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

Megan Christiansen
on behalf of Jun Wang
March 29, 2023

Project Summary

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- 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
- Solication: NNH21ZDA001N-HAQ
- Project Summary
  - The proposed project will first make the TEMPO AOCH research algorithm operational so the AOCH 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 PM2.5 forecast bias corrections, with inputs from TEMPO AOCH and AOD data, as well as GEOS-FP meteorological and aerosol fields.
- US CONUS

Project Partners/Collaborators

List project Co-Investigators, collaborators, and other partners

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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

Met with each stakeholder organization in smaller group meetings in January to better understand their vision for incorporating the FireAQ system into their individual workflows. This resulted in valuable feedback that has been summarized on slide 12.

Fires identified over the Northwestern US Sept 10, 2022 (FILDA-2 product)

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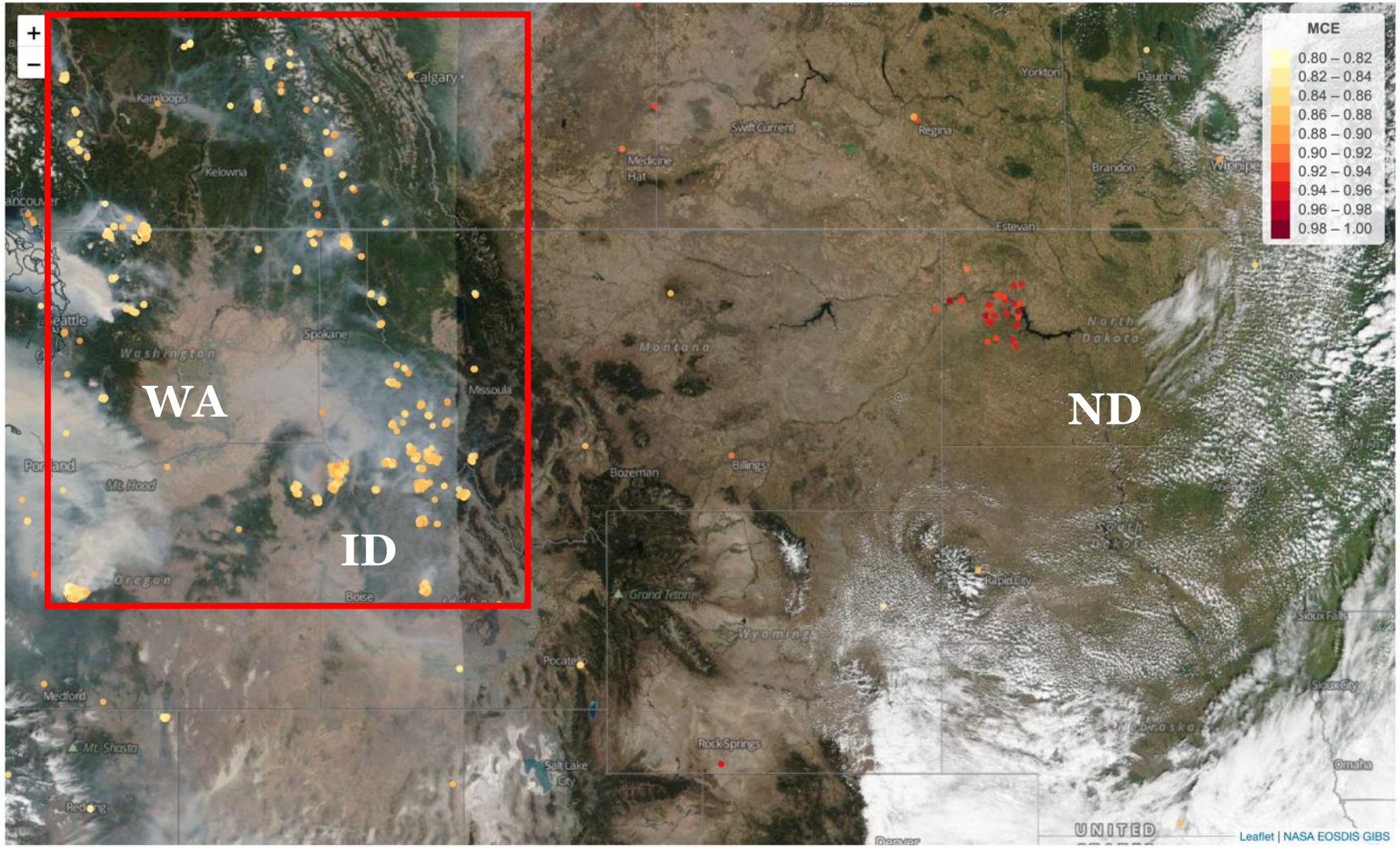

