ACX User Scientist Report

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On detail to NOAA Headquarters
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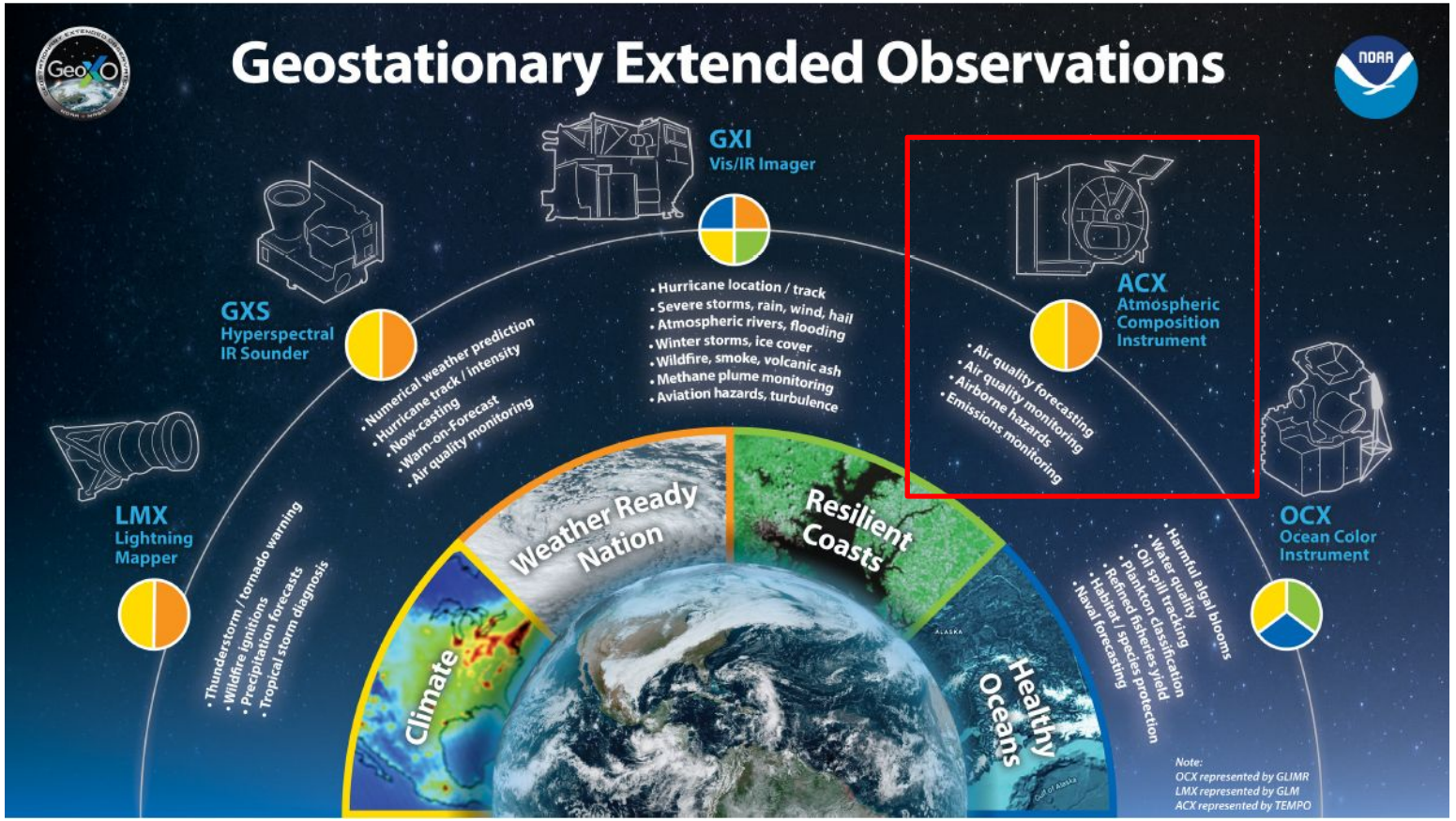
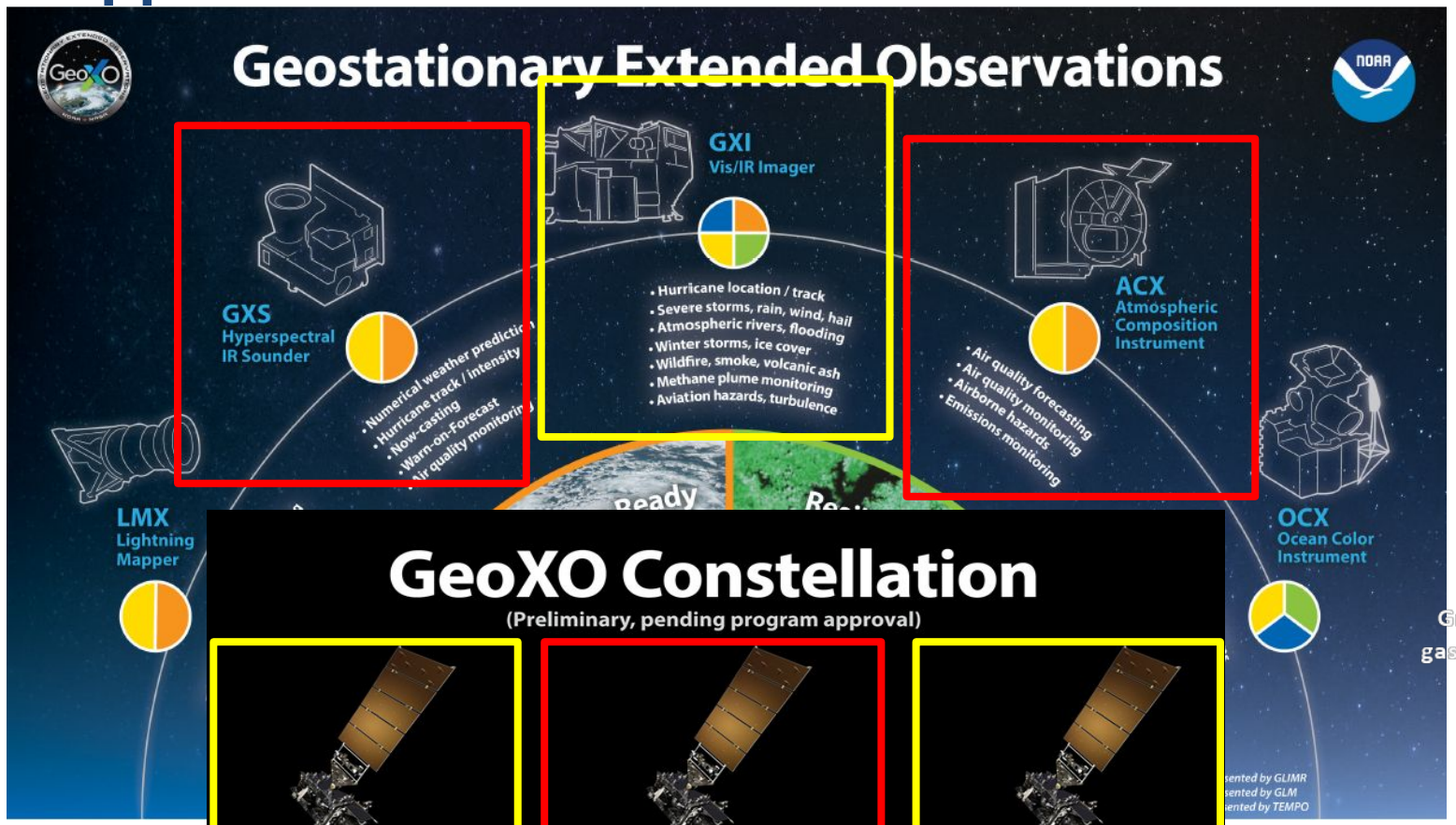
Acknowledgement: NESDIS GeoXO Program Office and Office of Common Services

