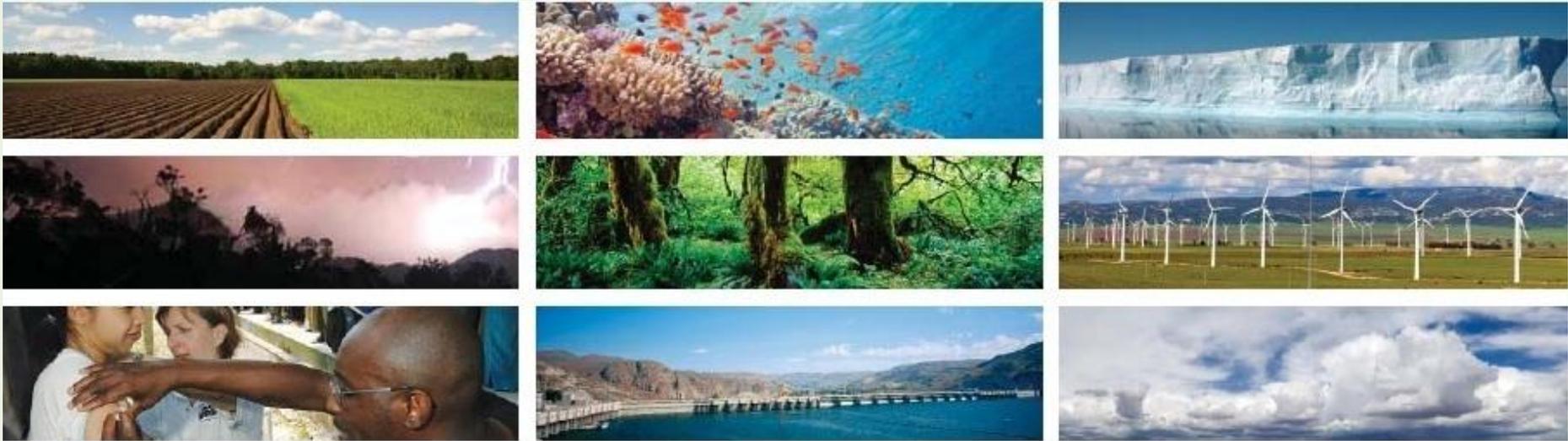# NASA Science Mission Directorate
Earth Science Division
Applied Sciences Program

Improving Malaria Decision Support with Earth Observations

NASA Health and Air Quality Applications

Program Review– September 10, 2019

Applied Sciences– Project Summary

- Project Title: Improving Malaria Decision Support with Earth Observations

- Project PI: John Beck

- Solicitation under which the project funding was awarded: ROSES 2017 A.39 Health and Air Quality **(NEW PROJECT)**

- Project Summary: Researchers at UAH in collaboration with the Centers for Disease Control and Prevention (CDC) and NASA propose to improve malaria control decision making in sub-Saharan Africa by developing and deploying a technology for incorporating the NASA Earth observations for surface temperatures, precipitation, and vegetation health into a widely used health management platform titled District Health Information Software 2 (DHIS2).

- Geographic Scope: Global

- Geographic Focus: sub-Saharan Africa

- Societal Benefit Area(s): Human Health

- Earth observations / models / technologies applied: Surface temperatures, precipitation, and vegetation health.

dhis2

DHIS2 is a free and open source software platform for the collection, management, analysis and use of data and information. The platform, now the national health information system in 67 countries, has become a global standard in international development and has a huge impact on how developing countries manage their information systems.

Globally, Doctors Without Borders, International Medical Corps, Norwegian Refugee Council, Population Services International, Save the Children and many other non-governmental organizations have utilized DHIS2 to manage their routine data.

Tailored data visualizations are accessible in real-time to managers at all levels of the health system through dashboards, scorecards, pivot tables, maps and charts. The new Dashboard app allows users to customize dashboards, create powerful visualizations, engage in data analysis and share their interpretations with other users.

