NOAA Chemical Sciences Laboratory

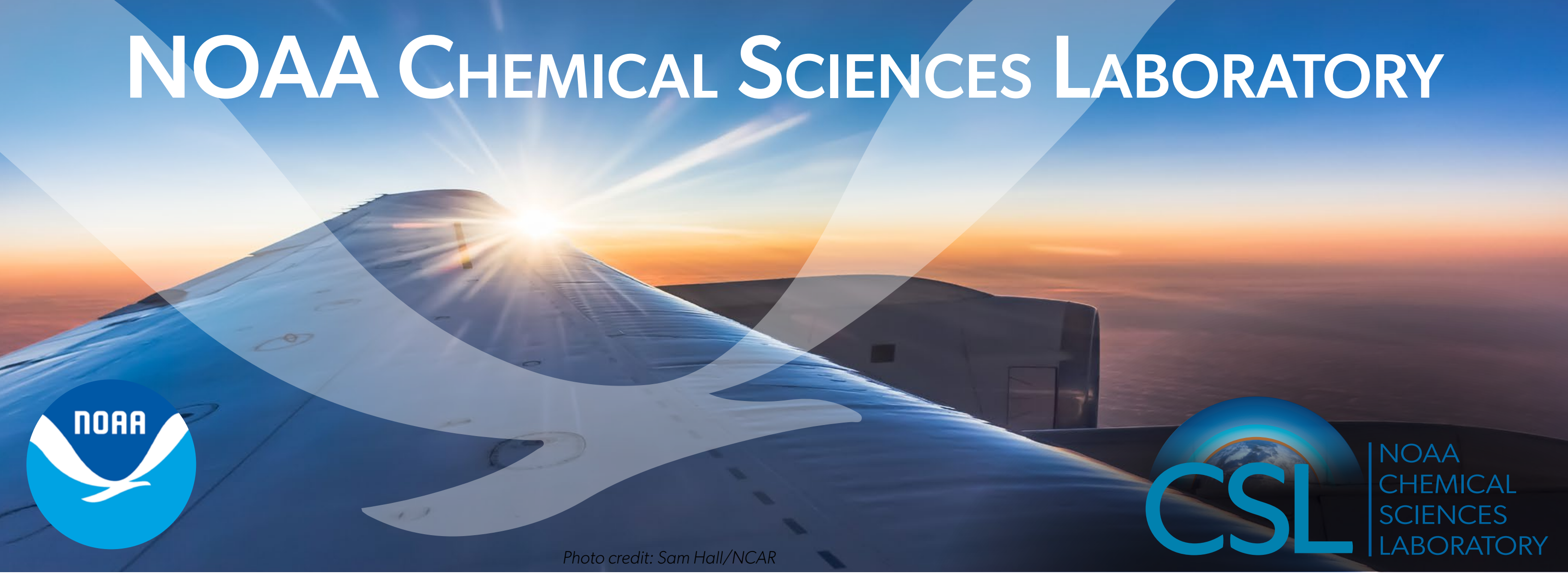


Photo credit: Sam Hall/NCAR

Mission : *To advance scientific understanding of the chemical and physical processes that affect Earth's atmospheric composition and climate.*

Vision : *A nation supported with the best scientific understanding and information about atmospheric chemistry and composition necessary to make optimal decisions for current and future generations.*

The NOAA Chemical Sciences Laboratory (CSL) is one of ten laboratories in the NOAA Office of Oceanic and Atmospheric Research (OAR), which is the science and research support line office for the Agency. CSL performs research in key societally relevant areas including air quality, climate, and the stratosphere. CSL executes this research through innovative use of state-of-the-art, custom-built instruments, models covering a range of complexities, world class laboratory studies, and comprehensive field campaigns. Discovery, new questions, and stakeholder needs drive CSL research. CSL research informs and improves operational NOAA products and services, results in technology transfer, informs decision makers, contributes to assessments and reports, and delivers an extensive collection of datasets and peer-reviewed publications to the wider scientific community.

Atmospheric Chemistry & Climate Research at CSL

Emissions Sources

- *Food production & agriculture*
- *Mobile (e.g., trucks, airplanes, on- and off-road vehicles)*
- *Energy production*
- *Urban & industrial*
- *Biomass burning*
- *Biogenics*
- *Marine*

Air Quality

- *Chemical kinetics*
- *Chemical mechanisms*
- *Photochemical processes*
- *Deposition*
- *Particle formation*
- *Mixing and transport*

Aerosols

- *Aerosol-cloud-precipitation interactions*
- *Radiative processes & forcing*
- *Aerosol composition*
- *Convective transport*

Atmospheric Dynamics

- *Fire weather*
- *Transport*
- *Boundary layer dynamics*
- *Sudden stratospheric warmings*

