NOAA CHEMICAL SCIENCES LABORATORY

Overview (2015-2020)

Outline
- Strategic Goals and Objectives
- CSL Mission and Vision
- Personnel and budget
- Strategy
- StoryMaps
- Supporting information
- Acknowledgements

Dr. David W. Fahey
Director

NOAA CHEMICAL SCIENCES LABORATORY

CIRES

NOAA and OAR Strategic Goals and Objectives

NOAA's Mission: Science, Service, and Stewardship

- *To understand and predict changes in climate, weather, oceans, and coasts,*
- *To share that knowledge and information with others, and*
- *To conserve and manage coastal and marine ecosystems and resources.*

NOAA's Vision of the Future:
Resilient Ecosystems, Communities, and Economies

NOAA's Long-term Goals:

- Climate Adaptation and Mitigation
- Weather-Ready Nation
- Healthy Oceans
- Resilient Coastal Communities and Economies

NOAA Office of Oceanic and Atmospheric Research (OAR)

OAR Goals and Objectives

1 Explore the Marine Environment

Increase knowledge of the oceans, coastal areas, and Great Lakes to support resource management and public awareness.

2 Detect Changes in the Ocean and Atmos-phere

Produce, analyze, and interpret observation records to understand the Earth system and inform the public.

3 Make Forecasts Better

Improve accuracy, precision, and efficiency of forecasts and predictions to save lives and property and support a vibrant economy.

4 Drive Innovative Science

Cultivate and deliver mission-relevant research to lead the environmental science community.

CSL Mission and Vision

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

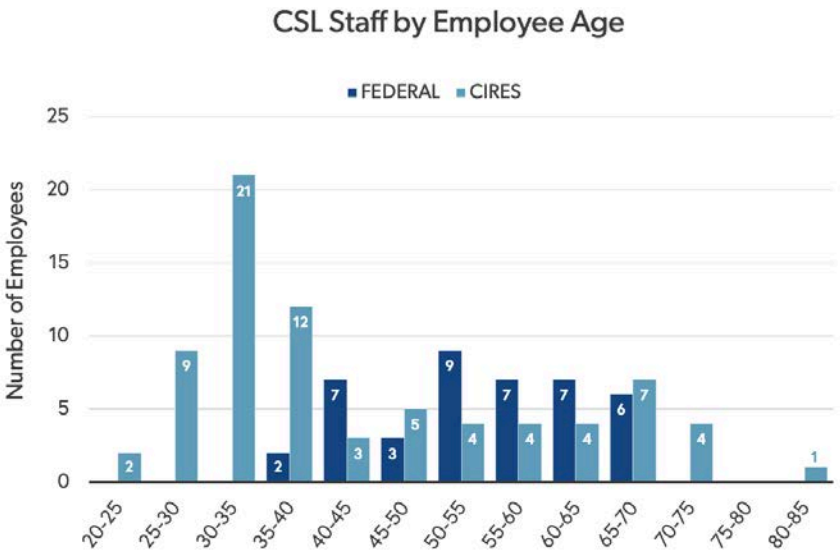
Our Vision:
A nation that has the needed scientific understanding and information about atmospheric composition to make optimal decisions for the well-being of current and future generations.

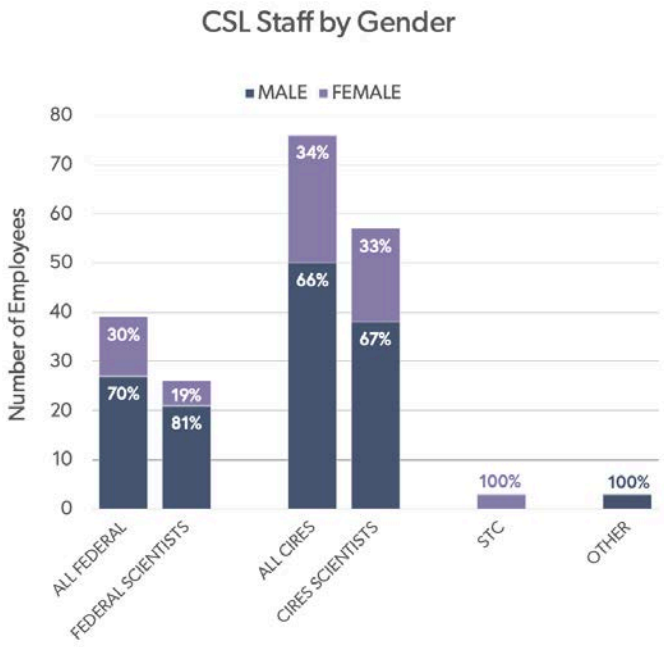
NOAA CHEMICAL SCIENCES LABORATORY

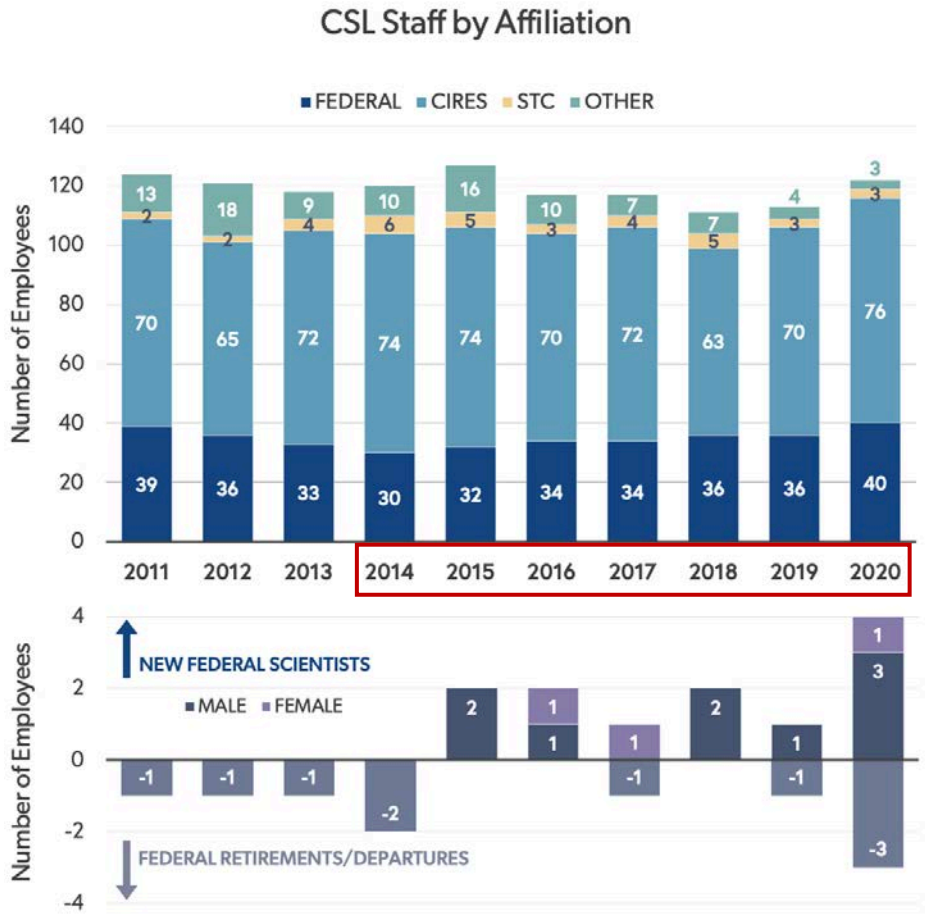
https://csl.noaa.gov/about.html

CSL Staffing and Demographics

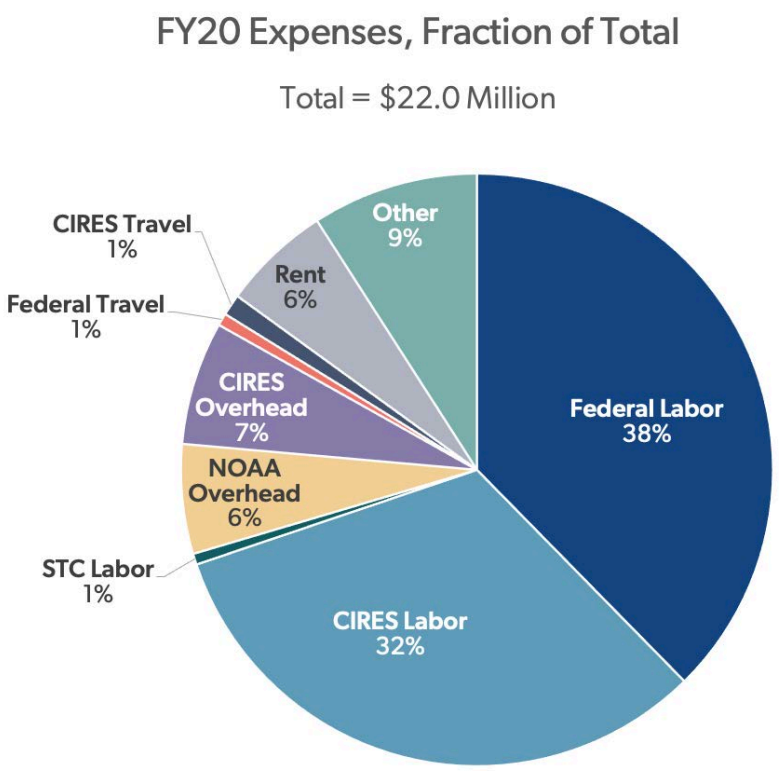
The NOAA – CSL – CIRES cooperative relationship is an essential aspect of CSL's long-term success.

