

Air Quality Monitoring and Forecasting

NASA Health and Air Quality Applied Science Team (HAQAST-3)

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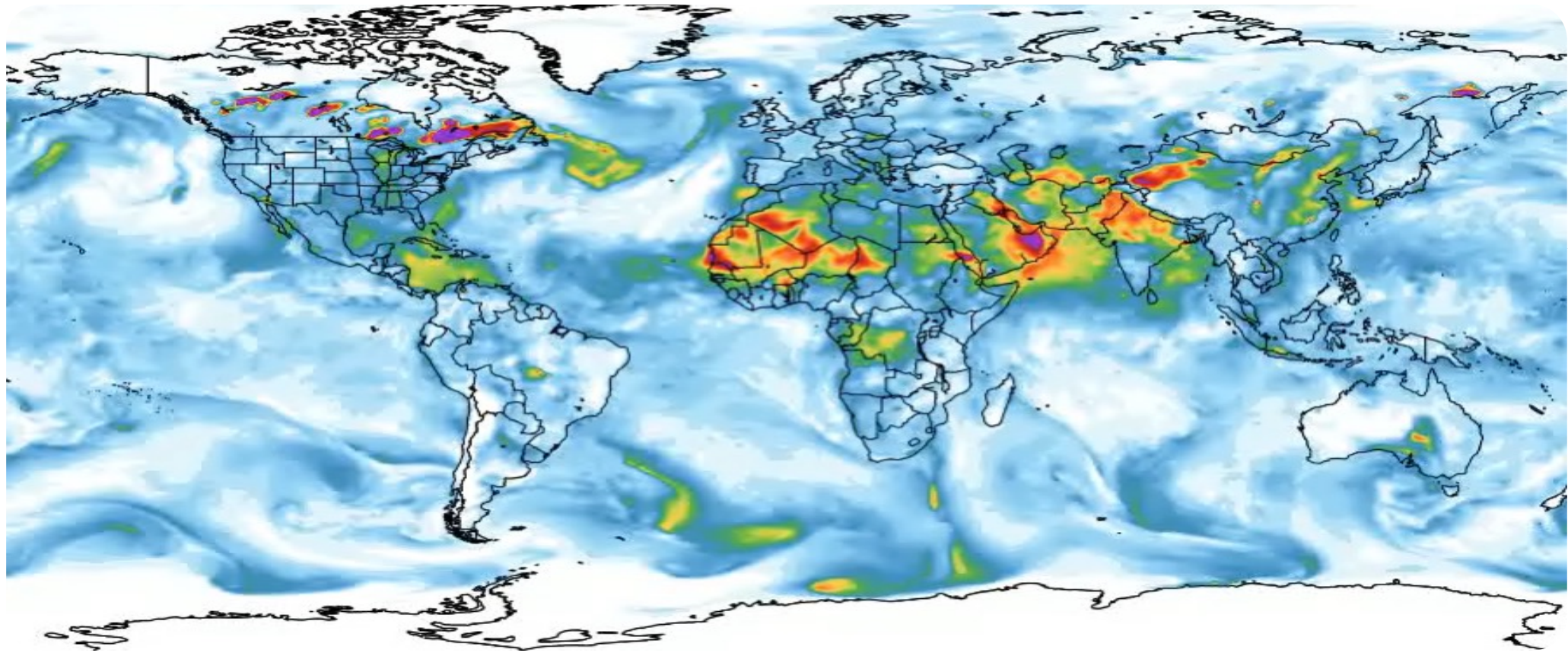
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Overview of Current HAQAST Project

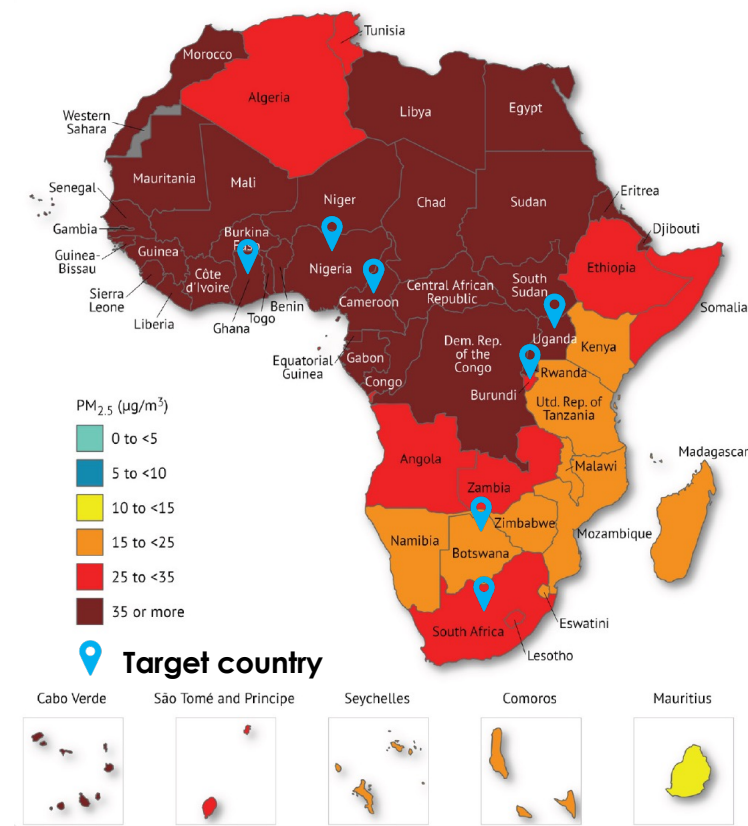


- **Why We're Doing This?**

- Not enough tools to measure serious air pollution in many African Countries/Cities
- Existing tools are limited
- Clear, trusted data is needed for better health and policy decisions

