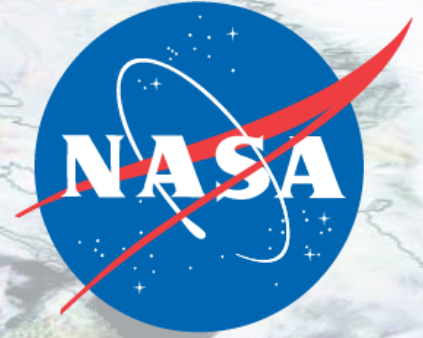


IOWA



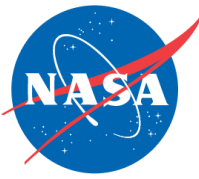
EARTH SCIENCE
APPLIED SCIENCES

**Enrich and Enhance the Application of TEMPO and
GEOS Data Products for Regional Air Quality and
Public Health Management under Smoke Conditions**

Jun Wang, Megan Christiansen, Lorena Castro Garcia
University of Iowa

April 23, 2024

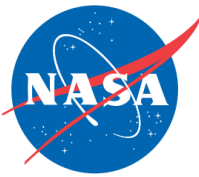
NASA HAQ Team



Project Summary

- Enrich and Enhance the Application of TEMPO and GEOS Data Products for Regional Air Quality and Public Health Management under Smoke Conditions
- FireAQ
- Jun Wang
- Solicitation: NNH21ZDA001N-HAQ
- Project Summary
 - The proposed project will first make the TEMPO AOCHE research algorithm operational so the AOCHE and AOD products from TEMPO can be ported to a new website for Fire and Air Quality (FireAQ) in NRT.
 - The proposed efforts will bridge application needs and TEMPO's operational data production. Published machine-learning tools will be used to provide NRT estimates of surface PM_{2.5} forecast bias corrections, with inputs from TEMPO AOCHE and AOD data, as well as GEOS-FP meteorological and aerosol fields.
- US CONUS

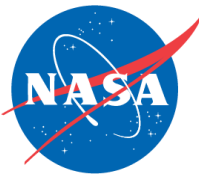
Project Partners/Collaborators



EARTH SCIENCE
APPLIED SCIENCES

List project Co-Investigators, collaborators, and other partners

Role	Name	Affiliation	Organization Type
PI	Jun Wang	University of Iowa	University
Co-I	Daven Henze	University of Colorado Boulder	University
Co-I	Xiong Liu	Harvard Smithsonian Observatory	University
Co-I	Melanie Follette-Cook	NASA GSFC	Federal
Postdoc/Stakeholder engagement	Megan Christiansen	University of Iowa	University
Collaborator/Stakeholder	Scott Epstein	South Coast Air Quality Management District, CA	State agency
Collaborator/Stakeholder	Zac Adelman	Lake Michigan Air Directors Consortium	Air quality research and planning
Collaborator/Stakeholder	Martha Webster	ME Dept. of Environmental Protection	State agency
Collaborator/Stakeholder	Daniel Welsh	CO Dept. of Public Health & Environment	State agency
Collaborator/Stakeholder	Ryan Biggerstaff	OK Dept. of Environmental Quality	State agency
Collaborator/Stakeholder	Christoph Keller	Universities Space Research Association	Data/Domain Scientist



Project End-users & Stakeholders

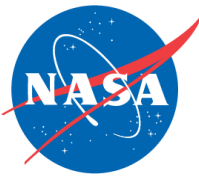
List organization names and organization types

Organization Name	Organization Type	Decision Making Activity
South Coast Air Quality Management District, CA	State Agency	Air quality forecasting/ exceptional event analysis
Lake Michigan Air Directors Consortium	Air quality research and planning	Air quality forecasting/ exceptional event analysis
ME Dept. of Environmental Protection	State Agency	Air quality forecasting/ exceptional event analysis
CO Dept. of Public Health & Environment	State Agency	Air quality forecasting/ exceptional event analysis
OK Dept. of Environmental Quality	State Agency	Air quality forecasting/ exceptional event analysis
Universities Space Research Association	State Agency	Air quality forecasting/ exceptional event analysis

Engagement plan and recent updates

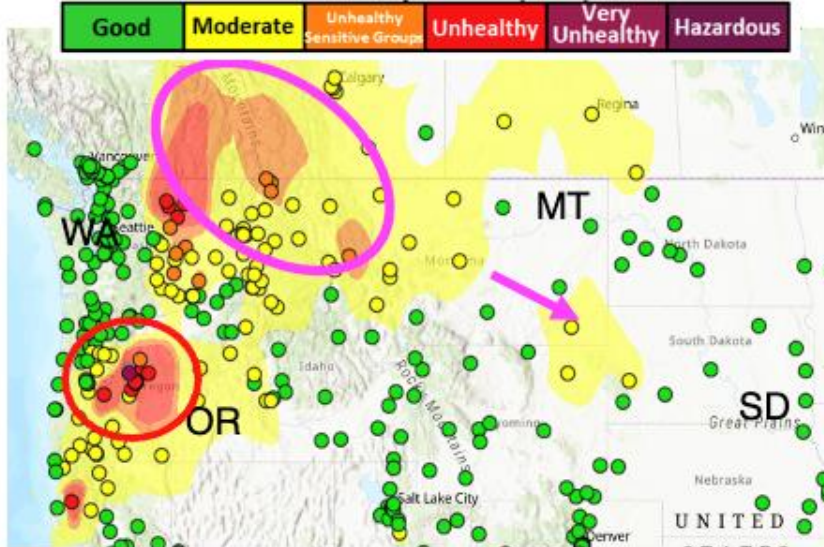
Meet with stakeholders on a quarterly basis to discuss project progress, website developments, and future needs for the AQPH agencies.

FireAQ weekly air quality briefings: 2023 summary



EARTH SCIENCE
APPLIED SCIENCES

EPA Air Quality Index (AQI), 16 August 2023



A retrospective analysis of AQ the week back and outlook a week ahead during US “fire season”

AIM: engage with the scientific community and end user organizations

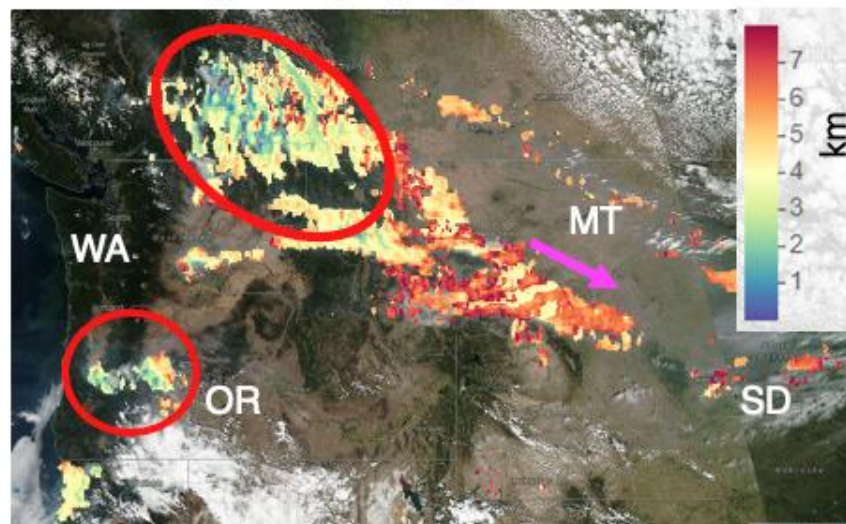
Occurred: Weekly from July – October 2023

Meeting attendees, and email subscribers, represented **21 groups** across universities, federal organizations, and state agencies.