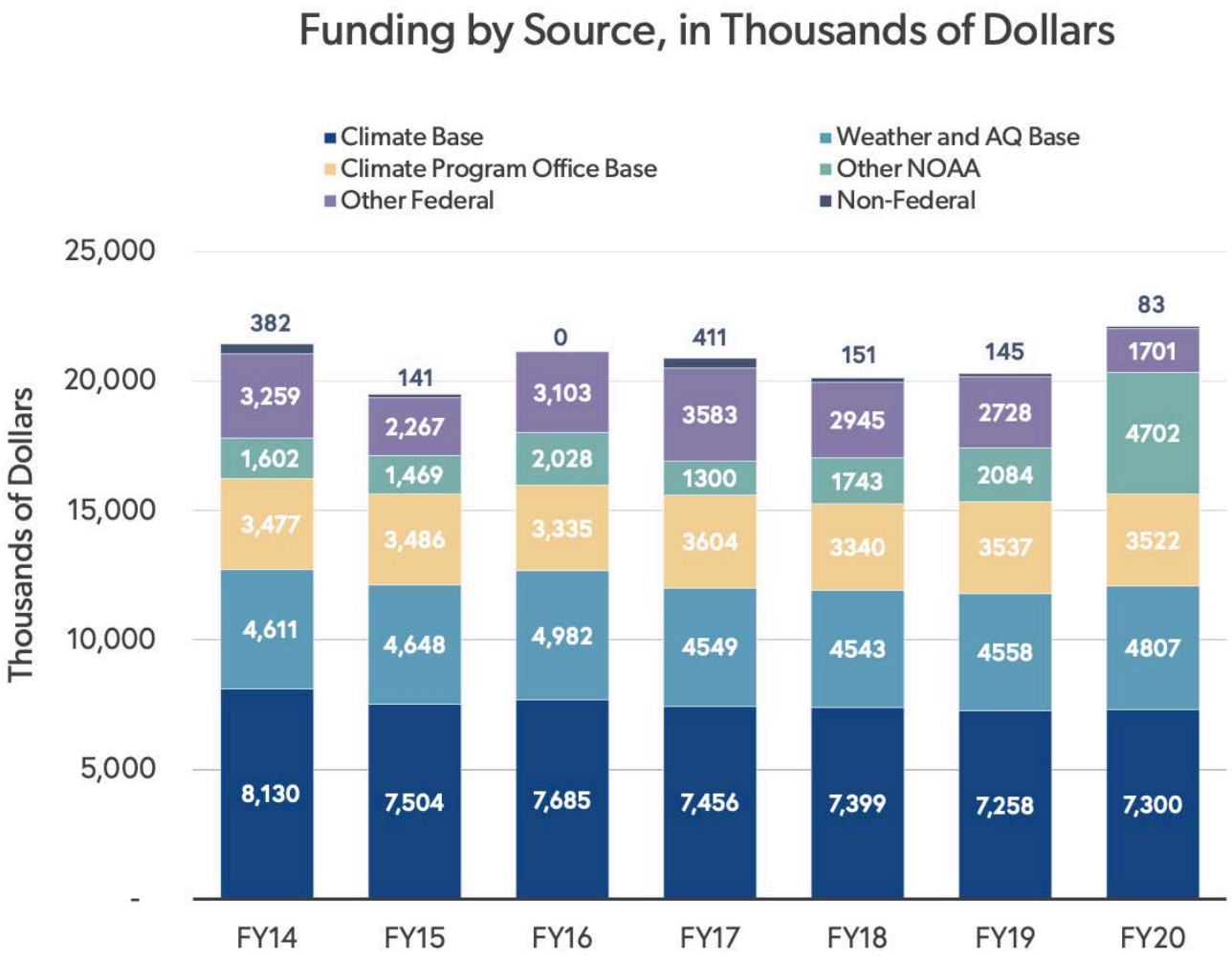




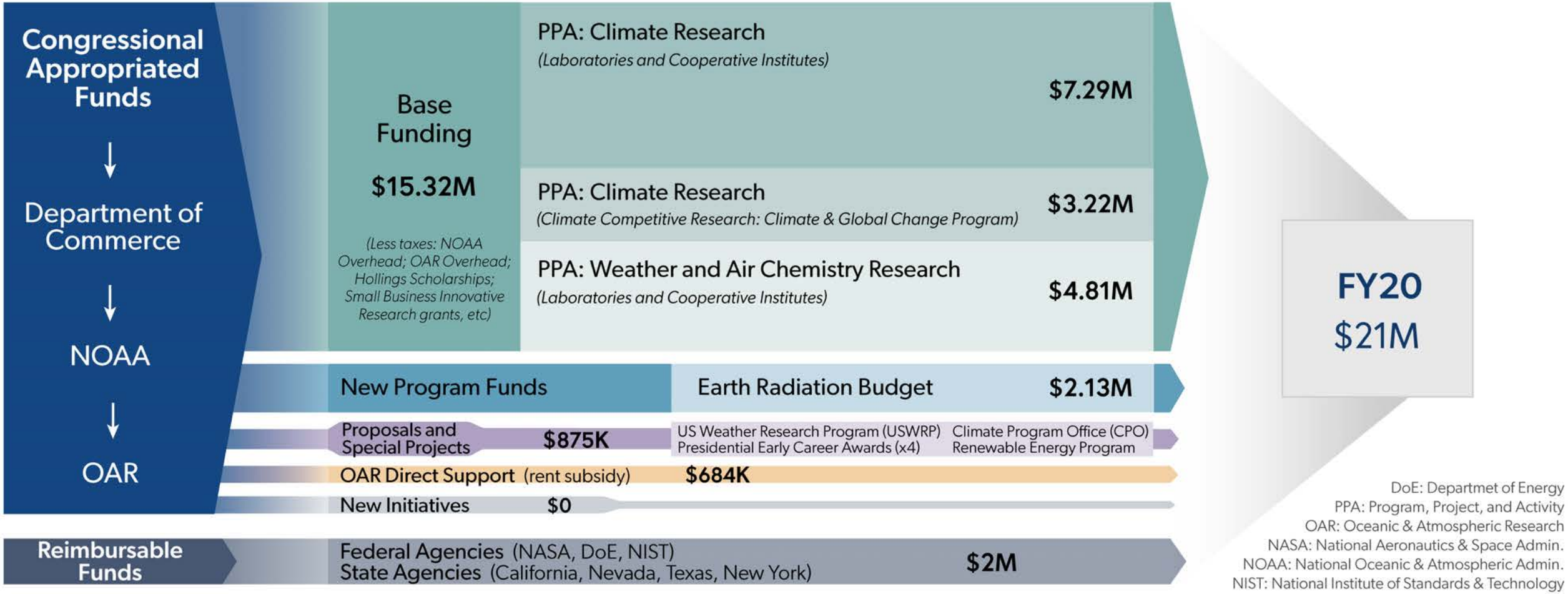


CSL Funding and Expenses





FY20 Budget of the NOAA Chemical Sciences Laboratory



CSL Strategy

CSL Research Themes

CSL Strategy 2021-2026 Document

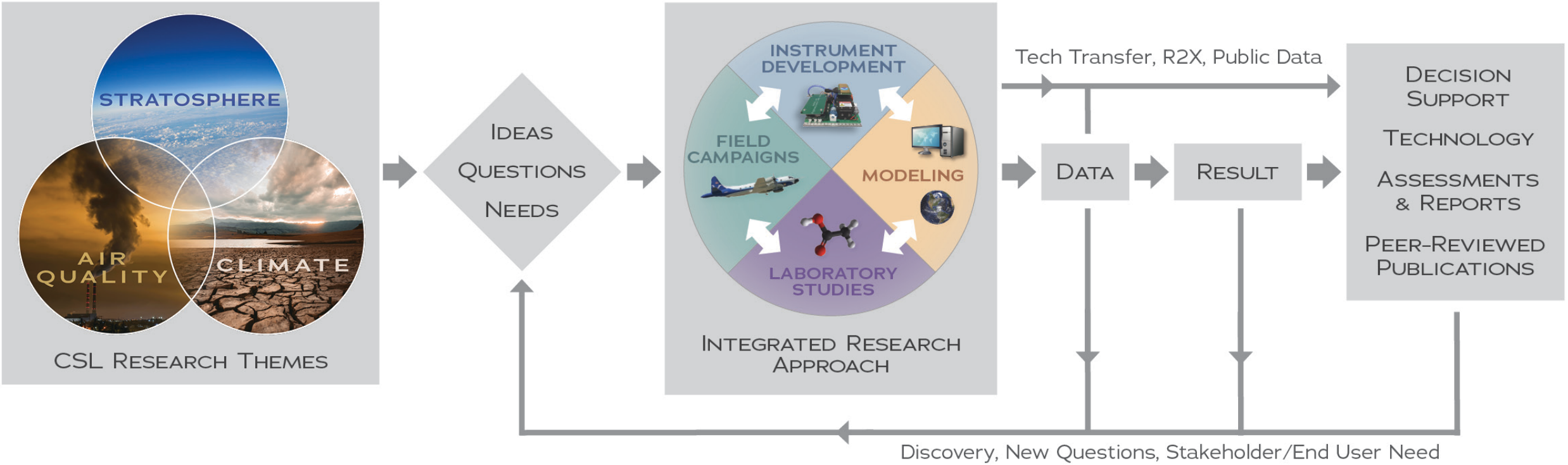
CSL's Strategy uses a holistic approach to understand the role of atmospheric chemistry and composition in the Earth system and is designed to address core scientific goals, capitalize on the unanticipated discoveries, and deliver results.

