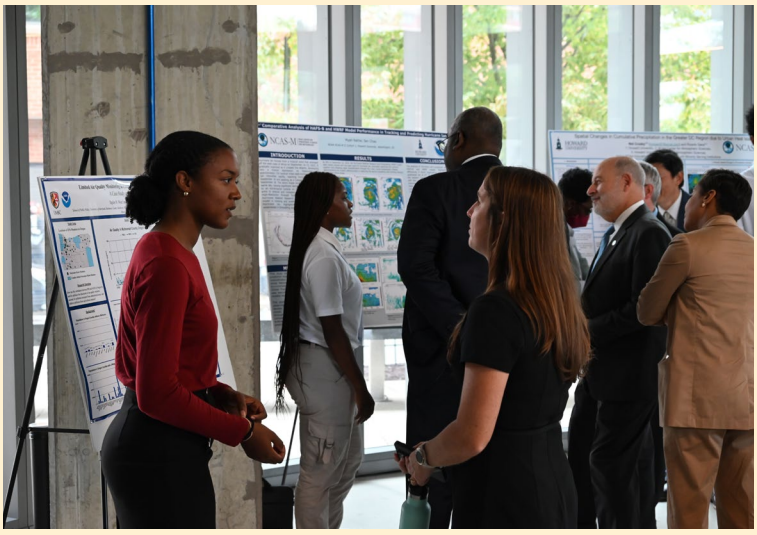
Special Operations and Research Division signed two inter-agency agreements

ARL signed a five year agreement with the Department of Energy Idaho and a ten year agreement with the Department of Energy Nevada National Security Site. These agreements mean ARL will continue to support both agencies with highly skilled and experienced professional and technical staff providing detailed and very specific meteorological information used for emergency response assistance, mission oriented research and a mobile remote-sensing capability.

▪ Marked a 20-year partnership

ARL and Howard University celebrated 20 years of partnership at a public event on the Howard University campus

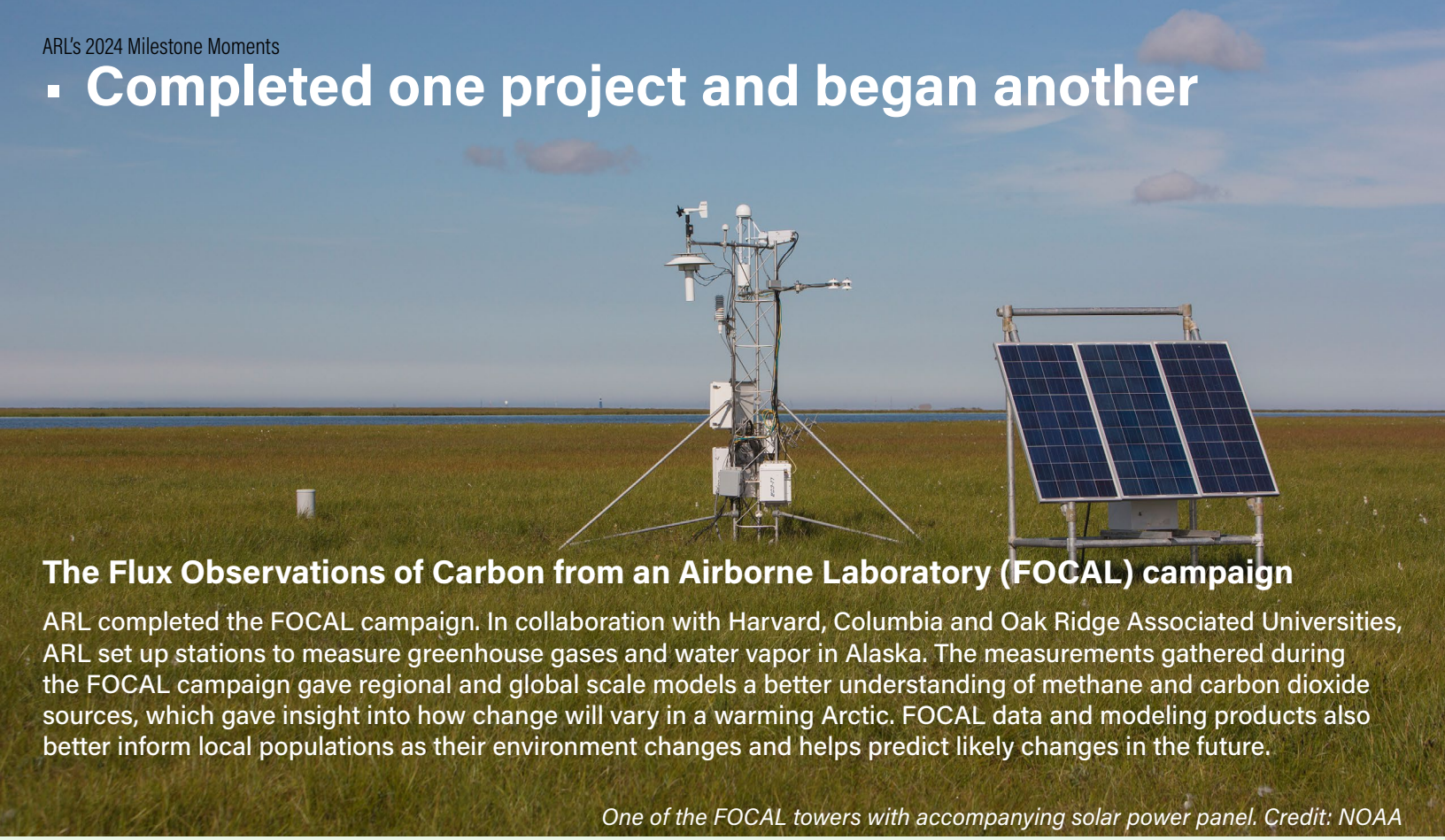
The event began with a showcase of NOAA Center for Atmospheric Science and Meteorology (NCAS-M) students poster presentations and ended with a tour of ARL's UrbanNet instruments on a rooftop tower. This partnership has resulted in highly-trained professionals in atmospheric and environmental sciences. With students actively engaged in researching atmospheric studies, they are better prepared to enter the NOAA and broader community workforce.



