National Aeronautics and Space Administration

Supporting local government public health and air quality decision-making with a sub-city scale air quality forecasting system from data fusion of models, satellite, in-situ measurements, and low-cost sensors

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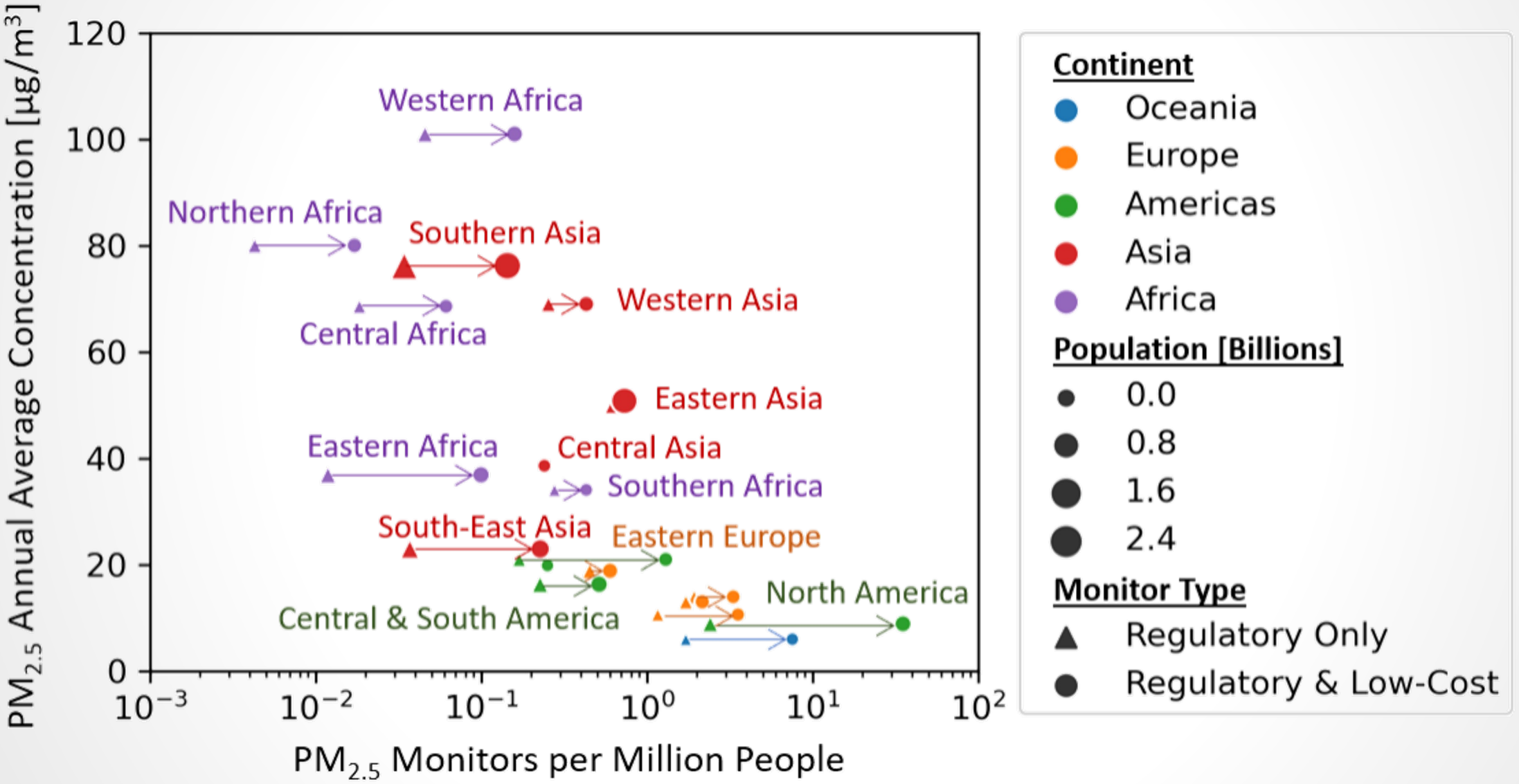
Collaborators: Sean Khan (UNEP), John White (US EPA), Dan Westervelt (LDEO), Sean Wihera (Clarity Movement Co.), Randall Martin (WUSTL)