Briefing slides are archived:

<http://fireaq.uiowa.edu/briefings.php>

Aerosol Layer Height (km), from U. Iowa & NASA



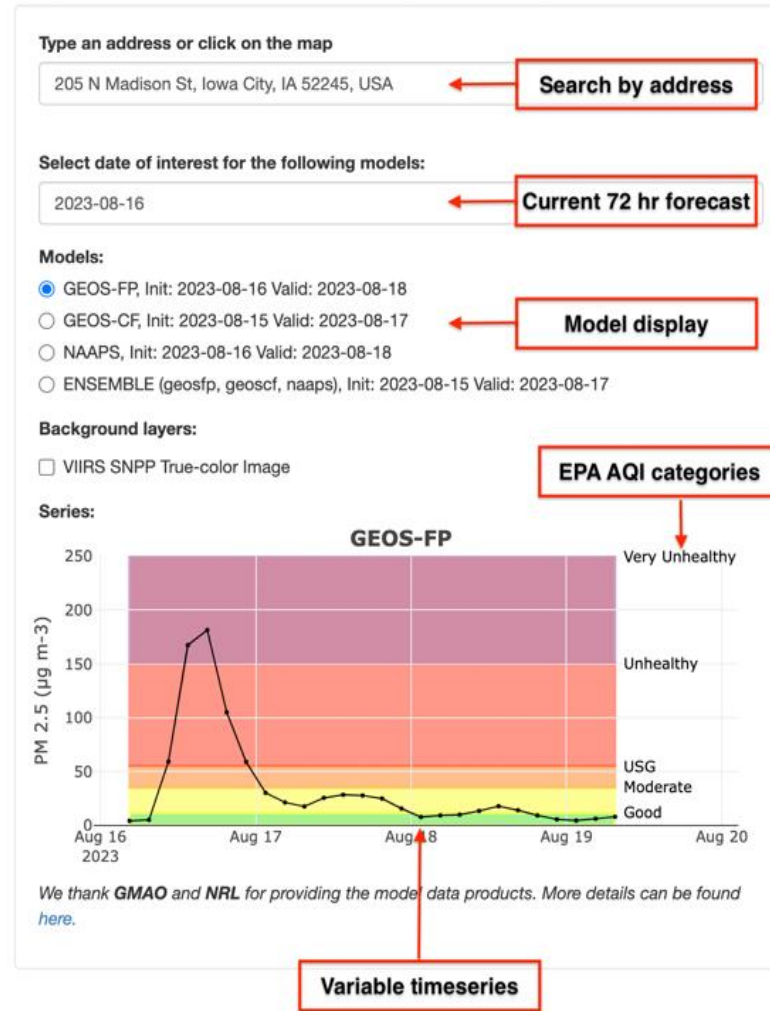
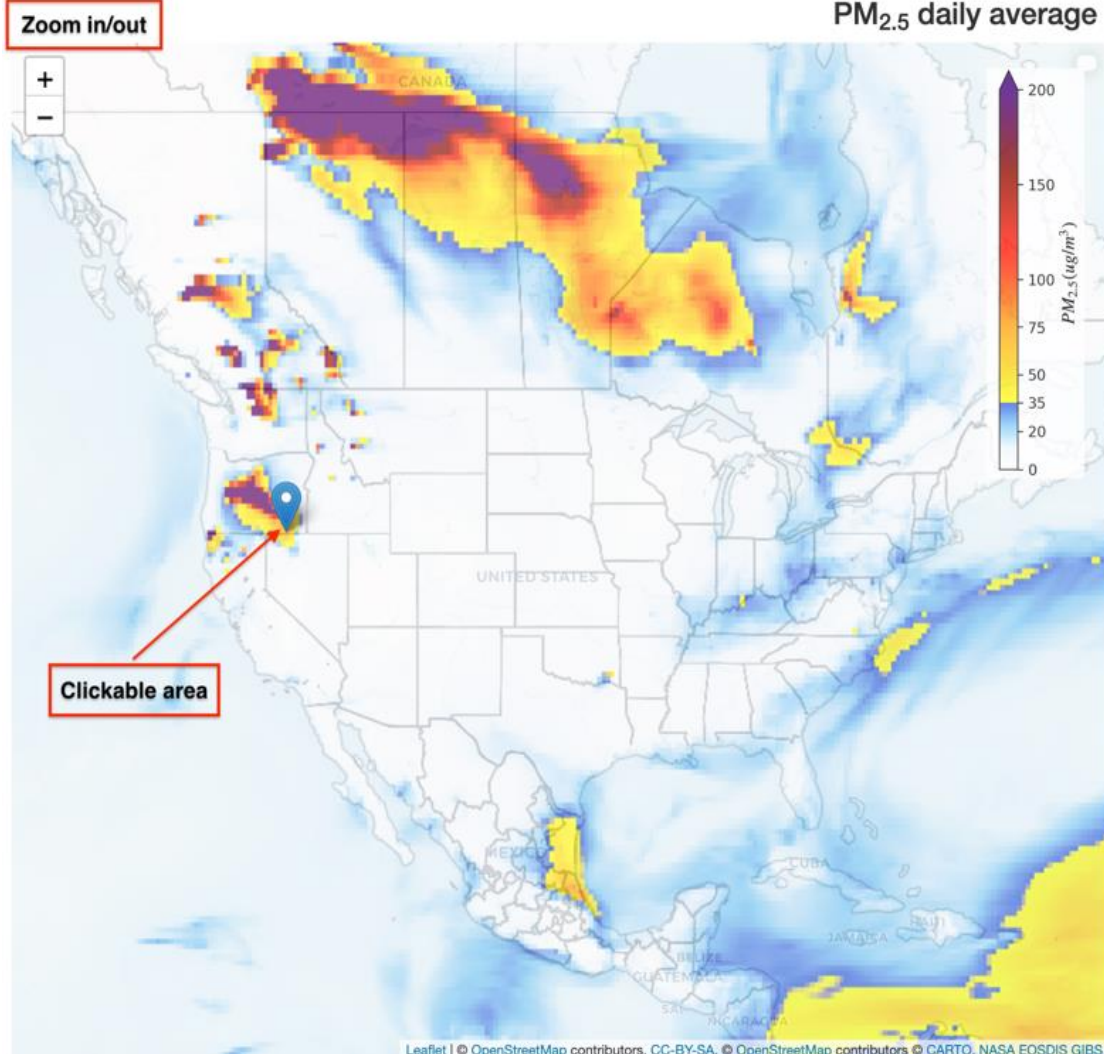


EARTH SCIENCE
APPLIED SCIENCES

Improvements to the FireAQ website design

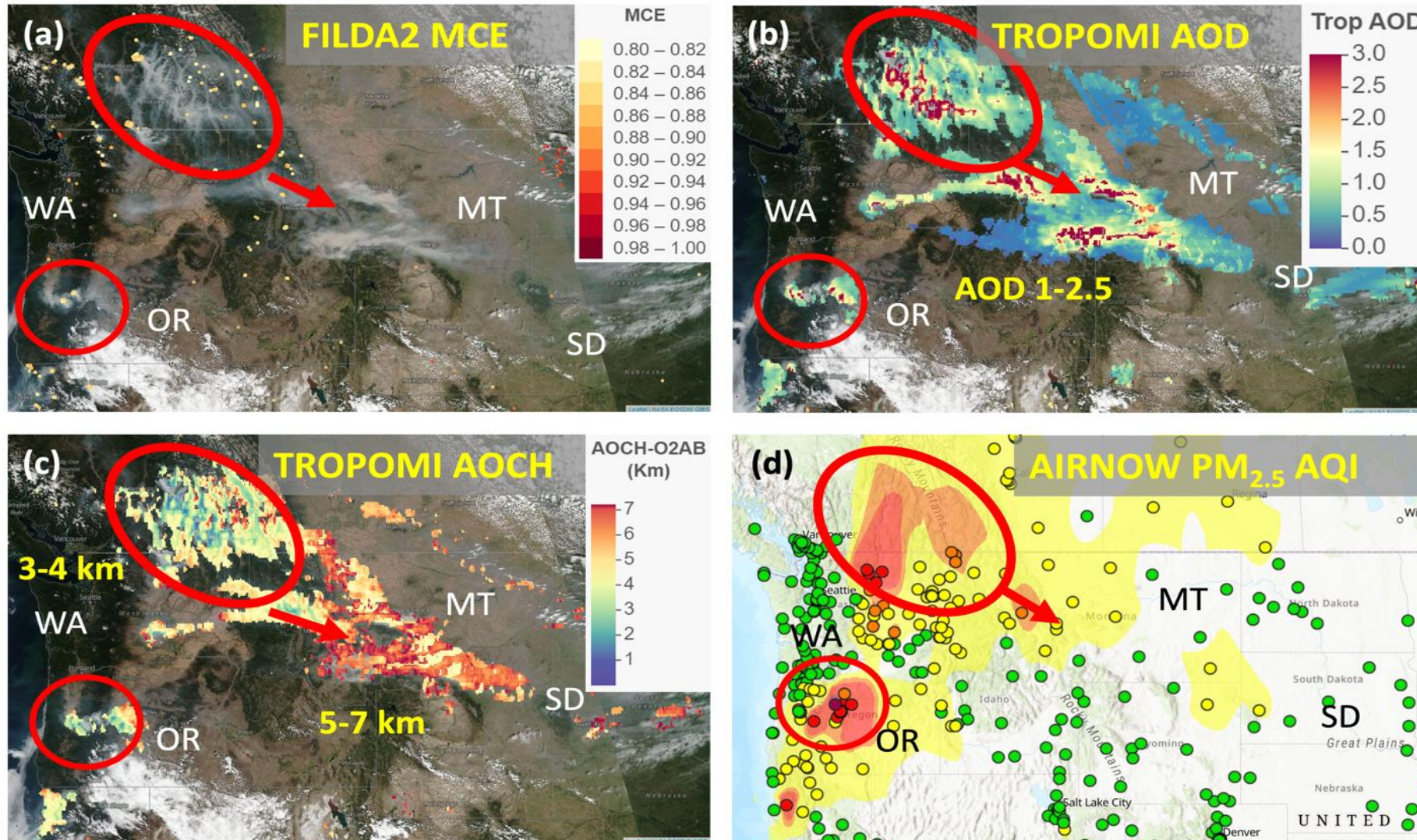
Home Timeseries FCST Daily Average Satellite Data Weekly Briefings AQI for you About