High AOD over the Great Plains associated with long-range transport of smoke

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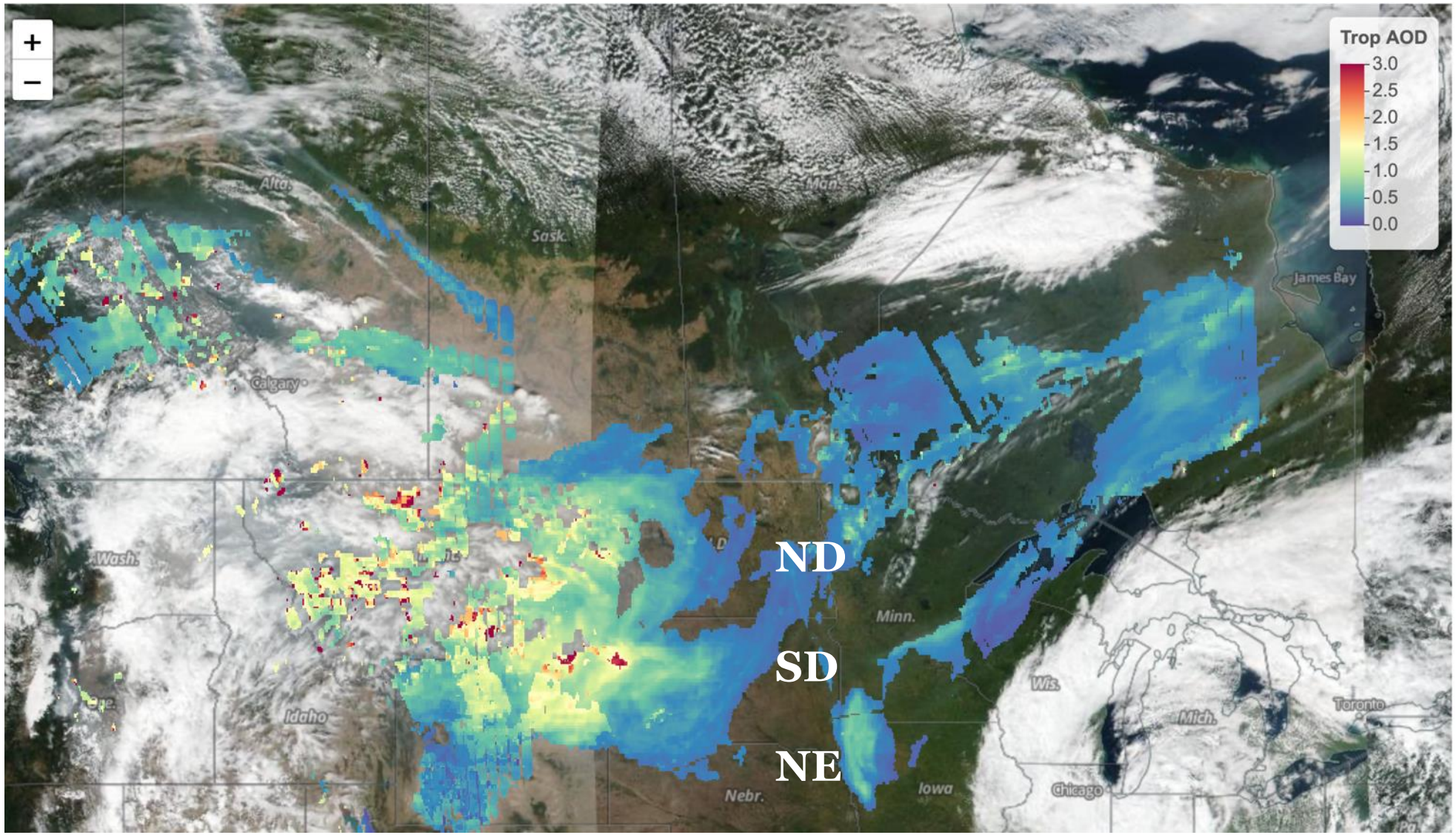
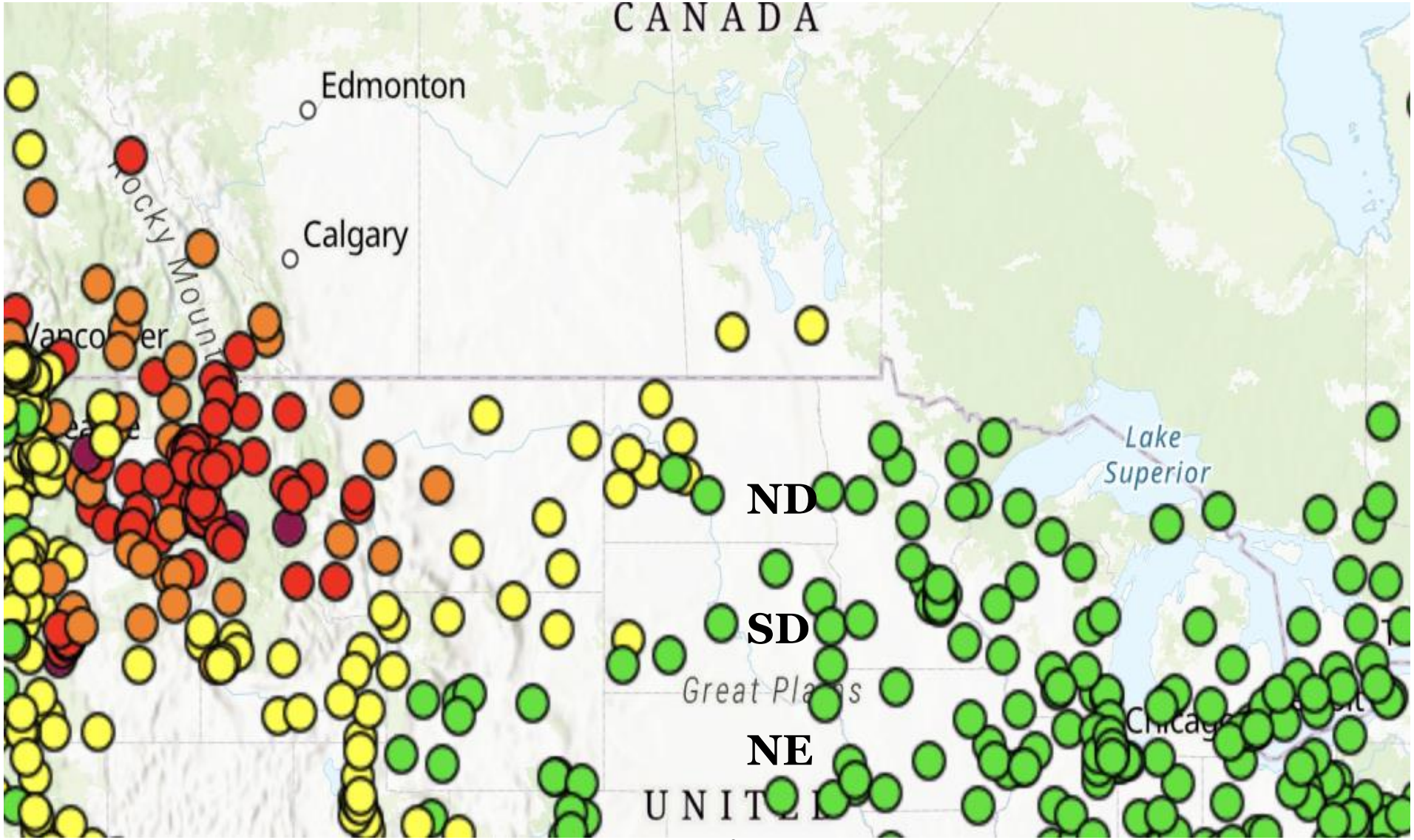