- **Vision Statement**

- **AAQE (African Air Quality Explorer)**
- **An Easy-to-use online tool** powered by NASA data that brings together:
 - 1) Historical air pollution trends
 - 2) Near real-time satellite imagery
 - 3) Air quality forecasts
 - 4) Local and satellite data in one place



Population weighted annual PM_{2.5} exposures in Africa [Health Effects Institute (HEI), 2022]



Technical Plan & Capabilities

• AAQE Features

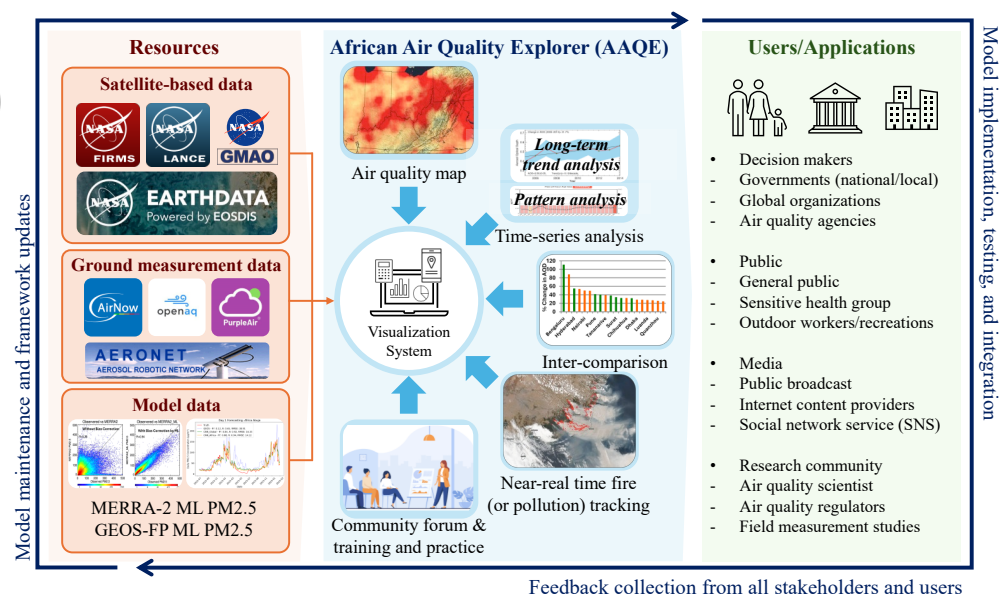
- Historical data (2000-present) data and interpretation
- Near real-time (NRT) satellite products (RGB, AOD, fires, etc.)
- PM2.5 forecast for next 72 hours
- Downloadable time-series for ~800 cities > 100,000 population
- Various data: MERRA2-ML, GEOS-FP-ML, VIIRS, FCI, AERONET, OpenAQ, etc.