Taylor West discussing her work during the NCAS-M presentations. Photo courtesy of NOAA

NCAS-M Director Dr. Sen Chiao highlights ARL instruments installed at Howard. Photo Credit: Monica Allen (NOAA)

▪ Completed one project and began another



The Flux Observations of Carbon from an Airborne Laboratory (FOCAL) campaign

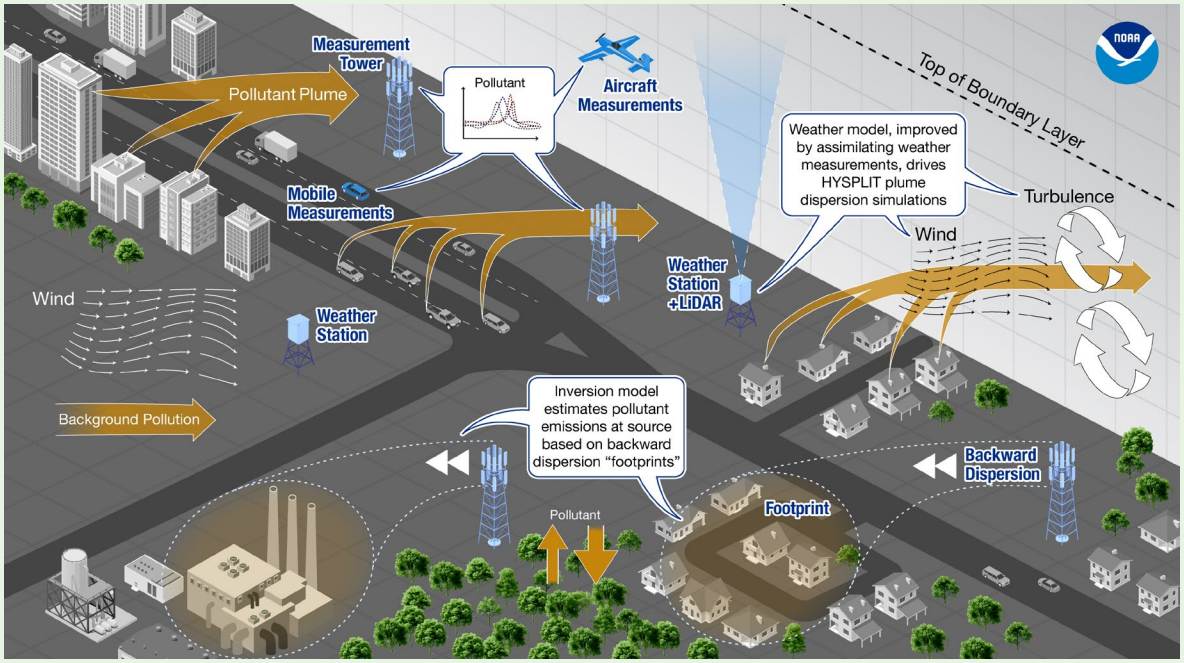
ARL completed the FOCAL campaign. In collaboration with Harvard, Columbia and Oak Ridge Associated Universities, ARL set up stations to measure greenhouse gases and water vapor in Alaska. The measurements gathered during the FOCAL campaign gave regional and global scale models a better understanding of methane and carbon dioxide sources, which gave insight into how change will vary in a warming Arctic. FOCAL data and modeling products also better inform local populations as their environment changes and helps predict likely changes in the future.

