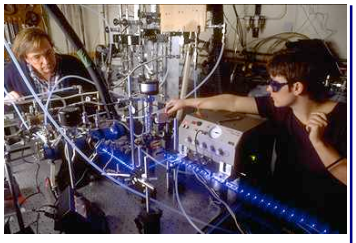
NOAA Earth System Research Laboratory
Chemical Sciences Division
…understanding the chemistry of our atmosphere



Chemical Sciences Division scientists conduct laboratory experiments to help improve NOAA's predictions in climate, air quality, and ozone-layer depletion.

The NOAA WP-3D and Twin Otter research aircraft and the NOAA R/V *Ronald H. Brown* become "mobile chemical laboratories" to study atmospheric processes in air quality and climate field studies organized by the Chemical Sciences Division and involving colleagues in other NOAA Research laboratories and other agencies and universities.

Chemical Sciences Division scientists and their colleagues discovered the atmospheric chemical processes that cause the Antarctic ozone hole. Division scientists continue to study the chemistry and processes associated with the recovery of the stratospheric ozone layer and the interactions between ozone depletion and climate change.

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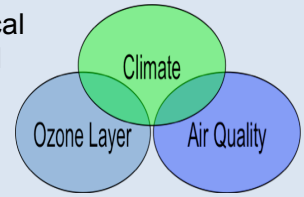
What does the ESRL Chemical Sciences Division do for the Nation?

Sound scientific basis for decisions and choices: Through research and assessments, the Chemical Sciences Division (CSD) provides a sound scientific basis for decisions and choices made by industry, government, and the public relating to climate change, air quality improvement, and ozone layer protection.

Understanding and identification of atmospheric processes: Chemical reactions and radiative processes (heating, cooling, and initiation of reactions) drive atmospheric change. Identification and characterization of these processes are needed for building better models of the atmosphere. CSD's ~120 scientists, staff members, and visitors are focused on understanding the chemical reactions and radiative processes that are important to model predictions of past and future changes in climate, regional air quality, and the stratospheric ozone layer.

Our Niche: Research in Three Environmental Issues

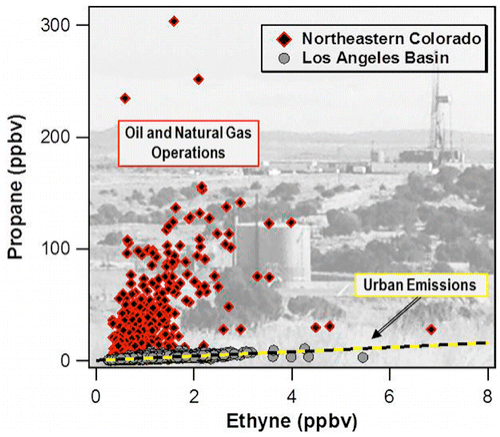
- Understanding and quantifying atmospheric chemical and radiative processes to underpin NOAA's global models
- Providing user friendly, policy-relevant scientific information to NOAA's information customers in government, industry, and the public.



An emerging focus of CSD is studying the interlinks between these three environmental issues.

The building blocks of better predictions:
- CSD laboratory investigations of atmospheric chemistry
- CSD field measurements in a variety of environments
- CSD diagnostic analyses and interpretations
- CSD leadership and scientific input for international efforts to assess the current scientific understanding and provide decision-support information

Recent Accomplishments:



- Atmospheric measurements at the Boulder Atmospheric Observatory near Erie, Colorado, showed definitively that oil and natural gas exploration/development activities are the source of some very high levels of volatile organic compounds (VOCs) in the vicinity. By measuring several different VOCs, the CSD researchers identified a "signature" for oil and gas activities that is clearly distinguishable from emissions by other urban and natural sources. ***Payoffs: This research provides a means of determining the local and regional air quality impacts of oil and natural gas exploration and development activities, which are increasing as the nation strives for greater energy independence.***

- CSD scientists completed the only detailed measurements of air quality-related chemistry during the 2010 Deepwater Horizon oil spill. The data were used to develop a new and independent approach for estimating the subsurface oil leak rate, as well as for determining the fates of the spilled oil. Analysis of the data also has led to new discoveries related to air quality and climate regarding the formation of organic fine particles (aerosols) in the atmosphere. ***Payoffs: NOAA's air chemistry measurements determined the leak rate of the Deepwater Horizon oil spill as well as the air quality impacts for disaster workers. Further analysis of the data is leading to new insights into the fundamental science related to air quality and climate.***
- Evaluated the climate effects of the ozone-depleting substances that have been controlled under the Montreal Protocol ozone-layer agreement; the work showed that the Protocol has already significantly benefitted climate (it has reduced the climate-weighted emissions by over 5 times the amount of the first Kyoto Protocol target). ***Payoffs: Decision makers are now considering the use of the Montreal Protocol for achieving additional climate benefits, such as new measures to control replacements for ozone-depleting substances that are strong climate gases, such as hydrofluorocarbons (HFCs).***
- Played extensive roles in leading, authoring, reviewing, editing, and/or publishing international scientific state-of-understanding assessments on the climate system, fine-particle pollutants, and the stratospheric ozone layer. ***Payoffs: These information products provide key scientific input to pending national and international decisions regarding these three societally relevant topics.***

What's next for the Chemical Sciences Division?

Over the next five to ten years, CSD will focus on:

- **Climate Research**

  Climate Change: Chemical Composition, Radiation, and Clouds
  - understanding the role of aerosol particles and processes in atmospheric heating/cooling, cloud formation and composition, and the alteration of atmospheric chemical composition
  - defining the role of intercontinental transport and chemical transformation in regional atmospheres and global climate
  - understanding the radiative effects of black carbon (soot), water vapor, and trace gases in the atmosphere

  Stratospheric Ozone Layer Recovery
  - determining how climate change will affect the ultimate recovery of the ozone layer and the timing of its recovery, and how changes in the ozone layer affect climate
  - evaluating the "ozone friendliness" and "climate friendliness" of proposed substitutes for the now-banned ozone-depleting compounds and their transitional substitutes
- **Air Quality Research**
  - identifying the factors (such as oil and gas exploration activities, agriculture, nighttime chemistry, and sea-to-land transport) that contribute to ozone pollution in various regions of the U.S. that are experiencing poor air quality
  - determining the measurements and diagnostic analyses that are needed as the scientific foundation for understanding and forecasting air quality
  - identifying regionally dependent factors that influence the formation of atmospheric fine particles and their chemical composition across the chemically diverse U.S.
- **Science at the Intersections of Climate, Air Quality, and the Ozone Layer**
  - investigating interlinks between these three issues in both science and policy-relevant information, for example: determining the contributions of individual (geographic, sectoral, etc.) emissions to climate forcing and air quality change; elucidating impacts of climate change on air quality; and determining the climate benefits of replacing ozone-depleting substances
  - providing the scientific information necessary for integrated real-world decision-making on these three topics

Research Partnerships

Several CSD scientists are affiliated with the Cooperative Institute for Research in Environmental Sciences (University of Colorado). CSD also has vital research and scientific partnerships with colleagues from other Divisions of the Earth System Research Laboratory, other NOAA/OAR laboratories, NOAA's National Weather Service and National Environmental Satellite Data and Information Service, NASA, NSF, U.S. Department of Energy, U.S. Environmental Protection Agency, private industry, and numerous universities and organizations worldwide.

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NOAA — National Oceanic and Atmospheric Administration — U.S. Department of Commerce

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