Research on Short-Lived Climate Pollutants (SLCPs) In NOAA's Earth System Research Laboratory Chemical Sciences Division (CSD)

- **Short-lived climate pollutants (SLCPs) have shorter persistence in the atmosphere than carbon dioxide, which means that their atmospheric abundances will respond quickly to emissions changes.**
- **Further, each of these SLCPs has other environmental impacts, especially air quality (health) impacts, such that they could be a part of win-win strategies for climate-air quality policy making.**

Examples of ESRL-CSD work on SLCPs:

Aerosols and Their Varied Roles

fine particles suspended in air

In climate…

- Cooling by scattering aerosols has "masked" the the potency of greenhouse gases (GHGs)
- Absorbing aerosols (e.g., soot) add to positive climate forcing (warming)
- Aerosol-cloud interactions are a major uncertainty in climate models

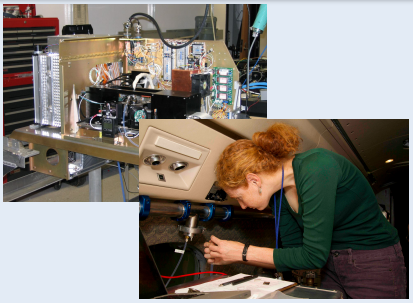
Synergies brought by working on both

In air quality…

- A criteria pollutant for health
- Sources and formation of particulate matter (PM2.5 and PM10) are not well known
- Secondary organic aerosols are a major emerging issue

CSD has developed new measurement techniques for atmospheric black carbon (soot) and conducted research to quantify its emissions (from sources such as shipping) and the impacts on climate and air quality.

CSD developed the cavity ring-down aerosol extinction spectrometer (CRD-AES). The instrument characterizes soot and other particles by measuring the loss of light through scattering and absorption in an optical cavity.



CSD's Single Particle Soot Photometer (SP2) quantifies the refractory black carbon (rBC) mass and mixing-state of individual rBC-containing particles.

Lower-Atmospheric Ozone in Climate and Air Quality

In climate…

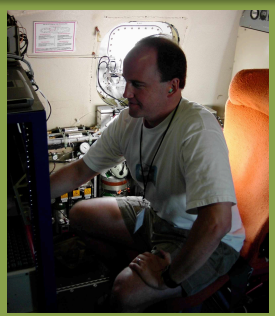
- "Controls" the tropospheric composition
- Is an important "non-CO_2" GHG and one of the "short-lived climate pollutants"
- Quicker response to mitigation than CO_2

Synergies brought by working on both

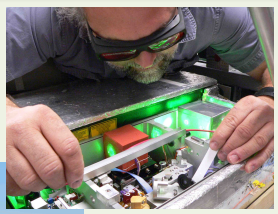
In air quality…

- A criteria pollutant for health
- Stricter standard are planned
- "One size does not fit all" (regional studies a must!)
- Intercontinental transport (we "export" and "import")

Gas chromatography-mass spectrometry is used to quantify several different volatile organic compounds in the troposphere. These compounds are precursors for ozone formation.



CSD deploys several instruments on the NOAA WP-3D research aircraft to measure trace gases and particles important to the atmospheric chemistry of air quality and climate.



The Tunable Optical Profiler for Aerosol and oZone (TOPAZ) lidar measures ozone and aerosol in the lower troposphere. Aircraft deployments achieve 90-m vertical and 600-m horizontal resolution.

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Developing Next-Generation Instruments For Studying Short-Lived Climate Pollutants

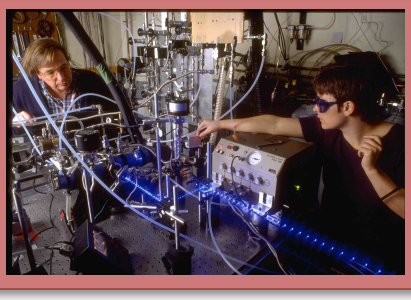
From R&D and use in the lab…

- Conceive of and develop "state-of-the-art" capabilities—no "off-the-shelf" option exists
- Apply to lab studies of short-lived climate pollutants
- Lead-in to light/portable/robust field prototypes

…to applications in the field

- Low-abundance species can be very important!
- Use new instruments developed in lab to discover new processes
- Unforeseeable applications (e.g., national emergency – Deepwater Horizon oil spill)

Research in CSD investigates fundamental atmospheric processes involving short-lived climate pollutants. The research often requires the development of new experimental methods to measure the reactivity, photochemistry, and the optical and physical properties of stable and transient species related to SLCPs. The work leads to the development of new instrumentation for use in field studies and provides much-needed information for industry, decision makers, and the nation.



NOAA and Short-Lived Climate Pollutants

The interplay between air quality and climate change with regard to the SLCPs is a major thrust and output of NOAA to provide science-based information to decision makers. NOAA's research includes the following key SLCPs:

Black Carbon

NOAA research ranges from developing instrumentation to measuring the amount of black carbon particulate matter (both long-term monitoring and more elaborate short-term studies), to quantifying emissions (e.g., from ships and other sources), to quantifying the impact of these emissions on climate using state-of-the-art climate models. NOAA also contributes to the U.S. Cookstove initiative via evaluating the climate benefits of reduced levels of black carbon emissions from better stoves.

Ozone and Aerosols (fine particles) in the Lower Atmosphere

NOAA has performed extensive observational and modeling research to understand the emissions and processes that lead to the production and trends in ozone in the lower atmosphere (troposphere). Ozone is a short-lived climate pollutant as well as a major component of air pollution (smog). The impact of atmospheric aerosols (fine particle suspended in air) on climate continues to have large uncertainties associated with it. NOAA scientists have explored sources of aerosol particles in intensive field campaigns and laboratory studies, and then investigated the impacts of aerosols on climate both through additional field campaigns and through state-of-the-art climate modeling activities.

Hydrofluorocarbons (HFCs)

NOAA scientists measure the atmospheric abundances, reactivities, and properties of various HFCs, which have been used as replacements of ozone-depleting substances (ODSs) that are harmful to Earth's stratospheric ozone layer. In addition, many proposed HFCs are evaluated in the laboratory for their "climate friendliness." NOAA is also currently examining the byproducts of HFC degradation in the atmosphere to help determine whether any of these byproducts might be harmful to the environment. NOAA scientists have demonstrated that HFCs destroy a negligible amount of ozone, and they have provided estimates of potential future climate impacts of replacing ODSs with HFCs and benefits of using shorter-lived HFCs.

Methane

NOAA scientists have been measuring the atmospheric concentration of methane for over two decades and have combined these measurements with calculations to determine the level to which we understand sources and sinks from various anthropogenic activities. NOAA scientists have also explored the extent to which past and predicted future emissions contribute to both climate forcing and air quality.

Key Partnerships for Our Science and Assessments

- Cooperative Institutes; other OAR Labs & Programs
- Other NOAA Line Offices (e.g., National Environmental, Satellite, Data, and Information Service - NESDIS)
- Other U.S. Agencies (e.g., National Aeronautics and Space Administration - NASA)
- Academia and Private Industry
- International

Key Partnerships to Deliver Decision-Support Info

- U.S. Government (e.g., State Department, Office of Science and Technology Policy – OSTP; Environmental Protection Agency – EPA)
- National Assessments
- State Agencies
- International Organizations
- Industry

CSD 10 Mackenzie Solomon, NOAA Office of Legislative and Intergovernmental Affairs, 202-482-2497, mackenzie.solomon@noaa.gov