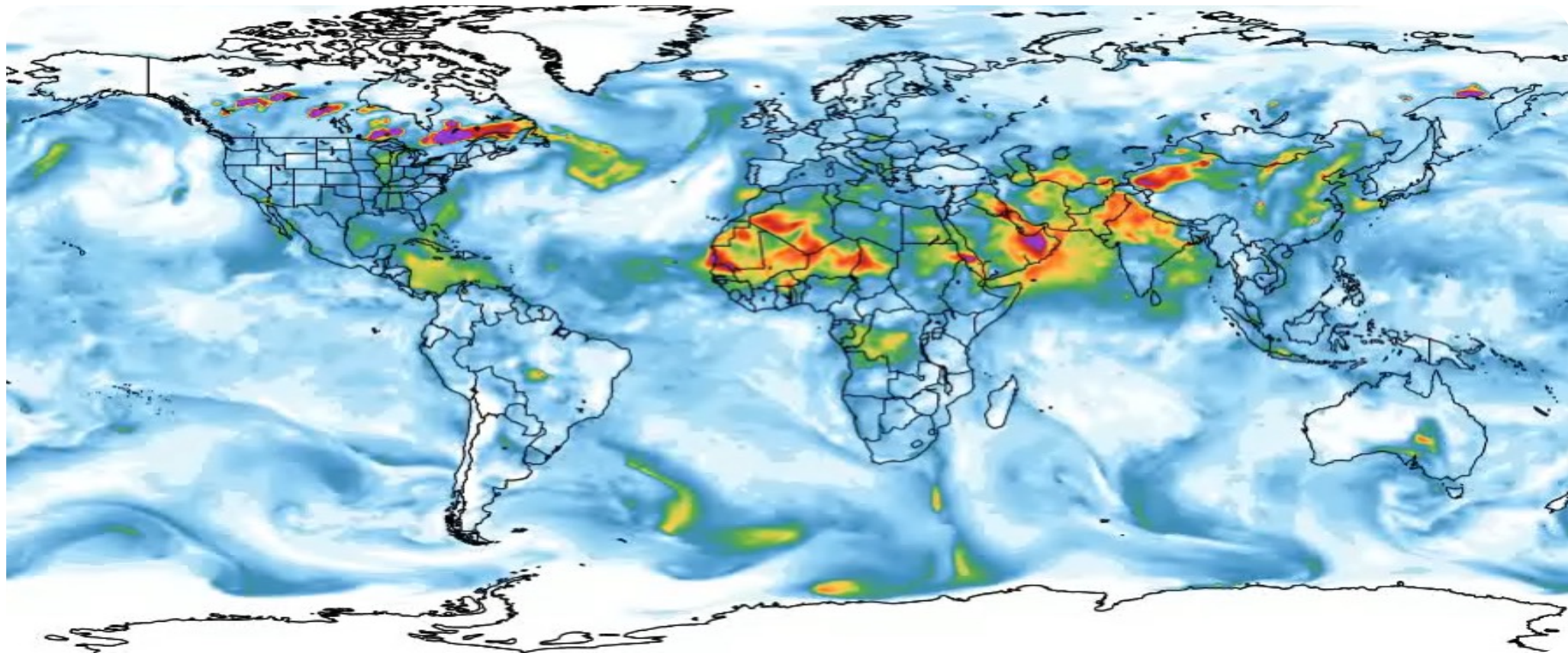
• Deployment

- Cloud-hosted (scalable and customizable)
- Open-source

• Engagement

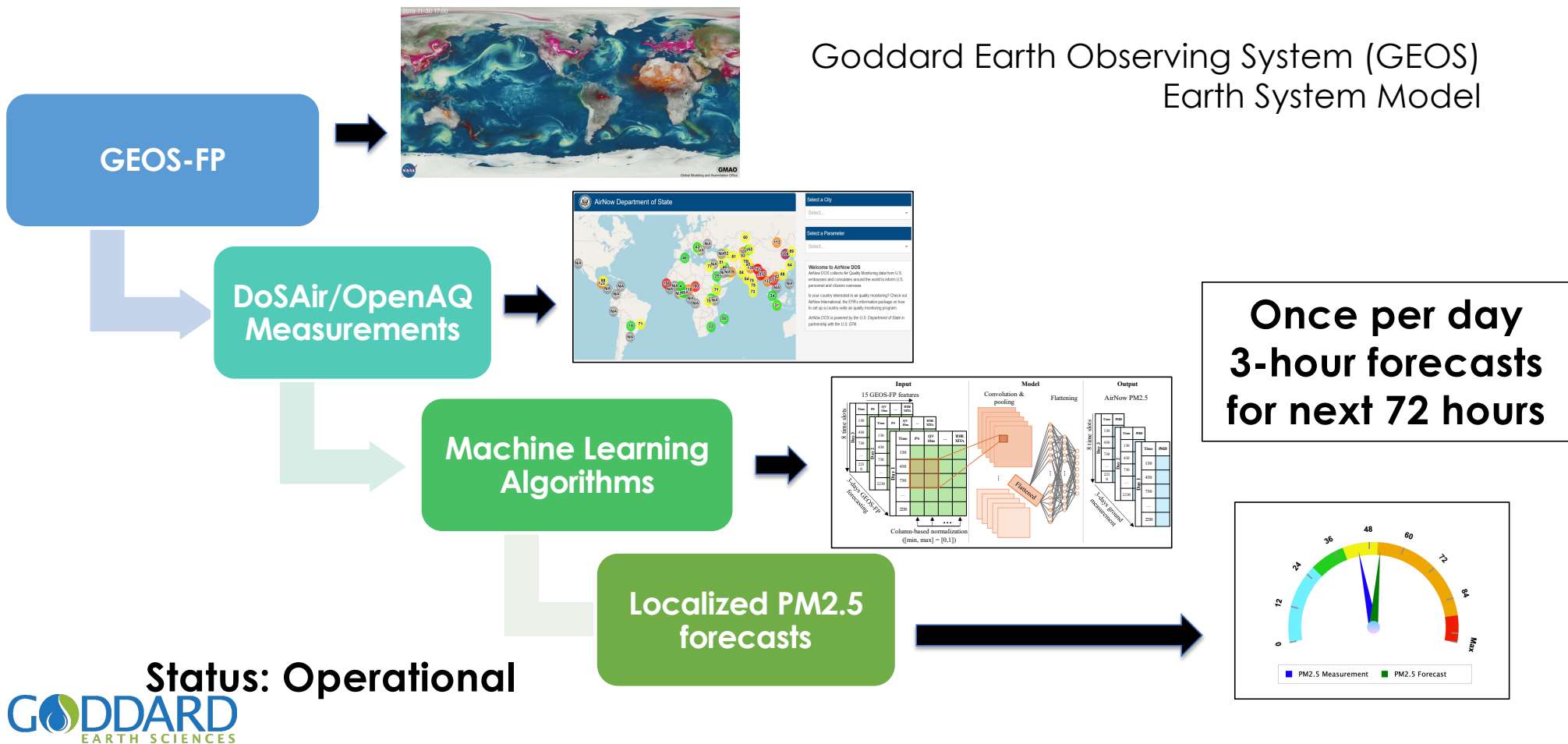
- End-user training (ARSET, webinar, and local workshops)
- Feedback-driven improvements to AAQE