Stratosphere

- *Circulation*
- *Radiative processes*
- *Ozone, water vapor, & aerosols*
- *Ozone chemical processes*
- *Stratosphere-troposphere coupling*
- *Stratosphere-troposphere exchange*

Image credit: Chelsea R. Thompson/NOAA

Chemical Sciences Laboratory
Oceanic and Atmospheric Research
National Oceanic and Atmospheric Administration

For more information, visit:
csl.noaa.gov
research.noaa.gov

Air Quality

CSL studies the processes that influence air quality on local, regional, and global scales to support informed air quality decision-making at local, state, national, and international levels. Air quality research encompasses the study of both directly emitted and secondary pollutants. The sources and the distribution of major anthropogenic (human-caused) emissions have changed dramatically over decades, continually redefining research needs. Secondary pollutants, such as ozone (O_3) and particulate matter (PM), form through complex chemical reactions in the atmosphere and directly influence human health. Air quality impacts arise from a complex interaction of a wide array of natural and human-caused emissions, background atmospheric composition, meteorology, and long-range transport.

CSL air quality research has three focal points:

1. Characterizing emissions and emission trends;
2. Understanding chemical, physical, and radiative processes that influence atmospheric composition; and
3. Understanding boundary layer dynamics and transport processes at all scales, from local to global.

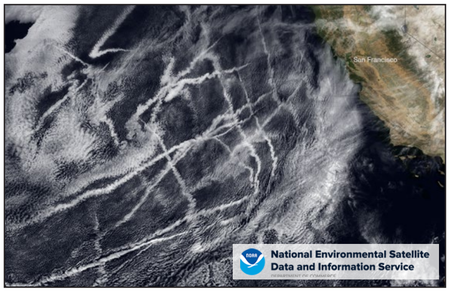
Recent Highlight

The lockdowns in 2020 in response to the COVID-19 pandemic provided an opportunity to study how atmospheric chemistry and composition change in response to emissions reductions, especially in the transportation sector. CSL quickly responded to this opportunity by deploying critical state-of-the-art instrumentation and modeling efforts coupled to analysis of satellite data to assess nationwide responses (more information, see COVID-AQS 2020). In addition, CSL scientists organized and led an international effort to analyze the impact of the lockdowns worldwide and the resulting impacts on urban air pollution (more information, see article in Elementa).

Air sampling inlets at NOAA David Skaggs Research Center in Boulder, Colorado during COVID-19 lockdowns.

Recent Highlight

Climate studies often rely on cloud tracks formed by ship exhaust as a proxy for the more general radiative impacts of anthropogenic aerosol on the reflectivity of stratocumulus cloud decks. Findings from research conducted by CSL scientists and published in Science indicate that using ship-track studies to estimate anthropogenic aerosol forcing of stratocumulus cloud decks could overestimate the cooling associated with aerosol effects on shallow clouds by up to 200%. These findings have implications for climate models as well as for marine cloud brightening as a possible climate intervention strategy.



Ship tracks off the California coast seen by the NOAA GOES-15 satellite.

Climate

CSL studies the processes that affect atmospheric composition and the impacts of those changes on Earth's climate system. CSL climate research focuses on the myriad of factors that determine Earth's climate. Research into the radiative, chemical, and dynamical processes that influence our current climate contribute to reducing major uncertainties in climate models and increase confidence in future climate projections.

CSL climate research has two focal points:

1. Understanding aerosol and cloud radiative interactions in the climate system; and
2. Characterizing the emissions, transport, chemical transformations, and distribution of key climate species.

Stratosphere

CSL improves understanding of stratospheric composition and chemistry and the impacts of stratospheric processes and changes on the troposphere (e.g., climate, weather, etc.).

CSL stratospheric research has four focal points :

1. Developing and using instrumentation to measure key species such as ozone, black carbon, aerosol composition, water vapor, and sulfur dioxide;
2. Understanding the chemistry, composition, and transport within the upper troposphere and lower stratosphere;
3. Developing and using atmospheric models to understand the radiative and dynamical coupling of the stratosphere and troposphere; and
4. Studying the relationship between climate change and changes in the stratosphere.

Recent Highlight

CSL scientists and a team of researchers recently published an article on the stratospheric impact of the massive 2019/2020 Australian New Year bushfires. The findings, published in Geophysical Research Letters, showed that the small percentage of black carbon contained in the almost one million metric tons of smoke that rose into the stratosphere caused a one-degree Celsius warming in the Southern Hemisphere stratosphere that lasted more than six months. The smoke may have contributed to the large and persistent ozone hole that formed over Antarctica during the Southern Hemisphere spring.

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