Climate Program Office Review

May 24-26, 2022

Pre-Recorded Presentation Supporting Review Activity
Area #1: ESSM

Overview of Atmospheric Chemistry, Carbon Cycle and Climate (AC4) Program
Monika Kopacz, Ph.D., AC4 Program Manager
Shiv Das, Ph.D., AC4 Program Specialist

Overview

- **Briefing Purpose:** Overview of AC4 Program
- **Context:** Subactivity for Activity Area 1; AC4 Program is part of CPO's Earth System Science and Modeling Division

Atmospheric Chemistry, Carbon Cycle and Climate (AC4) 101

AC4 was formed in 2013 with the goal to determine the **processes** governing atmospheric concentrations of **trace gases and aerosols** in the context of the Earth System. AC4 strengthens, extends and complements OAR Lab efforts with external and cross-LO engagement

Program Managers: Monika Kopacz, PhD (2010-present), Kenneth Mooney, PhD (?-2020)

Program Specialist: Shiv Das, PhD (2021-present)

✓ NOAA's Atmospheric Composition mandates: Clean Air Act, Global Change Research Act, Weather Act (2017) etc.
✓ AC4 was formed from chemistry and carbon programs to forge interdisciplinary connections
✓ Leveraging NOAA's 50+ years of experience in monitoring atmospheric composition (e.g. CO_2)
✓ AC4 is heavily involved in Atmospheric Composition strategic planning for OAR and NESDIS

Program components:

- $6.2M FY21 Budget
- Competitive Research (97%)
- Other (3%)
- Typical proposal funded by ~$600-750K for 3 Years or $1.5 million for larger awards
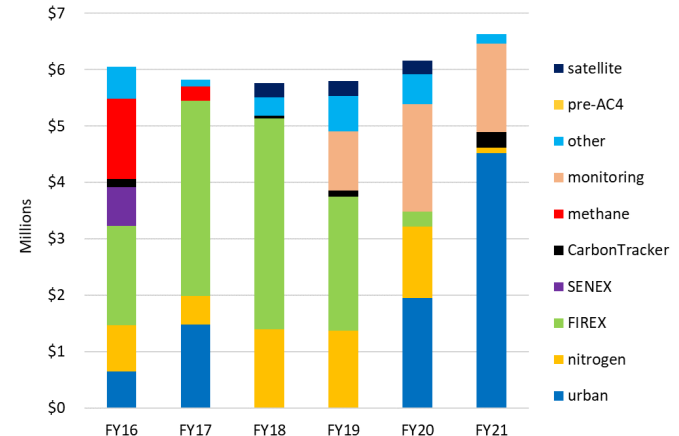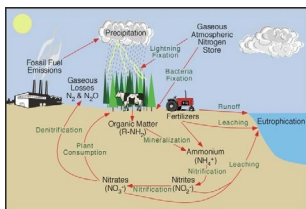

Budget by year and topic (2016-2021)

Atmospheric Chemistry, Carbon Cycle and Climate (AC4) 101, cont.

FY17-21 Research Portfolio Highlights

**FY16-17, 22:
Wildfire Smoke**

**FY18: Nitrogen
Cycle & aerosols**

**FY20, 21 & 22: Urban
Atmosphere (including
COVID effects)**

**FY16, 17 & 21:
Field Campaigns**

**FY19 Long term
monitoring**

**FY19-20:
CarbonTracker**

FY16-17 FIREX — 20 $10M

FY17 Urban Emission — 1 $1.5M

FY18 Aerosols from Biogenic Emissions — 10 $5M

FY19 Long-term Trends in Atmospheric Compositions — 10 $5M

FY20 Urban Atmosphere in a Changing Climate: Chemistry, Carbon and Composition — 9 $5.6M

FY21 Understanding of Emissions and Chemical Transformation in the Urban Atmosphere (AEROMMA) — 11 $5.5M

FY21 Multi Program: Atmospheric Impact Due To Changes in Anthropogenic Activity During the COVID-19 Pandemics — 8 $3.2M

2016 2018 2020 2022 2024

Key Accomplishments (FY17-21)