Air Quality Forecasting: Previous HAQAST and
SNWG Efforts

CARES (City Air quality foREcasting and analysis System)





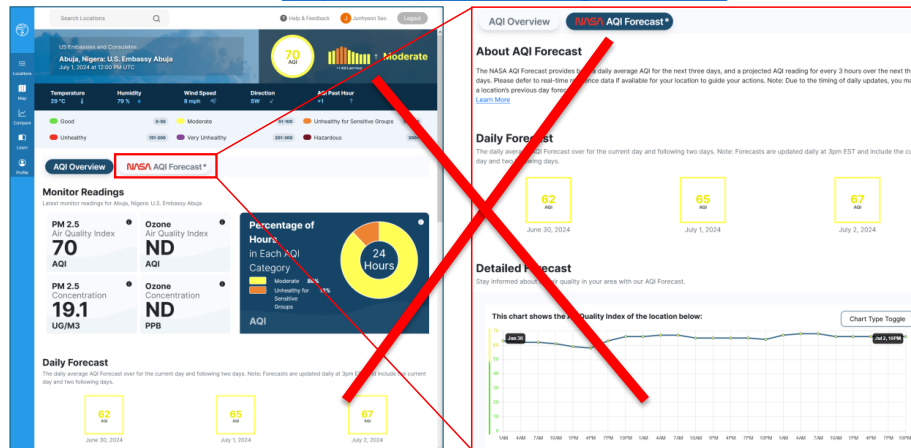
Implementation & Decision Making

Web Application

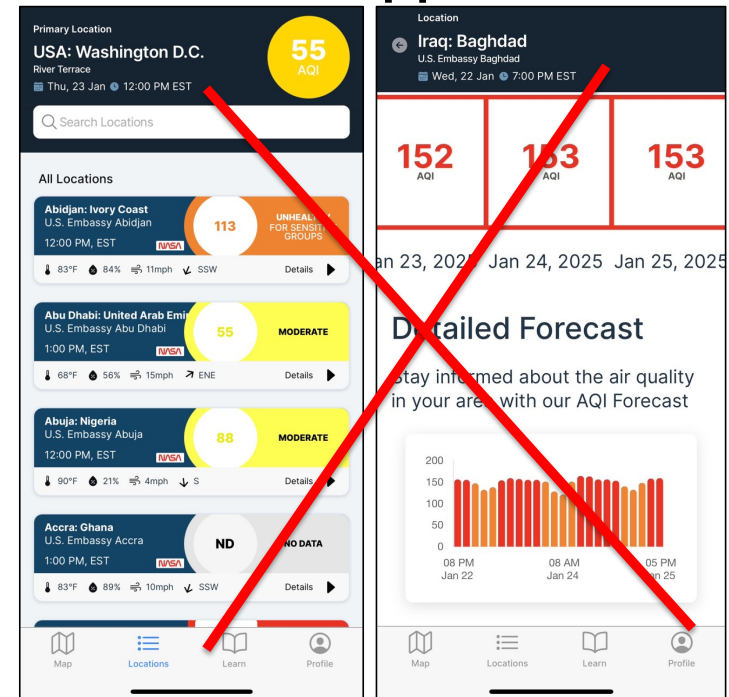


https://aeronet.gsfc.nasa.gov/new_web/aeronet_aqi/

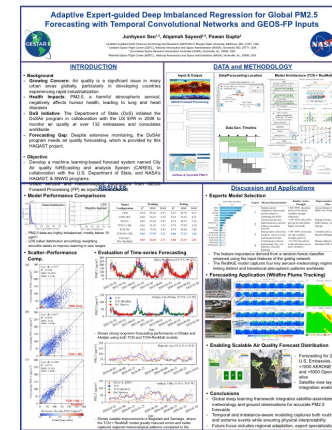
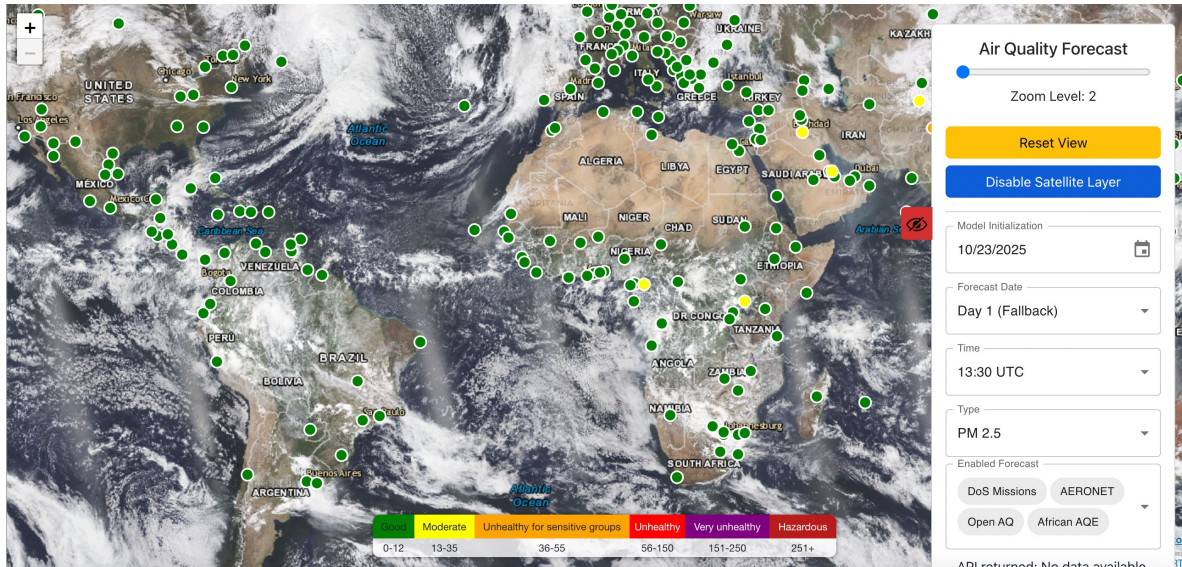