CSL's core scientific goals are to improve scientific understanding of:

- the processes that influence air quality on local, regional, and global scales to support informed air quality decision-making at the national, state, and local levels;
- the anthropogenic and natural processes that affect atmospheric composition and the impacts of those changes on climate; and
- the processes that control the composition of the stratosphere as well as the impacts of stratospheric variability and trends on weather and climate.

The scientific goals feed the CSL Strategy, allowing for discovery, new questions, and stakeholder needs to be addressed using state-of-the-art instruments and models, world-class laboratory studies, and unparalleled field campaigns. The outcomes of CSL research inform decision makers, result in transfer technology, contribute to assessments and reports, and deliver an extensive collection of peer-reviewed publications.

CSL Strategy



CSL's strategy is designed to meet NOAA OAR goals to detect changes in the atmosphere, make better forecasts and drive innovative science.

StoryMap 4 Overview

CSL Core Competencies

CSL Research Themes

- Seeking, creating and leveraging opportunities for scientific impact
- Identifying new research directions and gaps in current understanding
- Developing new instrumentation, sampling methods and modeling techniques
- Conducting laboratory studies of fundamental physical and chemical processes
- Observing the composition and physical state of the atmosphere from a variety of platforms
- Formulating and using models and diagnostic and interpretive methods to advance the understanding of atmospheric processes
- Communicating our results to other scientists and stakeholders through decision support, information products, applications, assessments and reports and publications in the peer-reviewed literature

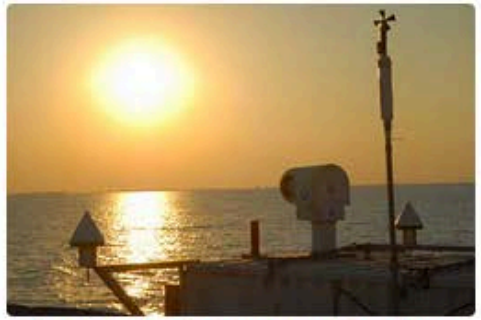
CSL Research Programs

Aerosol Properties & Processes

Dan Murphy, Program Lead

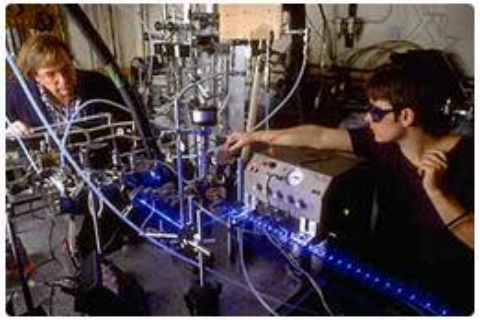
Atmospheric Composition & Chemical Processes

Shuka Schwarz, Program Lead



Atmospheric Remote Sensing

Alan Brewer, Program Lead



Chemical Processes & Instrument Development

Jim Burkholder, Program Lead

Chemistry & Climate Processes

Karen Rosenlof, Program Lead

Clouds, Aerosol, & Climate

Graham Feingold, Program Lead

Regional Chemical Modeling

Greg Frost, Program Lead

Tropospheric Chemistry

Steve Brown, Program Lead

https://csl.noaa.gov/groups/

CSL Lab Review StoryMaps

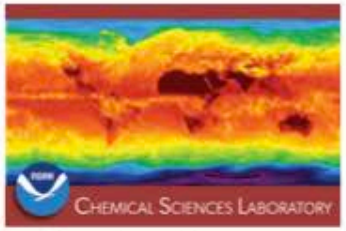
Air Quality:
Emissions to Impacts

Wild and Prescribed Fires:
from Lab to Field

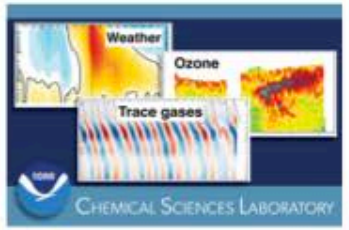
Atmospheric Composition,
Chemistry, and Dynamics

Aerosol-Cloud Interactions

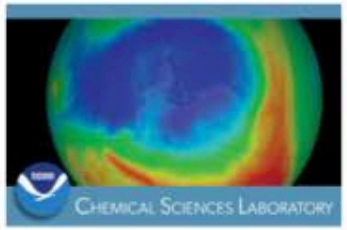
Aerosols and Their Role
in Climate



Greenhouse Gases and
Short-Lived Climate Forcers



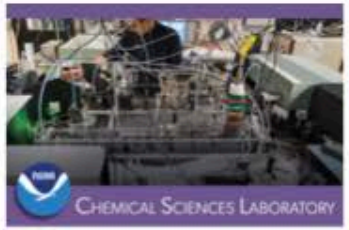
Stratosphere-Troposphere
Coupling and Impacts
on the Surface



Stratospheric Composition
and Dynamics

Stratospheric Aerosols

Innovative Instrumentation



Foundational Laboratory
Studies

Field Campaigns

Model Development
and Applications

Assessments & Other
Contributions to the
Scientific Community

StoryMaps: Fluid presentation of scientific results in the form of text, graphics, figures, schematics, photos, video, links.

↳ CSL scientists went above/beyond

- **Creative and Logistics Team:**
  Chelsea Thompson and Megan Melamed
- **CSL Web Redesign:**
  Catherine Rasco

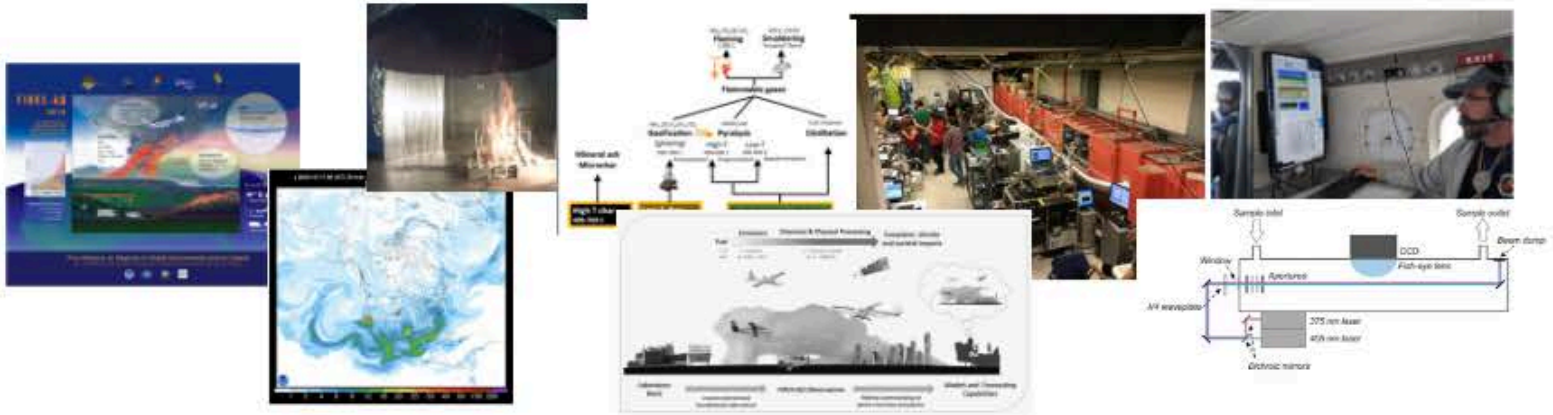
1. Research Theme: Air Quality

Air Quality:
Emissions to Impacts

- Shale oil and gas
- Wintertime pollution
- Urban air quality
- COVID-19 impacts

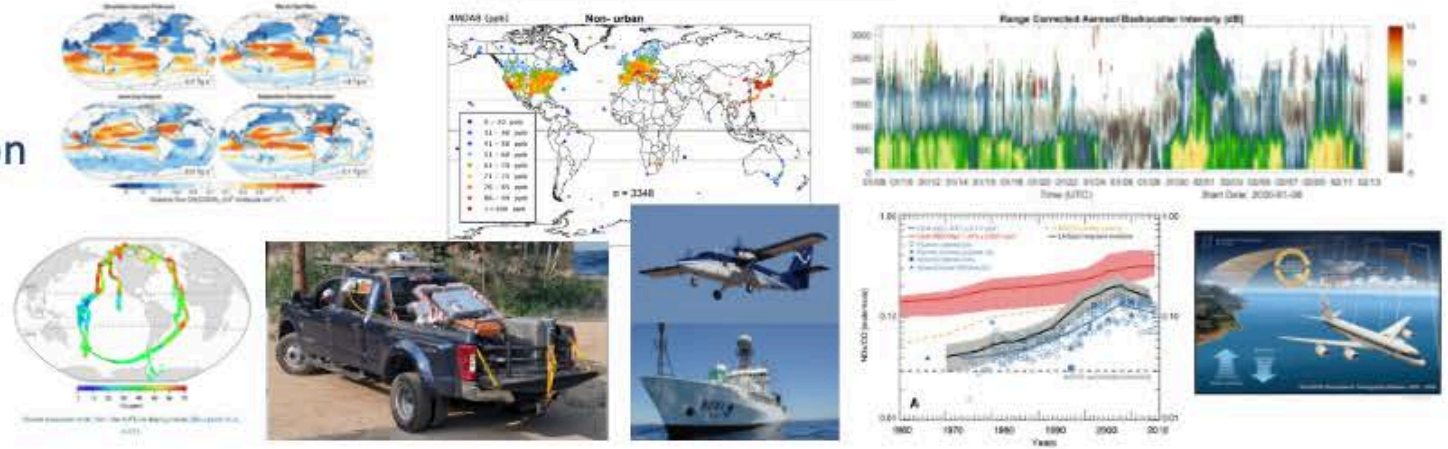
Wild and Prescribed Fires:
from Lab to Field