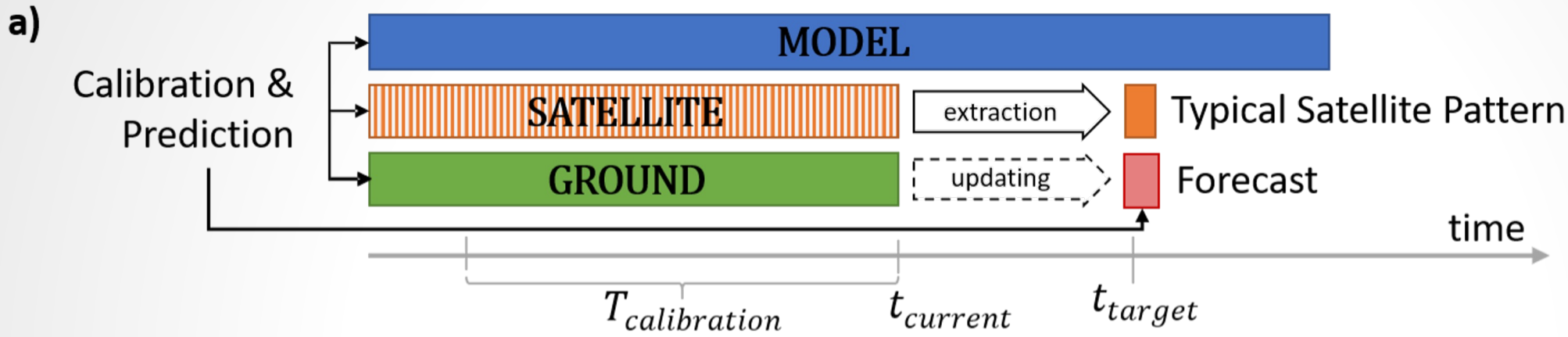
Local End-Users: Ministry of Environment and Sustainable Development, Dakar, Senegal Instituto Pereira Passos, City Municipal Government, Rio de Janeiro, Brazil

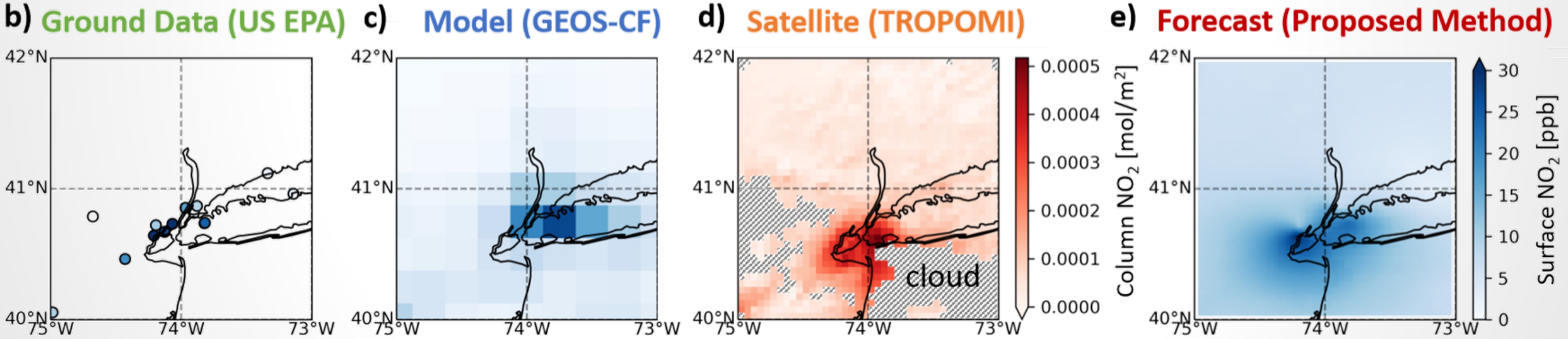
National/Global End-Users: UNEP & US EPA

Motivation: limited in-situ AQ data around the world



Merging Ground, Model, and Satellite Data (ARL 3)





Malings, Knowland, Keller, Cohn (2021) “Sub-city scale hourly air quality forecasting by combining models, satellite observations, and ground measurements” *Earth & Space Science* DOI: 10.1029/2021EA001743.