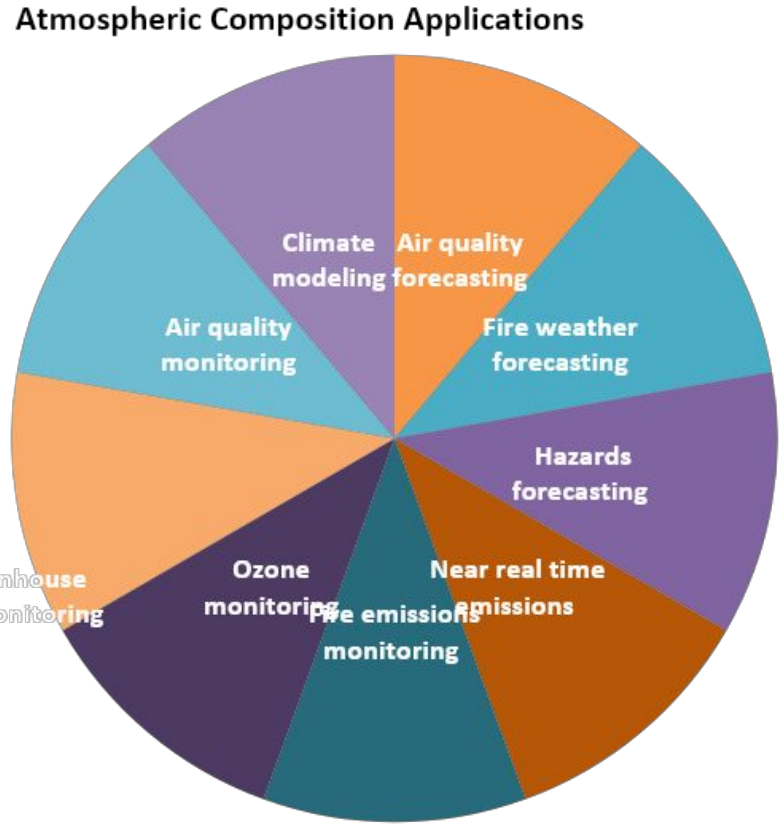
Responsibilities of the ACX User Scientist

