Improving Malaria Decision Support with Earth Observations

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Our Project

NASA **E**arth **O**bservations for **H**ealth Information Systems (**NEOH**)

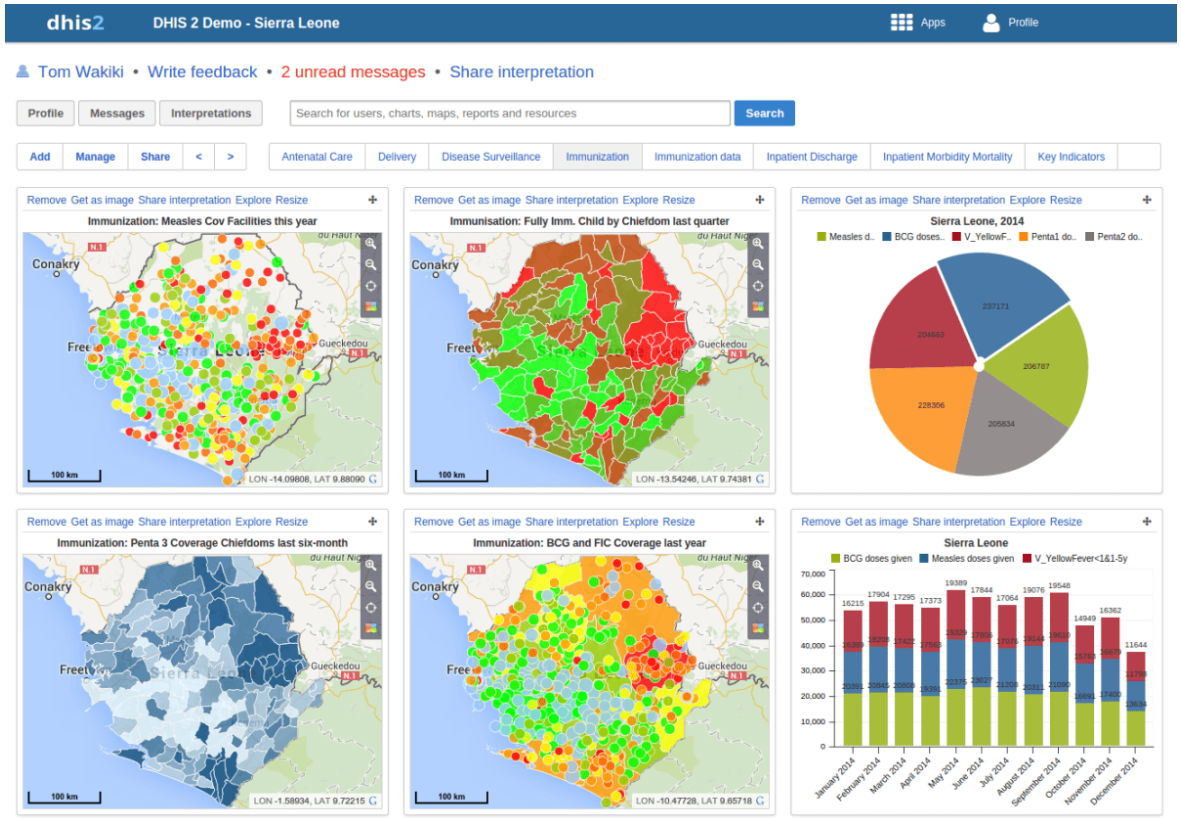
Researchers at the University of Alabama in Huntsville (UAH) in collaboration with the Centers for Disease Control and Prevention (CDC) and NASA are developing and deploying a technology for incorporating the latest NASA Earth observations for surface temperatures, precipitation, and vegetation health into the District Health Information Software 2 (DHIS2) to enhance malaria control decision making in sub-Saharan Africa.

NEOH Team

PI:	*John Beck, UAH*
Co-Is:	*Todd Berendes, UAH*
	Udaysankar Nair, UAH
	Jeffrey Luvall, MSFC/NASA
	John Painter, CDC
Team:	*Navaneeth Selvaraj, UAH*
	Nelli Westercamp, CDC

Motivation

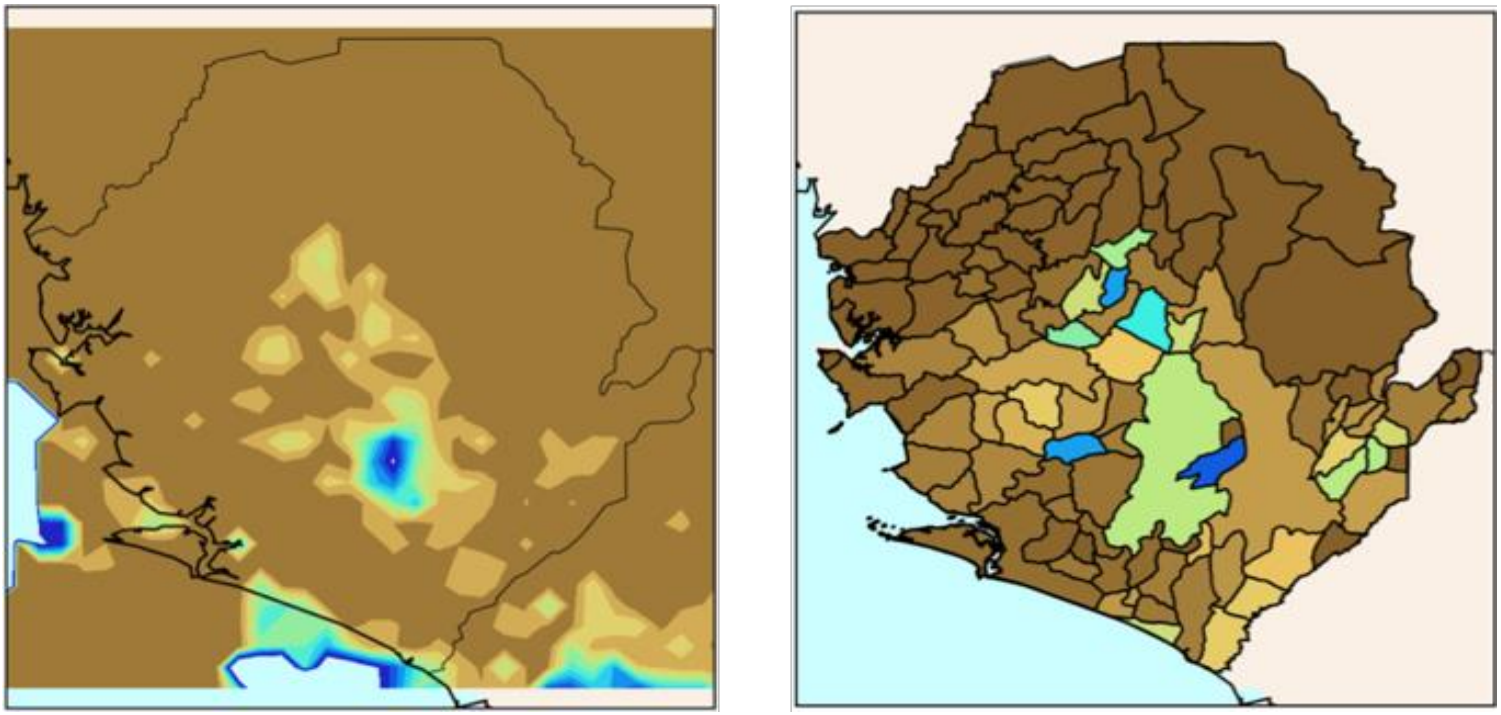
Demonstrate that **integration of Earth Observations (Precipitation, Surface Temperatures, and Vegetation Health) with disease and health information** will provide disease control decision makers with the integrated, accurate, and up-to-date situational view needed to optimize interventions.