Daily image subscription

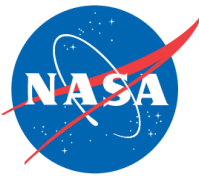


Example of
PM_{2.5} daily
average page

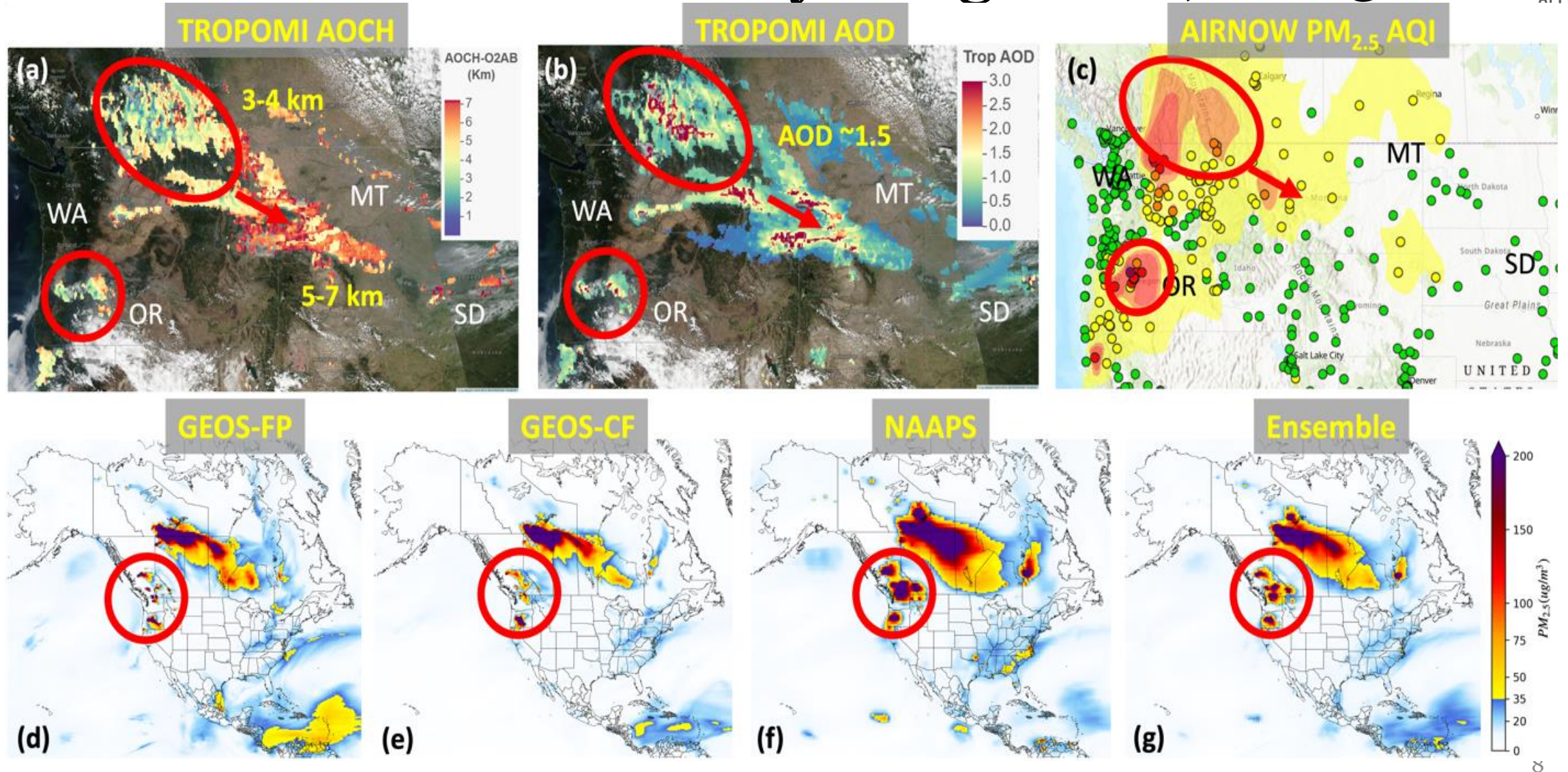
Aerosol Optical Centroid Height can help to constrain AOD Case Study: August 16, 2023



Aerosol Optical Centroid Height can help to constrain AOD Case Study: August 16, 2023