- 2016 FireLab
- 2019 FIREX-AQ
- Models

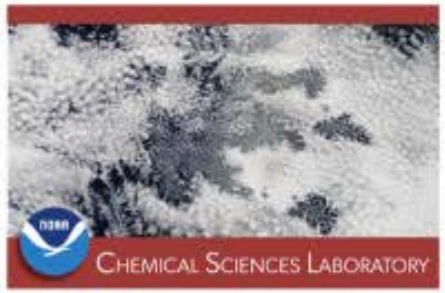


Atmospheric Composition,
Chemistry, and Dynamics

- Global emissions
- Atmospheric composition
- Atmospheric dynamics

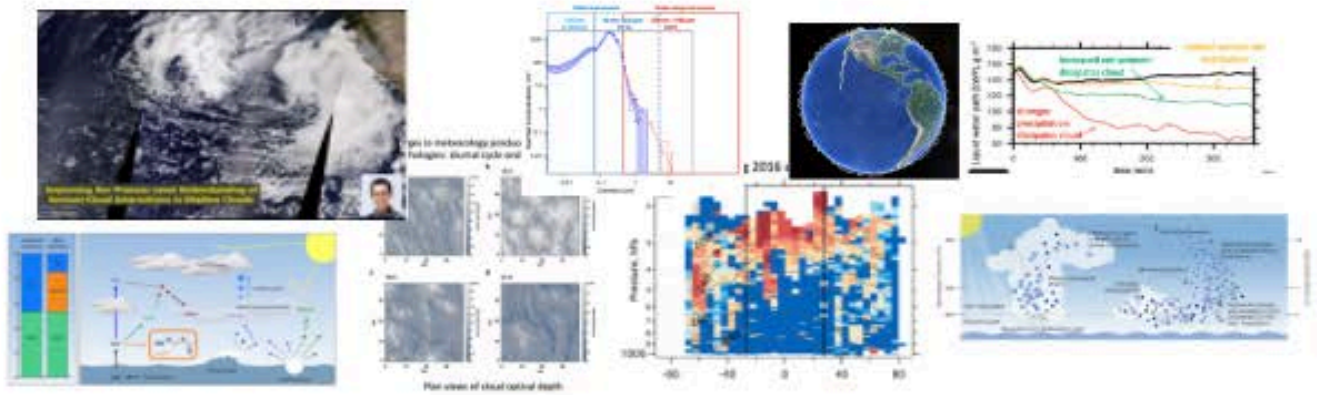


2. Research Theme: Climate



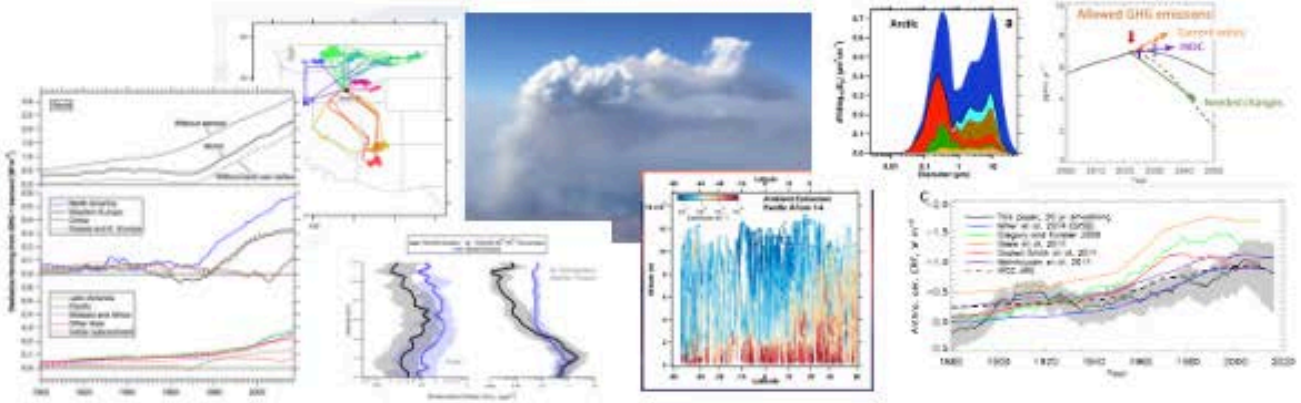
Aerosol-Cloud Interactions

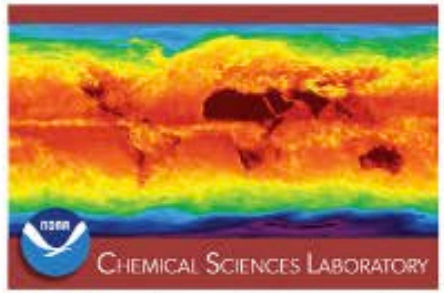
- Global aerosol budget
- Clouds in climate models
- Aerosol-cloud interactions



Aerosols and Their Role in Climate

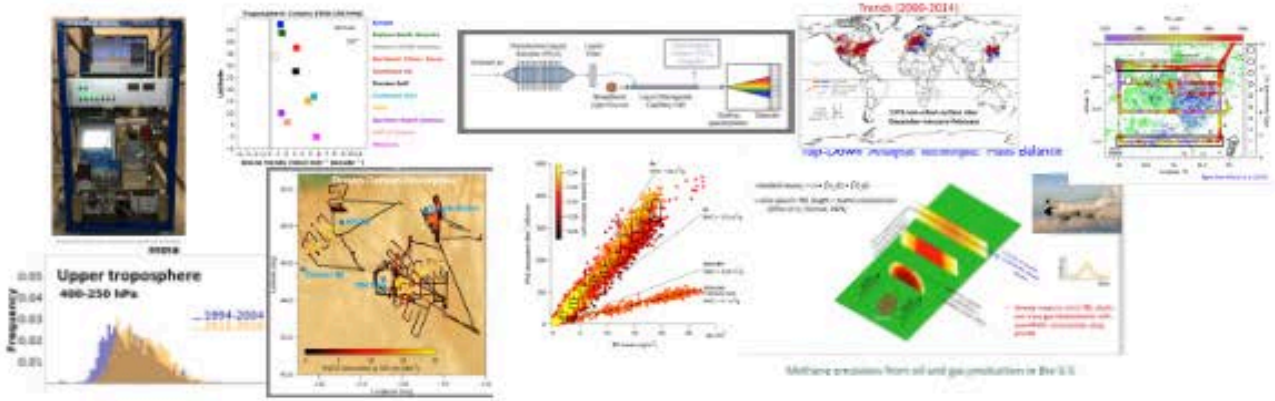
- Biomass burning
- Global scale measurements
- Climate modeling & analysis