Precipitation

NASA's Global Precipitation Measurement mission:

An international network of satellites that provide the next-generation global observations of rain and snow to advance our understanding of Earth's water and energy cycle, improve forecasting of extreme events, and provide accurate and timely information to directly benefit society.

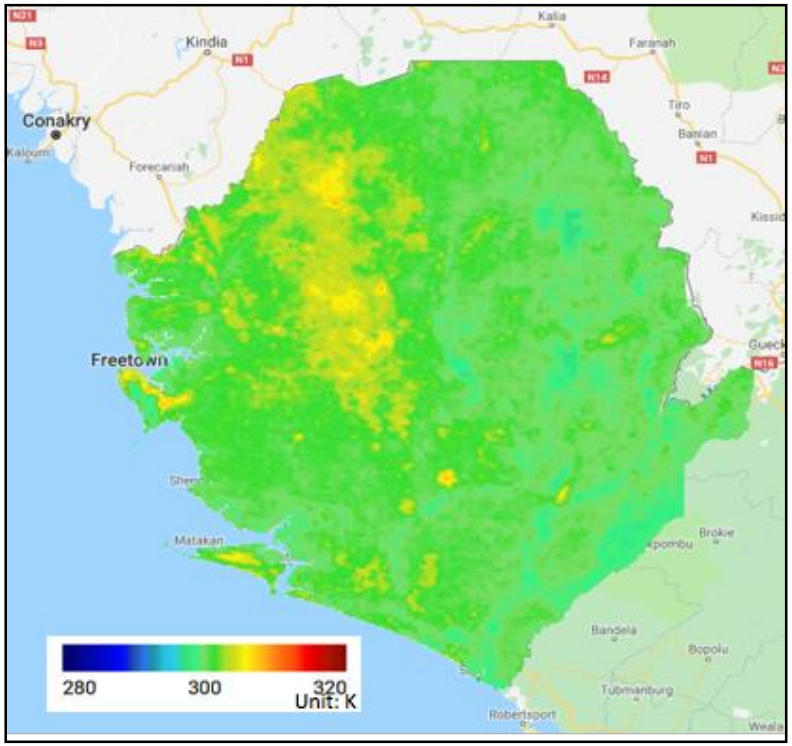


An example of NASA's GPM IMERG daily data for Sierra Leone and the data aggregated into health districts for Sierra Leone.

Surface Temperatures

NASA's MODIS Instrument Surface Temperatures:

The Moderate Resolution Imaging Spectroradiometer (MODIS) provides Land Surface Temperatures (LST) and Emissivity daily data that are retrieved at 1km pixels by the generalized split-window algorithm and at 6km grids by the day/night algorithm.



An example of NASA's MODIS 1km derived Land Surface Temperature (LST), 2017 average for Sierra Leone.

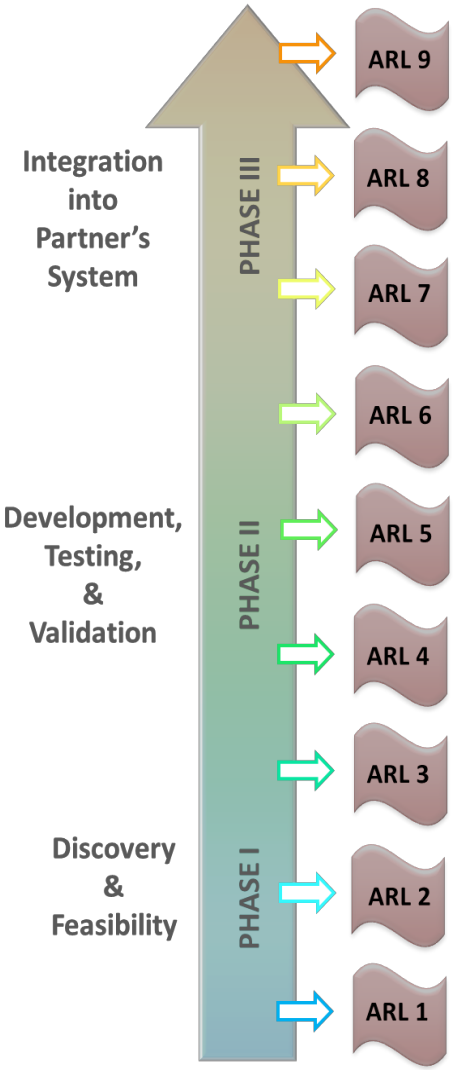
Vegetation Health

NASA's MODIS Instrument Vegetation Index:

The Moderate Resolution Imaging Spectroradiometer (MODIS) provides vegetation indices, produced on 16-day intervals and at multiple spatial resolutions, provide consistent spatial and temporal comparisons of vegetation canopy greenness, a composite property of leaf area, chlorophyll and canopy structure.

An example of NASA's MODIS 500 m 16-day Normalized Difference Vegetation Index product, nadir view. Combines both Terra and Aqua overpass for Sierra Leone.

Performance ARL



- Start-of-Project ARL = 3 *(11/16/2018)*
  - We estimated that the starting ARL for this project was a 3. Components of DHIS2 had been tested and validated by independent users, we conducted a simple feasibility study that assessed the potential viability of modifying the DHIS2 software and we established a proof a concept for the application, and we have a convincing case for the viability of our concept.
- Goal ARL = 9
- Current ARL = 7 *(08/03/2021)*
  - We have completed version 1.0 of the software and Co-I Painter has successfully installed the application into a DHIS2 application instance at the CDC. The software is working as expected and Co-I Painter is evaluating against Malaria data.