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Existing STI high-res AOD -> $PM_{2.5}$ maps in GEE (ARL 6)

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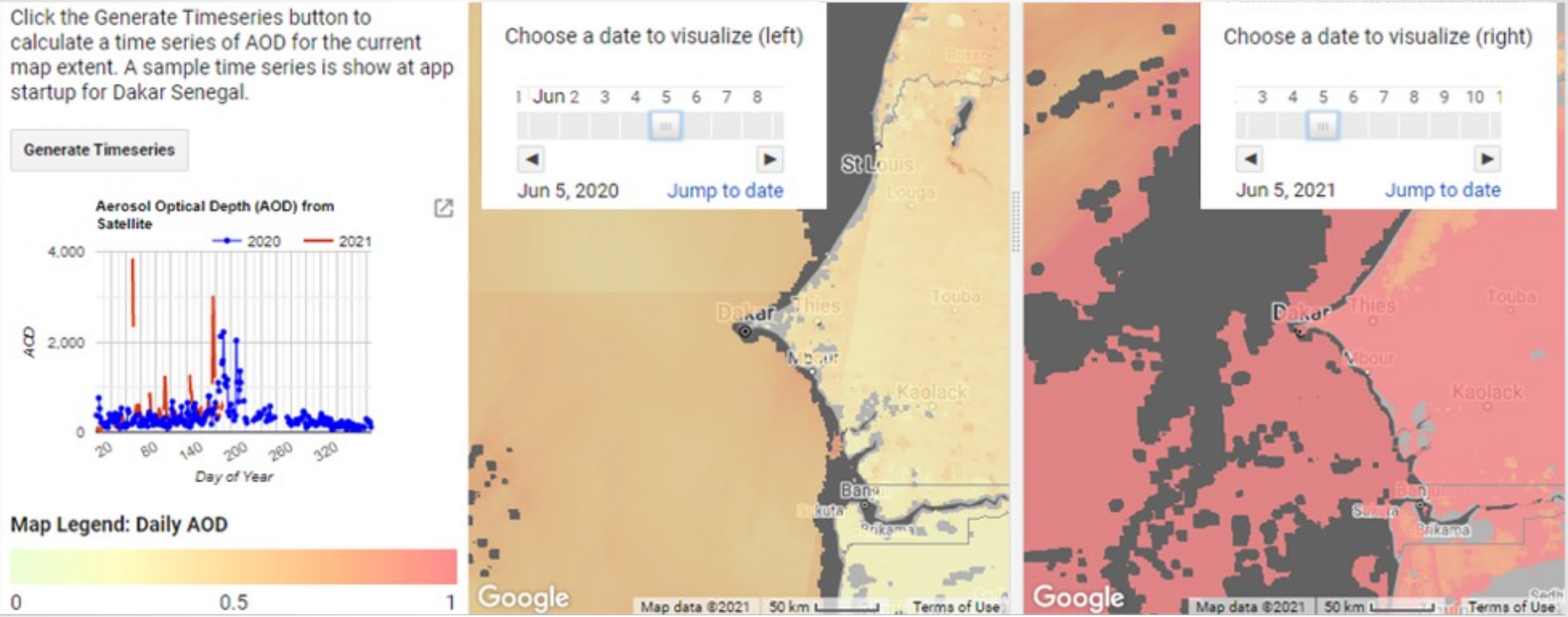

- ✓ Historical estimate
  - Need to configure for forecasting
- ✓ Uses CAMS analyses
  - Need to configure for GEOS-CF