- Co-lead ACX Science Team with ACX Instrument and Product Scientists
- Ensure ACX products and services meet users' needs
- Contribute to evaluation of ACX products
- Support development of applications using ACX products
- Lead cultivation of ACX user community
- Report on ACX to agencies and to Congress



GeoXO Atmospheric Composition is a multi-instrument strategy serving many NOAA applications



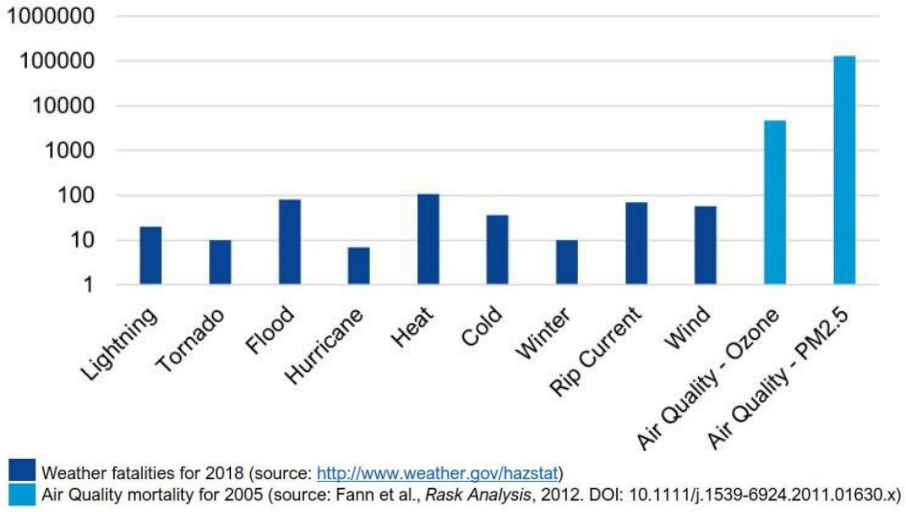


GEO capabilities for quantifying air pollution

Air pollution results in **100,000+ premature deaths** and nearly **$1T in damages** in the U.S. annually, many times greater than damages from extreme weather events.

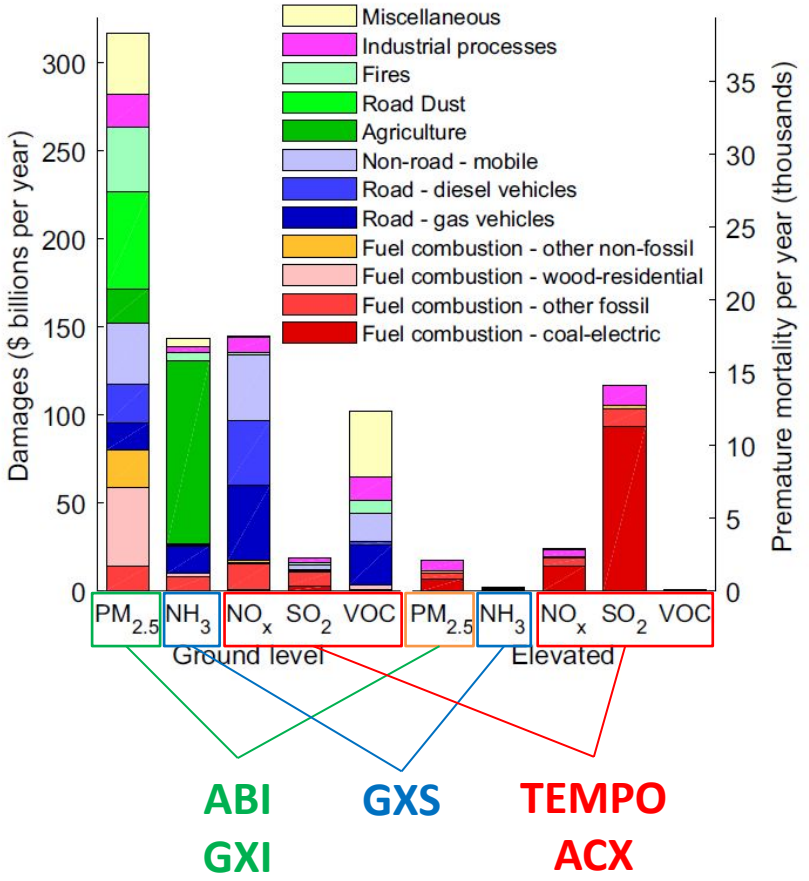
GOES ABI, TEMPO, and GeoXO's ACX, GXI, and GXS will measure air pollutants that are harmful to human health, informing **emissions estimates, air quality forecasts, and epidemiological studies.**