Project Schedule

Project Steps by Project Year Quarter	*Year 1*				*Year 2*				*Year 3*			
	Q1	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
Phase 1 - NASA Earth Observation (EO) Data Identification/Acquisition and Integration with District Health Information Software (DHIS2)												
Install and test DHIS2 with demonstration data	X	X	X									
Identify EO datasets, select common format, and develop scripts to automate the aggregation of data into DHIS2 Health District Boundaries		X	X	X								
Create appropriate DHIS2 fields, categories, data elements, etc. for EO data integration			X	X	X							
Use DHIS2 Web API and develop scripts for populating the DHIS2 database with EO data			X	X	X	X						
Build charts, tables, and maps for use by the CDC and NASA partners for testing and validation			X	X	X	X	X	X				
Phase 2 – Develop DHIS2 Plugin, Conduct NASA Data Analysis, and Perform Initial Deployment and Testing												
Expand DHIS2 metadata object models		X	X	X	X	X	X					
Develop and deploy EO data plugin for DHIS2				X	X	X	X	X	X			
Conduct data analysis with historical data				X	X	X	X	X	X	X		
Initial deployment, evaluation, and feedback							X	X	X	X	X	
Phase 3 - Adaptation into Decision Making Activity												
Establish data sharing agreements with countries				X	X	X						
Define EO data subscriptions to support future NASA data access for users									X	X	X	
Assist decision makers with environmental trends for precipitation, temperature, and vegetation					X	X						
Provide training, documentation, seek additional users								X	X	X	X	
ARL Level	**3**			**4**		**5**		**6**		**7**	8	**9**

X = Completed

Challenges and Risks

Rank	Type*	Risk	Mitigation Action
1	PM/B/ES	Overseas travel restrictions for the foreseeable future due to COVID-19	UAH team members and the CDC are implementing alternative outreach methods to demonstrate and deploy the technology to partner countries in Africa. We plan to present the functionality of our application through the development of a demonstration video. We will need to reallocate budget dollars from materials and supplies to other categories of need such as labor.
2	PM	Sustainability *(Cloud EO Data Processing)*	Opportunities such as using Open Data Cube is a possible solution for long-term sustainment for the cloud EO data processing. Other options may include integration with NASA data centers.

End User / Stakeholder Engagement

- Held several meetings with the developers of DHIS2 at the University of Oslo, Norway. They want to partner with us to establish a means to incorporate our project and web application into the core functions of DHIS2. In addition, they will help establish relationships with us and the African countries that use DHIS2.
- Submitted an abstract to the upcoming 2021 AGU Annual Conference.
- Submitted an abstract to the upcoming 2022 AMS Annual Conference.
- Accepted an invitation to give a presentation at the upcoming American Mosquito Control Association 2022 Annual Meeting.
- This program was highlighted in NASA's Applied Sciences Program during the National Mosquito Control Awareness Week 2021.
- Participated in a Video Tele-Conference (VTC) with members from the Bill and Melinda Gates Foundation with regards to Malaria elimination.

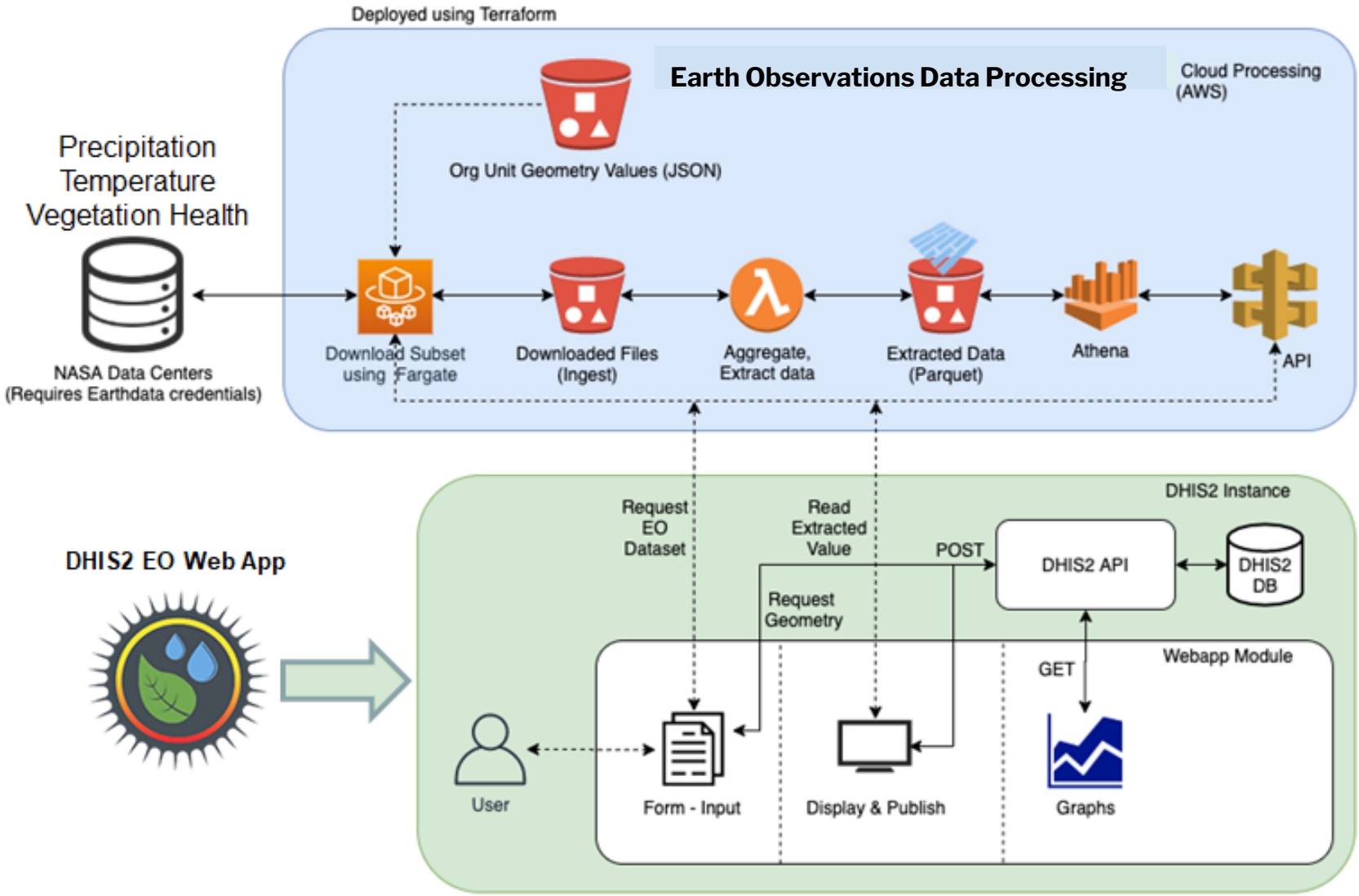
Project Details

NASA **E**arth **O**bservations for **H**ealth Information Systems (NEOH)