Project Partners

- List project Co-Investigators, collaborators, and other partners

Role	Name	Affiliation Organization	Organization Type
Co-I	John Painter	CDC	Federal Agency
Co-I	Jeffrey Luvall	NASA/MSFC	Federal Agency
Co-I	Udaysankar Nair	UAH/NSSTC	Academic Institution
Co-I	Todd Berendes	UAH/ITSC	Academic Institution
Collaborator	Walt Petersen	NASA/MSFC	Federal Agency

End-Users / Stakeholders

- List organization names and organization types

Organization Name	Organization Type
World Health Organization (WHO)	Global Organization
Centers for Disease Control and Prevention (CDC)	Federal Agency
Africa Country Ministries of Health (MOH) (Sierra Leone, Uganda, Malawi, Guinea, and Burkina Faso)	Other

Results / milestones accomplished this year

- Held initial kickoff meeting and subsequent monthly meeting of team members
- Installed, tested, and deployed a working version of DHIS2 (Sierra Leone)
- Exported and distributed Health District Boundaries (HDB) to Co-I(s)
- Co-I Painter traveled to Africa and conducted initial stakeholder engagement with Ministry of Health (MOH) officials from Uganda and Burkina Faso
- Co-I Painter attended National DHIS2 Conference in Oslo, Norway
- Drafted three data models for entering Earth Observation (EO) data into DHIS2
- Co-I Berendes developed a script to process and aggregate NASA's GPM IMERG gridded precipitation product into DHIS2 HDBs for Sierra Leone
- Co-I Luvall provided support for using MODIS's 1km Land Surface Temperature (LST) products
- Co-I Nair developed a script within Google Earth Engine to process MODIS's 500m, 16 day vegetation product for Sierra Leone
- PI Beck gave a presentation about the project to the CDC's Malaria Branch
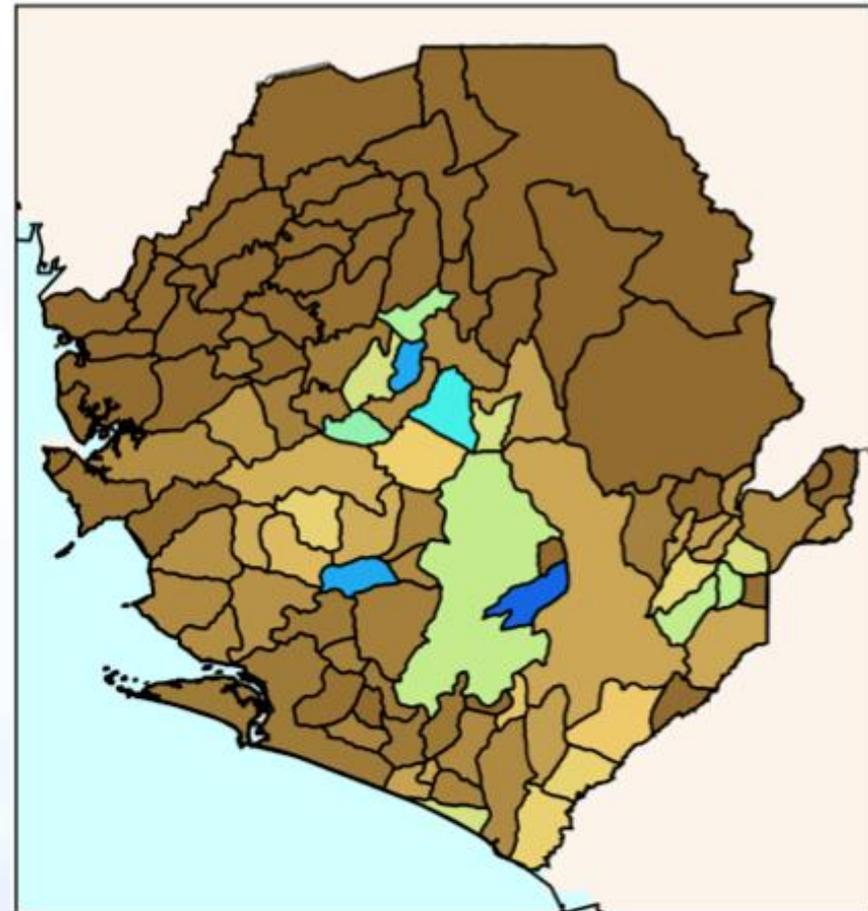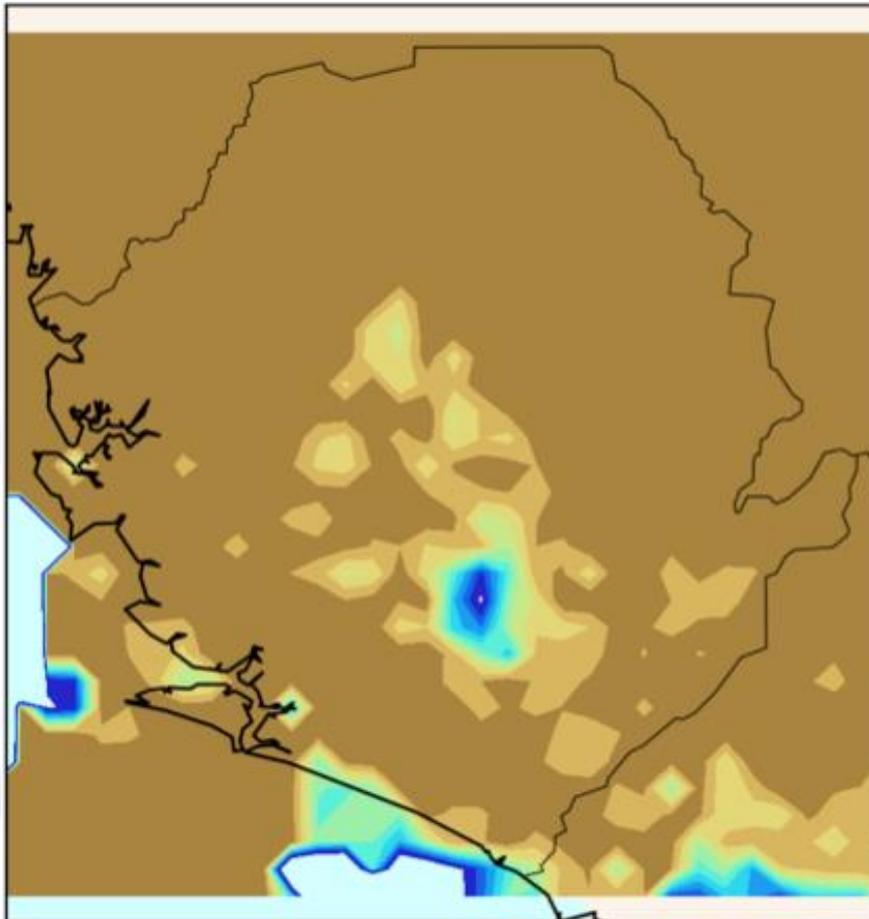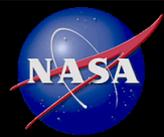- Submitted abstracts to AGU and AMS