<https://zephyr.stategdi.cloud/>



Mobile Application



CARES Continues, Improved and Scaled



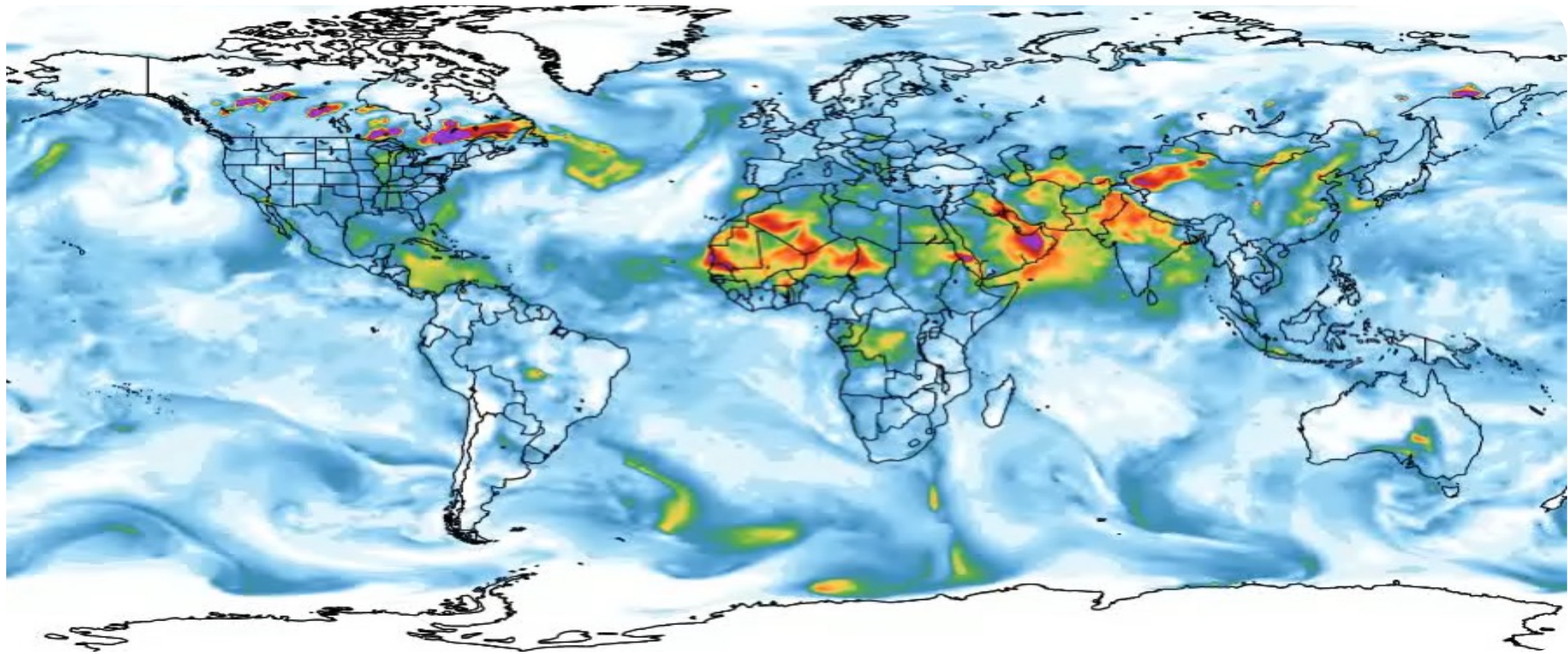
Publication

Poster

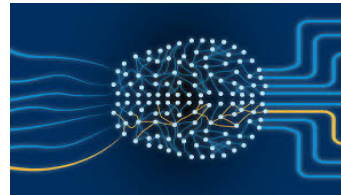
- The operational PM2.5 forecasts are provided for:
 - 270 US Missions (Embassies/Consulates)
 - 1000+ AERONET Stations
 - 5000+ OpenAQ locations
 - 800+ Cities in Africa (Current HAQAST)