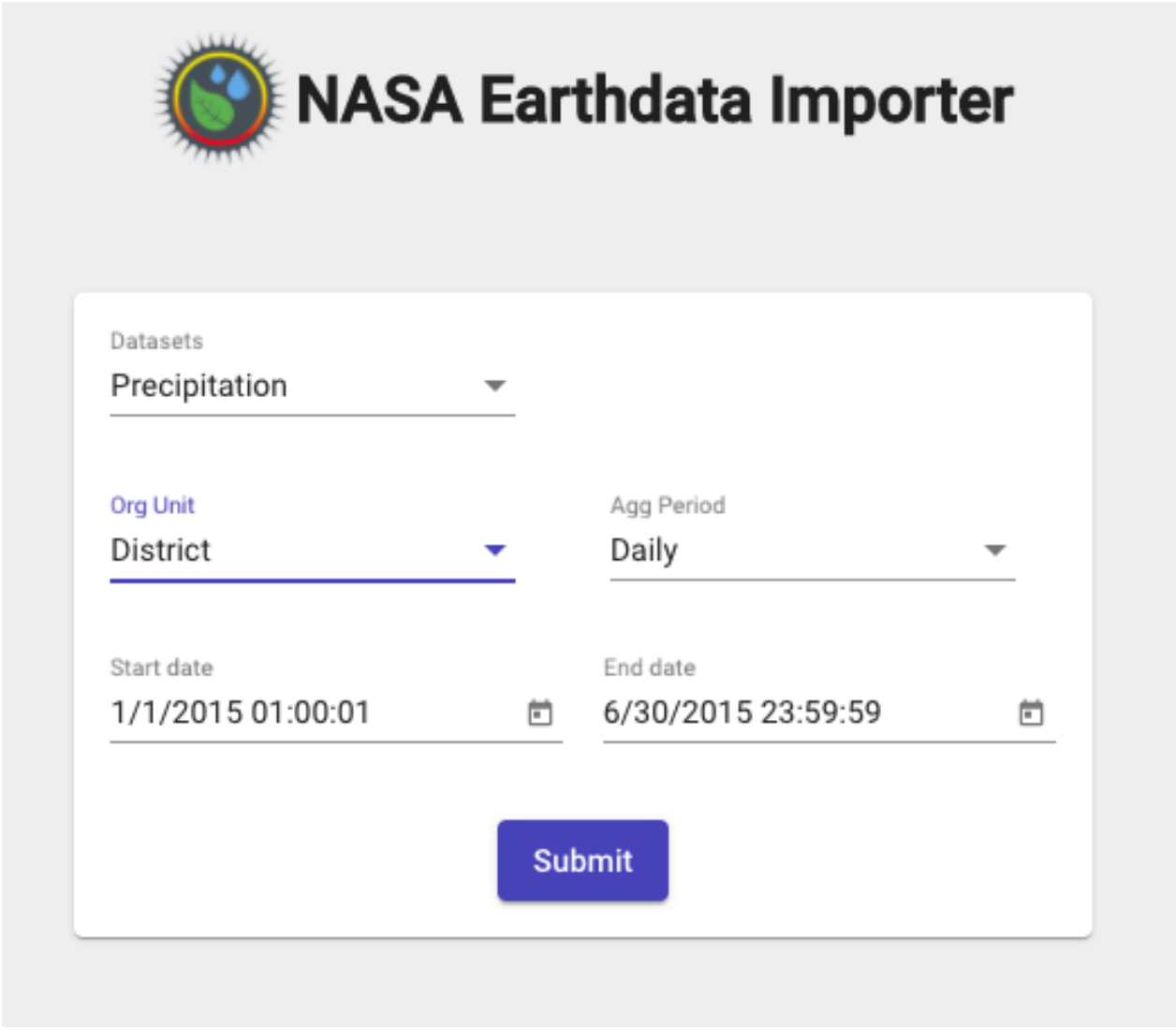
- Cloud-based Analytical Processing Application
  - Retrieve, Process, and Disseminate Earth Observations from NASA

- DHIS2 Web Application
  - “Earth Observations Import Tool”