Annual U.S. premature mortality

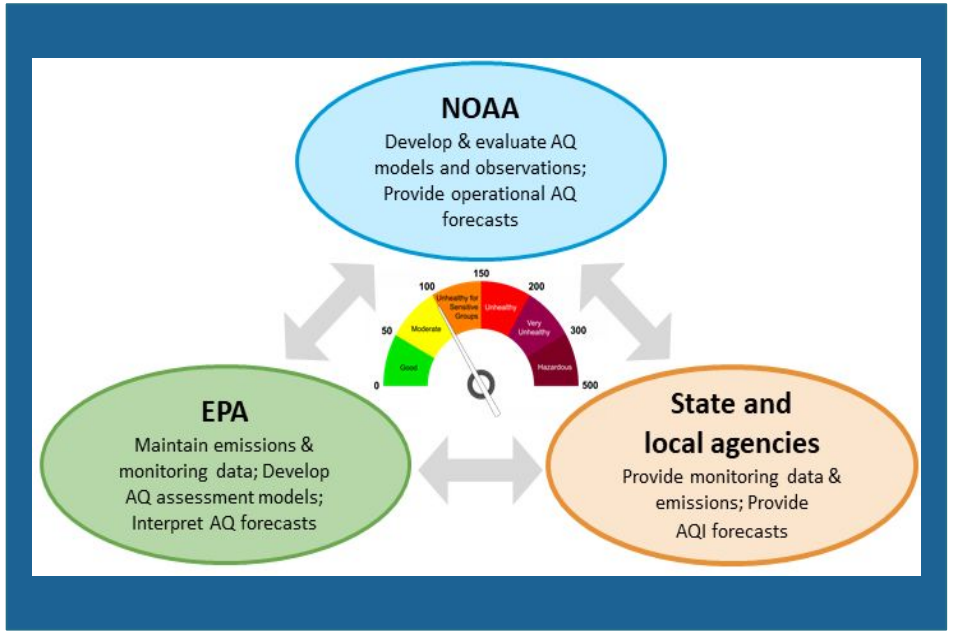


U.S. Damages from Air Pollutants by Source

Goodkind et al., Proc. Natl. Acad. Sci., 2019



Potential for GEO observations to improve NOAA forecasts

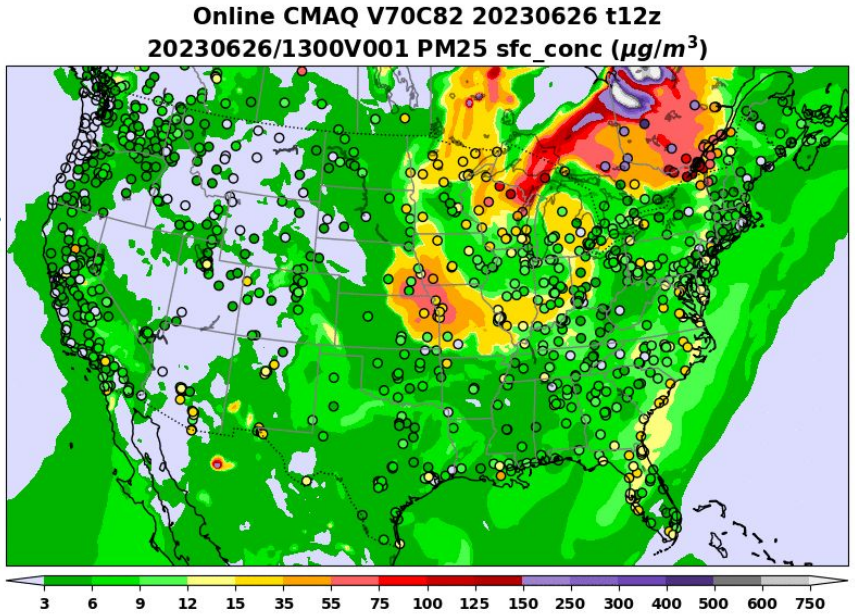


NOAA's **National Air Quality Forecasting Capability** provides guidance to the US EPA and state/local agencies that monitor air pollutant levels and disseminate **air pollution alerts**, which lead to reduced exposure and lower health care costs.

Improvements in NOAA's air quality forecasting capability from GOES, TEMPO and GeoXO AC observations could result in **improved pollution alerts and better regulatory guidance, leading to billions of dollars saved, reduced health care costs, and lower premature mortality.**

Impact of transported smoke from 2023 Canadian fires on U.S. air quality (PM2.5)

Forecast model input includes RAVE wildfire emissions that use NESDIS satellite products (Kondragunta et al.)