Surface AQI from EPA's AIRNOW



Hourly AOCH data from TEMPO using TROPOMI data as proxy

12 Sep. 2022

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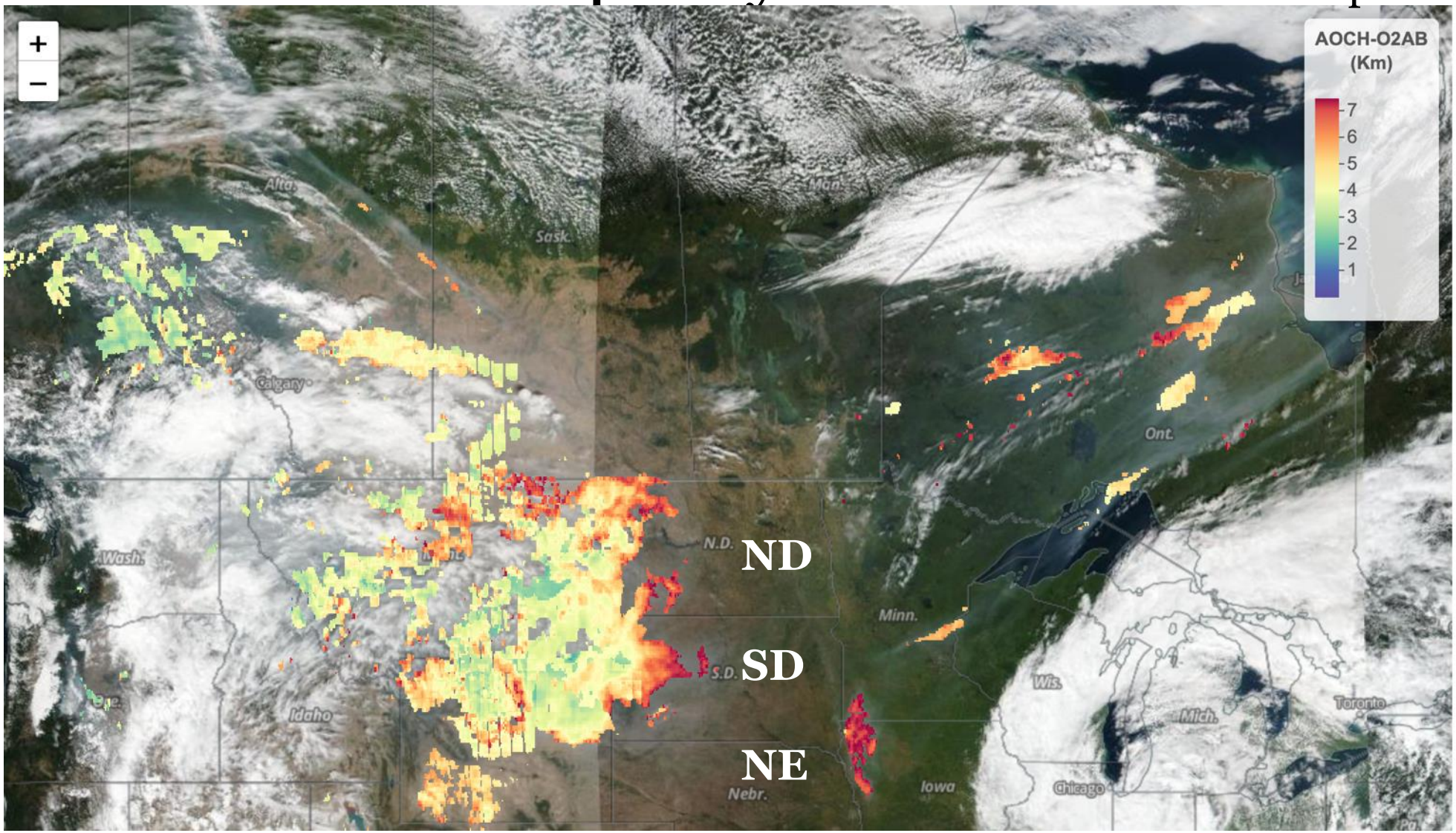