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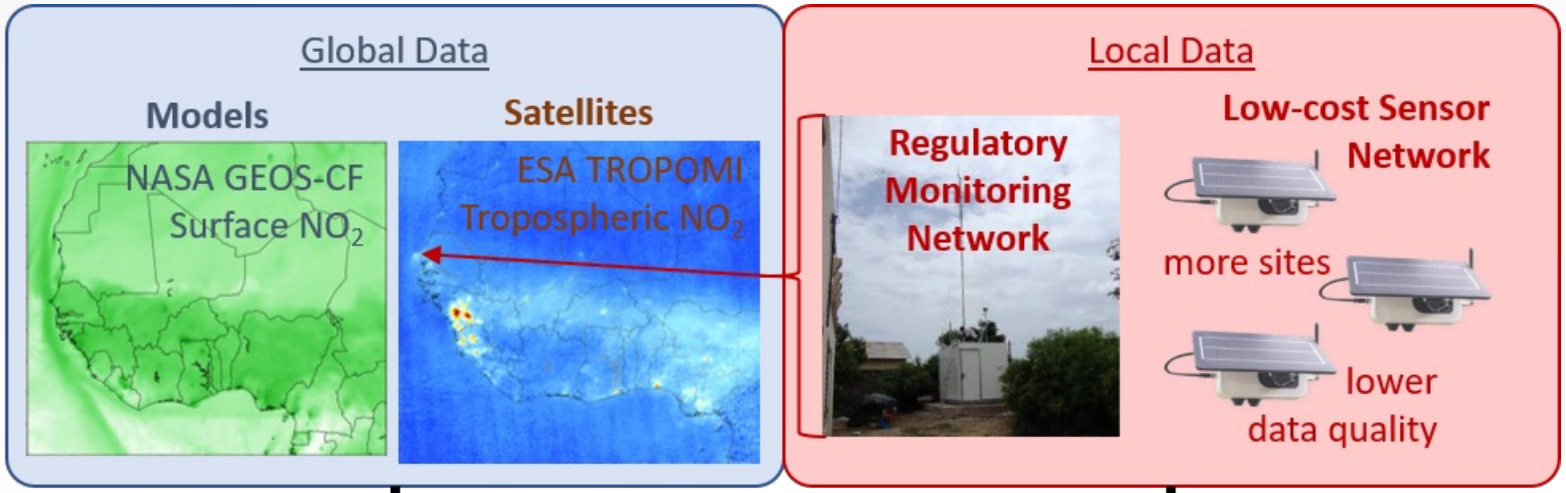
Project Concept & Goals



Data Fusion System

Implemented in Google Earth Engine (GEE)

End-User Orgs
US EPA
UNEP

Air Quality Policy Decision-Making

End-User Cities
Dakar, Senegal
Rio, Brazil
TBD US Cities

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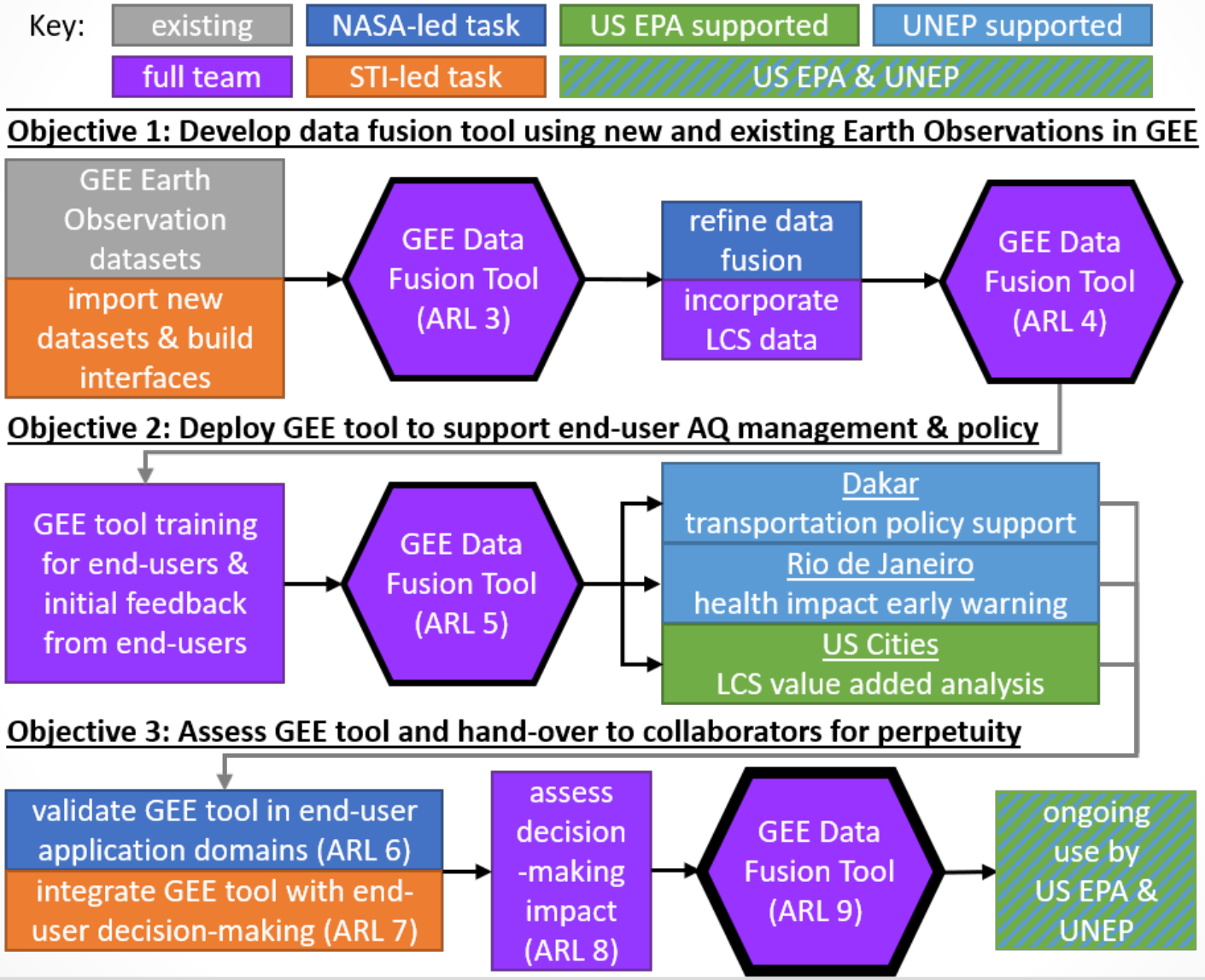
Project Workflow & Objectives