(global scaling is supported by NASA SNWG)



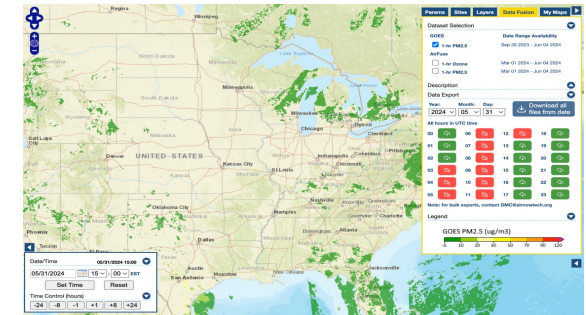
PM2.5 Monitoring



Hourly distribution at 00:00, 2023/06/07

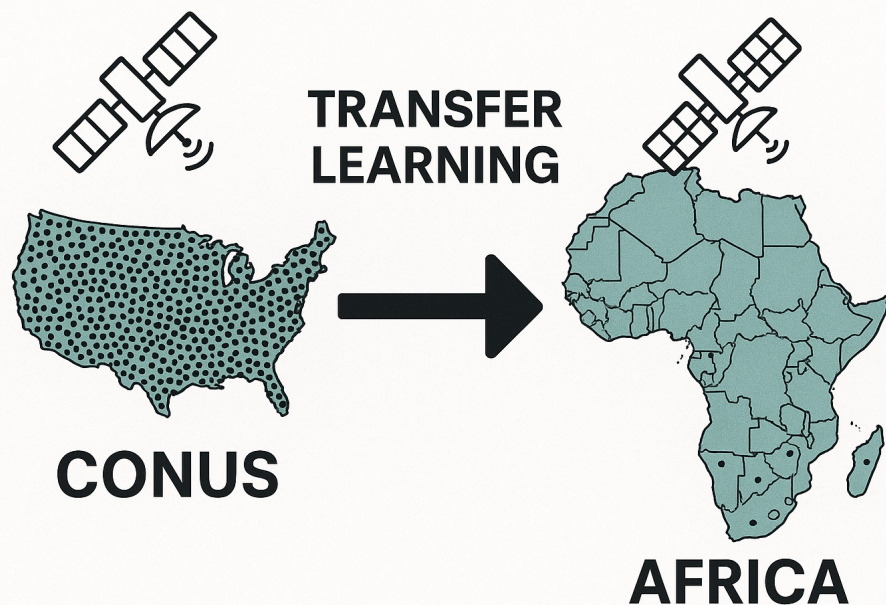
PM_{2.5} Concentration (µg/m³)

52°N, 46°N, 40°N, 34°N, 28°N, 105°W, 96.75°W, 88.5°W, 80.25°W, 72°W

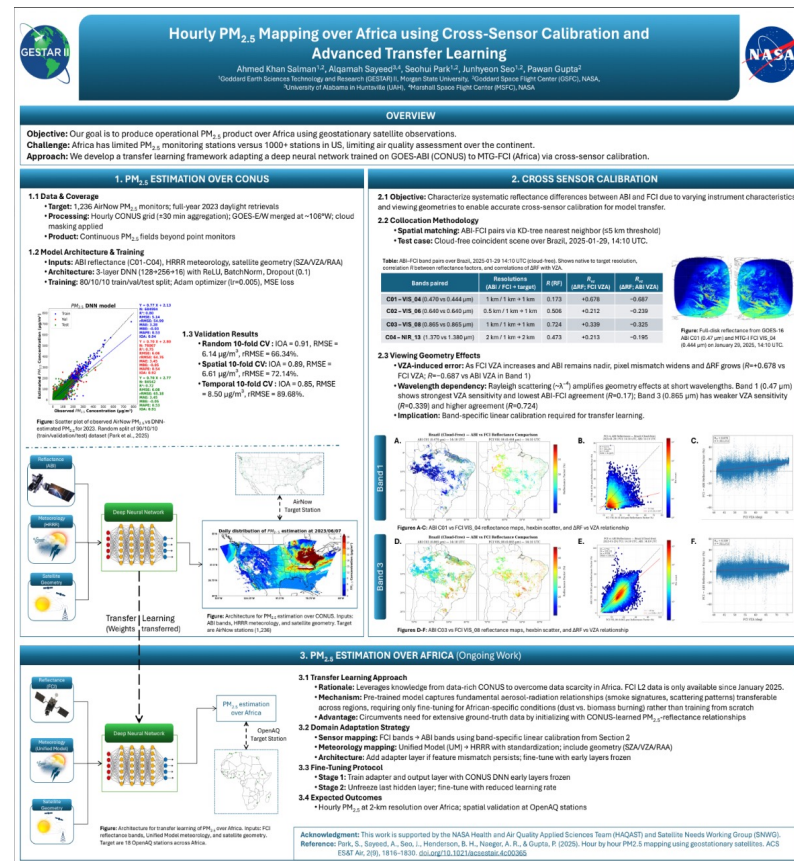


Jenny Bratburd, Pawan Gupta, et al., Incorporating Satellite Data Updates into AirNow, *EM Plus*
Sayeed, A., **Gupta, P.**, Henderson, B., Kondragunta, S., Zhang, H., & Liu, Y. (2025). GOES-R PM_{2.5} evaluation and bias correction: A deep learning approach. *Earth and Space Science*, 12, e2024EA004012. <https://doi.org/10.1029/2024EA004012>