$PM_{2.5}$ forecasts generally captured the high concentrations, but overestimated the spatial distribution

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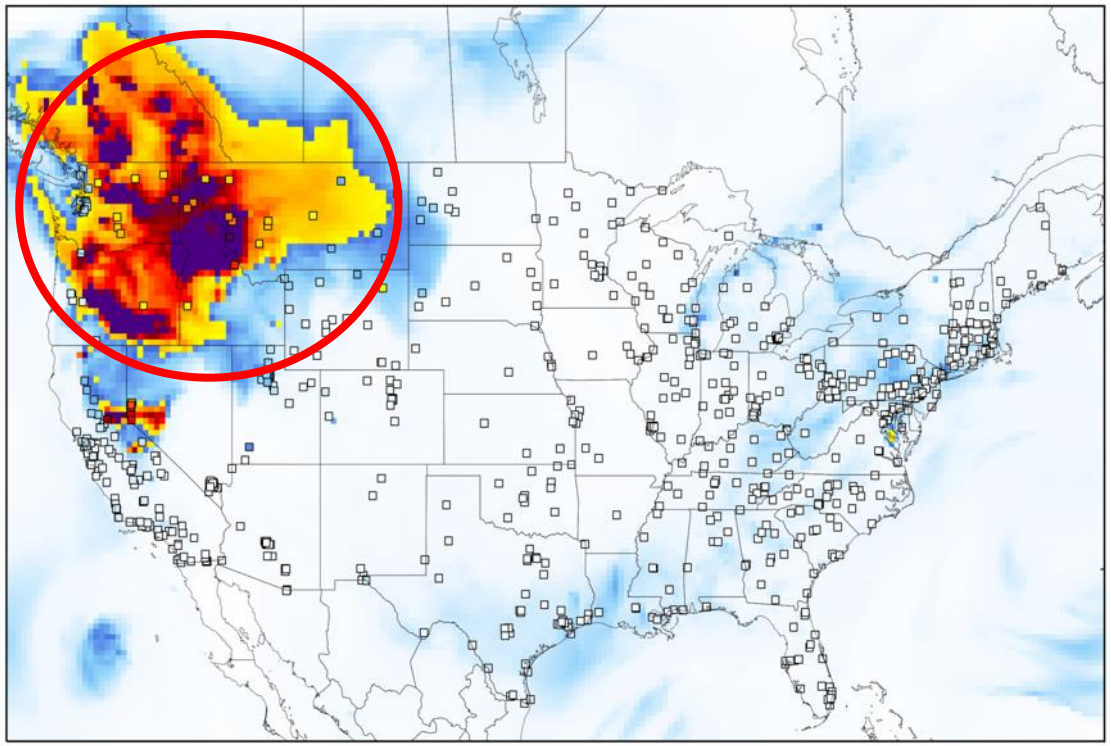
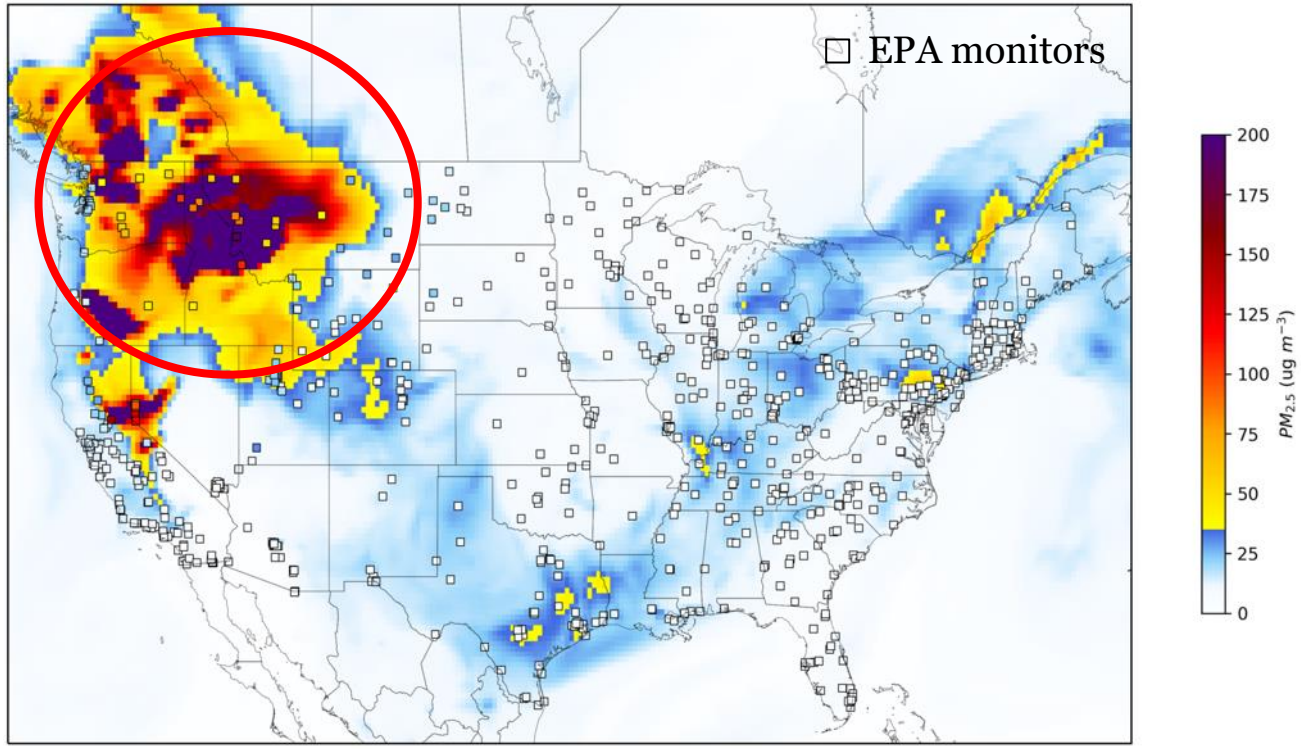
GEOS-FP Daily Average



