Overview of Atmospheric Chemistry, Carbon Cycle and Climate (AC4) Program
Monika Kopacz, Ph.D., AC4 Program Manager
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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
AC4 was formed in 2013 with the goal to determine the processes governing atmospheric concentrations of \textit{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
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

FY17 Urban Emission

FY18 Aerosols from Biogenic Emissions

FY19 Long-term Trends in Atmospheric Compositions

FY20 Urban Atmosphere in a Changing Climate: Chemistry, Carbon and Composition

FY21 Understanding of Emissions and Chemical Transformation in the Urban Atmosphere (AEROMMA)

FY21 Multi Program: Atmospheric Impact Due To Changes in Anthropogenic Activity During the COVID-19 Pandemics
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)

**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)

- **125** Atmospheric Chemistry and Physics
- **55** Enviro. Science & Tech
- **29** JGR Atmos.
- **28** PNAS
- **13** Other (incl. Atmos. Measurement Techniques, Geo. Research Letters, etc.)

**Most Cited Publication, By Year**

- **Hobbie et al.** "Contrasting nitrogen and phosphorus budgets in urban watersheds and implications for managing urban water pollution." PNAS (2017) - 207 citations
- **Tian et al.** "A comprehensive quantification of global nitrous oxide sources and sinks." Nature (2020) - 194 citations
- **Tzompa-Sosa et al.** "Atmospheric implications of large C2-C5 alkane emissions from the US oil and gas industry." J. Geophys. Res. Atmos. (2021) - 11 citations

**The Boston Globe**

Massachusetts vastly underestimates emissions from natural gas, study finds

**The New York Times**

The most detailed map of Auto Emissions in America

"Uinta Basin is hemorrhaging methane as leaks go undetected"

**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
- Assessment report: 2nd State Of **Carbon Cycle Science Report** (SOCCR 2)
Key Accomplishments (FY17-21)

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

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