Images courtesy of National Weather Service

Preparing for GeoXO ACX

Proxy Data

Analysis

Analyze existing aerosol and trace gas products to understand retrieval performance

Algorithm Development

Adapt NOAA enterprise processing system algorithms to run on existing L1B data

Calibration and Validation

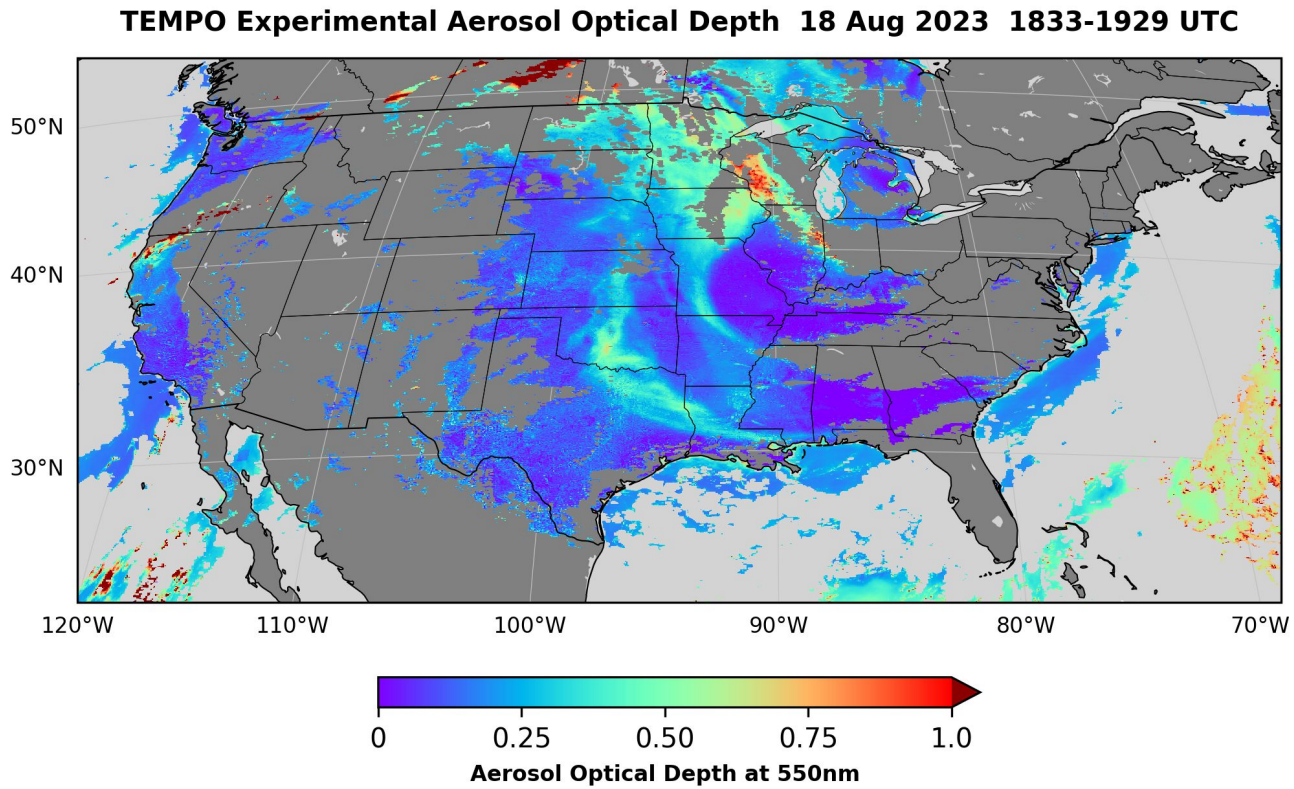
Support field campaigns and long-term monitoring to validate existing satellite aerosol and trace gas products