Relevance

Strategic Partnerships

NOAA

- **OAR Labs:** CSL, GML, GFDL, ARL, PMEL
- **NESDIS:** STAR, JPSS, GeoXO
- **OAR Programs:** WPO
- **NWS:** NAQFC

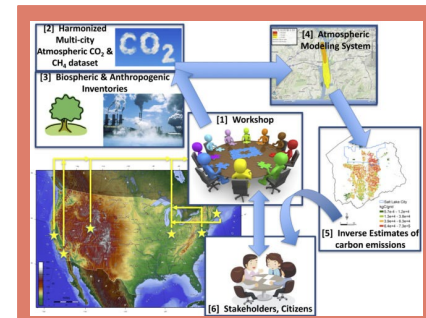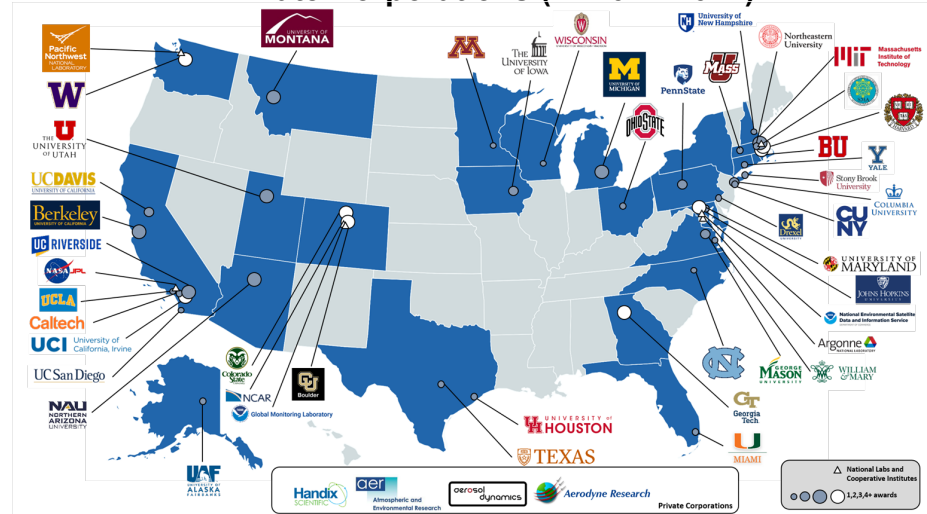**Academia:** Universities in 30+ states

Private sector: NOFO and SBIR

Federal agencies: NSF, NASA, EPA, DOE, NIST, *CCIWG*

International: IGAC, IG3IS (WMO)

AC4 Funded Universities, Institutes and Private Corporations (FY2017-2022)

Actively engaged with various NOAA/CPO priorities: Heat Risk Team; Fire Weather Act; NESDIS GeoXO constellation planning; NESDIS Satellite performance Assessment Team (core membership), NOAA User Readiness Plan for Atmospheric Composition from Space (NURPACS) development, Developed **CO2-USA** Community of Practice - urban carbon focused group of scientists and stakeholders

"CO₂-USA" Network

Key Accomplishments (FY17-21)

Quality

Total Publications, by Journal (250)

Pie chart:
- 125 — Other (incl. Atmos. Measurement Techniques, Geo. Research Letters, etc.)
- 55 — Atmospheric Chemistry and Physics
- 29 — Enviro. Science & Tech
- 28 — JGR Atmos.
- 13 — PNAS
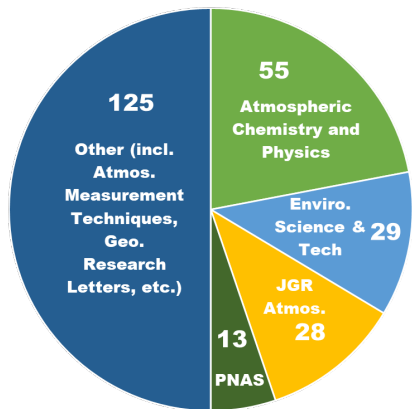
The Boston Globe

Massachusetts vastly underestimates emissions from natural gas, study finds

By David Abel Globe Staff, Updated October 25, 2021, 4:35 p.m. 36

The New York Times

The most detailed map of Auto Emissions in America

The Salt Lake Tribune

"Uinta Basin is hemorrhaging methane as leaks go undetected"

Most Cited Publication, By Year

207 — Hobbie et al. "Contrasting nitrogen and phosphorus budgets in urban watersheds and implications for managing urban water pollution." PNAS (2017)

147 — Koss et al. "Non-methane organic gas emissions from biomass burning: identification, quantification, and emission factors from PTR-ToF during the FIREX 2016 laboratory experiment." Atm. Chem and Phy. (2018)

79 — Resplandy et al. "Quantification of ocean heat uptake from changes in atmospheric O_2 and CO_2 composition." Sci. Rep. (2019)

194 — Tian et al. "A comprehensive quantification of global nitrous oxide sources and sinks." Nature (2020)

11 — Tzompa-Sosa et al. "Atmospheric implications of large C2-C5 alkane emissions from the US oil and gas industry." J. Geophys. Res. Atmos. (2021)

DOC Bronze medal for FIREX-AQ (2019)

DOC Bronze medal for COVID-19 response (2021)