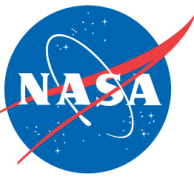
EARTH SCIENCE
APPLIED SCIENCES



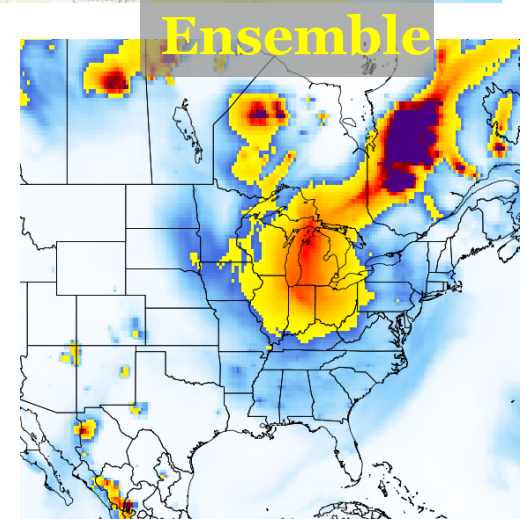
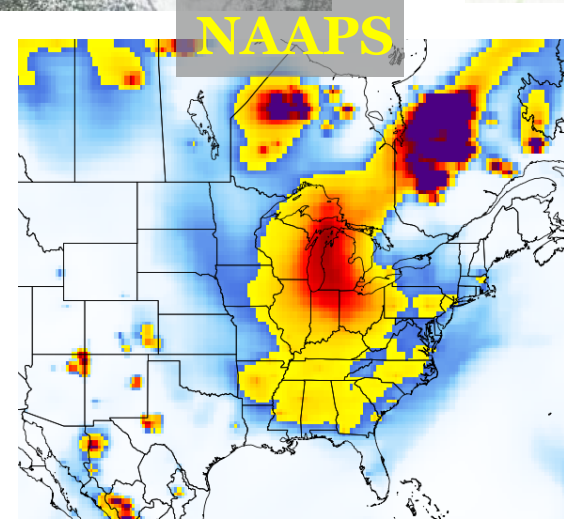
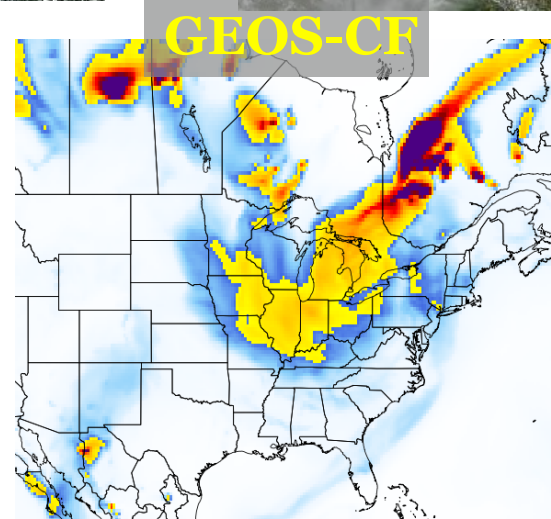
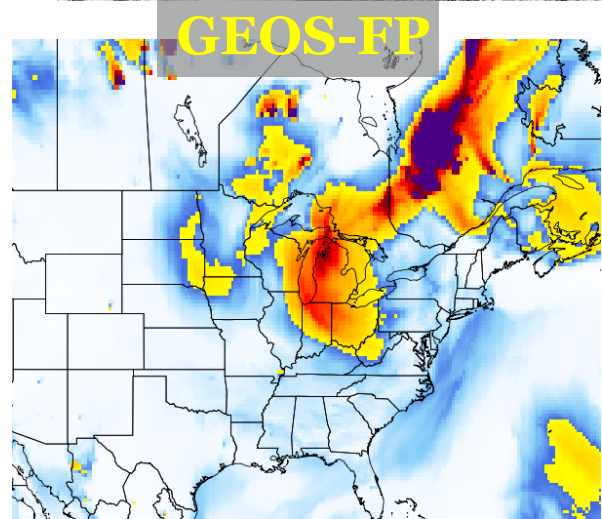
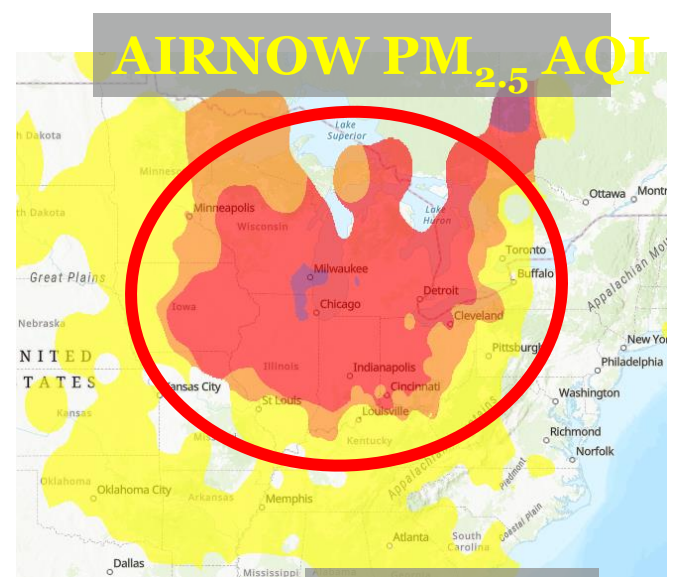
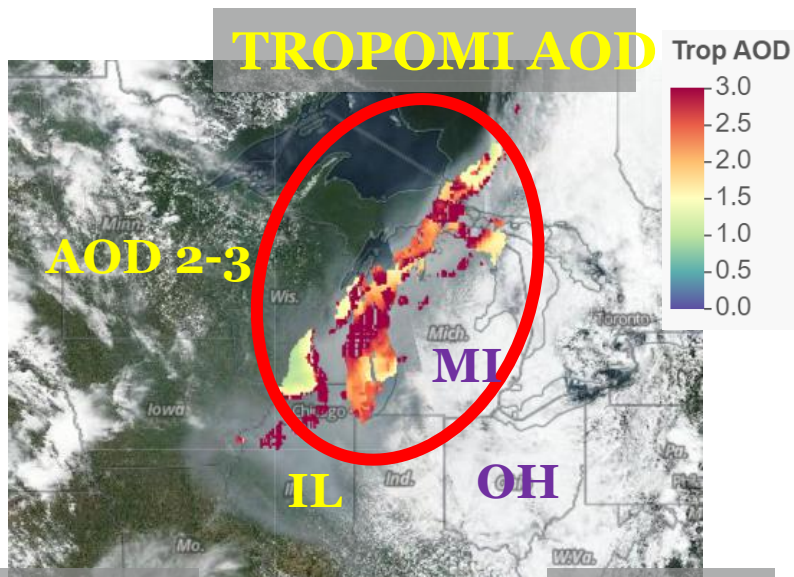
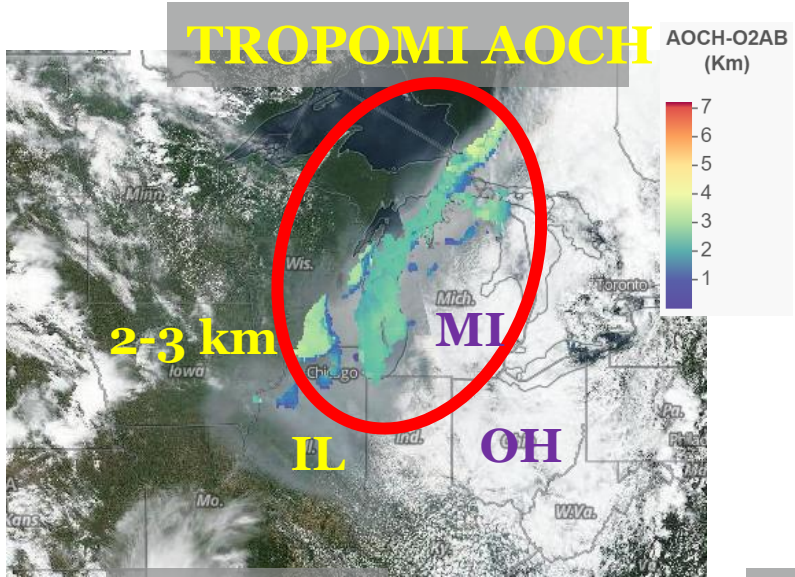
FireAQ