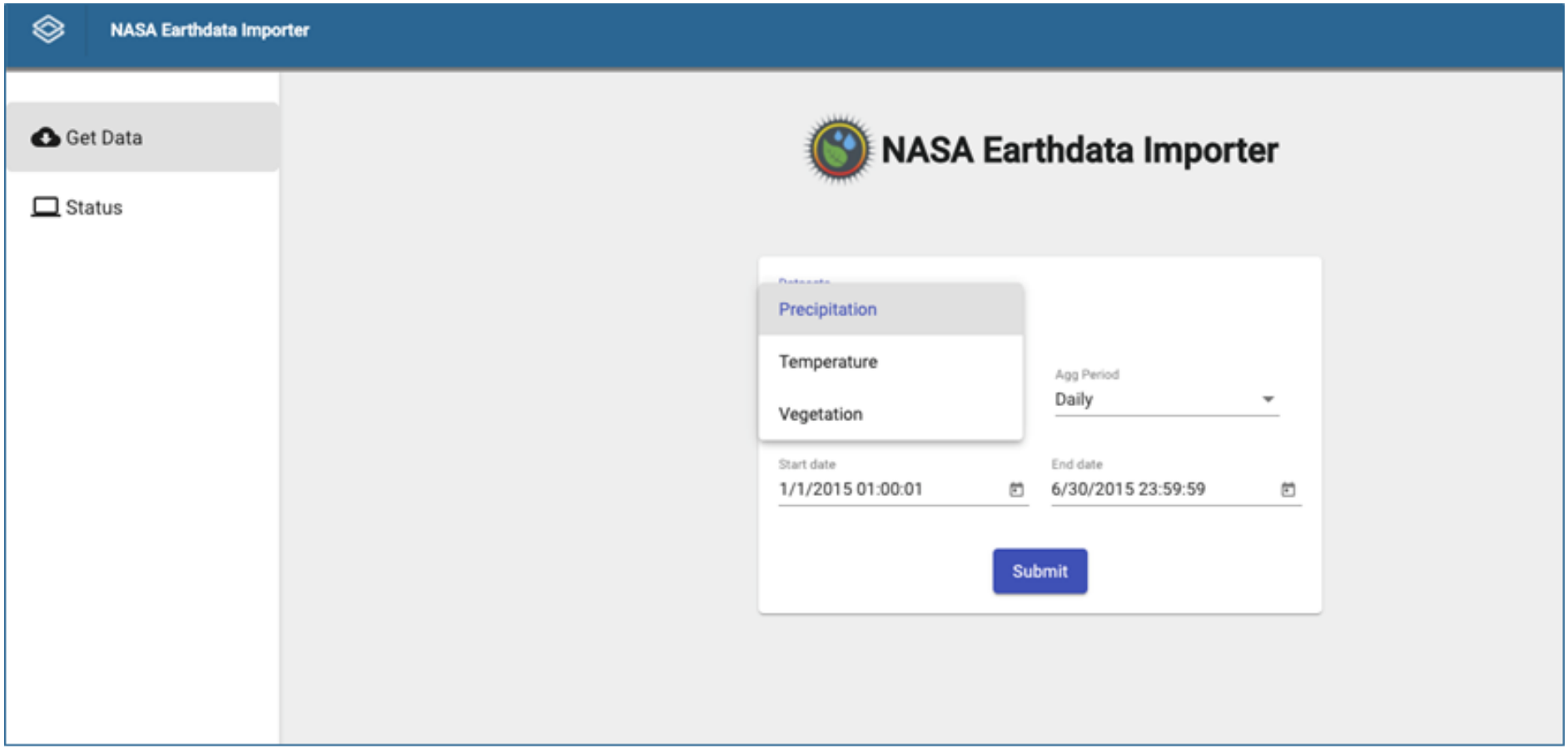
NEOH Components



DHIS2 EO Import App

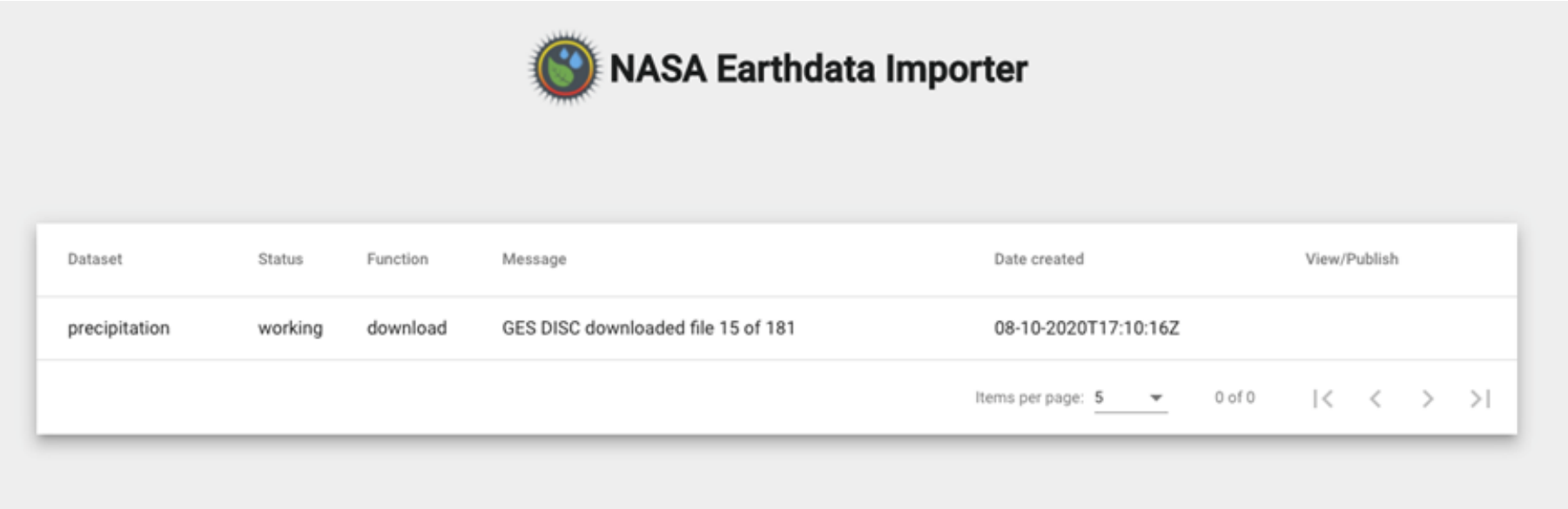


DHIS2 EO Import App



Web Application Interface for the NASA Earthdata Importer for DHIS2.

DHIS2 EO Import App

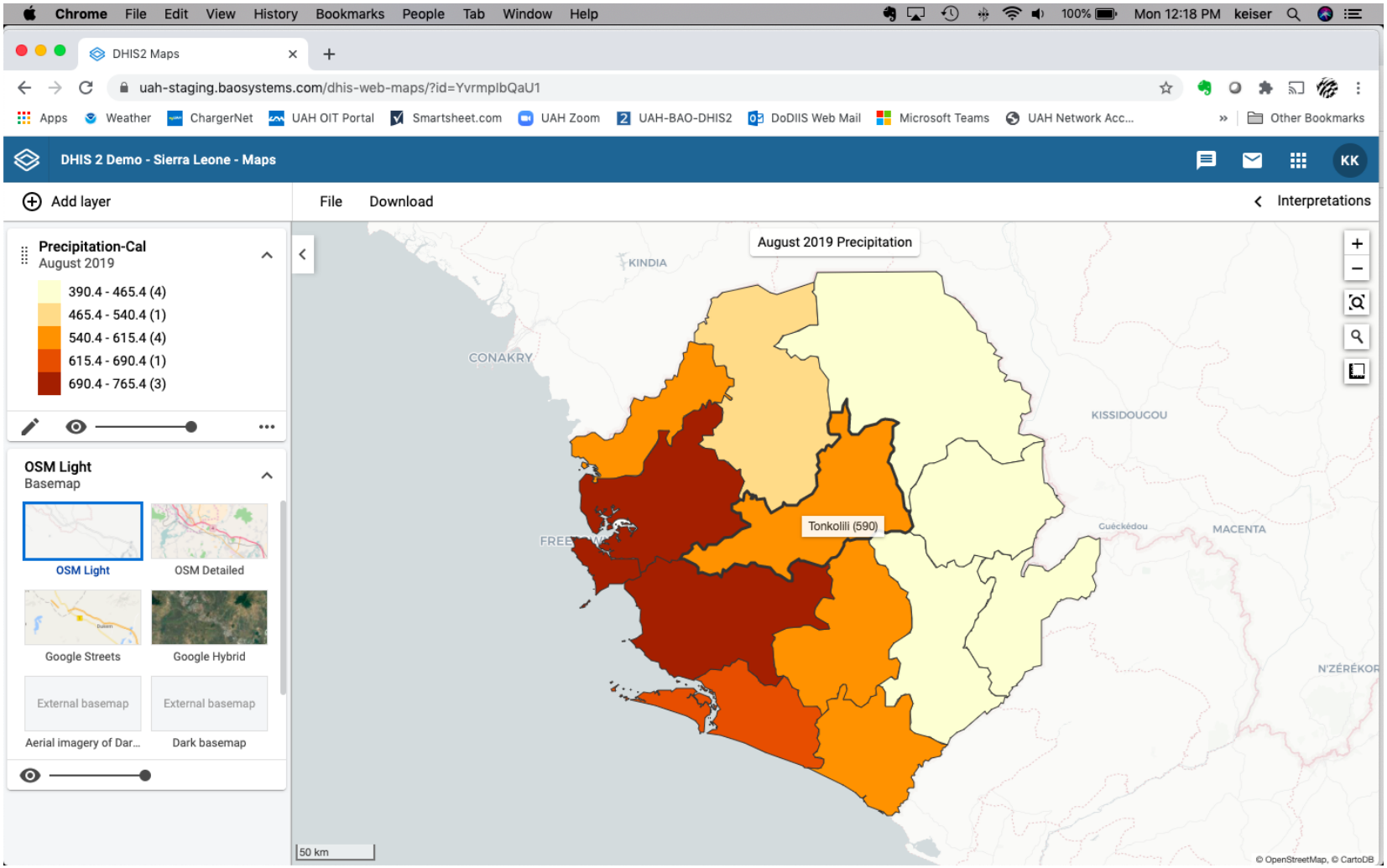


Data Status Page NASA Earthdata Importer for DHIS2.