New: GEOS-CF in GEE

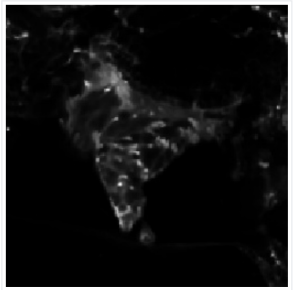
GEOS-CF replay files (15-min instantaneous and 1-hour average) available in Google Earth Engine

developers.google.com/earth-engine/datasets/catalog/NASA_GEOS-CF_v1_rpl_tavg1hr

Earth Engine Data Catalog | Search | Language | Sign in

Home | View all datasets | Browse by tags | Landsat | MODIS | Sentinel | API Docs

GEOS-CF rpl tavg1hr v1: Goddard Earth Observing System Composition Forecast



Dataset Availability

2018-01-01T00:00:00Z–2022-09-16T23:00:00

Dataset Provider

NASA / GMAO

Earth Engine Snippet

```
ee.ImageCollection("NASA/GEOS-CF/v1/rpl/tavg1hr")
```

Tags

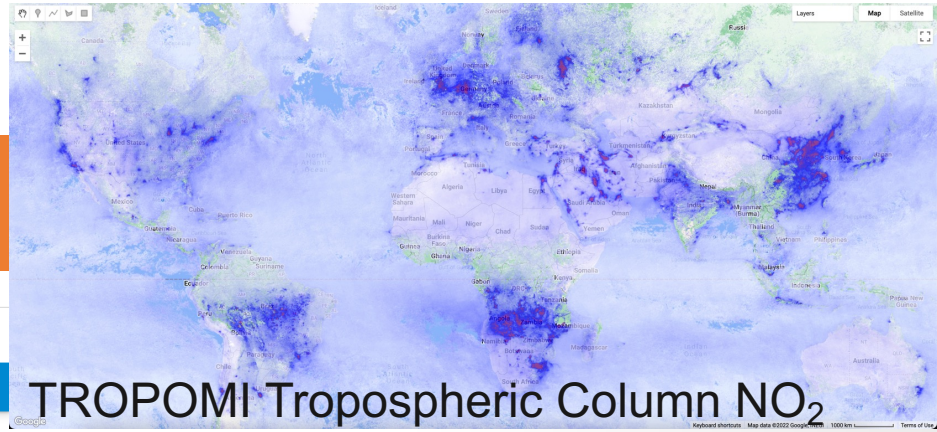
composition | forecast | geos | gmao | nasa

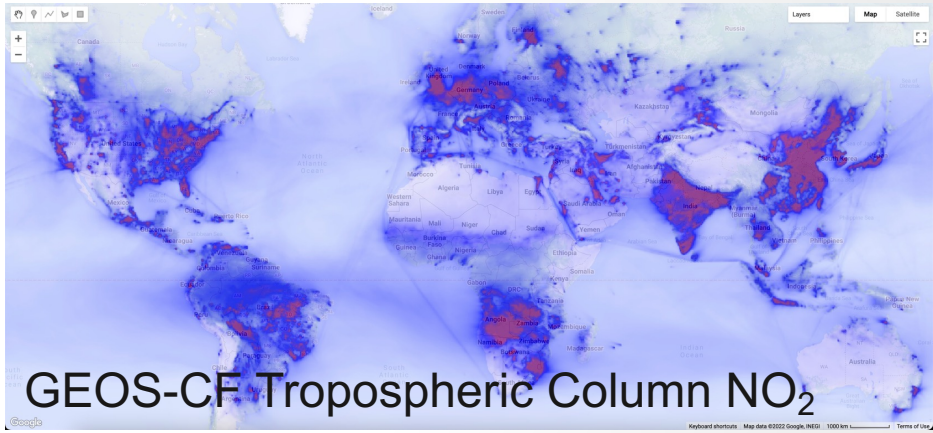
Description | Bands | Terms of Use | Citations | DOIs