Potential use during exceptional event analyses

Smoke Event: Day 2, June 27, 2023



EARTH SCIENCE
APPLIED SCIENCES

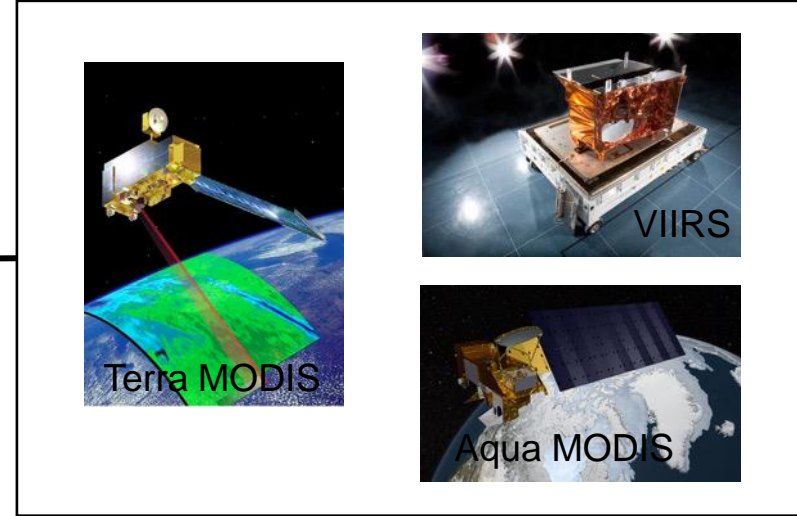


Multi model and satellite bias correction ensemble approach: Kalman Filter

GMAO products
- GEOS FP
- GEOS CF

NRL model
- NAAPS

Models

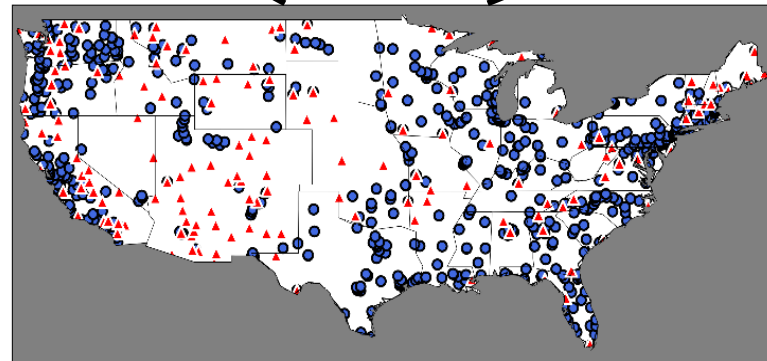


Terra MODIS

VIIRS

Aqua MODIS

Satellites

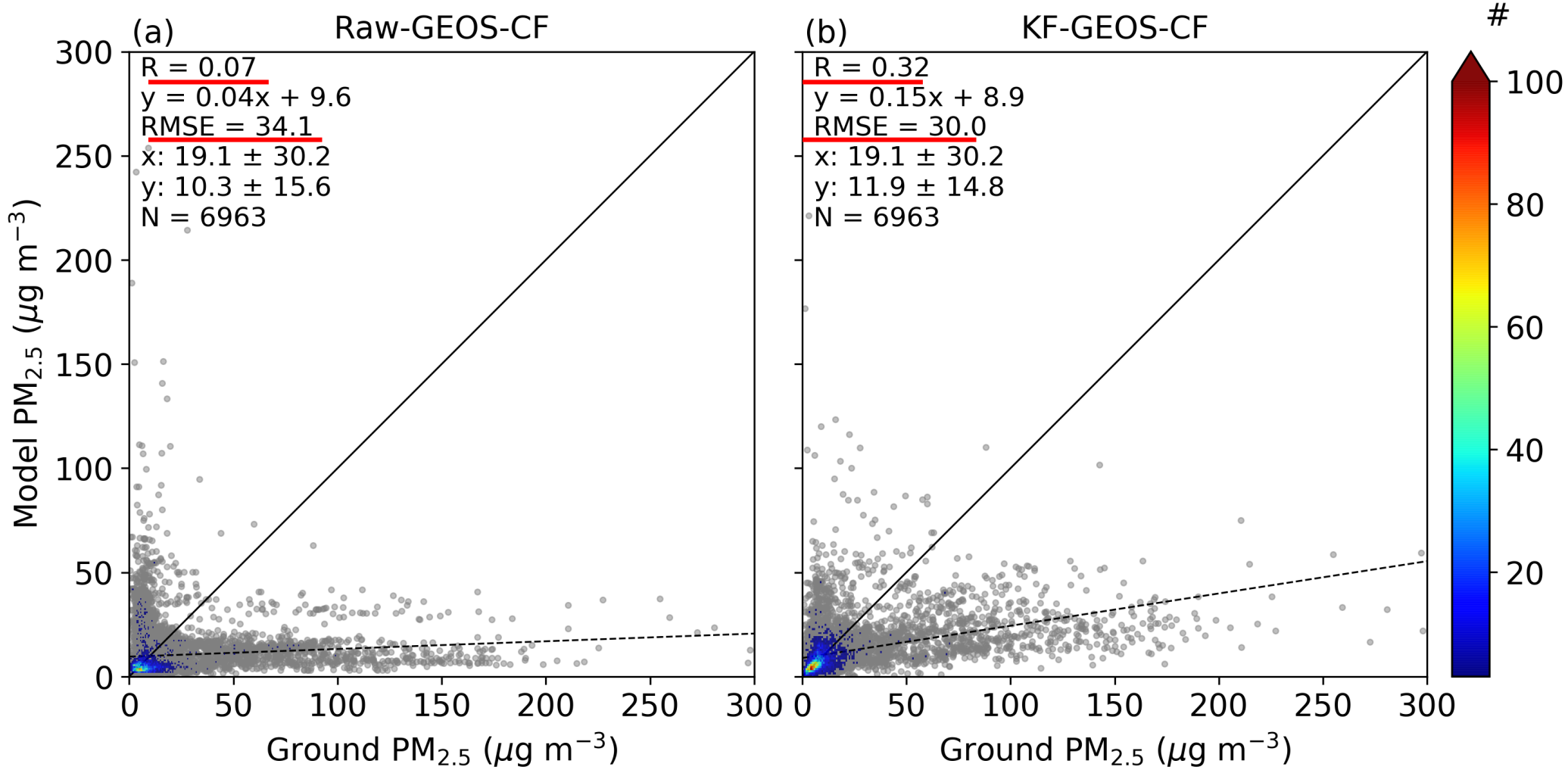


Ground observations

Developed under a
NASA HAQAST
project for smoke
forecast in Alaska

Preliminary results KF bias correction for FireAQ domain

Smoke Event:
June 25-30,
2023

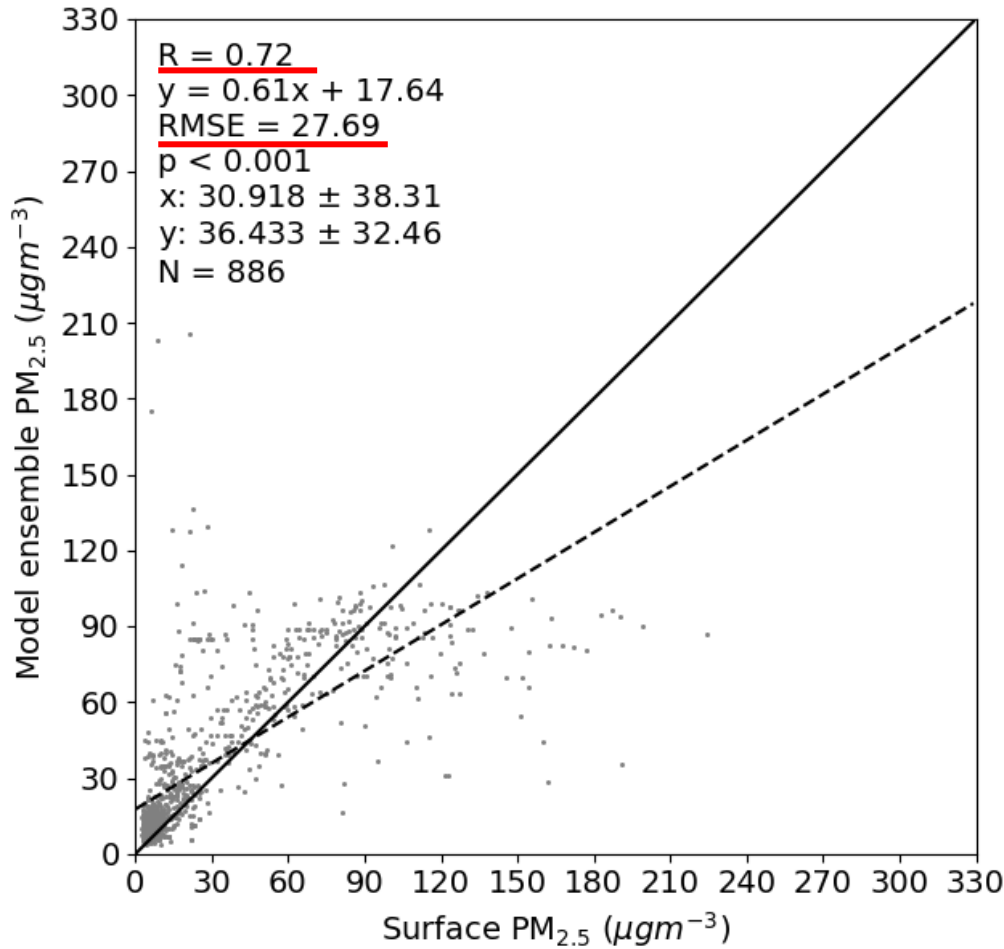


Preliminary PM_{2.5} bias correction results employing MultiLayer Perception Neural Network