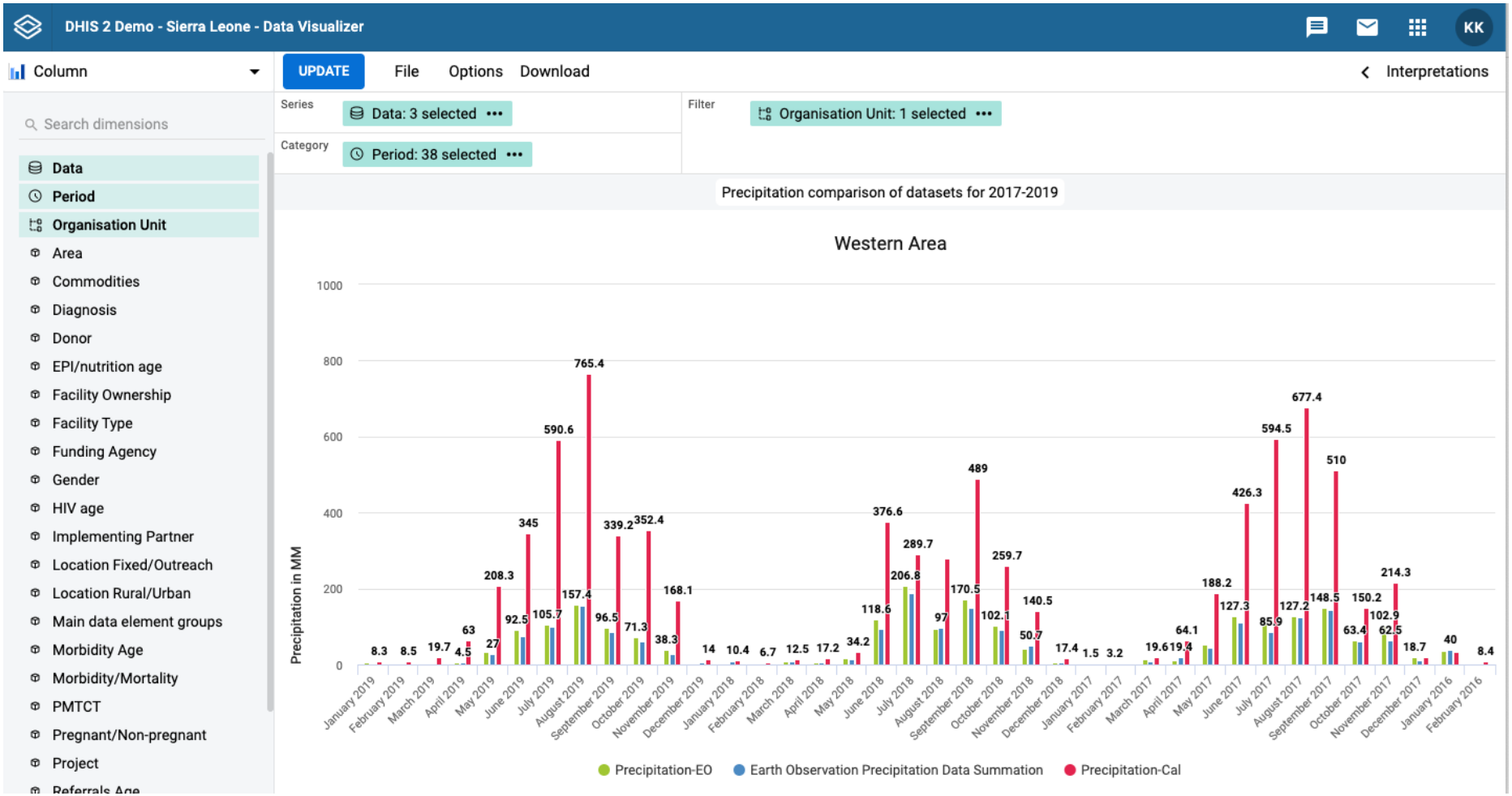
We implemented multiple processing

Precipitation

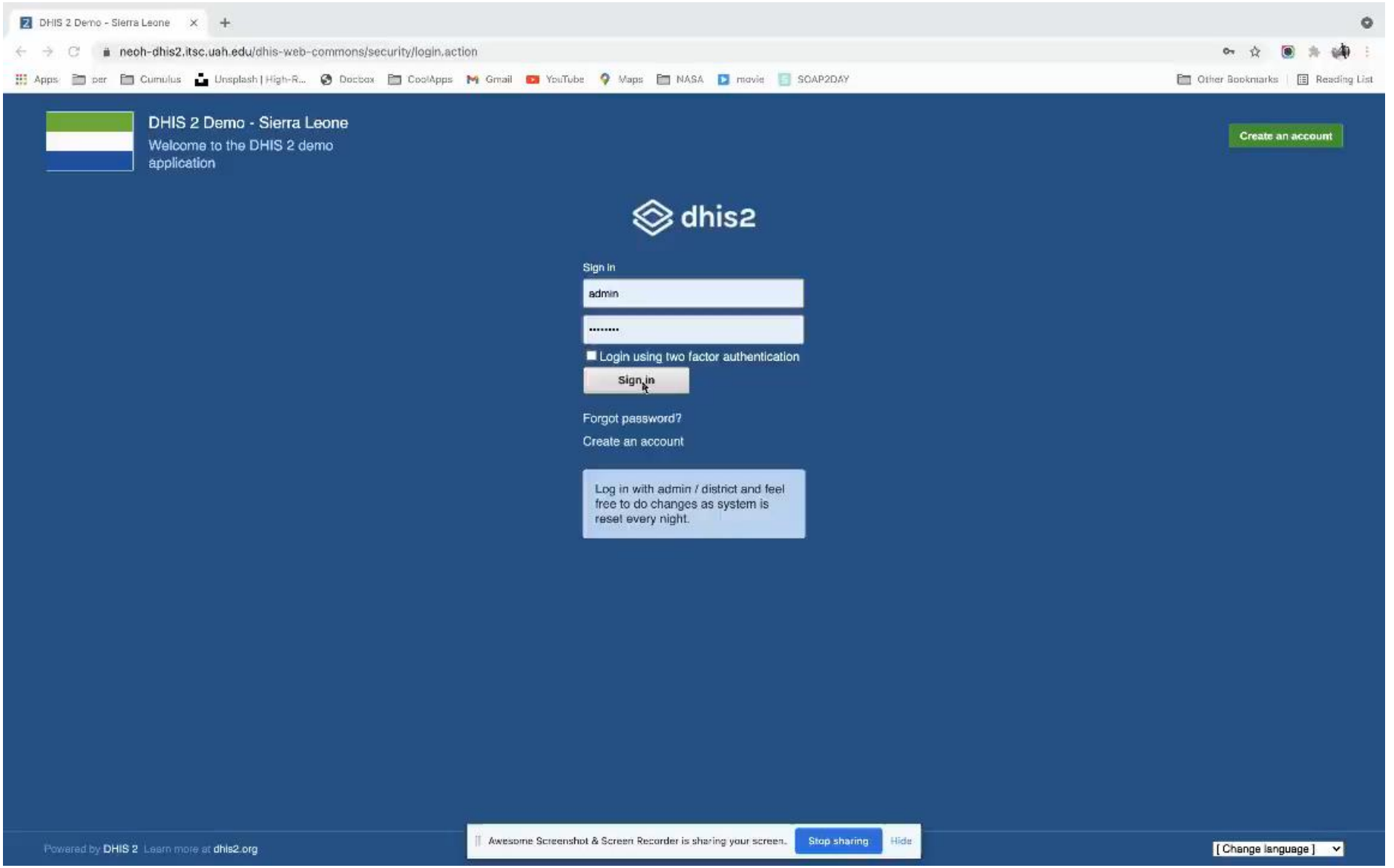