Sierra Leone District Median
Sep 28 2018 Day V06 HQ Precipitation
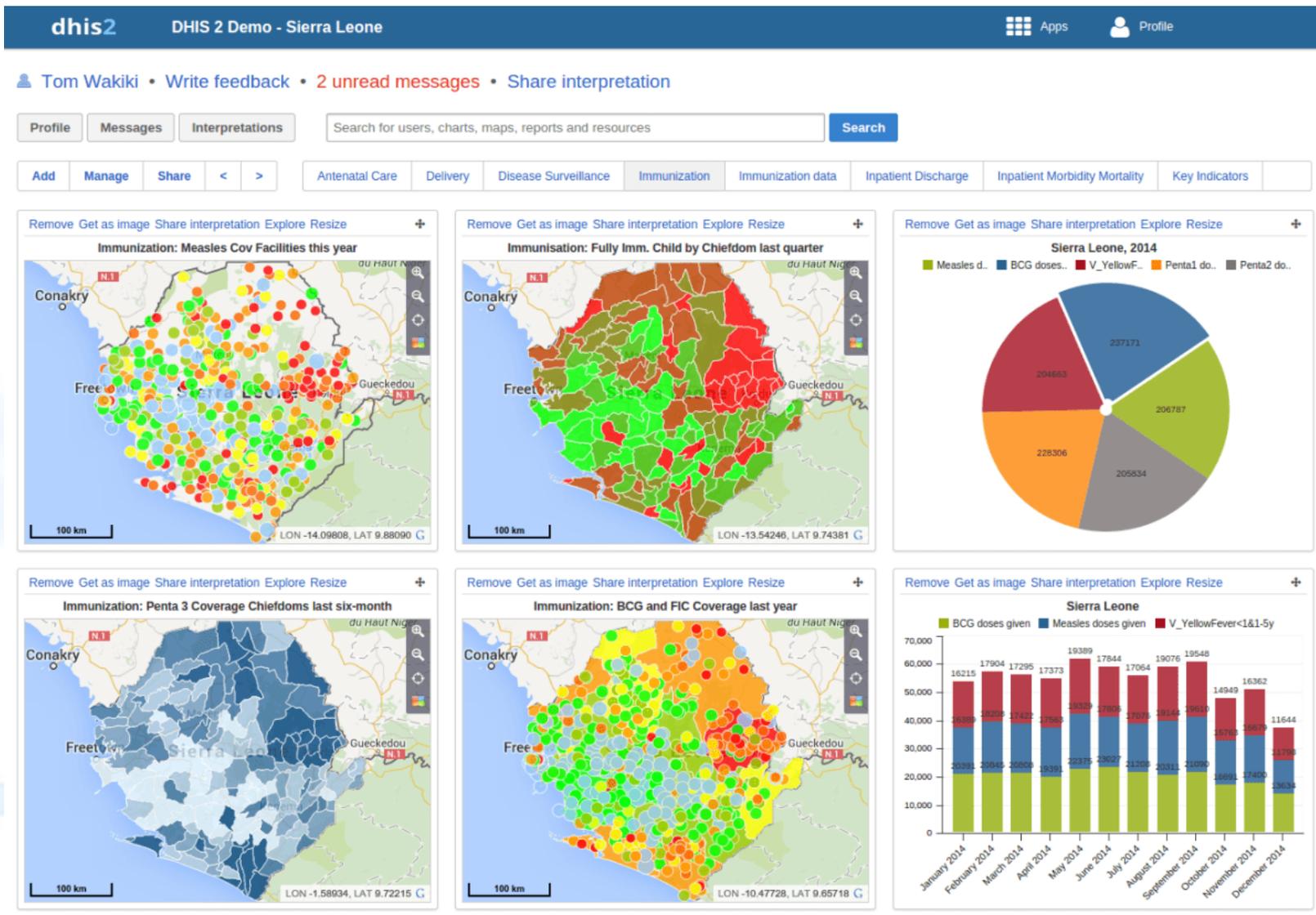
Figure 1: Example DHIS2 