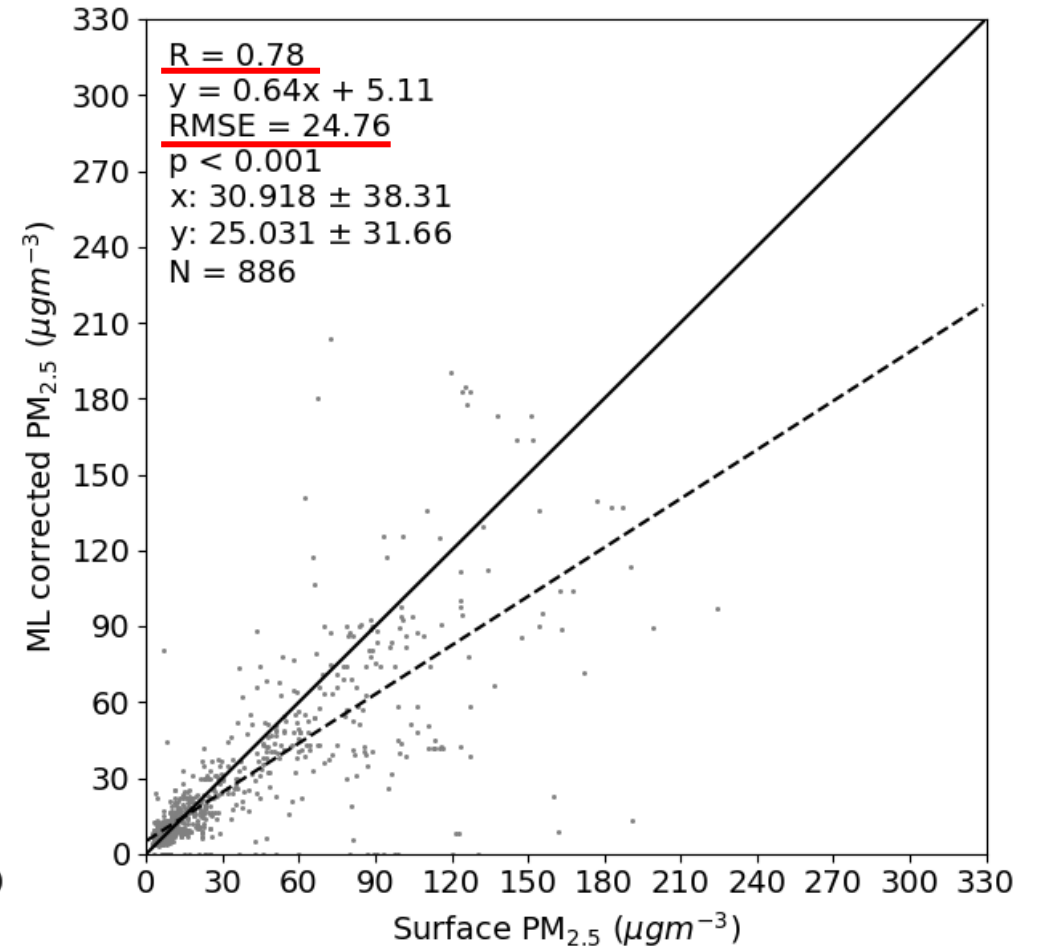


Test Day:
June 29, 2023

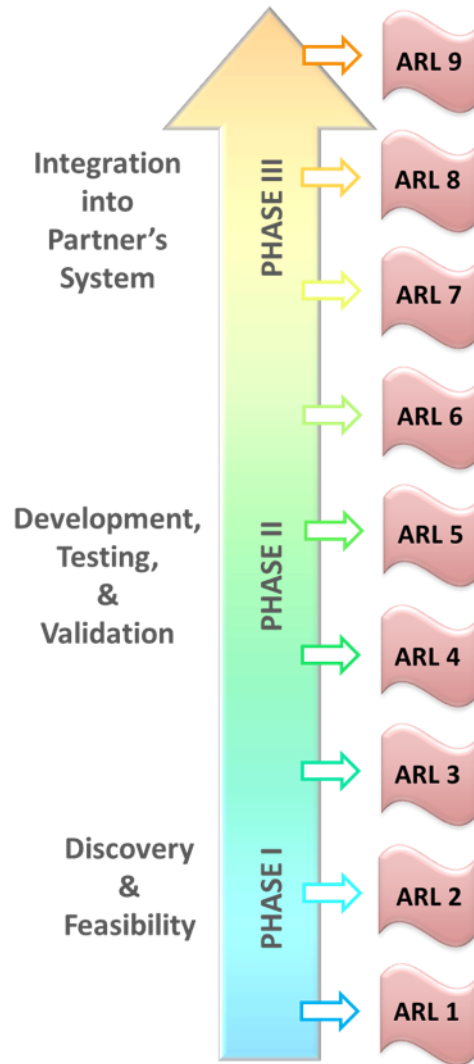
Original Ensemble



MLP - Ensemble

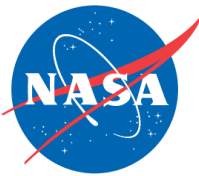


ARL Performance



- Start-of-Project ARL = 2-3 (*August 2022*)
 - AOCH/AOD algorithm tested with Tropomi and documented
- Goal ARL = 8
- Current ARL = 7 (*April 2024*)
 - Web portal developed and live (documented workflow)
 - Model and satellite data visualization operational
 - Preliminary ML bias correction tested

Current ARL-Supporting Evidence



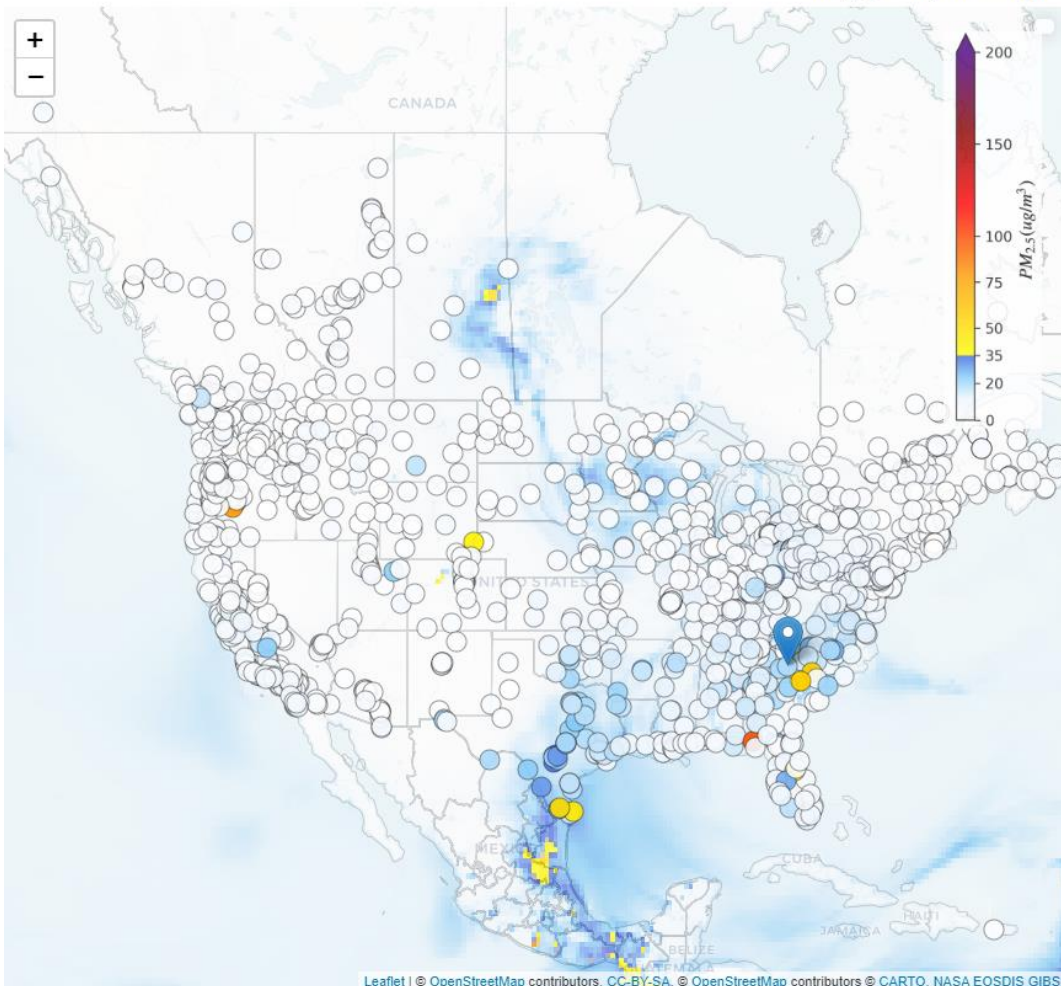
EARTH SCIENCE
APPLIED SCIENCES

IOWA

Home Timeseries FCST Daily Average Satellite Data Weekly Briefings AQI for you About