GEOS-CF Daily Average



Multi model and satellite bias correction ensemble approach: Kalman Filter

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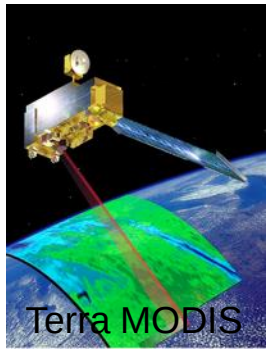
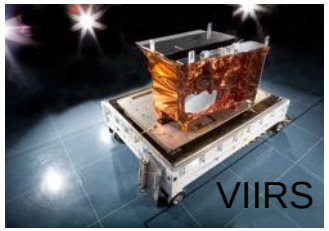
GMAO products
- GEOS FP
- GEOS CF

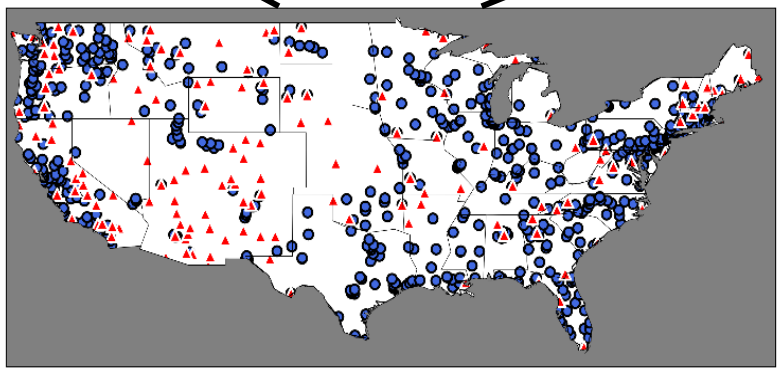
NRL model
- NAAPS

Models



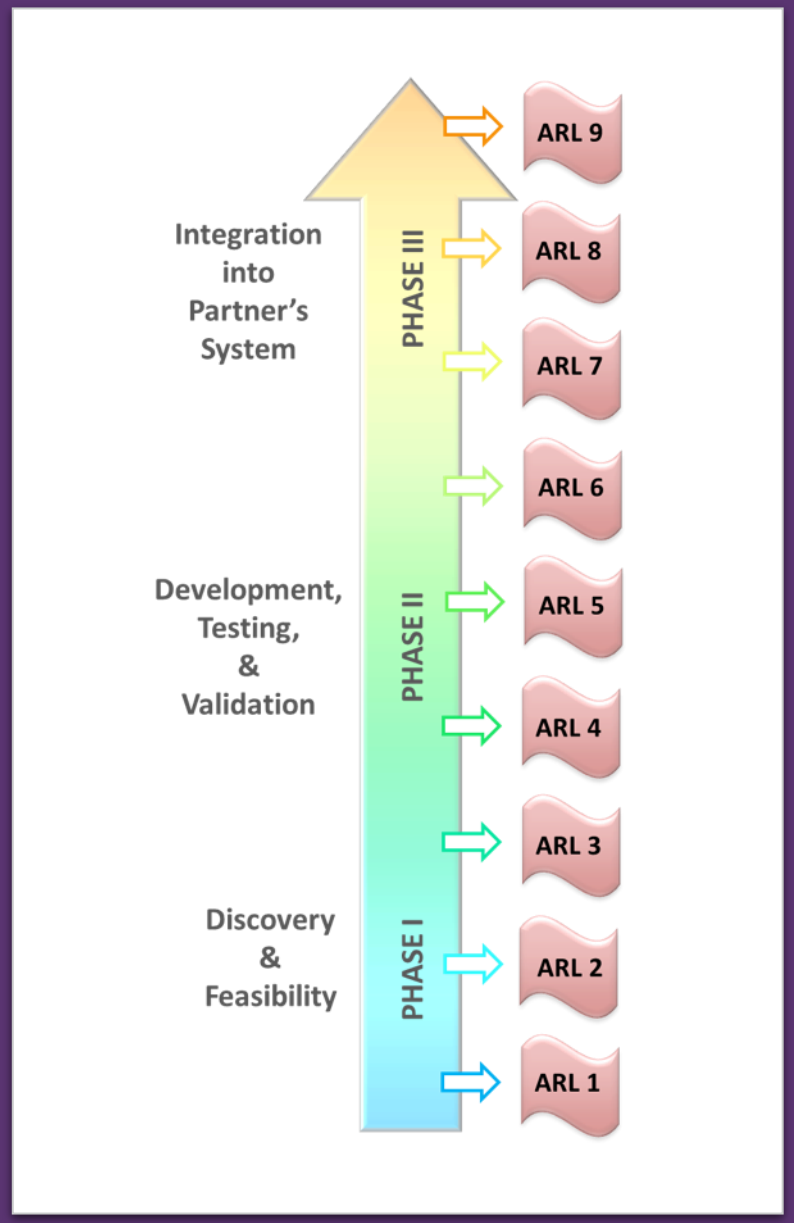


Satellites



Ground observations

Developed under a NASA HAQAST project for smoke forecast in Alaska



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ARL Performance

- Start-of-Project ARL = 2-3 *(August 2022)*
  - AOCH/AOD algorithm tested with Tropomi and documented
- Goal ARL = 8
- Current ARL = 4 *(March 2023)*
  - Web portal developed and live (documented workflow)
  - Model and satellite data visualization operational