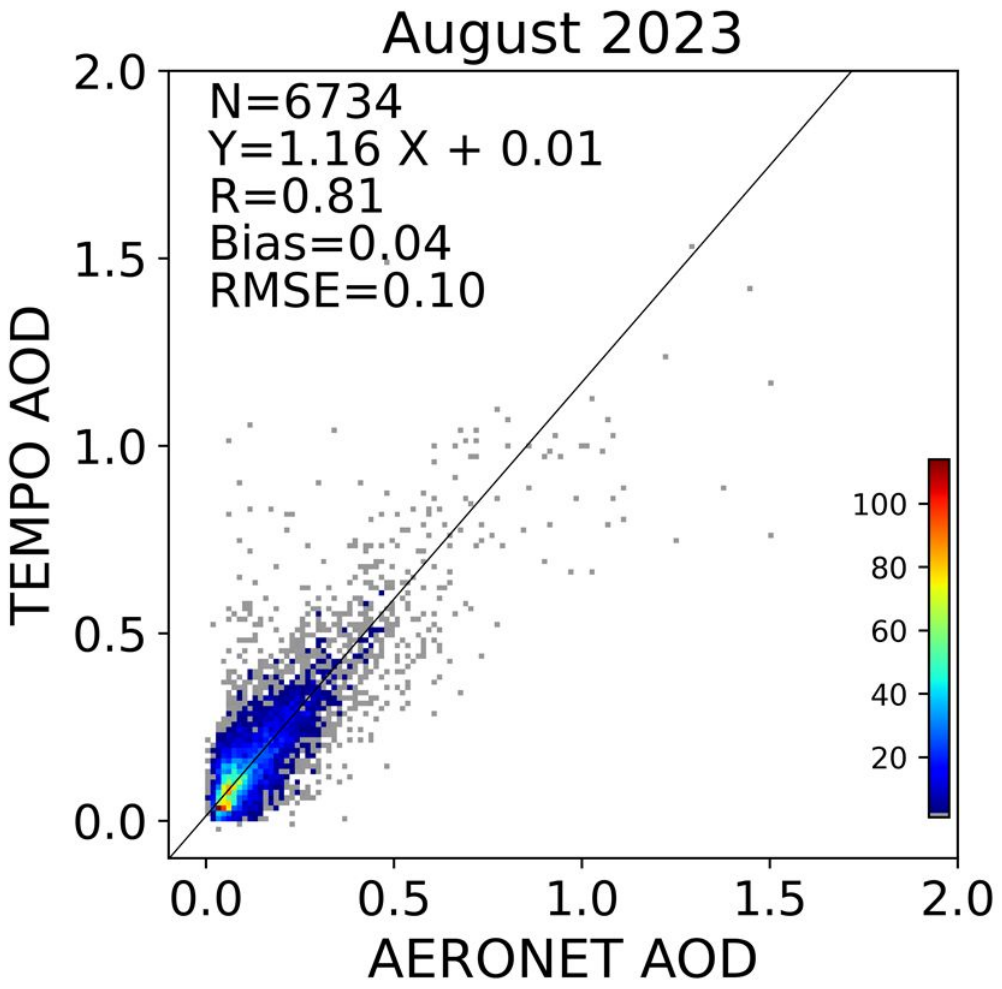
See GeoXO ACX Product Team presentations by:

- *Shobha Kondragunta (value studies)*
- *Hai Zhang (aerosol optical depth)*
- *Pubu Ciren (smoke and dust detection)*

Atmospheric composition product evaluations

NOAA has adapted its enterprise aerosol algorithms to TEMPO using NASA provided L1B. NOAA and NASA sharing responsibilities to optimize data utilization from an EV mission





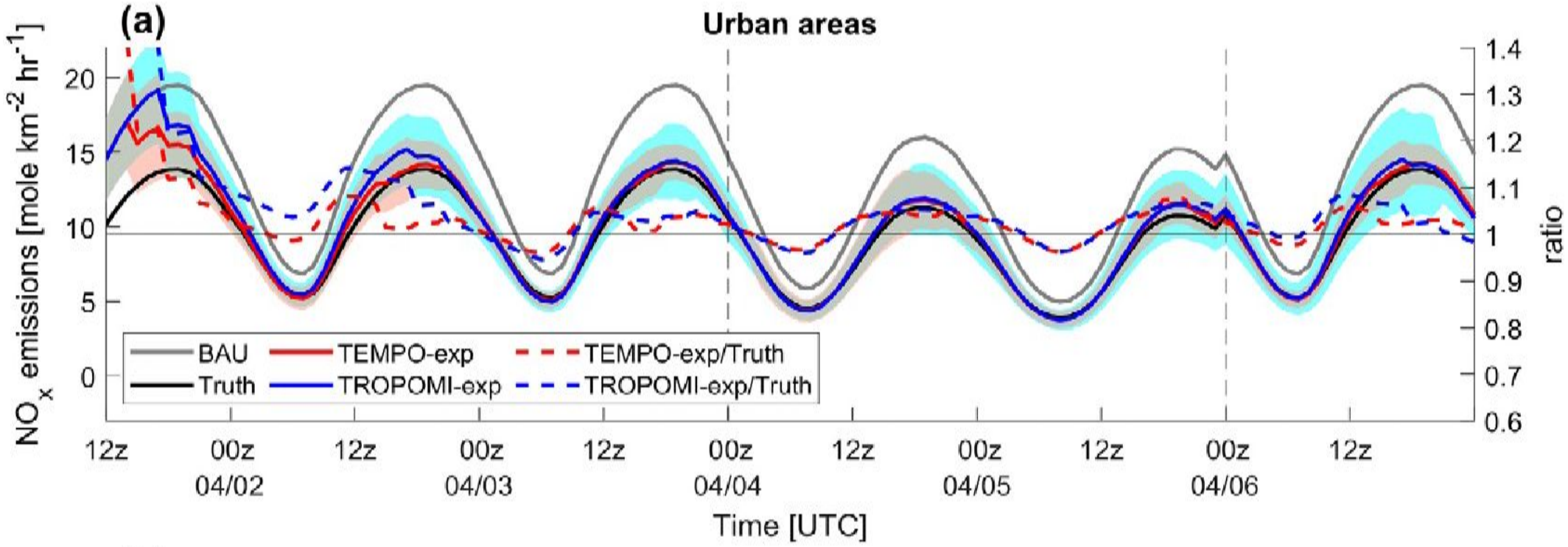
See Hai Zhang's presentation and attend Amy Huff's training to learn more about TEMPO aerosol products