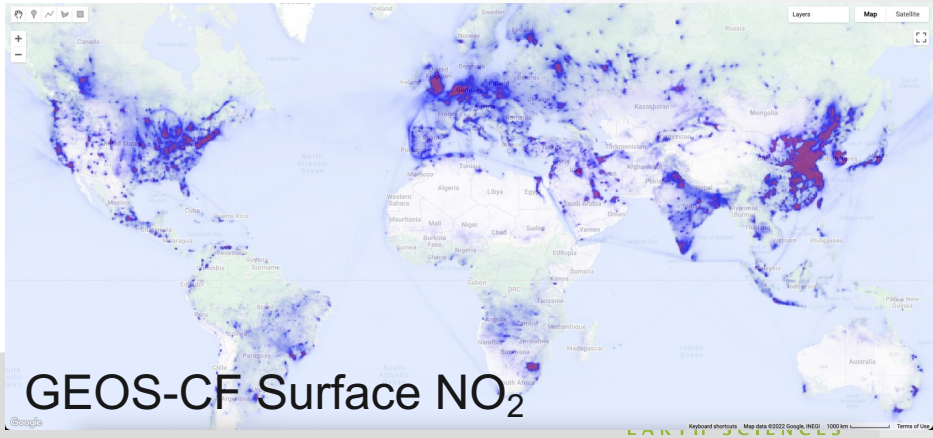
This dataset contains meteorological replay (rpl) of time-average one hour data (tavg1hr). It is built by merging the original GEOS-CF collections chm_tavg_1hr_g1440x721_v1, met_tavg_1hr_g1440x721_x1, and xgc_tavg_1hr_g1440x721_x1. The Goddard Earth Observing System Composition Forecast (GEOS-CF) system is a high-resolution (0.25°) global constituent prediction system from NASA's Global Modeling and Assimilation Office(GMAO).

GEOS-CF offers a new tool for atmospheric chemistry research, with the goal to supplement NASA's broad range of space-based and in-situ observations. GEOS-CF expands on the GEOS weather and aerosol modeling system by introducing the GEOS-Chem chemistry module to provide hindcasts and 5-days forecasts of atmospheric constituents including ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), and fine particulate matter (PM2.5). The chemistry module integrated in GEOS-CF is identical to the offline GEOS-Chem model and readily benefits from the innovations provided by the GEOS-Chem community.

Sept 8-15, 2022 mean fields







GMAO: Knowland, Malings; Keller, Cohn | STI: Pavlovic, AQ scientists, software engineers | US EPA (White) & UNEP (Khan) supporting end-users

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Objective & Tasks		Year 1		Year 2		Year 3	
1	a. Import new datasets to GEE, including GEOS-CF and RGM and LCS data						
	b. Merge existing GMAO and UNEP/STI data fusion methodologies						
	c. Refine data fusion system, including uncertainty quantification capabilities+						
	d. Incorporate LCS in the data fusion system, with uncertainty quantification*						
	e. Implement data fusion system into GEE tool, including interfaces						
	f. Refine GEE tool, especially input/output capability and interfaces						
2	a. Assess the status and identify key end-user needs for the GEE tool						
	b. Train end-users in the functionality and capabilities of the GEE tool*						
	c. Pilot deployment of GEE tool in end-user domains of interest						
3	a. Validate data fusion system in end-user domains of interest+						
	b. Integrate GEE tool into end-user decision-making processes						
	c. Evaluate the project's impact on decision-making outcomes						
	d. Integrate GEE tool with US EPA AirNow-Tech and UNEP GEMS Air systems						
	e. Transfer GEE tool to US EPA, UNEP, end-users for operational use						
Anticipated Application Readiness Level (ARL) metric		3		4	5	6,7	8,9

* with LDEO (Westervelt) & Clarity (Wihera)

\+ with WUSTL (Martin)

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