One of the FOCAL towers with accompanying solar power panel. Credit: NOAA

Urban-AMMS

ARL began a collaboration with other OAR labs and the National Institute for Standards and Technology to develop an operational capability to measure and model fluxes in urban settings. This system is designed to integrate existing capabilities into an urban-scale system in the Washington D.C.-Baltimore region with two primary goals: To calculate downwind impacts of pollutant fluxes to the air - which are critical for protection of life and property; And to calculate the locations and amounts of those fluxes which are important to mitigate threats to life and property.

2024 work culminated in a workshop in December introducing local government, academia, non-profit and private sector organizations in the region to Urban-AMMS products. The workshop also gave the Urban-AMMS team insight into how their data products will be used so that they can better tailor products for users.



Overall conceptual schematic of the Urban-AMMS system. Credit: Maria Raykova (NOAA/Groundswell)

▪ Participated in four large field campaigns

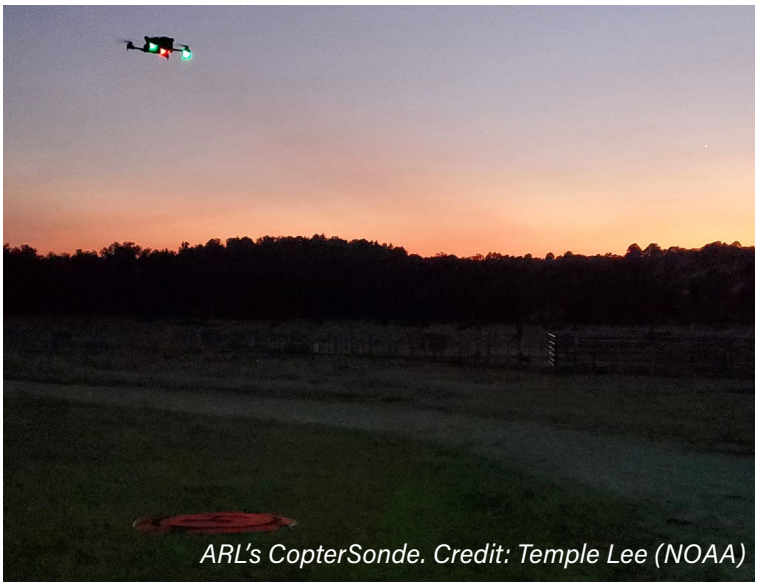
L-R: Xinrong Ren (NOAA), Sam Brasch (CO Public Radio) and Alan Brewer (NOAA) on the NOAA Twin Otter. Credit: Xinrong Ren (NOAA)

Airborne and Remote Sensing Methane and Air Pollutant Surveys

ARL's Air Resources Car (ARC) can usually be found traveling between the Washington D.C. area and Baltimore, MD, and up the northeast corridor. However, this summer, the ARC team traveled to Colorado and Utah for four weeks to participate in the Airborne and Remote Sensing Methane and Air Pollutant Surveys (AiRMAPS) initiative. By using the ARC and providing the same instruments for NOAA's Twin Otter plane, ARL helped to demonstrate the value of using an integrated observing system with instruments in space, in the air and on the ground to accurately evaluate methane and air pollutants. These evaluations generate actionable information that supports state and local stakeholders in their efforts to improve regional air quality.

Small uncrewed aerial systems Coordination for Atmospheric Low-Level Environmental Sampling

ARL was a key participant in the Small uncrewed aerial systems Coordination for Atmospheric Low-Level Environmental Sampling (SCALES) Uncrewed Aerial Systems (UAS) campaign. ARL participated in the northeastern Oklahoma study using our CopterSonde from the Cooperative Institute for Severe and High-Impact Weather Research and Operations at the University of Oklahoma. The CopterSonde helped measure changes in near-surface atmospheric processes after sundown. This work helps scientists better understand boundary layer processes and improve weather prediction models.