Value Assessment Study on Emissions Adjustments

Adjust biases in anthropogenic nitrogen oxides (NOx) emissions using **GEO** (TEMPO) & **LEO** (TROPOMI) satellite data and a **regional data assimilation system** (WRF-Chem/DART)

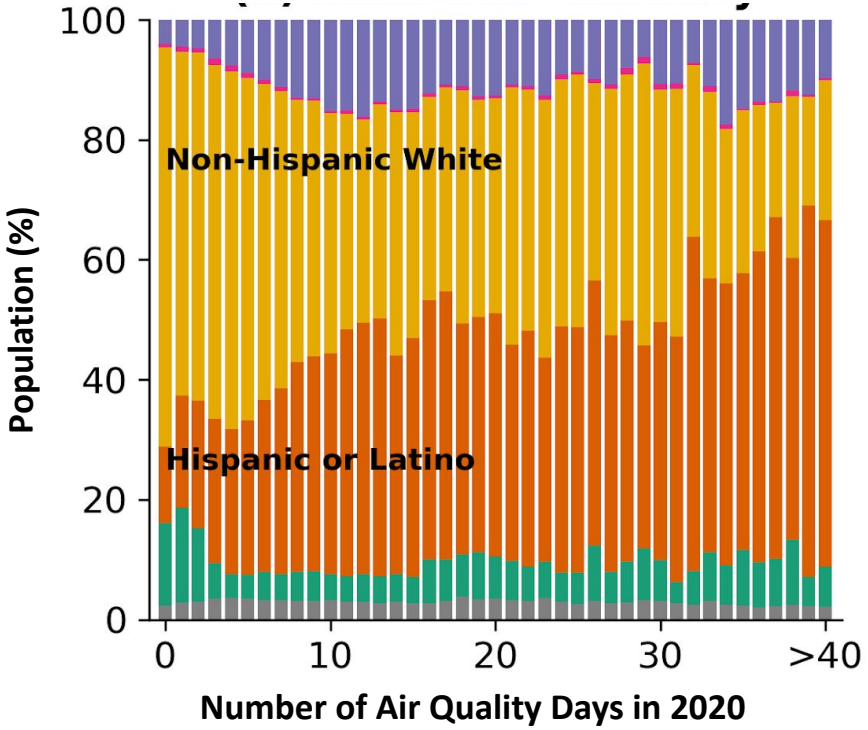
- GEO data enables true NOx emissions be retrieved using **half as many simulation days** as LEO data, and GEO data **improves accuracy** of NOx emissions estimates over LEO data

See Brian McDonald's talk this afternoon



Hsu, C.-H., *D. K. Henze, A. P. Mizzi, G. González Abad, J. He, C. Harkins, A. R. Naeger, C. Lyu, X. Liu, C. Chan Miller, R. B. Pierce, M. S. Johnson, and B. C. McDonald (**2024**), An Observing System Simulation Experiment Analysis of How Well Geostationary Satellite Trace-Gas Observations Constrain NOx Emissions in the US, Journal of Geophysical Research: Atmospheres, 129, e2023JD039323, doi:https://doi.org/10.1029/2023JD039323*