NASA's GPM IMERG Product



Precipitation



Demonstration



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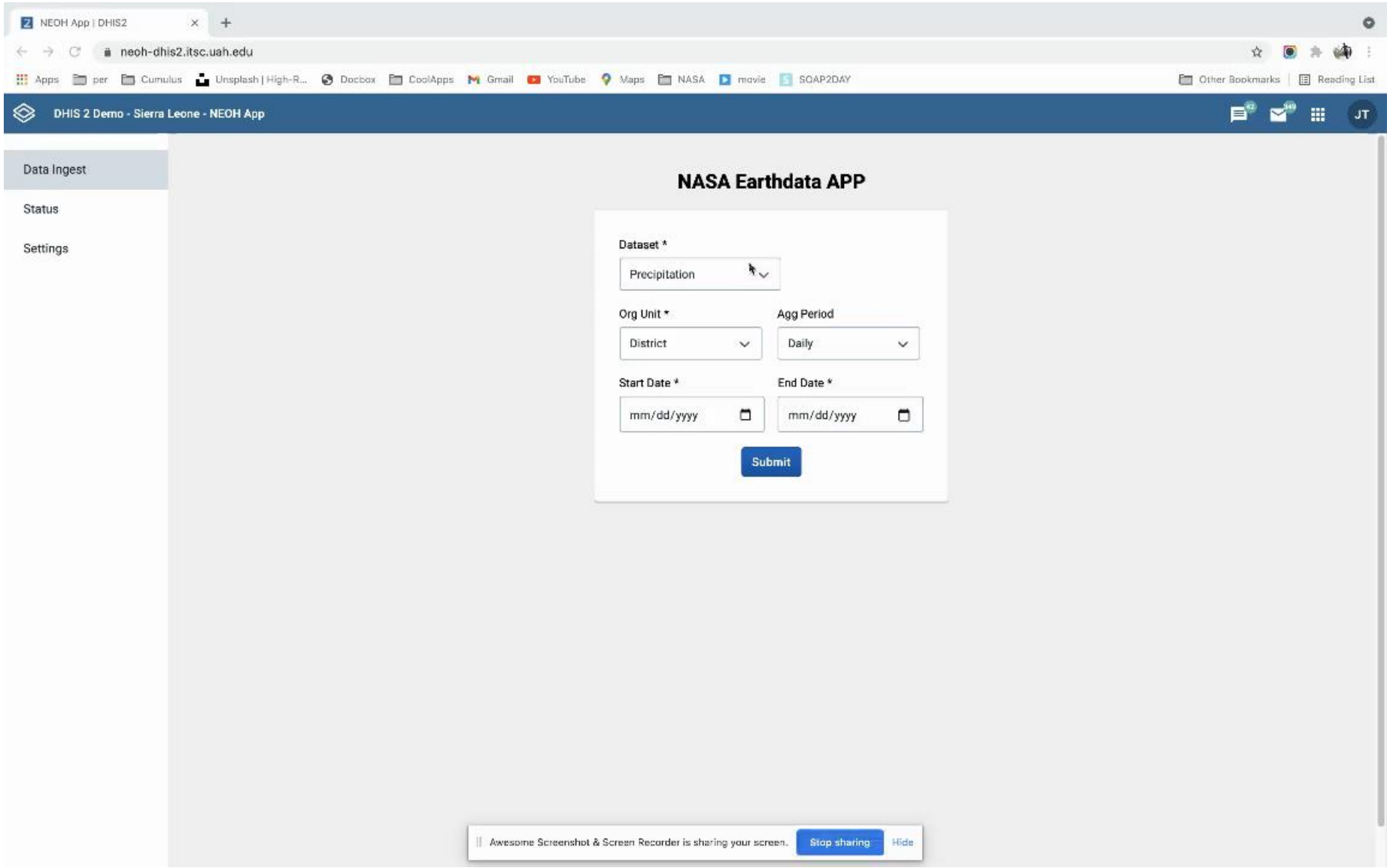