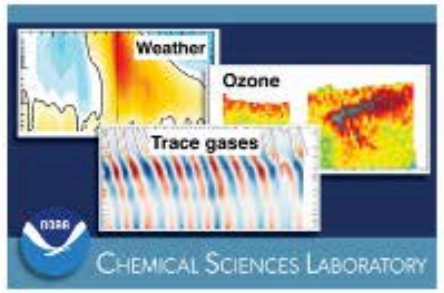


Greenhouse Gases and Short-Lived Climate Forcers

- Methane
- Tropospheric ozone
- Black & brown carbon aerosol

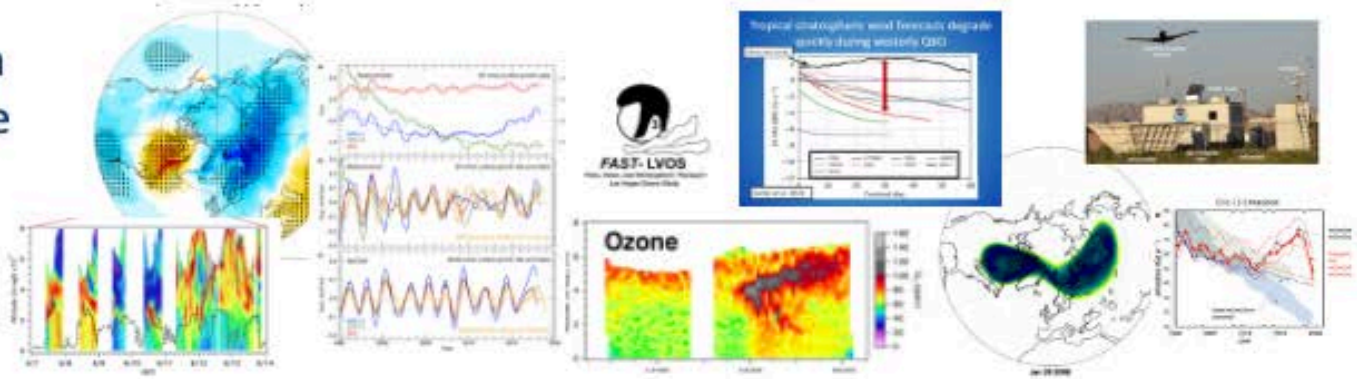


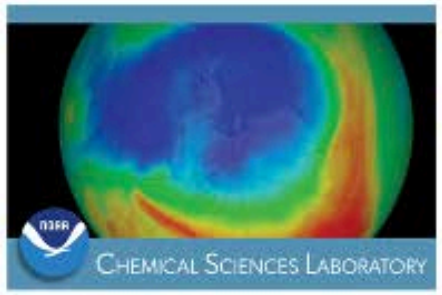
3. Research Theme: Stratosphere



Stratosphere-Troposphere Coupling and Impacts on the Surface

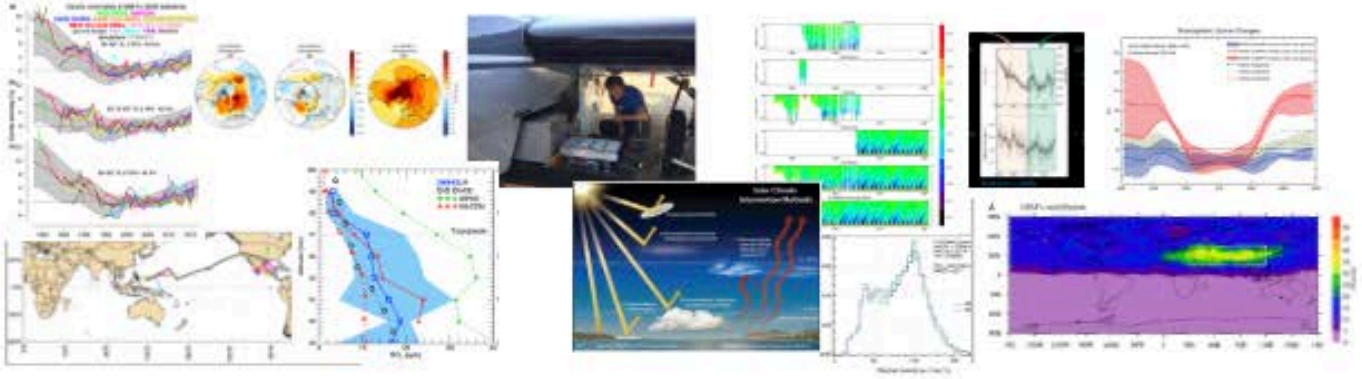
- Surface weather & prediction
- Tropospheric & surface ozone
- Trace gases & emissions





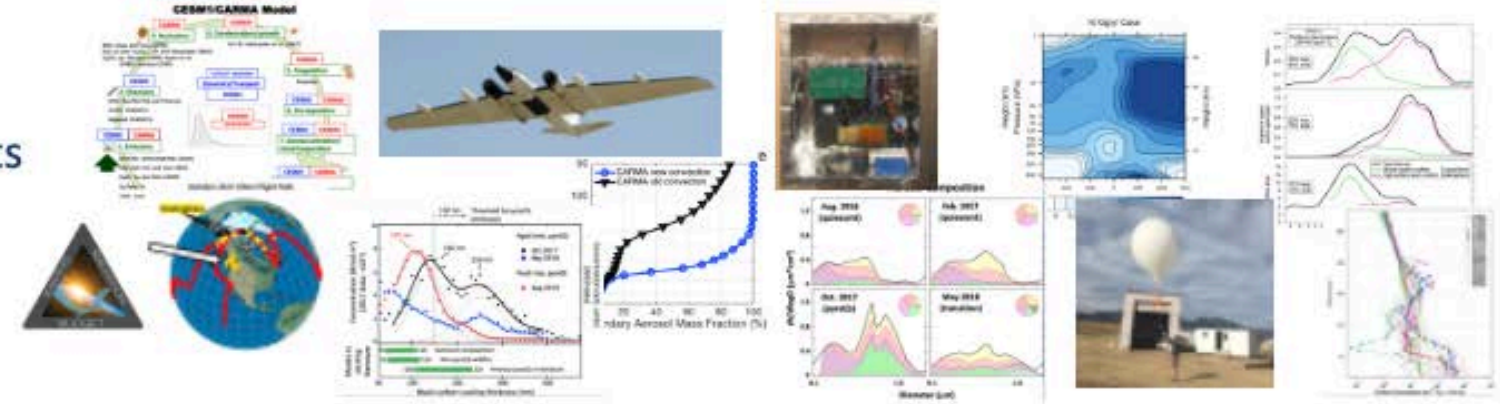
Stratospheric Composition and Dynamics

- UT/LS airborne observations
- Ozone depletion & recovery
- Circulation & composition