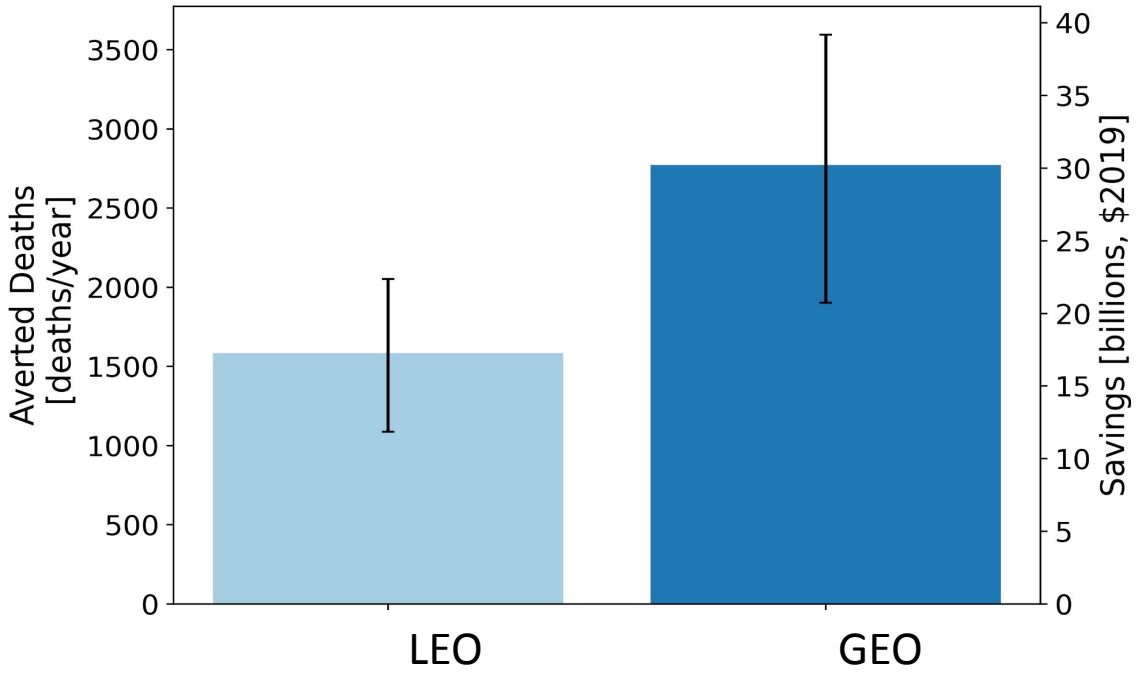
Value Assessment Study on Air Quality Alerts



Communities exposed to 2020 alert days were more likely to:

- identify as Hispanic/Latino or Asian/Pacific Islander,
- report speaking English less than “very well”,
- have less than a high school education, and
- be classified as disadvantaged by U.S. government.

See Susan Anenberg’s talk this afternoon



Compared to LEO data, air quality alerts based on GEO data could lead to 1200 additional premature deaths averted with ~$13B savings in one year

***Katelyn O’Dell**, Shobha Kondragunta, Hai Zhang, Daniel Goldberg, Gaige H. Kerr, Zigang Wei, Barron Henderson, and Susan C. Anenberg (**2024**). Public Health Benefits from Improved Identification of Severe Air Pollution Events with Geostationary Satellite Data, GeoHealth.*

Engaging the user community

GeoXO GEOSTATIONARY EXTENDED OBSERVATIONS

Who are our stakeholders?

- Operational forecasters for air quality and weather
- Federal, state, & local environmental regulators
- Climate, stratospheric, & air quality monitoring teams
- Environmental assessment bodies
- Public health officials
- Diplomats
- Research community
- Media
- General public

How are we connecting with them?

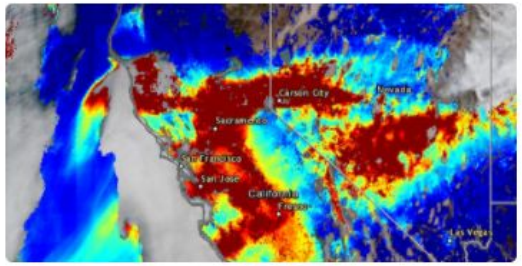
- Town halls
- 1-on-1 meetings
- Website
- GeoXO Pathfinder process
- Trainings: e.g., https://tinyurl.com/fnyvdzsx
- Social media: e.g., @AerosolWatch

AerosolWatch
Every 10 minutes..

AGU FALL MEETING

Top Tweet earned 29.3K impressions

Ongoing #CaliforniaFires producing optically thick #smoke (dark red shading) today (31 Aug) that is spreading across north/central CA and central NV, shown by #GOES17 #ABI aerosol optical depth composite (15-18 UTC) overlaid on GeoColor imagery, from the AerosolWatch website. pic.twitter.com/ZqxplCPalA



Attend one-on-one parallel session between stakeholders and GeoXO User Lead Andy Latto on Wednesday

Looking ahead

- Continue evaluations of TEMPO, GEMS, etc. to develop and improve ACX and other GeoXO algorithms and products
- Encourage ACX Science Team to carry out new analyses and applications of GEO atmospheric composition data
- Expand support for value assessments through GeoXO Program and NESDIS Enterprise Proving Ground support
- Engage with user community to build readiness for ACX products and applications
- Co-invest with NASA in the development of new capabilities:
  - Nitrogen dioxide as a proxy for carbon dioxide
  - Volatile organic compounds from GXS
  - Methane from GXI