Current ARL-Supporting Evidence

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- Summary of feedback from initial meetings with stakeholder agencies

Data Visualization and Documentation

- Ability to overlay model output, fire identifications, satellite products, and ground monitors in one screen
- Documentation of verification or User Manual

Data Structure and Availability

- Tools to download in different data formats (excel, csv, NETCDF, etc.)

Future Data Products for EEA and AQ Monitoring

- Model ensemble means of $PM_{2.5}$
- $PM_{2.5}$ sectored by composition or source
- Aerosol vertical distributions

Current ARL-Supporting Evidence

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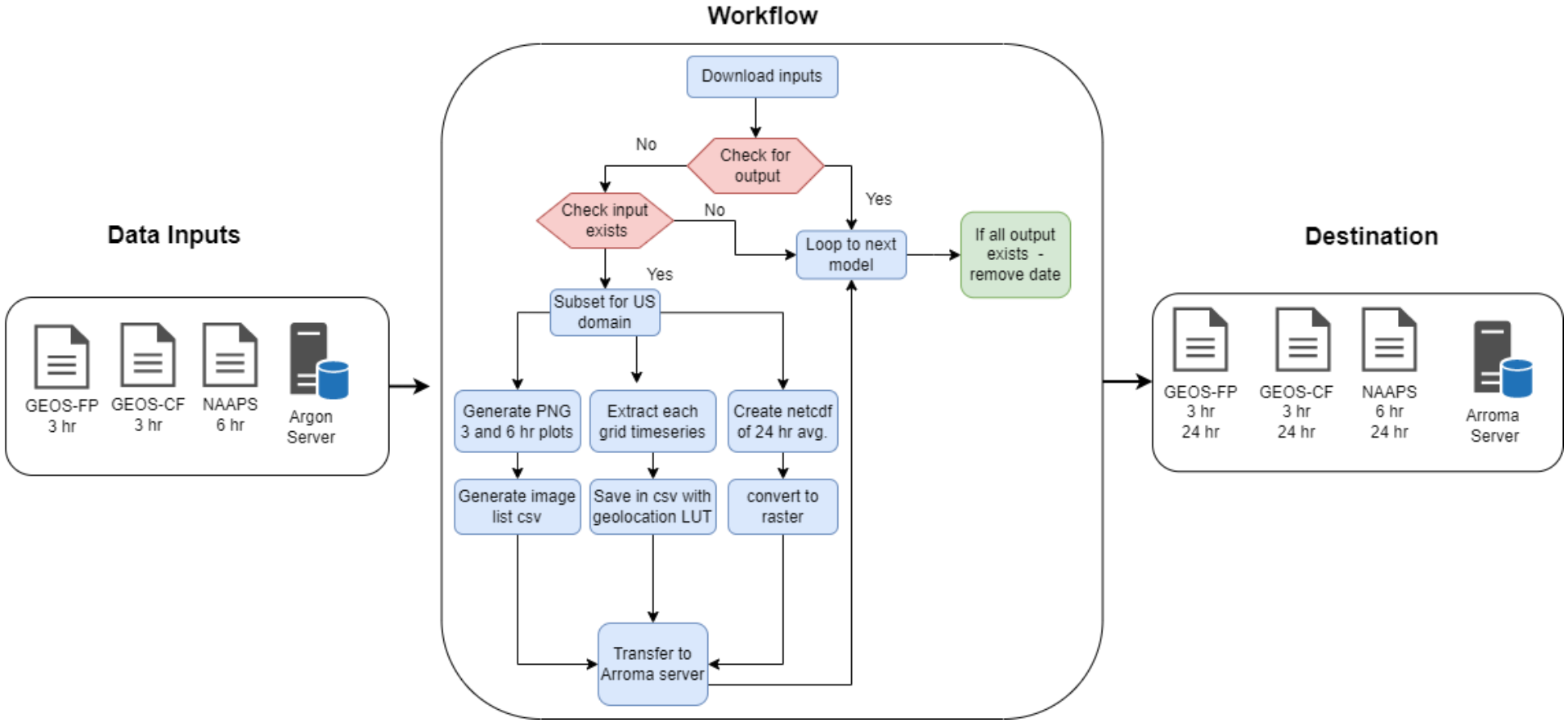
- Workflow for operational model visualization from download to published online
- Includes PM2.5 calculation for GEOS-FP and daily forecast mean for all models



