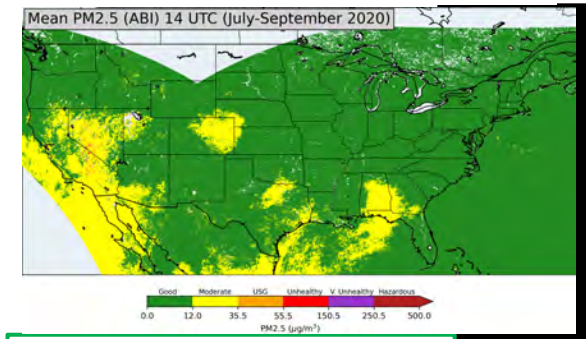
Atmospheric Composition from GeoXO

Greg Frost

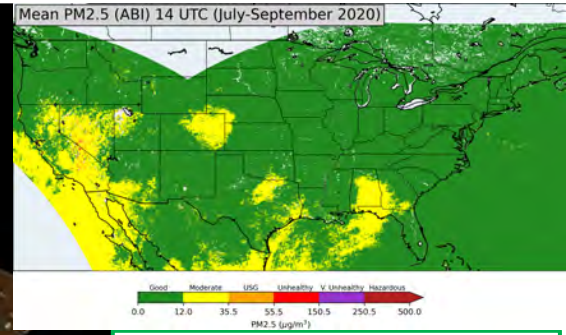
NOAA CSL

Future GeoXO Atmospheric Composition Capabilities

PM2.5 derived from GOES ABI AOD



PM2.5 derived from GOES ABI AOD



Launching in 2032-2036

GeoXO Constellation

(Preliminary, pending program approval)

GEO-West

Visible/Infrared Imager

Lightning Mapper

Ocean Color

GEO-Central

Hyperspectral Infrared Sounder

Atmospheric Composition

Partner Payload

GEO-East

Visible/Infrared Imager

Lightning Mapper

Ocean Color

Vis/IR Imager (GXI)

ABI analog

- Fire detection
- Fire radiative power
- Aerosol type
- Aerosol optical depth
- Aerosol concentration

Vis/IR Imager (GXI)

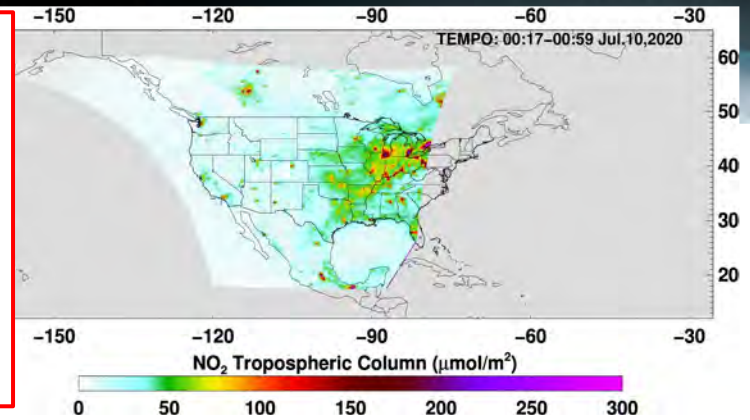
ABI analog

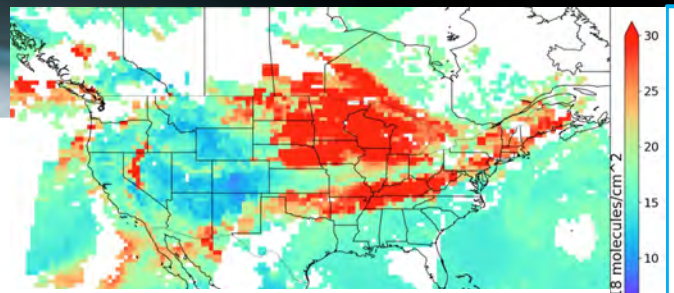
- Fire detection
- Fire radiative power
- Aerosol type
- Aerosol optical depth
- Aerosol concentration

UV/Vis Spectrometer (ACX)

TEMPO analog

- Ozone
- Nitrogen dioxide
- Sulfur dioxide
- Formaldehyde
- Aerosol layer height





CO total column, CrIS on NOAA-20, 14 Sep 2020

IR Sounder (GXS)

CrIS analog

- Ozone
- Carbon monoxide
- Carbon dioxide
- Ammonia

Satellite product support for AGES field campaigns

GeoXO will build on legacy products from GOES-R series Aerosol Baseline Imager (ABI), JPSS series (VIIRS, OMPS, CrIS), and partner instruments (e.g. TEMPO, TROPOMI)

ABI products for campaign support:

- Dust, smoke masks
- Visible imagery
- Dust RGB
- Fire RGB
- Fire detections
- Fire radiative power
- Fire emissions
- Aerosol optical depth
- Surface PM2.5

These products can be tailored for any of the urban areas under consideration in 2023

Scientific objectives for product development from field work:

- Evaluate GOES, JPSS, TEMPO, and TROPOMI products
- Test assumptions in lookup tables used in retrieval algorithms
- Capture actual spatial gradients in air pollution
- Quantify surface heterogeneity effects on retrievals
- For EJ considerations, separating real signal from artifacts is critical

Examples of past field campaigns helping with satellite cal/val:

- ATOM: aerosols, trace gases in the remote marine troposphere
- FIREX-AQ: fire products, aerosols, trace gases in wildfire plumes
- COVID-AQS: trace gases, aerosols during pandemic disruptions
- SUNVEx: trace gases, aerosols over Los Angeles and Las Vegas

For more info on existing NOAA products:

- https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/
- https://www.star.nesdis.noaa.gov/smcd/emb/aerosols/products.php
- https://www.star.nesdis.noaa.gov/atmospheric-composition-training/

Post AGES campaigns satellite data analysis

- Run NOAA trace gas algorithms on TROPOMI and TEMPO
- Evaluate data from GOES ABI; JPSS VIIRS, OMPS, and CrIS; TEMPO; TROPOMI
- Evaluate trace gas and aerosol retrievals from aircraft and satellite as function of viewing geometry, to understand sun-satellite geometry issues inherent to GEO
- Identify retrieval artifacts over urban areas
- With additional sun photometers and ceilometers in Northeast US sites, look at issues with scaling AOD to estimate surface PM2.5

How AGES campaigns can inform future/upcoming satellite product development

- Identify and try to overcome gaps in NOAA satellite capabilities
  - e.g. speciated PM
- Understand cloud interference impacts in trace gas and aerosol retrievals
- Understand aerosol impacts in trace gas retrievals
- Lessons learned from 2023 analysis will be applied to GeoXO product development
- These analyses will also inform future field work as we approach the GeoXO era
- Background ozone and aerosol levels are increasing. Even low levels of aerosols are harmful. Satellite data are often the only observations over rural areas.
  - Can we learn more from satellite data for low levels of pollutants?
  - Should future field work target rural areas?
- There will be other emerging issues that we may not have contemplated. Satellite observations can help to identify areas where our understanding is lacking.