ARL's CopterSonde. Credit: Temple Lee (NOAA)

NOAA's Very Big Methane Release experiment

By taking advantage of a scheduled methane release, NOAA was able to verify the Advanced Baseline Imager on the new GOES-19 satellite. Using GOES-19, an airplane fitted with methane-detecting sensors and mobile platforms with those same sensors, NOAA was able to verify their measurements with the known quantity that was released. This will lead to faster, more complete information on the location and amount of methane emissions during accidental leaks. ARL contributed a methane/ethane detector that was deployed on the Chemical Sciences Lab's mobile laboratory. ARL scientists also used HYSPLIT to forecast the trajectory of the methane plume to help create a flightpath and plan the driving route for the airborne and mobile sensors in order to ensure accurate measurements from the sky and ground.

GOES-19 satellite illustration. Credit: NASA

Smoke plume from one of the burn plots. Credit: Charles Fite (NOAA/CISESS)

The Effect of Fuel Characteristics and Fire Dynamics on Emissions from Prescribed Forest Burns: Konza Prairie 2024

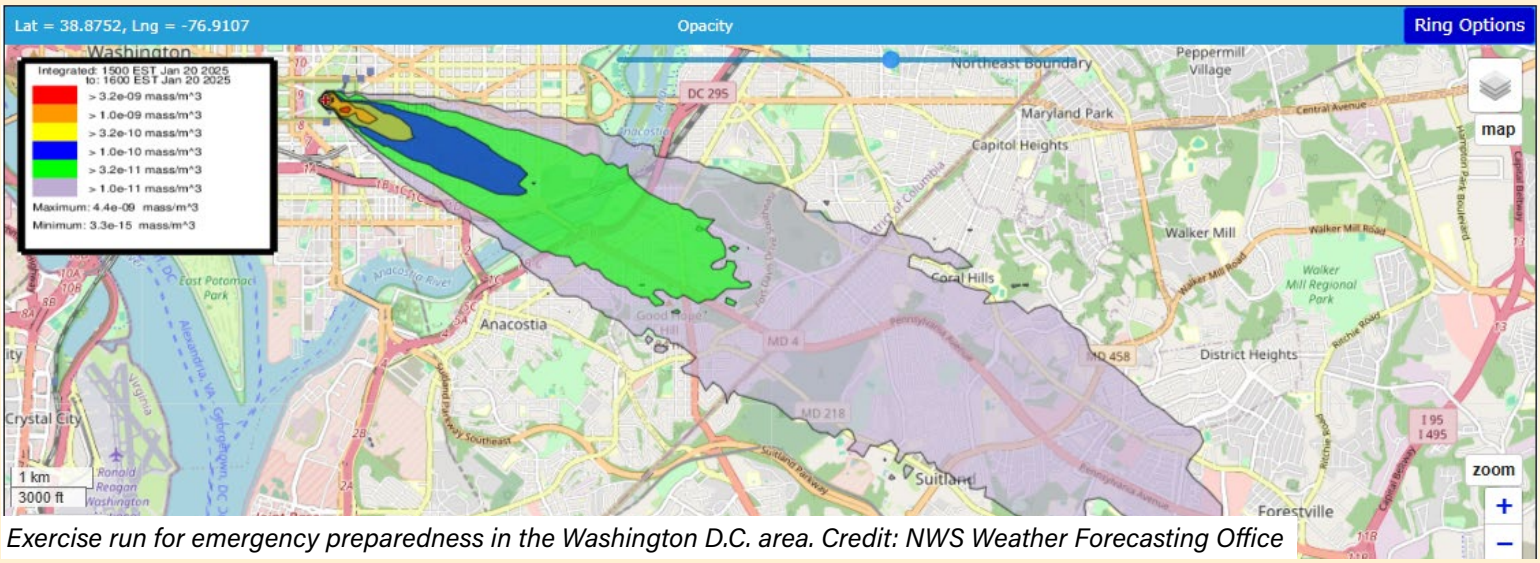
ARL collaborated with the U.S. EPA and others in prescribed burns at the Konza Prairie Biological Station. This project measured emissions of key pollutants and meteorological variables using unmanned aerial vehicles and ground sensors. During the campaign, ARL provided daily plume dispersion forecasts using HYSPLIT and fire emissions from the U.S. Forest Service Bluesky Framework, to aid in decisions for where and when to ignite the burns. ARL also set up wind sensors and took ground clipping samples of the biomass in each of the burn plots to estimate fuel density and fuel moisture; both of which impact fire dynamics and emissions. Fuel density, fuel consumption, emission factors of chemical species and other information measured from these burns improves our calibration and representation of these fires in atmospheric dispersion models such as HYSPLIT.