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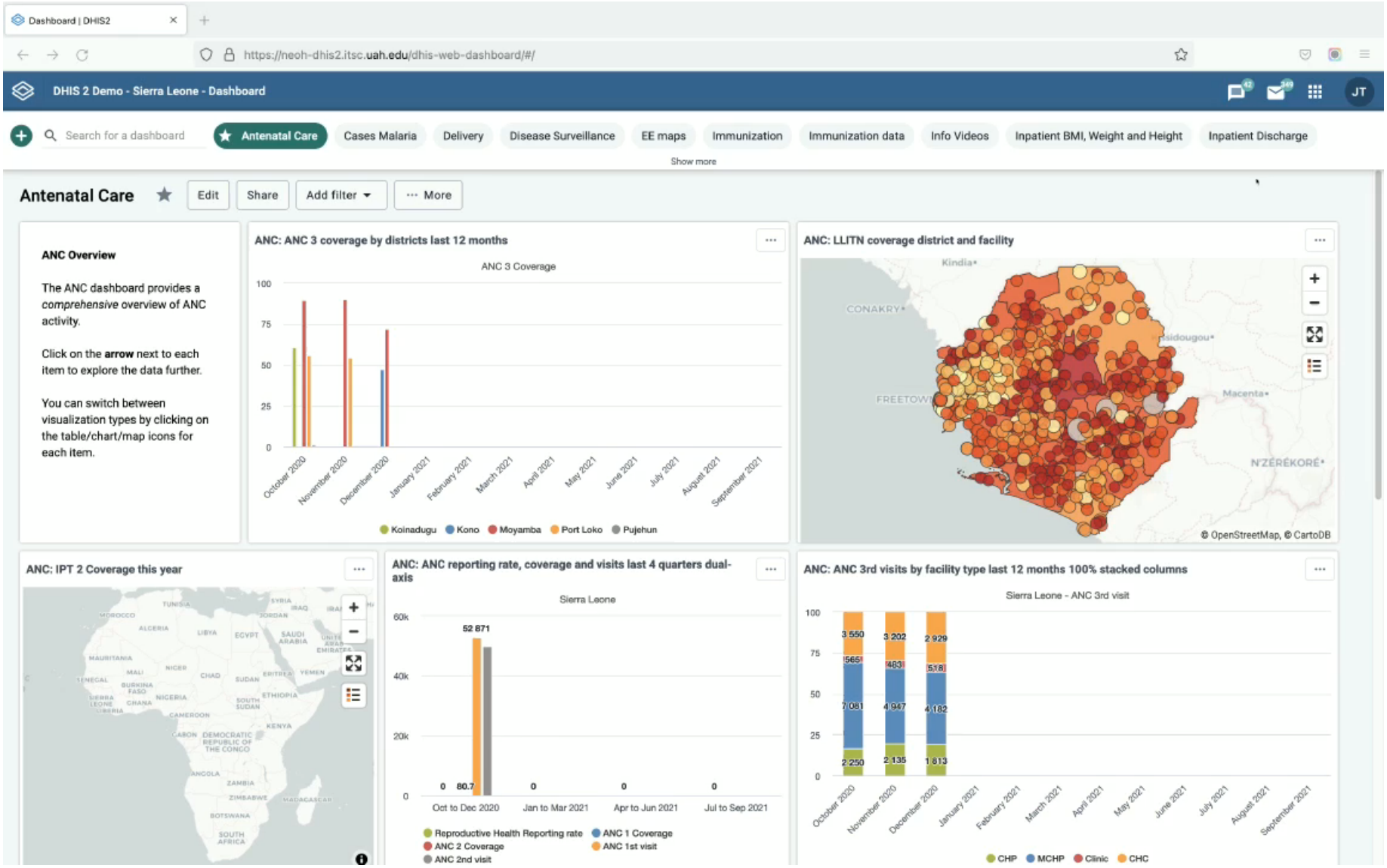
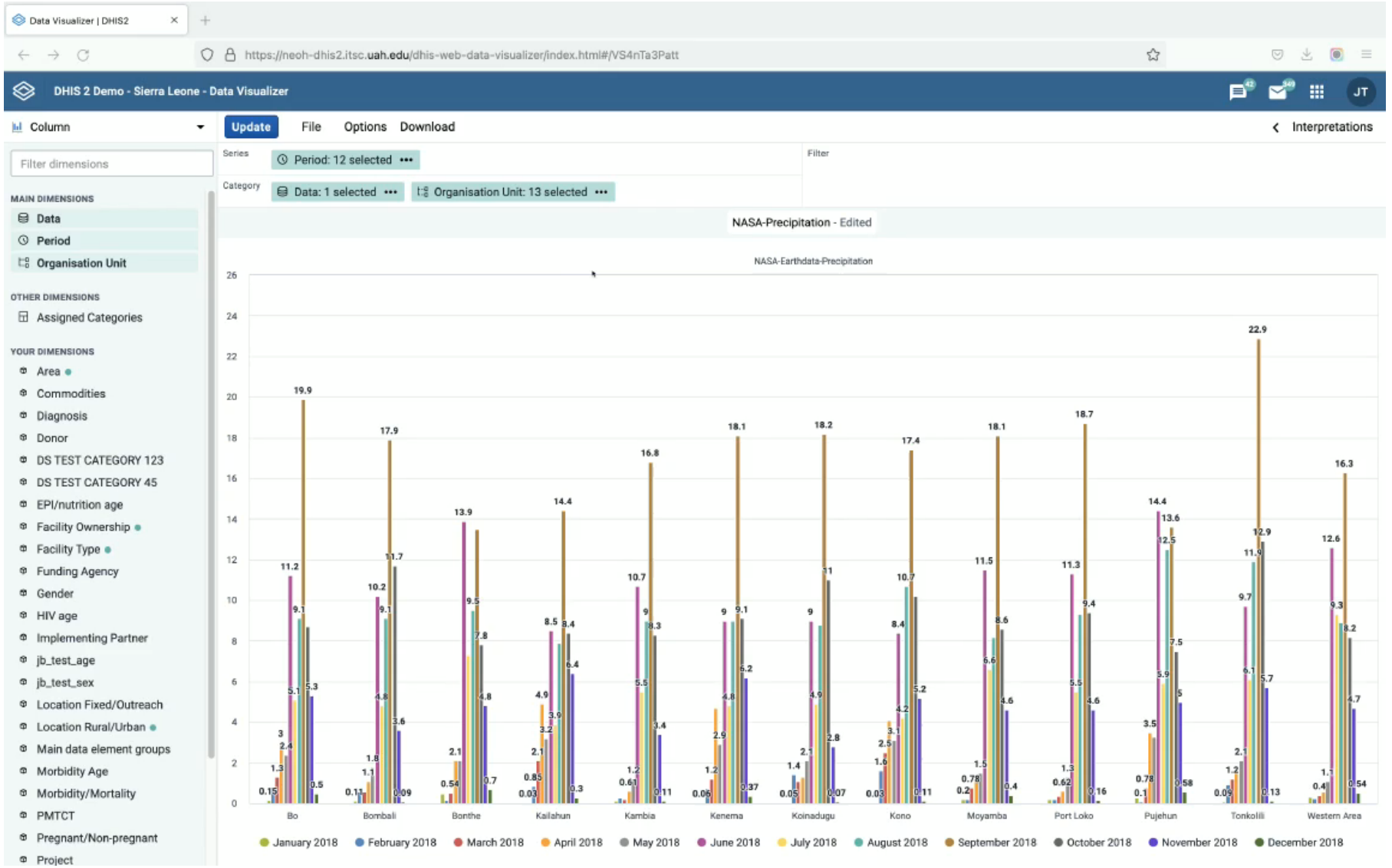


Demonstration



Future Plans

- Co-I Berendes developing scripts to ingest ECOSTRESS data to provide auxiliary temperature data from space.
- Co-I Luvall is providing updated ECOSTRESS data (night and day pairs) for processing into the system
- Co-I Painter currently evaluating version 1.0 and comparing demonstration Malaria data from Sierra Leone with actual data stored at the CDC.
- Co-I Nair is working on a presentation and paper. He submitted an abstract to the Health and Air Quality Team's session at the upcoming AGU Annual Conference.
- PI Beck is working on the narrative for producing a demonstration video.

Contact Information

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