Stratospheric Aerosols

- Modeling
- Aircraft measurements
- Balloon profiles
- Future directions

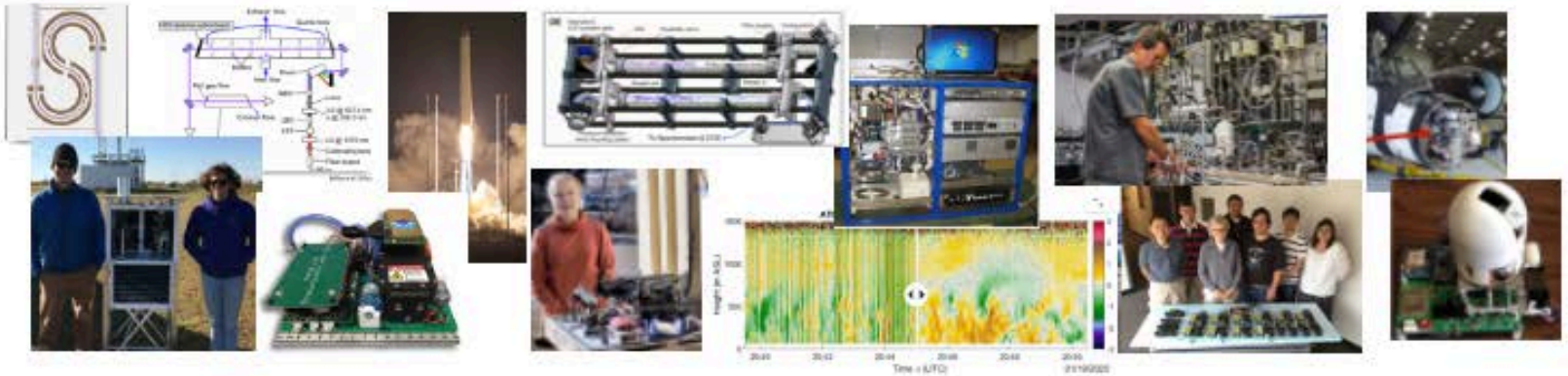


4. Research Theme: Research Strategies

Innovative Instrumentation

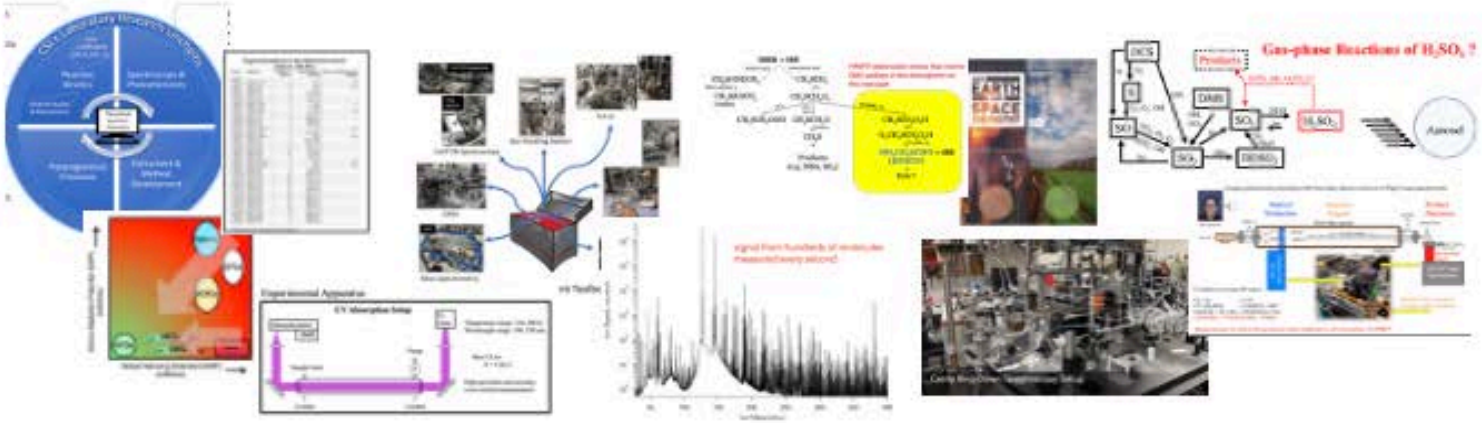
- Innovation
- Evolution
- Adaptation

See timeline



Foundational Laboratory Studies

- Capabilities/Tour
- Air quality
- Stratosphere/Climate
- Climate



Field Campaigns

- CSL's main research areas
- Stakeholder/program needs
- Future field campaigns

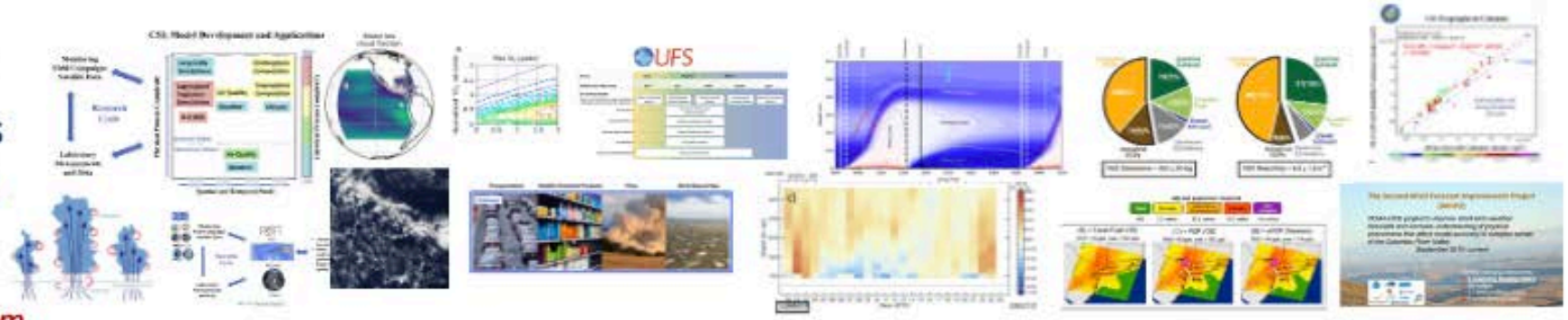
See timeline

4. Research Theme: Research Strategies (cont'd)

Model Development and Applications

- Weather/ Dynamics
- Air quality
- Climate

See compendium



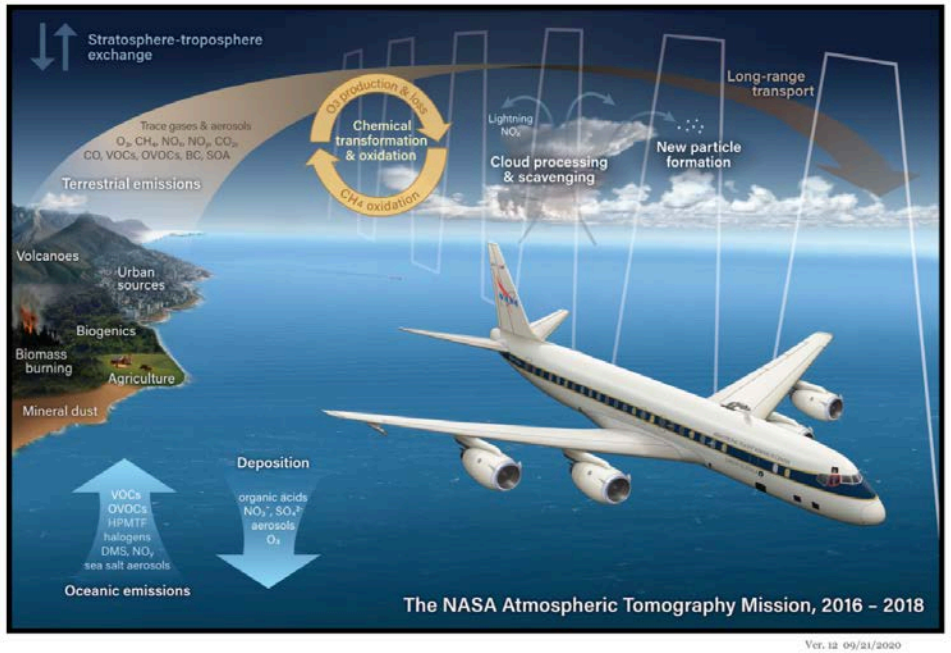
Leadership and Contributions to the Scientific Community

- Montreal Protocol
- NCA4
- TOAR
- Additional assessments
- Datasets

67 items in Compilation of Assessments, Reports, Overview Papers, and Datasets, 2015–2020

NOAA Field Missions

NASA Atmospheric Tomography Mission



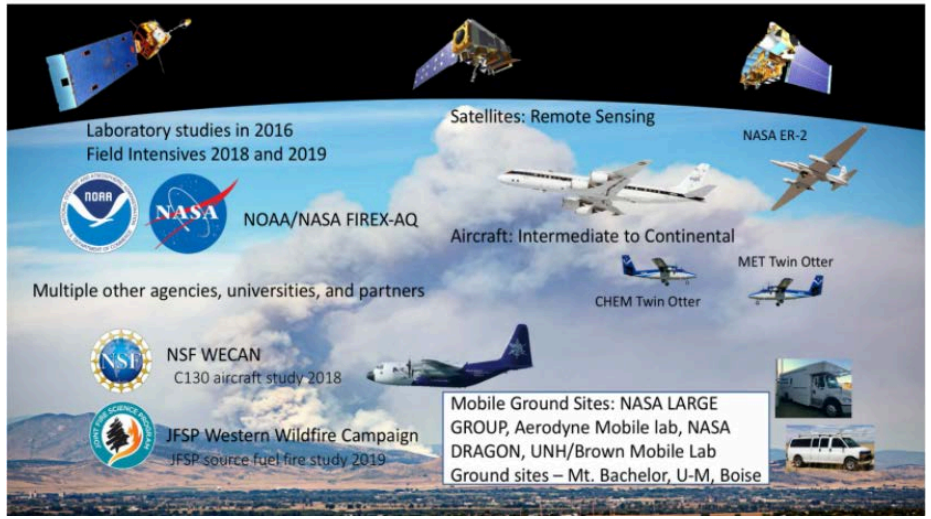
Tom Ryerson, Science Payload Manager

See videos of DC-8 payload (1.2.3 and 2.2.4)

NOAA FIRELab

Jim Roberts and Carsten Warneke, Leaders

NOAA/NASA FIREX-AQ Mission



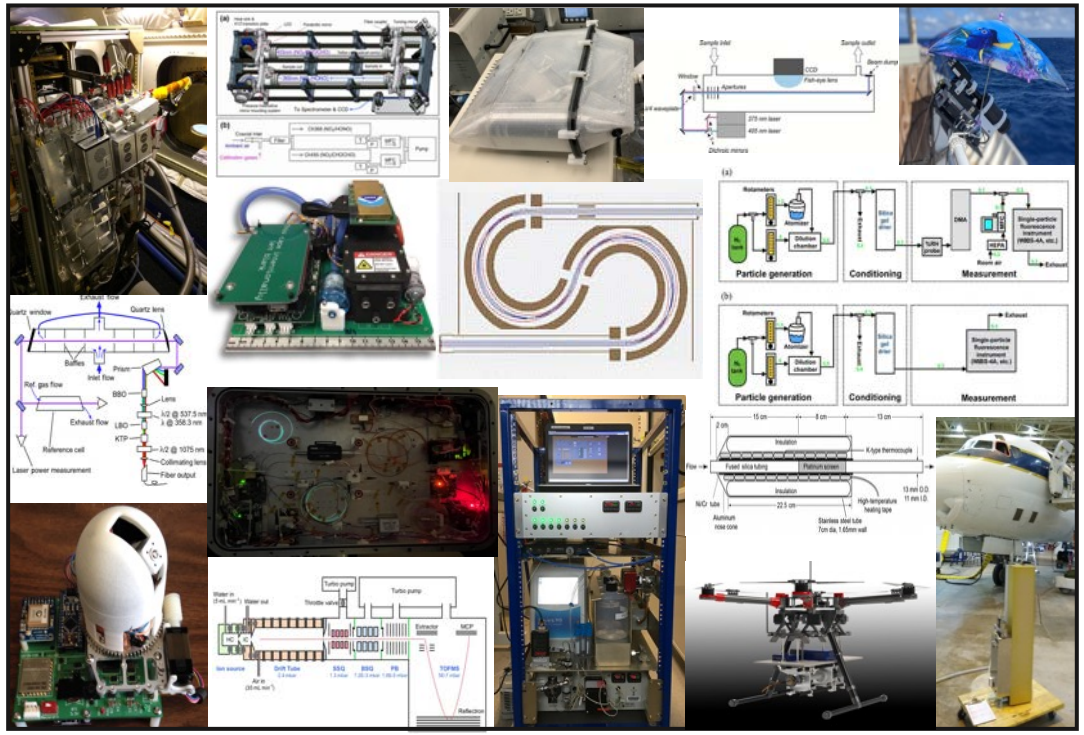
NOAA DC-8 Mission Scientists: Joshua Schwarz and Carsten Warneke,

NOAA Twin Otter Mission Scientists: Steve Brown and Alan Brewer

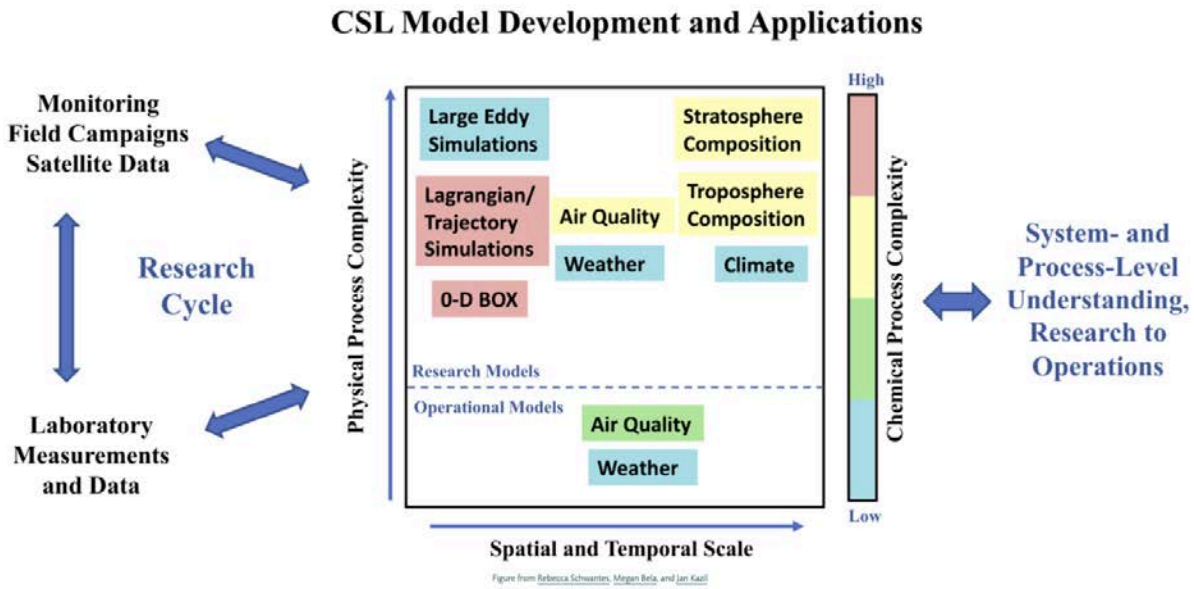
ATom, FIRELab, and FIREX-AQ exemplify CSL's leadership and scientific and technical competencies.