Charles Fite holding a sonic anemometer. Credit: Gina Grier (EPA)

▪ Made major upgrades to widely-used models

HYSPLIT update for the National Weather Service

HYSPLIT is an atmospheric transport and dispersion model developed, updated, and maintained at ARL for about 75 years. HYSPLIT is available for use by the public via the HYSPLIT READY website, but ARL also developed a version specifically for the National Weather Service (NWS) that includes features and capabilities not available on the public version. In June, the HYSPLIT team finalized a number of major updates to the NWS model and conducted a very thorough and well received workshop for two NWS Weather Forecast Offices. The NWS uses HYSPLIT to create simulations in response to a real event, in an exercise or to aid planning. They also use it to help emergency managers respond to active events to keep first responders and the community safe. For instance, in the event of a propane leak, the NWS can let emergency managers know the probable path of the propane so that they can issue evacuation or shelter in place orders for areas in the path of the plume.



Exercise run for emergency preparedness in the Washington D.C. area. Credit: NWS Weather Forecasting Office

ARL and NOAA's Environmental Modeling Center released an air quality model update

In May, ARL and NOAA's Environmental Modeling Center released a major update to their Air Quality Model (AQMv7). This update builds on the Unified Forecast System framework to incorporate more sources of data and other models to more accurately depict a wider variety of pollutants. This update also produces hourly air quality forecasts, updated four times a day and forecasting three days ahead.

Forecast of hourly PM2.5 from airquality.weather.gov

▪ Installed instruments and sensors for more accurate measurements and better detection

Improvements to mesonets in Idaho

ARL installed new instruments to measure wind, solar radiation, rain and temperature and humidity, and communicators to transmit that data, in the mesonets that ARL operates in partnership with the U.S. Department of Energy Idaho National Laboratory in Idaho Falls, ID. We also added new electronic enclosures to protect the meteorological stations in the network.

Expanded Lightning Detection Sensor network

ARL added a new lightning detection sensor that improved our detection capability on the Nevada National Security Site in Las Vegas, Nevada. This addition better triangulates lightning strikes across the entire site to more accurately locate strikes. Other sensors are hardwired for power, but this new site is too remote. ARL and the NNSS radio and communications group developed a way to reliably power the sensor with solar power and added a new microwave communications link to send data to our main lightning server. ARL's work in both strike detection and forecasting storms allows us to keep the NNSS personnel safe. People in the field can be pulled out before storms hit to avoid injuries and complicating their missions and strike location information lets NNSS personnel get to and put out small fires quickly.

Despite the sensors, each year there are still wildfires and this year there were two. The first was the most significant. It went on for multiple days and burned just over 8,000 acres. ARL provided routine weather forecasts for the fire's location and frequent updates on current weather conditions. Weather information was briefed to the NNSS Emergency Response Organization Emergency Manager, and the NNSS Fire Chief.

Stock image of Las Vegas, NV

▪ Joined a new air quality network

ARL and FALCON

One of the new instruments installed on the Chestnut Ridge tower included one that is part of the Fluxes of Aerosol Continuous Observing Network (FALCON) led by Colorado State University. The goal of this network is to provide the first long-term dataset measuring the flow and number of particles passing through an area over time between the atmosphere and the Earth's surface, or particle flux. As we better understand this process, it will help increase the accuracy of weather and air quality forecasts and predictions of our changing climate.

New instrument mounted on the Chestnut Ridge Tower. Credit: Mark Heuer (NOAA/ORAU)

▪ Was recognized for expertise in volcanic ash

ARL Director appointed to National Volcano Early Warning System Advisory Committee

ARL was recognized as a leader in volcanic ash dispersion forecasting. Director Ariel Stein was appointed by the Secretary of Interior to a two-year term to serve on the National Volcano Early Warning System Advisory Committee (NVEWSAC). As part of this committee, ARL is helping implement the National Volcano Early Warning and Monitoring System to provide data for NVEWSAC decisions and recommendations.

Stock image of Mount St. Helen

ARL by the numbers:

141
USCRN sites maintained with a

95%
annual data receipt rate

31
publications in peer-reviewed journals with

42
citations

53
presentations at conferences and workshops

600
students inspired through outreach events

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