Current ARL-Supporting Evidence

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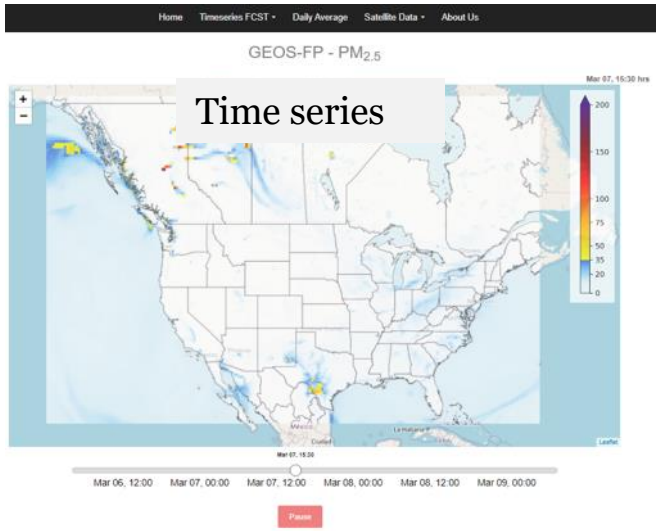
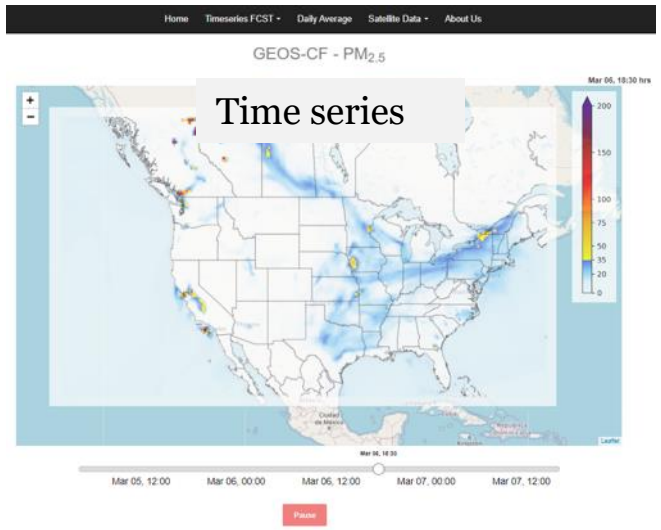
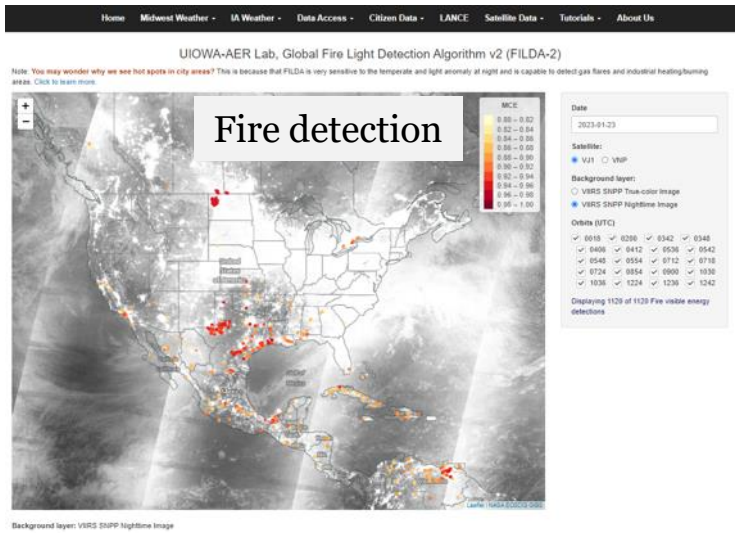
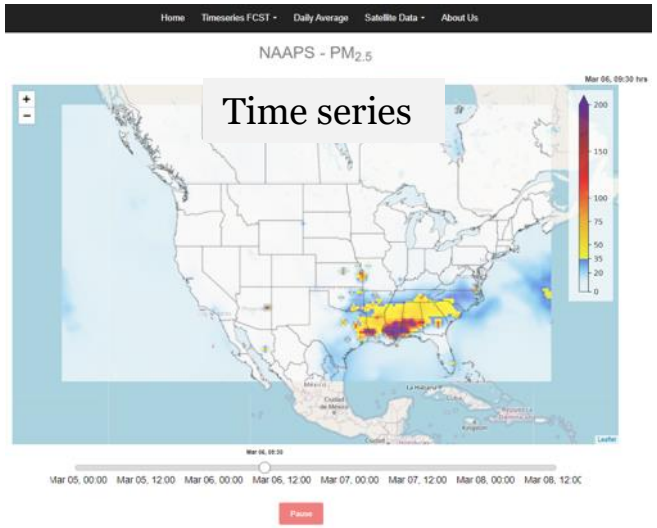
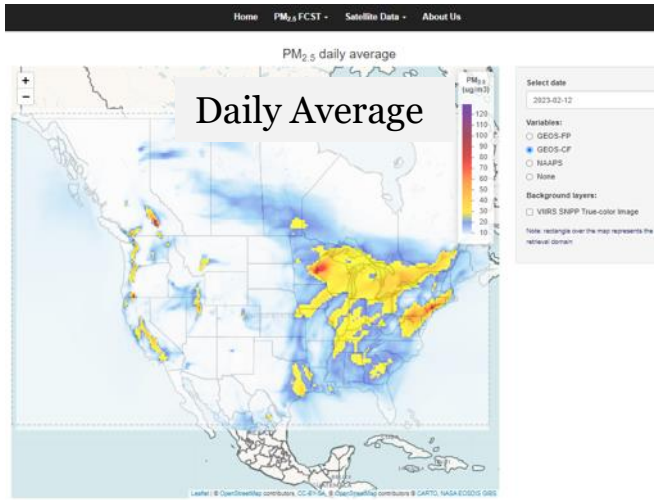
- Website (https://fireaq.uiowa.edu) screenshots. All visualizations are interactive, updated daily