CSL Instruments & Model Development

CSL has produced 21 new/custom instruments since 2015



See 4.1.1 Instrument timeline and CSL webpage



See 4.4.2: Scope of Modeling at CSL (15 models)

CSL instrumentation and modeling exemplify CSL's leadership and scientific and technical competencies.

StoryMap 4 Overview

StoryMap Video Presentations by CSL Scientists

Air Quality

1.1.1. A shift in our understanding of urban air pollution (Brian McDonald)
1.2.2. Fire emissions characterization (Chelsea Stockwell)
1.2.2. From emissions to chemistry (Matt Coggon)
1.2.3. Flying through smoke day and night to understand air quality (Zachary Decker)
1.2.3. Improving our ability to measure and speciate volatile compounds found in wildfire smoke with a high degree of spatial resolution (Aaron Lampugh)
1.2.4. Using FIREX-AQ observations to improve fire emissions in the RAP-Chem real-time air quality forecasting mode (Megan Bela)
1.3.3. NOAA Bite Sized Science: Atmospheric Tomography Mission (ATom)
1.3.3. Tropospheric Ozone Assessment Report: Achievements of TOAR-I and goals of TOAR-II (Owen Cooper)
1.3.4. Making Atmospheric Dynamics Measurements using a Scanning Doppler Lidar (Alan Brewer)
1.3.4. Boulder Canyon Upslope Flow (Alan Brewer)

Climate

2.1.2. New particle formation in the remote free troposphere (Christina Williamson)
2.1.4. Improving our process level understanding of aerosol-climate interactions in shallow clouds (Tak Yamaguchi)
2.1.4. Marine cloud brightening (MCB) (Graham Feingold)
2.2.3. Biomass burning smoke particles (Gregory Schill)
2.2.4. Building a global-scale database of aerosol properties (Charles Brock)
2.2.4. How much greenhouse gas can we emit and limit global warming to 2°C? (Erik Larson)
2.3.2. Methane emissions from oil and gas production in the U.S. (Jeff Peischl)
2.3.3. Tropospheric Ozone Assessment Report: Achievements of TOAR-I and goals of TOAR-II (Owen Cooper)
2.3.3. Tropospheric ozone is still increasing across the Northern Hemisphere (Audrey Gaudel)
2.3.4. Evolution of brown carbon aerosol absorption downwind of wIldfires in the Western U.S. (Rebecca Washenfelder)

Stratosphere

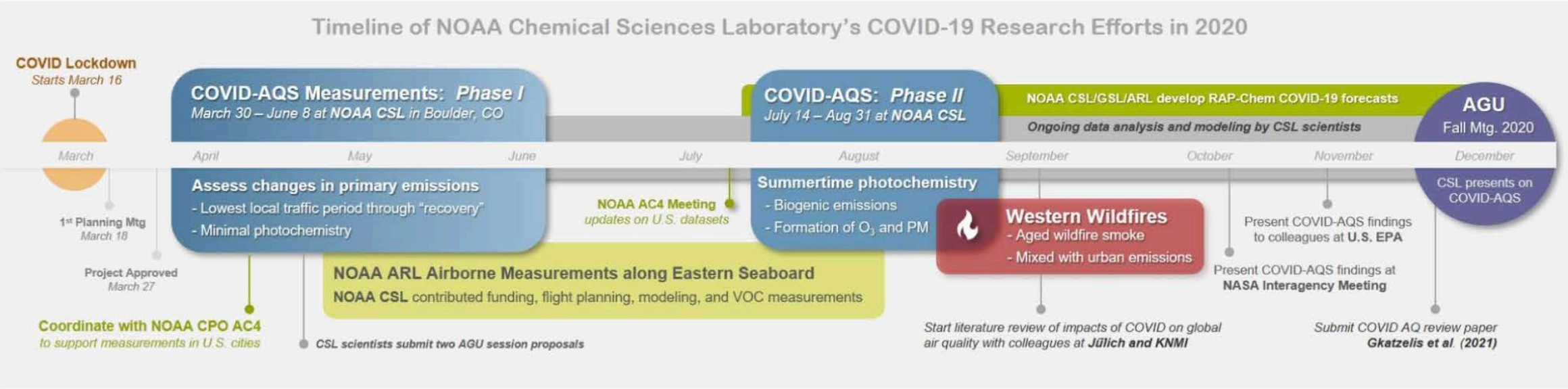
3.1.2. The stratosphere's role in subseasonal weather prediction (Amy Butler)
3.2.3. SWOOSH: the Stratospheric Water and OzOne Satellite Homogenized data set (Sean Davis)
3.2.4. Understanding the tropical width (Antara Banerjee)
3.3.3. Fingerprints of pyrocumulonimbus (pyroCb) in the stratosphere (Joseph Katich)
3.3.4. POPS: Balloon-borne stratospheric measurements of aerosol size and abundance (Lizzy Asher)

Research Strategies

4.1.2. LIF: Laser Induced Fluorescence (Pamela Rickly)
4.1.2. POPS: A Portable Optical Particle Spectrometer for atmospheric research (Troy Thornberry)
4.1.3. NOAA micro-doppler lidar collaboration (Amanda Makowiecki)
4.1.4. TERN: TAG (Thermal desorption Aerosol Gas chromatograph) ExploreR and iNtegration package (Jessica Gilman)
4.2.2. Introduction to laboratory studies (James Burkholder)
4.2.2. Laboratory studies (James Burkholder)
4.2.3. Air quality laboratory studies (Aparajeo Chattopadhyay)
4.2.4. Stratosphere/climate introduction (James Burkholder)
4.2.5. Climate laboratory studies (Andy Neuman)
4.2.5. CSL's innovative laboratory approach to quantify HPMTF formation (Zach Finewax, Emmanuel Assaf)
4.3.3. COVID-AQS (Ann Middlebrook)
4.3.3. FAST-LVOS (Raul Alvarez)
4.3.5. CSL staff working on field campaigns
4.4.2. Improved processes for NOAA's weather forecasting models (Megan Bela)
4.4.3. Model development of emissions and chemistry to advance scientific understanding of air quality (Rebecca Schwantes)
4.4.4. Large eddy simulations and high resolution model development and applications (Jan Kazil)

41 video presentations

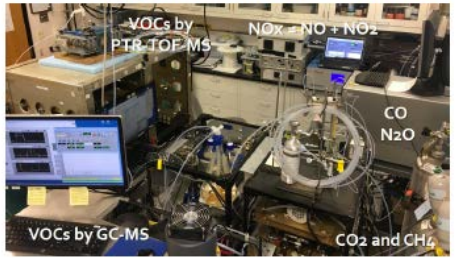
COVID-19 Response & Impacts

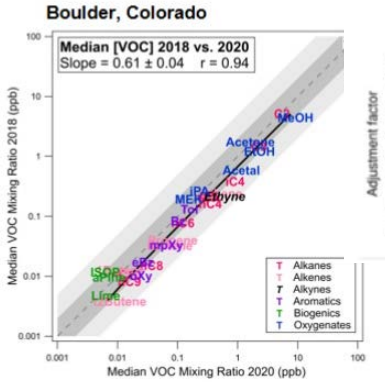


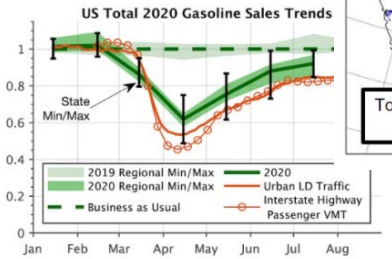
StoryMap 1.1.5

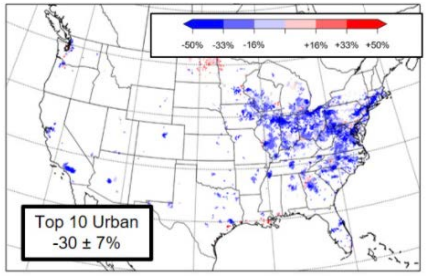
Timeline of NOAA CSL's COVID-19 air quality researtch efforts and collaborations [credit: Jessica Gilman]