Transfer Learning and New Geostationary Satellite over Africa



The graphic is produced using ChatGPT



Seohui Park, Alqamah Sayeed, Junhyeon Seo, Barron H. Henderson, Aaron R. Naeger, and Pawan Gupta, **Hour by Hour PM_{2.5} Mapping Using Geostationary Satellites**, *ACS ES&T Air* 2025 2 (9), 1816-1830 DOI: 10.1021/acsestair.4c00365

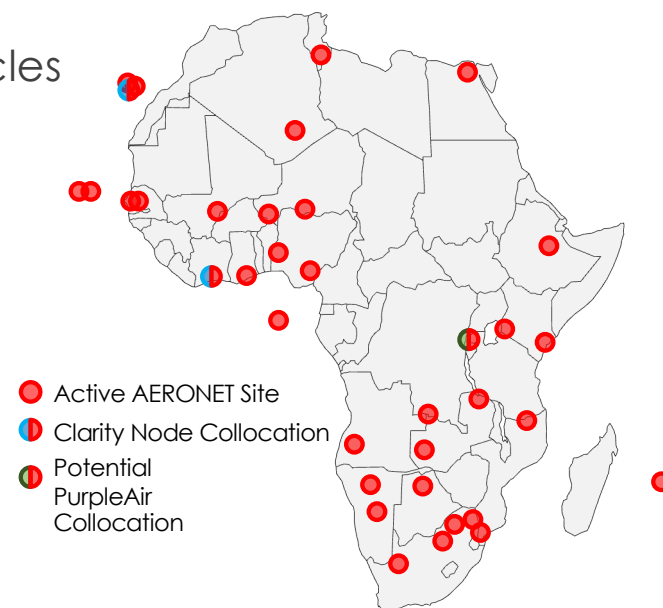
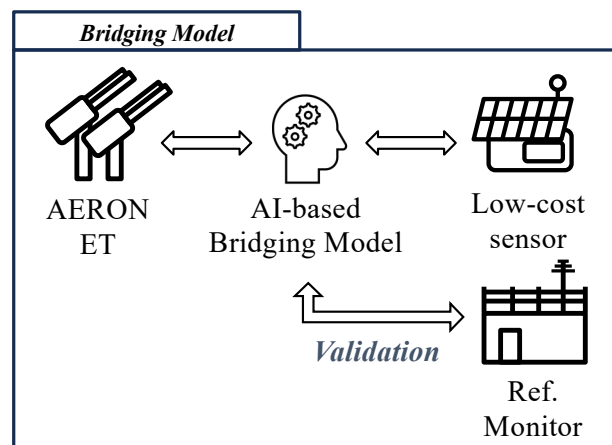
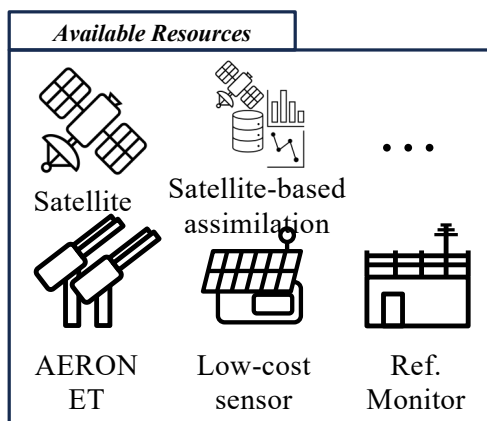
Low-cost PM2.5 Sensor Network in Africa

