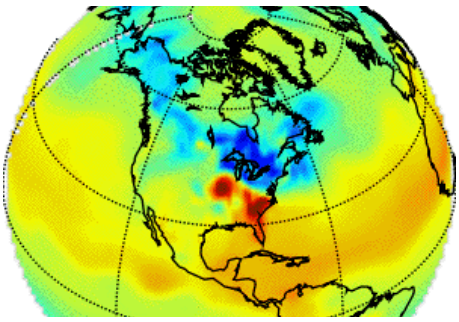
Earth System Research Laboratory
Global Monitoring Division
Monitoring the changing atmosphere



Top. A GMD scientist prepares an air flask for measurements. GMD makes precise measurements from air samples collected weekly around the world and shipped to Boulder, Colo. Photo courtesy of Will von Dauster, NOAA.
Middle. GMD scientists are participating in a multi-agency, five-year mission to study the detailed composition of the atmosphere—from North to South Pole, around the world—by airplane. Photo courtesy of Will von Dauster, NOAA.
Bottom. GMD created CarbonTracker, a model that starts with observations of the greenhouse gas carbon dioxide, taken from around the world, and tracks its increases and decreases in the atmosphere, associated with human and natural causes. NOAA image.

What Does The Global Monitoring Division Do For The Nation?

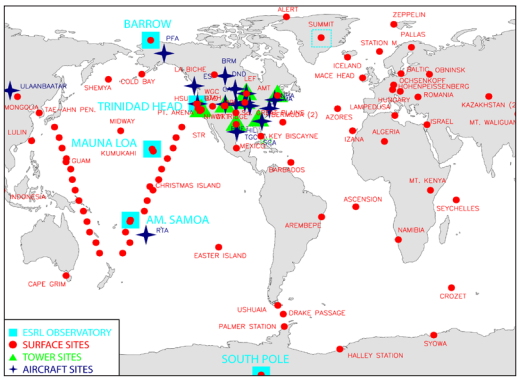
The Global Monitoring Division (GMD) of the Earth System Research Laboratory (ESRL) established, continues, maintains, and analyzes long-term records of global atmospheric measurements, from the concentration of greenhouse gases, ozone, and ozone-depleting chemicals to the amount of solar radiation reaching the Earth's surface. Records from GMD's Mauna Loa, Hawaii and South Pole observatories stretch back to 1957, and the Mauna Loa carbon dioxide record is considered one of the most critical long-term geophysical records. GMD data form the basis of international understanding of climate change, ozone depletion, particulate pollution, baseline air quality and global radiation balance.

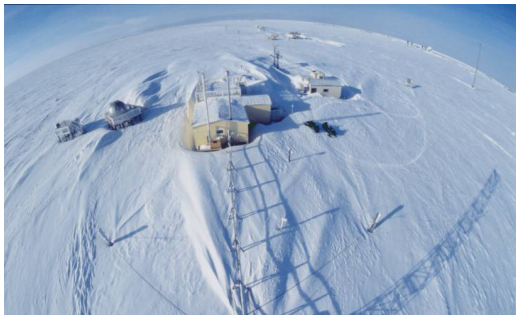
GMD Scientific Goals

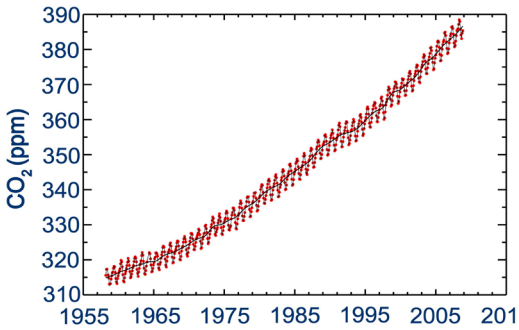
- Understand the climate-related dynamics of greenhouse gases, ozone depletion, and aerosols based on ongoing measurements from 269 cooperative atmospheric monitoring sites on land and sea around the world, and from aircraft.
- Operate five manned atmospheric baseline observatories girding the Earth from north to south that continuously monitor hundreds of atmospheric and solar radiation parameters.
- Maintain a suite of United Nations-recognized calibration standards for greenhouse gases, ozone, and ozone-depleting substances, to ensure that all climate forcing measurements are on the same scales.