Interface illustrating health information from Sierra Leone.
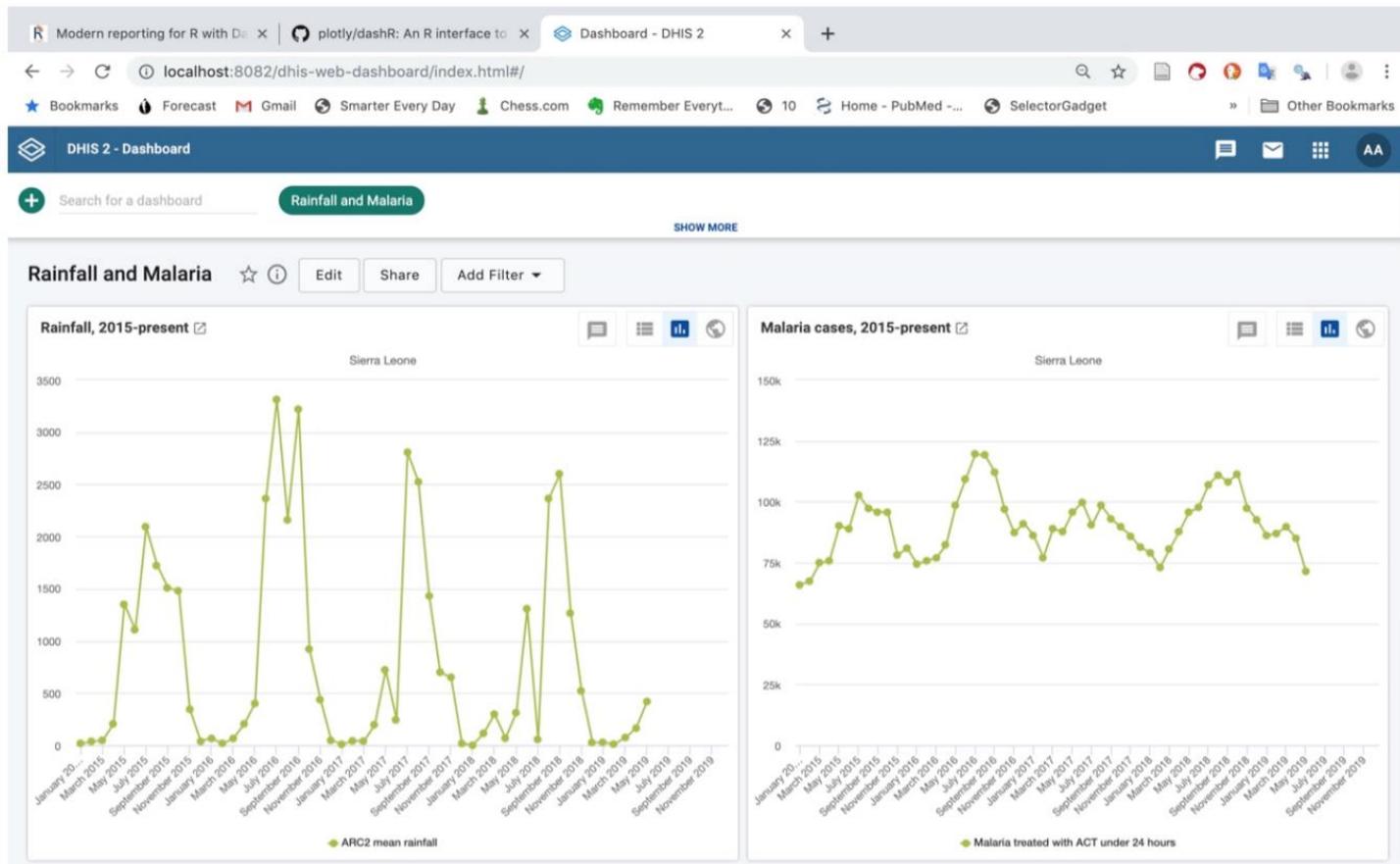
Plans / milestones for FY 2020