NESDIS Collaboration award (2021)
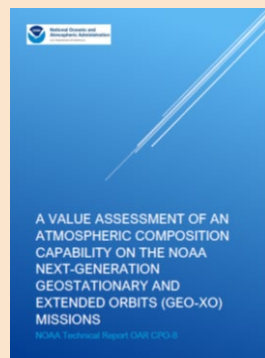
Key Accomplishments (FY17-21)

Performance

In the past 5 years,

- Established AC4 as the major program in the US focused on **urban atmospheric composition** (GHG and Air Quality) research
- AC4 has selected and managed **89 projects**
- Met **100%** of AOP milestones and executed **100%** of the annual budget, met **100%** of grants processing deadlines, all ahead of schedule

25-40% proposals funding rate during FY17-21

Reports
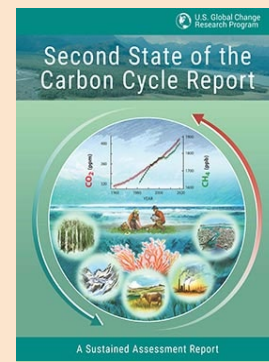
- National Academies of Science report on Anthropogenic **Methane Emissions** in the United States (2018)
- Assessment report: 2nd State Of **Carbon Cycle Science Report** (SOCCR 2)
- **NESDIS GeoXO** planning contribution: AC Value Assessment **Report** (2020), Atmospheric Composition **Town Hall** (April 2021)

Satellite value assessment
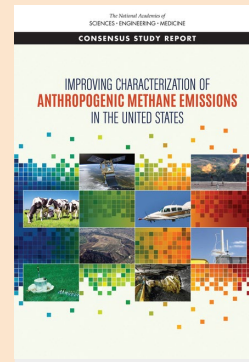
US Methane Emissions

Carbon Cycle

Program Highlights - new policy relevant science

- Facilitated, strengthened a large interagency **field campaign**: **FIREX-AQ** **- developed an unprecedented dataset of** wildfire smoke composition
- Contributed to development of GeoXO constellation with a **first ever dedicated operational** instrument for **Atmospheric Composition (ACX)**
- **Nitrogen cycle**: including bi-directional exchange of ammonia in GFDL Earth System Model; improvements to nitrogen containing aerosols

GeoXO Constellation
(Preliminary, pending program approval)

GEO-West
Visible/Infrared Imager
Lightning Mapper
Ocean Color

ACX

GEO-East
Visible/Infrared Imager
Lightning Mapper
Ocean Color

Multi-agency collaborations to study complex fire systems

Satellites: Remote Sensing — NOAA GOES-R, NOAA/NASA JPSS, NASA TERRA

NOAA/NASA FIREX-AQ
Laboratory study: 2016
Field intensive: 2019
Funding from NOAA/OAR & NASA/SMD
Scientists from NOAA, NASA, Academia and private sector

Aircraft: Local to Continental In-situ & Remote Sensing — NASA DC-8, NASA ER-2, CHEM Twin Otter, MET Twin Otter, NOAA/CU NightFOX

NSF WE-CAN 2018
NCAR C130 aircraft
Wyoming King Air (BB-FLUX)

Mobile Ground Sites: Local — Aerodyne, NASA, NOAA, AERONET

JFSP Western Wildfire Campaign (FASMEE)
Source fuel fire studies: 2019+

Groundbreaking Scientific Findings:
- "US particulate matter air quality improves except in **wildfire-prone areas**" (*McClure and Jaffe PNAS 2018*)
- **Urban trees** (aka fragmented forests) are more efficient in taking up carbon, but are more vulnerable to climate change (*Reimann and Hutyra, PNAS 2017*)
- **Methane leakages** from US oil & gas production: varied diurnal cycle and super-emitters (*Lin et al., Nature Scientific Reports 2021*); leaks at consumer end (*Sargent et al., PNAS 2021*)

Strategic Lookahead

- **Drivers:**
  - Administrative priority on reducing **greenhouse gas** emissions
  - NOAA's next generation of geostationary **satellite** planning and development
  - **Wildfires** and especially smoke causing increasing damage to life and property
  - Changing emissions in **urban areas** as traditional pollutants decrease (e.g. cars) and consumer products emissions increase (e.g. personal care products, cleaning agents, etc.)

- **Some Strategic Considerations:**
  - How can AC4 help assess the success of the pledged **greenhouse gas** reductions and collaborate with other agencies on CDR effort? (directly and through Carbon Cycle Interagency Working Group)
  - How can AC4 community take advantage of the golden era of **satellite measurements**?
  - How can AC4 best connect **field campaigns** to analysis and modeling efforts across NOAA and to the external community?

Backup Slides

Additional resources:
- AC4 website
- AEROMMA website
- FIREX-AQ website
- GeoXO website
- CCIWG SOCCR 2
- IG3IS