



Earth System Research Laboratory

Serving society through science

What Does the Earth System Research Laboratory Do for the Nation?

At NOAA's Earth System Research Laboratory (ESRL), scientists study atmospheric and other processes that affect air quality, weather, and climate. By better understanding the dynamic Earth system, we can better understand what drives this afternoon's haze, next month's hurricanes, and next century's climate. ESRL researchers monitor the atmosphere,

study the physical and chemical processes that comprise the Earth system, and integrate those findings into environmental information products. Our work improves critical weather and climate tools for the public and private sectors, from hourly forecasts to international climate science assessments, with policy-relevant findings.



Top: A NOAA research airplane takes off for the CalNex mission. Photo by Dan Lack, CIRES/NOAA. **Middle:** Installing a new supercomputer at ESRL. Photo by Will von Dauster, NOAA. **Bottom:** Field measurements in Tiksi, Russia. Photo by Taneil Uttal, NOAA.

Recent Accomplishments

Understanding Climate. ESRL has made unparalleled contributions to the scientific understanding of climate change, starting with its global atmospheric monitoring program. This year, ESRL scientists drew on a unique record from Boulder, CO—30 years of water vapor measurements—and satellite data to link surface warming with changes in stratospheric water vapor. ESRL staff trained researchers from China and India in how to set up long-term greenhouse gas measurement programs, and they completed the field phase of a major mission to study the intersection of air quality and climate on the U.S. West Coast. **Benefits: ESRL data and discoveries let scientists and the public understand and predict climate variability and change and inform policy.**

Improving Forecasts. ESRL scientists contributed to significant advances in understanding and predicting hurricanes and fire weather, and in evaluating the roles of weather variation (vs. climate change) on high-impact events such as Washington's snowstorms. ESRL also installed a powerful new supercomputer, dedicated to improving hurricane models; and made significant improvements to experimental Earth system models, including FIM (the flow-following, finite-volume icosahedral model). Finally, scientists here are using an innovative technique developed here—GPS meteorology, to measure water vapor—to improve forecasting and climate understanding. **Benefits: ESRL improves the weather forecasts on which people, companies, and governments depend. The annual value of U.S. weather forecasts is estimated to be \$31.5 billion.**

Watching Earth's Poles. ESRL scientists celebrated the opening of the Tiksi Hydrometeorological Climate Observatory this summer, after years coordinating its establishment. The site in Russia, is now one of an international group of Arctic climate observatories from which climate data are freely available. ESRL researchers also installed instruments at Summit, Greenland, to better understand how clouds contribute to rapid warming in the region; and continued to monitor the seasonal Antarctic ozone hole, which formed again this year, but is likely to show signs of recovery within a decade. **Benefits: ESRL's scientific eyes on Earth's poles ensure that rapid changes in the remote areas will be tracked and understood.**

Educating future scientists and the public. ESRL researchers are developing a raindrop exhibit with the Exploratorium museum in San Francisco. Science On a Sphere®, ESRL's renown visualization

tool, is now in more than 50 locations worldwide including the World Expo in Shanghai, China, this year. ESRL researchers mentored dozens of high school, undergraduate, and graduate students last year, and helped run an Earth System modeling workshop for graduate student. **Benefit: ESRL educational programs contribute to a more scientifically literate society.**

Investigating air quality. ESRL's air quality research this year included a quick-response mission to study air pollutants released during the Gulf oil spill and controlled burning. Researchers here also published significant studies about dusty snow (dark-colored dust settling on Rocky Mountain snowpacks ends up robbing the Colorado River of about five percent of its water) and imported pollutants (plumes of air from Asia carry ozone and other pollutants above western North America). ESRL scientists also demonstrated that the "mountain chimney effect" can loft ozone—and possibly other pollutants—from the Los Angeles Basin as far as Colorado. **Benefit: ESRL research provides a scientific basis for efforts to improve air quality, protecting public health and ecosystems.**

What's Next for the Earth System Research Laboratory?

- Expand global atmospheric observation networks, recognizing a growing need to monitor factors involved in warming and air pollution.
- Better model and understand the regional effects of climate change and variability on water resources, floods, and droughts.
- Design and evaluate new instruments for collecting data on hard-to-measure components of the atmosphere affecting climate change, air quality, and ozone depletion.
- Improve hurricane models and forecasts, using new supercomputing power and by experimenting with diverse models and data assimilation techniques.
- Analyze emissions inventories for atmospheric chemical compounds, and evaluate their impacts on atmospheric composition.
- Initiate a pilot measurement system in India's Ganges Valley, to study aerosol's effects on warming, convection, and cloud formation, including during the monsoon.

Research Partnerships

ESRL's partners include other groups in NOAA, the Cooperative Institute for Research in Environmental Sciences (University of Colorado at Boulder), the Cooperative Institute for Research in the Atmosphere (Colorado State University in Fort Collins), the National Center for Atmospheric Research (Boulder, CO), NASA, the Environmental Protection Agency, the National Science Foundation, the Department of Energy, and other academic and research institutions worldwide.

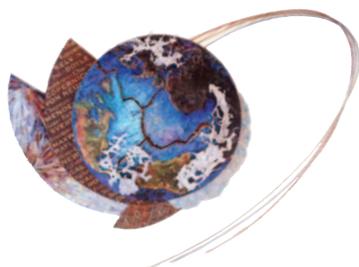
Budget and Staff

ESRL has an annual operating budget of approximately \$85M, 228 Federal employees, and 390 affiliates. Funding sources include Congressionally enacted budgets, funding provided by other NOAA entities where ESRL provides research support, and funds provided by other government and private sector partners who rely on ESRL-developed science and technology.

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esrl.noaa.gov



A controlled burn of oil on the surface of the Gulf oil spill sends plumes of smoke into the sky. U.S. Coast Guard photo.



Did You Know?

ESRL scientists are working with colleagues at the National Marine Mammal Laboratory to experiment with monitoring sea-ice-dependent marine mammals using unmanned aircraft systems (UAS). A mission in the Bering Sea last year produced 25,000 photographs. Now researchers are using sophisticated software to scan the images for evidence of seals.