Daily image subscription

PM_{2.5} daily average



Leaflet | © OpenStreetMap contributors, CC-BY-SA, © OpenStreetMap contributors © CARTO, NASA EOSDIS GIBS

Type an address or click on the map

205 N Madison St, Iowa City, IA 52245, USA

Select date of interest for the following models:

2024-04-17

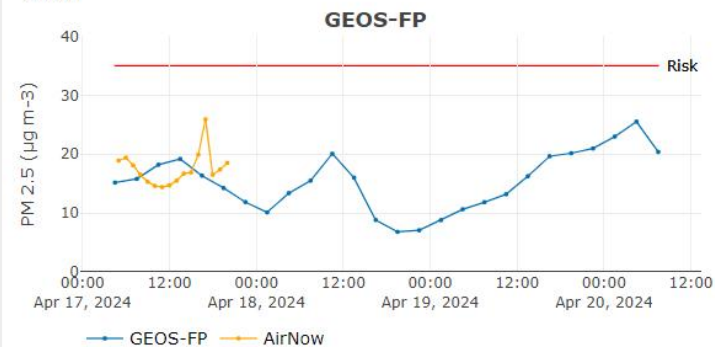
Models:

- GEOS-FP, Init: 2024-04-17 Valid: 2024-04-19
- GEOS-CF, Init: 2024-04-16 Valid: 2024-04-18
- NAAPS, Init: 2024-04-16 Valid: 2024-04-18
- ENSEMBLE (geospf and geoscf), Init: 2024-04-14 Valid: 2024-04-16

Background layers:

- VIIRS SNPP True-color Image
- EPA AirNow observations
- Clustering the EPA AirNow stations

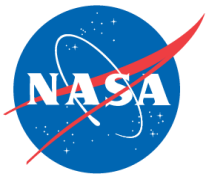
Series:



We thank **GMAO** and **NRL** for providing the model data products. More details can be found [here](#).

Addition of current
Airnow PM_{2.5}
observations to
landing page

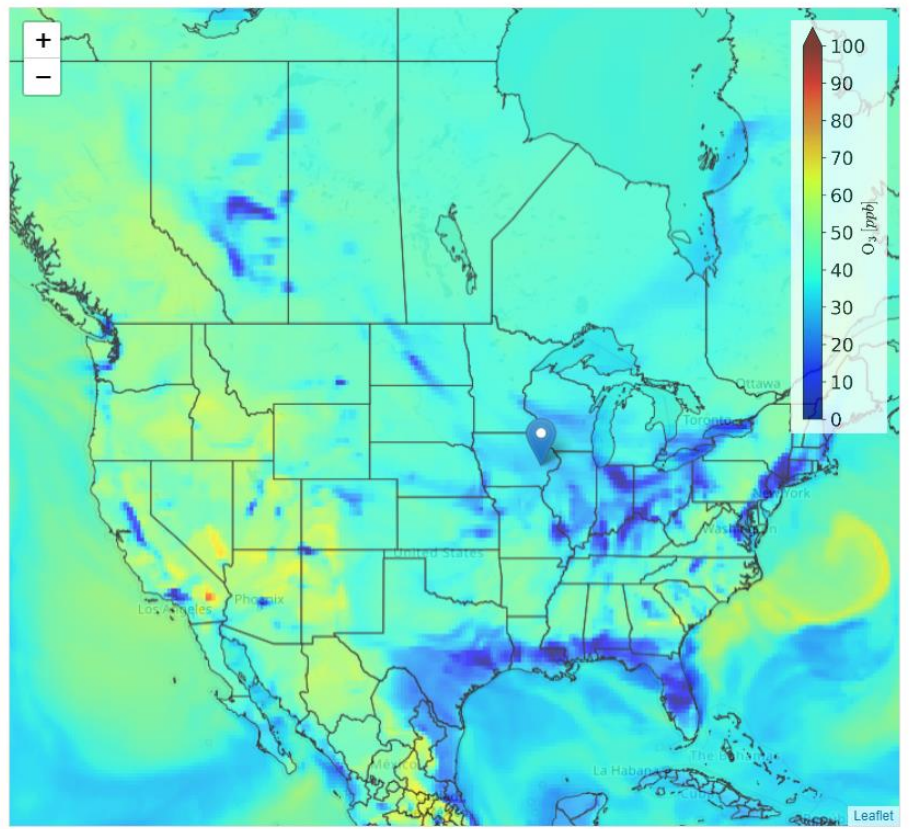
Current ARL-Supporting Evidence



EARTH SCIENCE
APPLIED SCIENCES

GEOS-CF - O₃

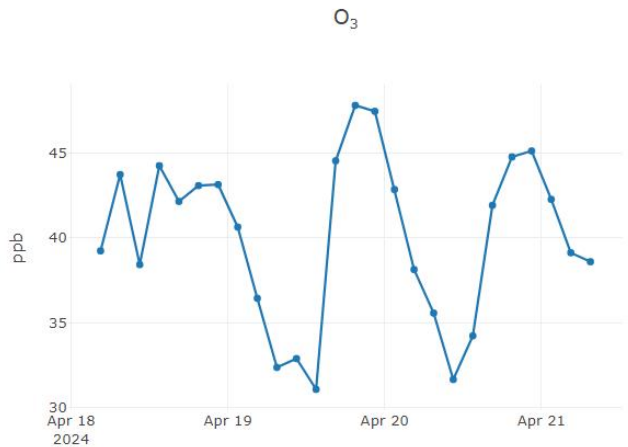
InitDate: 2024-04-18 04:00
EndDate: 2024-04-20 10:00



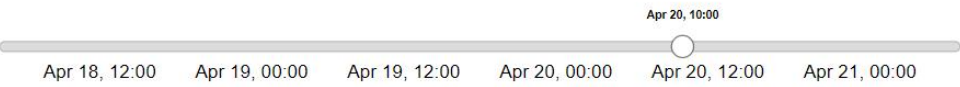
Input an address or click on the map to get pm2.5 forecasts

Address:

- Models:
- GEOS-FP
 - GEOS-CF
 - PM_{2.5}
 - O₃
 - NAAPS

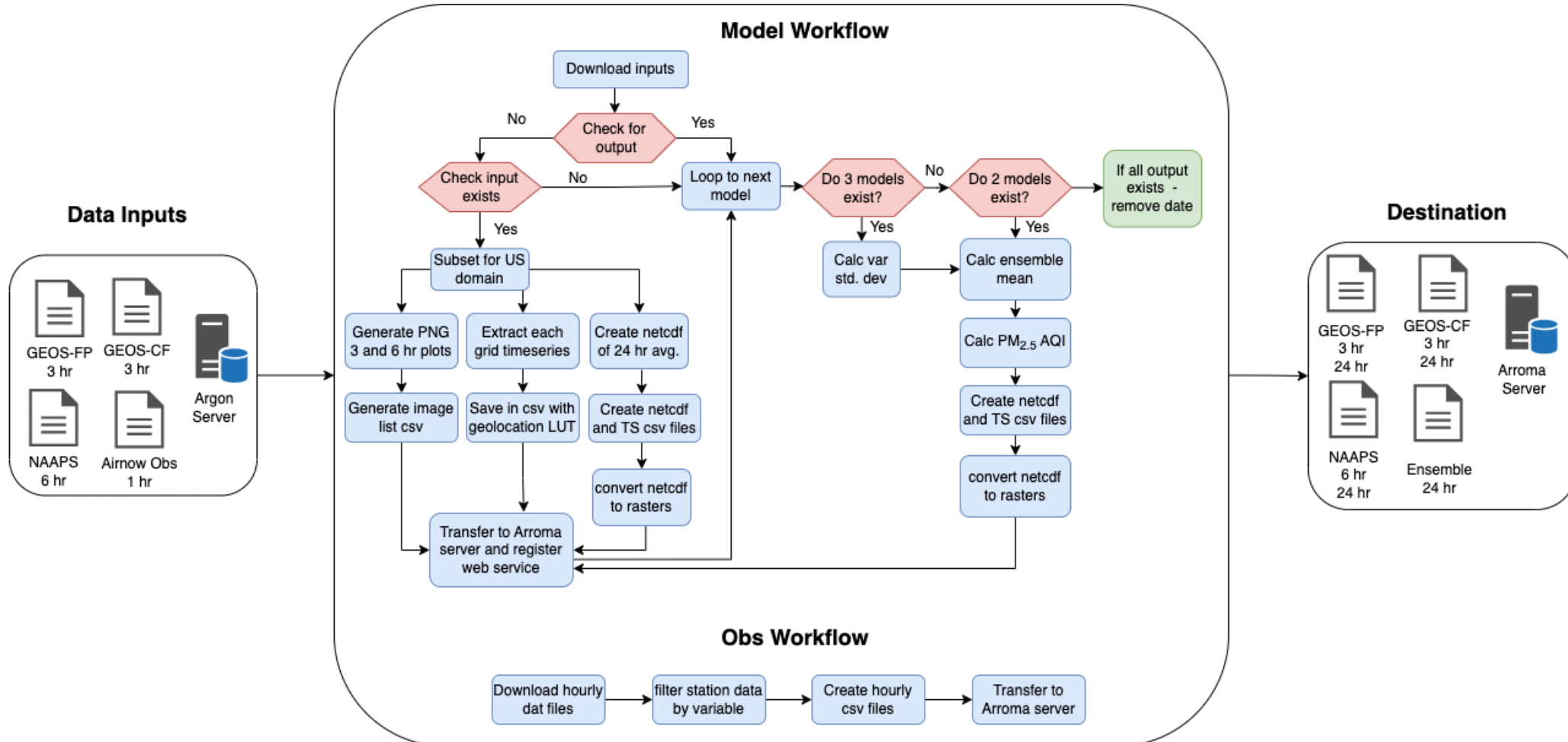


User friendly time-series webpage and inclusion of GEOS-CF ozone forecast



Current ARL-Supporting Evidence

- Workflow for operational model visualization from download to published online
- Includes PM_{2.5} calculation for GEOS-FP, ensemble mean, and Airnow observations

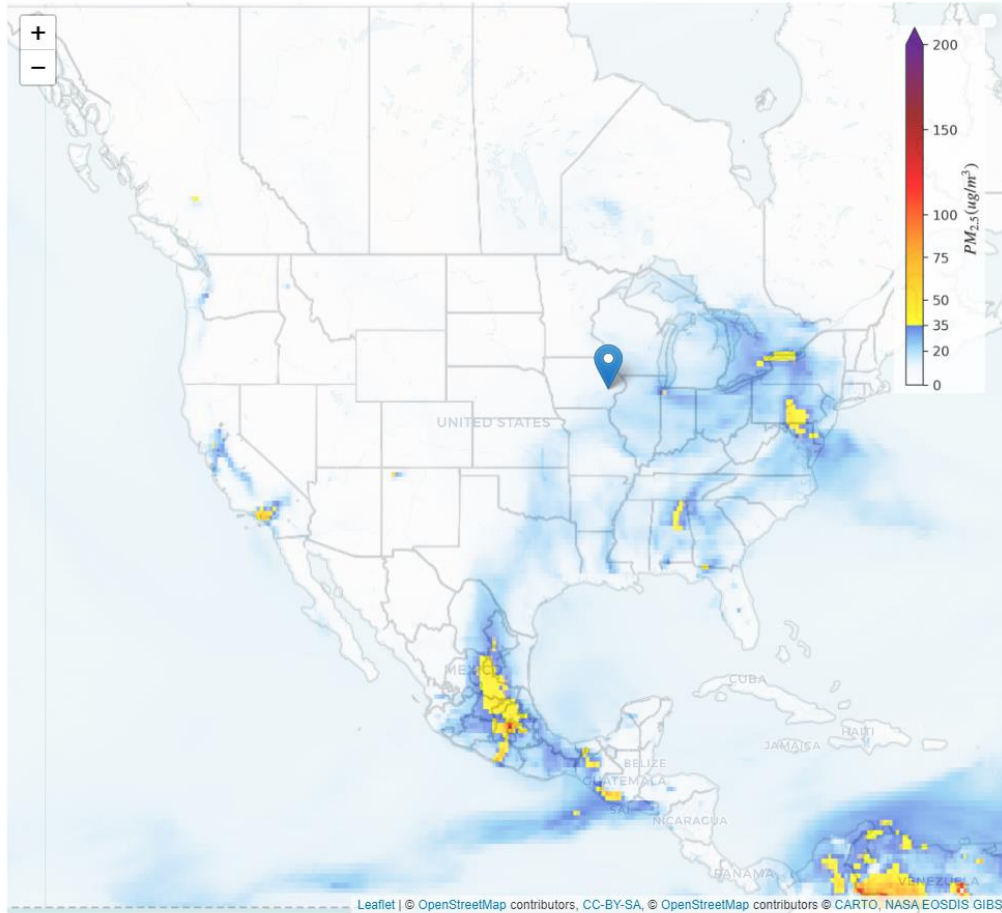


Highlight Image – Overlay Prototype

AQI for You webpage based on Ensemble mean daily forecast

IOWA Home Timeseries FCST Daily Average Satellite Data Weekly Briefings AQI for you About

Tailored AQI Recommendations from PM2.5 Ensemble Models



Ensembled models: GEOSFP AND GEOSCF Init: 2024-04-18 Valid 2024-04-20

Type an address or click on the map

205 N Madison St, Iowa City, IA 52245, USA

Select date of interest for the following models:

2024-04-18

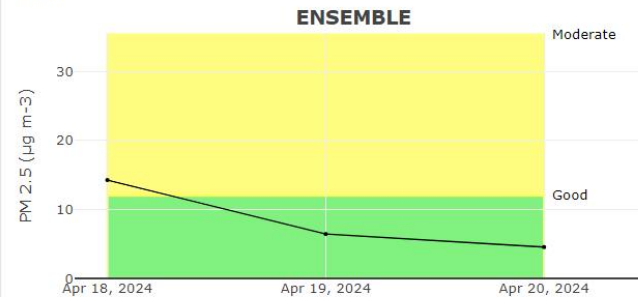
AQI for you!

It looks like the air quality for today and tomorrow is **good**. Some recommendations to consider are:

Today and Tomorrow Air Quality: **good** (PM_{2.5} concentrations of 6.43 and 4.54 µg/m³ respectively)

It is a great day to be active outside!

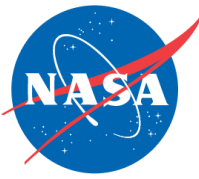
Series:



Background layers:

VIIRS SNPP True-color Image

We thank **GMAO** and **NRL** for providing the model data products. More details can be found [here](#).



Accomplishments Summary

- Hold quarterly meetings with state agency collaborators in support of stakeholder engagement
 - Feedback summarized and included in report
- Website Design:
 - User friendly improvements to data web pages and inclusion GEOS-CF ozone and Airnow PM2.5 visualizations
- Began testing MLPNN for PM2.5 bias correction

Questions?