- Co-I Painter will travel to Africa to conduct initial stakeholder engagement with MOH officials from Sierra Leone and Malawi
- Finalize processes to ingest precipitation, temperature, and vegetation data into DHIS2
- Develop a plan and test different levels of EO granularity
  - Daily, monthly, yearly
  - District, sub-district, facility levels
- Conduct Unit Testing on DHIS2 ability to process EO data
- Develop EO data plugin for DHIS2
- Establish data sharing agreements with at least two countries

Project Challenges & Risks

Rank	Type*	Risk	Mitigation Action
1	PM	Sustainability	Early research has shown that opportunities such as using Open Data Cube is a possible solution for long-term sustainment. Other options may include NASA data centers.
2	ES	End User Acceptance	Early discussions with CDC personnel and their African counterparts. Successful demonstrations and examples of how to use Earth Observations.
3	B	Behind on Spend Rate	Spend rate will increase over the 4th Quarter as the PI and Co-I(s) level of effort increases, as additional programming support is added, and the PI is scheduled to travel to National Conferences.
...			

* Please designate risk type as: Technical (T), Budget (B), End-User/Stakeholder (ES), or Project Management (PM)

OPEN DATA CUBE

The Open Data Cube (ODC) is an open source solution for accessing, managing, and analyzing large quantities of Geographic Information System (GIS) data - namely Earth observation (EO) data. It presents a common analytical framework composed of a series of data structures and tools which facilitate the organization and analysis of large gridded data collections.

The Open Data Cube system is designed to:
- Catalogue large amounts of Earth Observation data
- Provide a Python based API for high performance querying and data access
- Give scientists and other users easy ability to perform Exploratory Data Analysis
- Allow scalable continent scale processing of the stored data
- Track the provenance of the data to allow for quality control and updates

Project Challenges & Risks

Rank	Type*	Risk	Mitigation Action
4	T	DHIS2 Software versions change frequently	Select a common version that participating countries currently use and implement within UAH AWS instance
5	T	Earth observations are collected at different spatial, spectral and temporal resolutions	Use the DHIS2 Web API to develop data elements and categories for handling different data resolutions
6	T	DHIS2 database capabilities to process EO data for analytics	Unit testing and a detailed analysis of the level of granularity for each data set will help offset any limitations that the DHIS2 application and database may have in processing the data.
...			

* Please designate risk type as: Technical (T), Budget (B), End-User/Stakeholder (ES), or Project Management (PM)

Performance/ARL
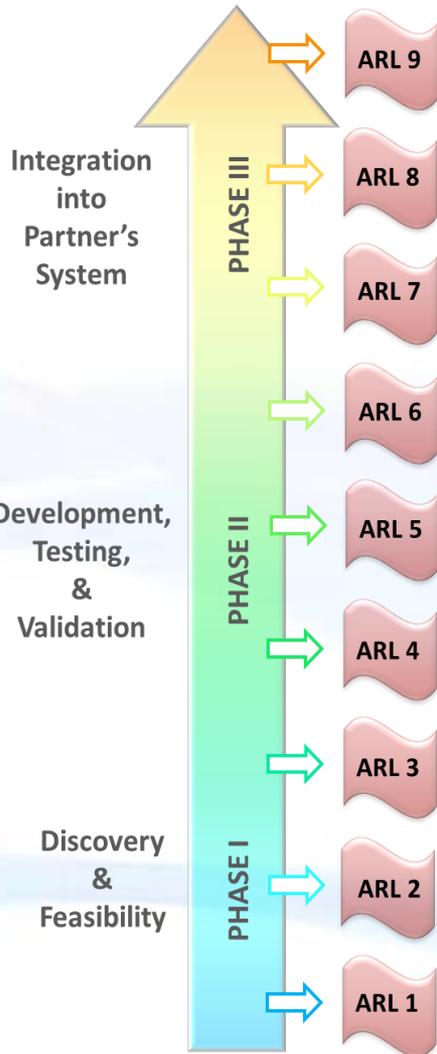
- Start-of-Project ARL = 3 *(11/16/2018)*

  – We estimate that starting ARL for this project is a 3. We base this evaluation on three factors: 1) Components of DHIS2 have already been tested and validated by independent users, 2) we have 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 3) we have a convincing case for the viability of our application concept.

- Goal ARL = 9

- Current ARL = 3 *(08/16/2019)*

  – We estimate that current ARL for this project is a 3. Different components of the application system are not yet integrated.

| 14

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

Legend: 🟩 Completed 🟨 In Progress ⬜ Scheduled