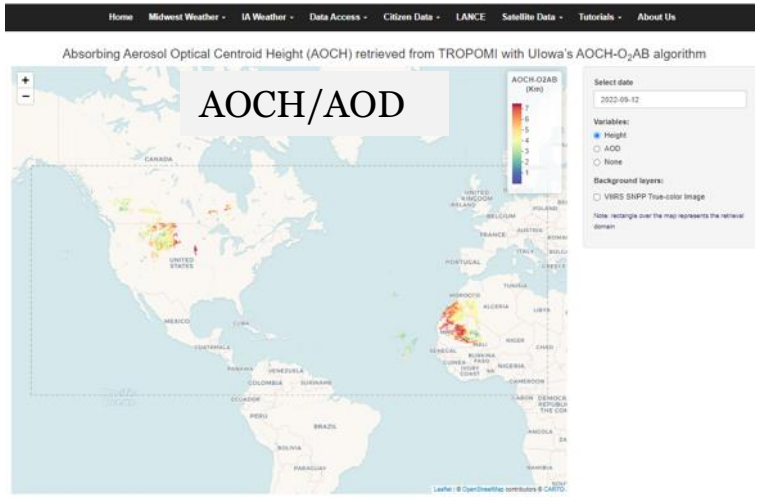












Highlight Image – Overlay Prototype

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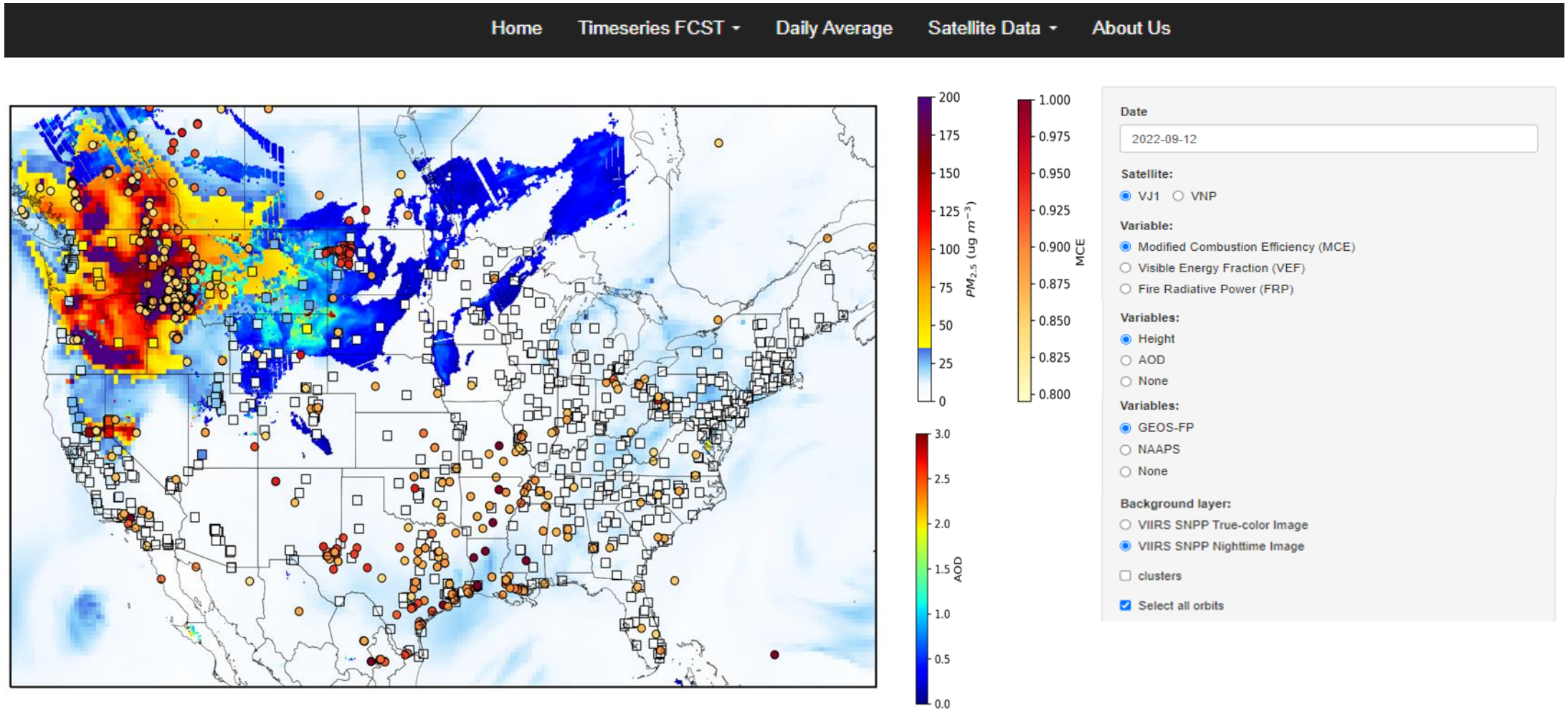
Overlay NRT data: Forecasts, fires, aerosols, EPA monitor



Accomplishments Summary

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- Held initial meetings with state agency collaborators in support of stakeholder engagement
  - Feedback summarized and included in report
- Website Design:
  - domain assigned, infrastructure built, and visualization workflow made operational
- Began processing ground station measurements to evaluate GEOS forecast models benchmark performance

Questions?