Recent Accomplishments

- GMD scientists and their collaborators discovered that ozone smog, a ground-level pollutant normally associated with hot summers in big cities, can form in the cold, too, at levels exceeding U.S. Environmental Protection Agency standards. Ozone can cause respiratory damage, especially in children and the elderly.
- ESRL's research on the ozone layer and on ozone-depleting chemicals was key input to global agreements, including the Montreal Protocol to protect the ozone layer. Through regular global measurements of gases that deplete the ozone layer, GMD has established that total chlorine and bromine levels are now slowly decreasing in the atmosphere. One class of ozone depleters, however, the HCFCs, has increased significantly, up 60 percent from 2004 to 2007.
- Through precise measurements of global atmospheric methane—the second-most influential greenhouse gas after carbon dioxide—GMD has shown that the rate of methane increase came almost to a halt from 1999 to 2006, and increased again during 2007 to 2008.
- Through carbon dioxide analysis of samples from the Global Air Sampling Network, GMD established that forests and agriculture in North America may be sequestering a sizable fraction of the carbon dioxide produced by fossil fuel consumption in the United States. GMD also







Top. Measurement sites in GMD's atmospheric carbon cycle monitoring network. NOAA image.
Middle. GMD operates atmospheric baseline observatories in five locations, including Barrow, Alaska. NOAA photo.
Bottom. Global carbon dioxide record from Mauna Loa, Hawaii. GMD data.

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determined that year-to-year variations in carbon dioxide uptake are likely related to terrestrial processes involving forests and agriculture.

- From measurements in the Atlantic, Pacific, and Southern oceans, GMD demonstrated that the global oceans are a major net sink for atmospheric methyl bromide (CH_3Br), an ozone-destroying compound used extensively for agricultural fumigation.
- From continuous, long-term background measurements at the Mauna Loa, Hawaii and Barrow, Alaska observatories, and ozone profile measurements at the Trinidad Head, Calif. station, GMD has confirmed the transport of dust and air pollution (containing black carbon) from Asia to North America, especially into the Arctic.

What's Next For GMD?

During the next five to ten years, GMD will continue to support NOAA by:

- Expanding the global cooperative global air sampling network, to accommodate a growing need for monitoring of atmospheric constituents that cause climate forcing (warming or cooling). The Atmospheric Carbon Cycle Observing System will use instrumented small aircraft and tall communication towers to reduce uncertainty in the North American carbon uptake and provide U.S. regional carbon emission and uptake data to policy makers.
- Continuing to monitor trends in the chlorine- and bromine-bearing compounds that deplete stratospheric ozone, critical for tracking the effectiveness of the Montreal Protocol in protecting the ultraviolet (UV)-absorbing ozone layer.
- Increasing baseline air quality monitoring, to deal with an expected increase in effluents from expanding Asian economies. Because of possible ramifications of this pollution for air quality standards, particularly in West Coast states, GMD established the Baseline Station at Trinidad Head, Calif., and is expanding measurement programs off the east coast of Asia. Furthermore, the Division will continue to conduct weekly airborne vertical profiles of trace gas and ozone concentrations upwind of the California coast near Trinidad Head.

Research Partnerships

GMD has joint research projects with other ESRL Divisions, such as integrated field studies associated with GMD's monitoring sites or using GMD's monitoring methods. The Division also has research partnerships with federal agencies such as NASA, the Department of Energy, the Environmental Protection Agency, and the U.S. Geological Survey; with 22 U.S. universities; and maintains cooperative greenhouse gas sampling and/or ozone monitoring projects in 34 states and 68 foreign countries. GMD also has working agreements with the United Nations Environment Program and the World Meteorological Organization.

Contact

Dr. James Butler, GMD Director
325 Broadway
Boulder, Colorado 80305
303-497-6898