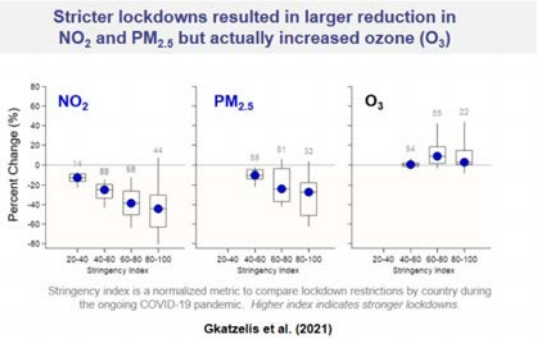
COVID-AQS gas-phase measurements at NOAA DSRC



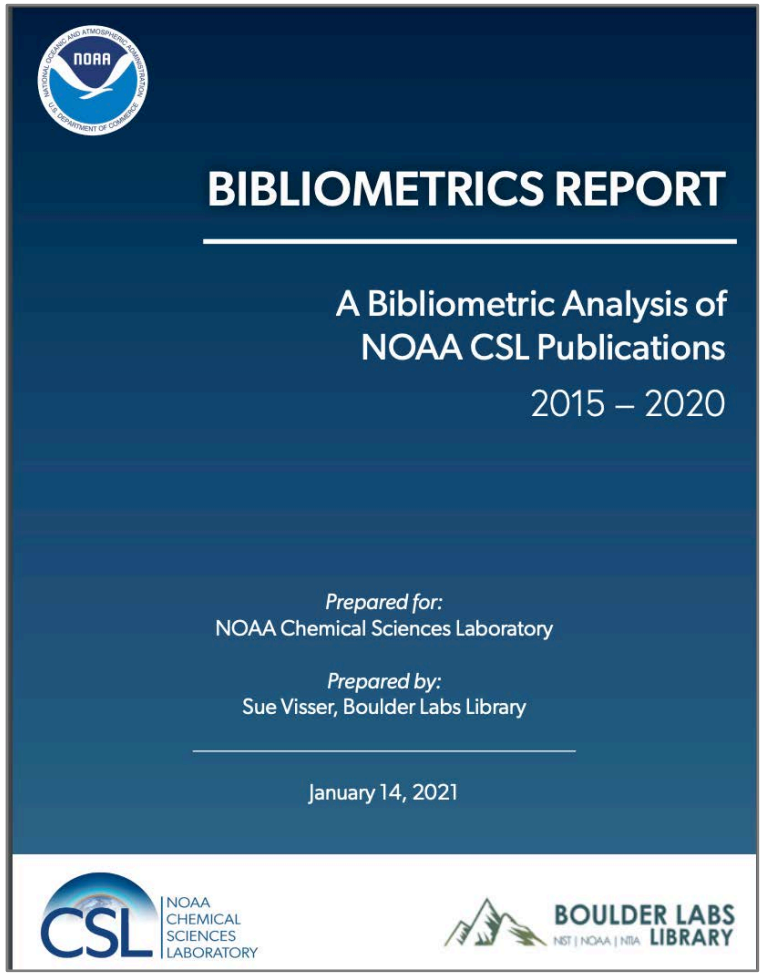








CSL Publications

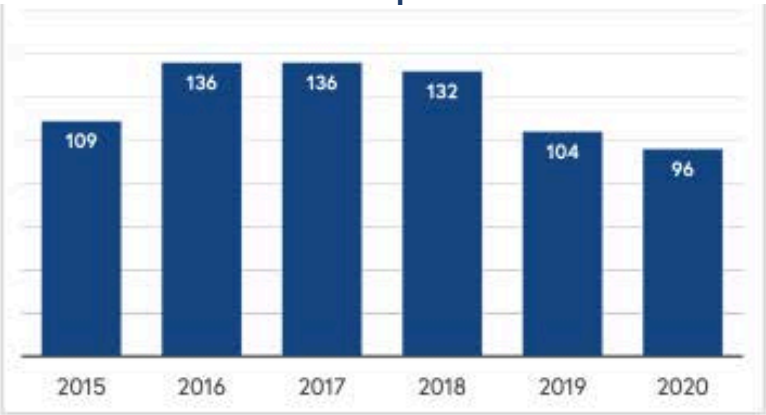


CSL publications 2015-2020

Summary Metrics	
Total number of publications	713
Total times cited	17,400
Average citations per publication	24
Group h-index	63
Number of papers with CSL first author	141

- *Science, Science Advances*: 6
- *Nature; Nature Sustainability, Nature Geoscience, Nature Climate and Atmospheric Science, Nature Climate Change, Nature Communications, Nature Scientific Reports*: 28
- *Proc. Nat. Acad. Sci.*: 18
- *Geophys. Res. Lett*: 60

CSL annual publications



CSL Recognition

Awards, Honors, and other recognition

(84 entries)

- International Awards
- Presidential Awards
- DOC/NOAA/OAR Awards
- CIRES Awards
- Other U.S. Awards
- Refereeing/Reviewing Awards
- Recognition from Academia
- Recognition of Publications
- Recognition of Posters & Presentations
- Recognition of Outreach and Education,
- CO-Labs consortium

Leadership Roles

(122 entries)

- NOAA and Other Federal
- CIRES
- U.S. Nonfederal
- International
- Field Mission Leadership
- Conferences
- Memberships

Outreach, Communication, Education

(147 entries)

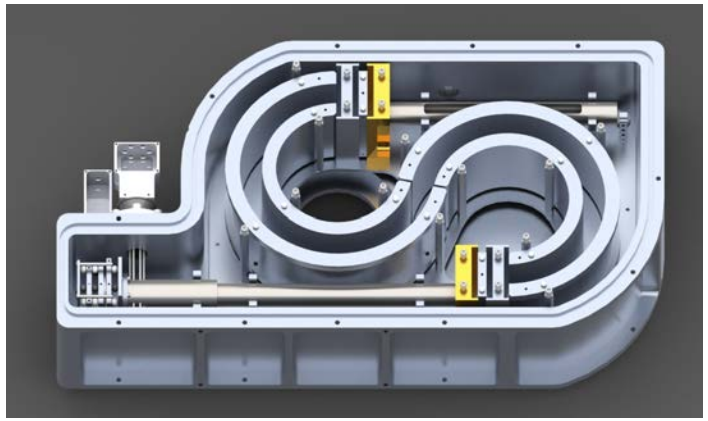
- Mentors
- Academic advisor
- Education/outreach
- Other

CSL Recognition

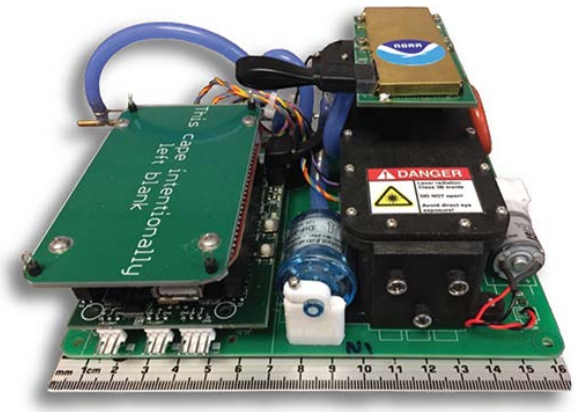
Technology Transfer & Patents

(19 entries)

- Patents
- Patent license
- Patent SBIR
- Disclosure
- Publication
- Possible license
- Development

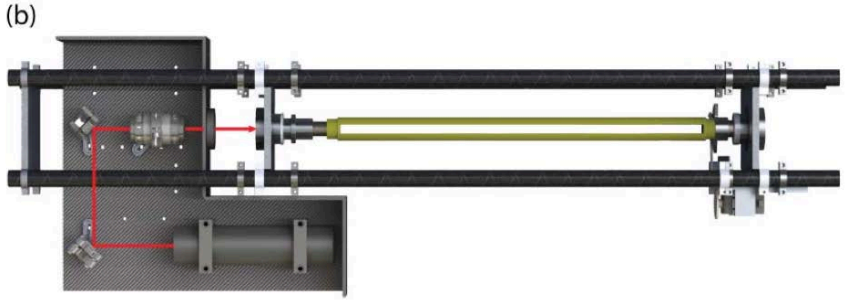


S-curve Time-of-Flight Mass Spectrometer (2 Patents, Dan Murphy)



Portable Optical Particle Spectrometer (POPS) (Tech transfer, Rushan Gao)

(3.3.4 & 4.1.2 StoryMap Videos)



Open Path (OP) Optical Cell for Cavity Ring-Down Spectrometer (CRDS) (Patent, Dan Murphy)

Review structure

Review Criteria

- **Performance**: The effectiveness and efficiency with which research and development activities are organized, directed and executed
- **Quality**: The merit of the scientific and technical work within the scientific community
- **Relevance**: Value of the research results to users beyond the scientific community

https://csl.noaa.gov/reviews/2021/

CSL Objectives

- Communicate scientific results and their importance and impact
- Provide a range of materials:
  - StoryMaps
  - Theme overview presentations
  - Documents
    - > Guiding documents
    - > CSL Planning documents
    - > Prior Science reviews
    - > Bibliometrics, awards, recognition, staffing funding, technology transfer
- Conduct virtual meetings over 3 days
  - Director's overview presentation
  - Theme in-depth discussions
  - Stakeholder conversations
  - Closed sessions

Acknowledgements

- Barry Lefer, Belay Demoz, Emily Fischer, Astrid Kiendler-Scharr, Amanda Maycock, Paul Newman, Brad Pierce for their efforts as reviewers
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- Richard Tisinai and Macy Morgan for IT and v-meeting support
- CSL staff for their dedication and imagination in preparing materials for this review