• Pilot Study Overview

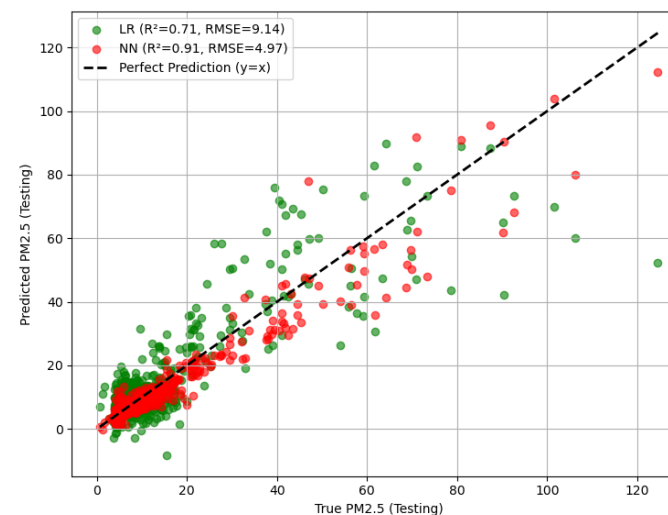
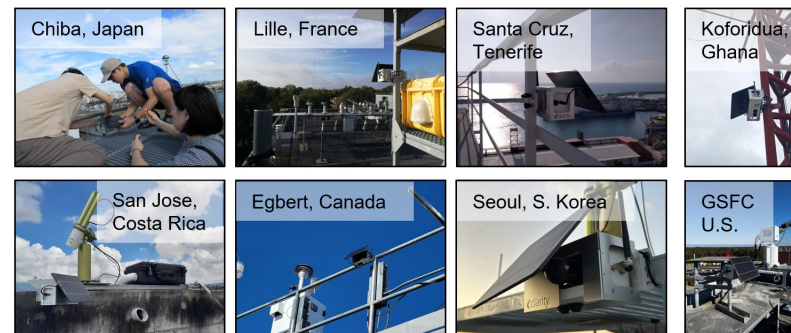
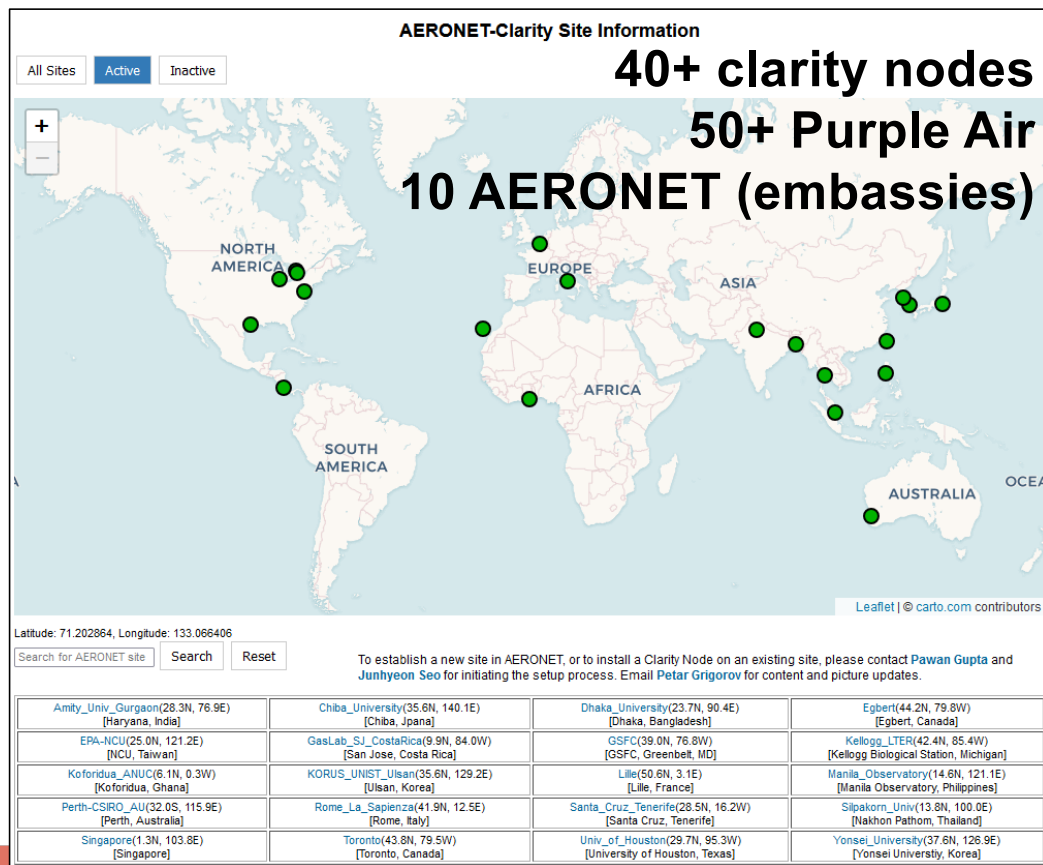
- Deploy low-cost sensors at AERONET stations for 1-1.5 years
- Collect simultaneous surface PM2.5 and aerosol column (AOD) measurements

• Key Research Goals

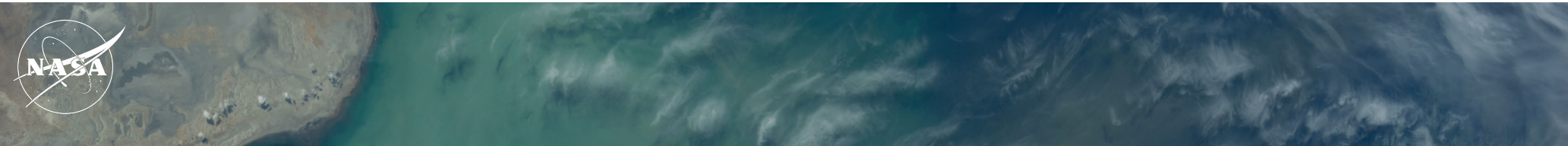
- Investigate surface and column aerosol relationships
- Analyze spatiotemporal variability, including diurnal cycles
- Address gaps in collocated AOD-PM2.5 measurements



Expanding Ground Monitoring



Supported by AERONET-SNWG-DoS Collaboration



Thank you!