**NASA DEVELOP National Program**

****NASA Goddard Space Flight Center

*Summer 2017*

**Short Title: Niger Water Resources**

**Subtitle:** Implementing a Global Tool for Mercy Corps Based on Spatially Continuous Precipitation Analysis for Resiliency Monitoring and Measuring at the Community-Scale

**VPS Title:** Stress and Duress in the Sahel: Building Resiliency in Niger

**Project Team**

**Project Team:**

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James Favors (Science Systems and Applications, Inc., NASA Headquarters)

**Project Overview**

**80-100 Word Objectives Overview:**

Expand the current NASA and Mercy Corps partnership by including precipitation analysis within the integrated approach to resiliency measuring and monitoring that the two organizations are jointly working towards. Tools created here build off learning from the Middle East Water Resources project (summer 2016) and understanding from Mercy Corps about the types of analysis that work best when engaging with communities across the globe. In addition to creating an additional layer of information for the larger resiliency tool, products from this project will also be applicable in the day-to-day operations for Mercy Corps field teams once the products are delivered.

**Abstract:**

Global water resources are important for societies, economies, and the environment. In Niger, limited water resources restrict the expansion of communities and agriculture. Mercy Corps, a humanitarian aid agency, currently works in over forty countries around the world to address a variety of stresses. These include water resources and building long-term food resilience. A partnership between NASA DEVELOP and Mercy Corps was established as a means to facilitate the integration of NASA Earth observations into Mercy Corps’ resilience building process. Using the Tropical Rainfall Measuring Mission (TRMM), Global Precipitation Measurement (GPM), and Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), the team created a precipitation climatology that highlights low and high rainfall from 1981 to 2016. A Google Earth Engine tool, RAIn (Rainfall Analysis Integration), was built to help visualize and analyze both environmental and socioeconomic datasets. This tool allows for near real-time updates of trends in precipitation and improves Mercy Corps’ ability to spatially evaluate changes in resiliency by monitoring shocks and stressors.

**Keywords:**

Remote sensing, precipitation, GPM, TRMM, CHIRPS, Google Earth Engine, Mercy Corps, resiliency

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Mercy Corps | Eliot Levine, Senior Climate Change Advisor & Danielle Jolicoeur, Regional Resilience Advisor for North, West, & Central Africa | End User | Yes |

**Community Concerns:**

* Agricultural drought is a serious threat to economic and societal stability. This type of drought is linked with the number of dry spells rather than annual rainfall (Wildemeersch, Garba, Sabiou, Fatondji, & Cornelis, 2015).
* “It has been estimated that about 25% of dryland areas around the world are affected by desertification. This process has major effects on the environment and societies, including soil erosion, increases in the frequency and magnitude of dust storms, reduction of vegetative cover, change in plant community composition, or the loss of land productivity, biodiversity and food security” (D’Odorico, Bhattachan, Davis, Ravi, & Runyan, 2013).
* Population growth is a significant threat to water resources in parts of Niger with projections for increased vulnerability in the future (Vörösmarty, Green, Salisbury, & Lammers, 2000).

**Current Decision-Making Practices & Policies**:

In Niger, poverty, conflict, political instability, and drought are among the shocks and stressors that Mercy Corps assesses and works to build resilience against. Mercy Corps uses their Strategic Resilience Assessment (STRESS) methodology. This process centers on local expert knowledge and quantitative data to develop a theory of change, system maps, and stakeholder maps. The four phase process includes scope, inform, analyze, and strategize. The theory of change and adaptive management processes then takes an iterative approach to embrace complexity, develop capacity, foster “good enough” mentality, and fill knowledge gaps.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release** |
| Precipitation Google App using Google Earth Engine Repositories | GPM DPR, TRMM PR, Terra MODIS, and SRTM | The partner’s resiliency is directly affected by precipitation. Changes in long-term precipitation causes changes in agriculture and water resources. This product will allow proactive planning for agriculture and a better understanding of the relationship of precipitation to social and economic variables. | IV |

**Project Benefit to End User**:

Products generated by this project will enhance Mercy Corps and its in-country stakeholders’ ability to accurately assess the role of precipitation as a shock or stressor impacting communities. By having a spatially continuous dataset to use irrespective of geography, the project provides a common platform for decision making in countries where Mercy Corps operates. This spatially continuous dataset will provide Mercy Corps with a new, holistic view of resiliency that could provide lessons learned around shared characteristics between geographically divided communities dealing with similar issues. In addition, Mercy Corps can continuously upload new precipitation data as it becomes available, thus allowing them long-term use of the product.

**Project Details**

**Applied Sciences National Application Addressed:** Water Resources

**Study Area:** Niger

**Study Period:** January 1981 – December 2016

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| GPM DPR | Precipitation | Statistical analyses and visualization of precipitation were used to understand trends and inform Mercy Corp’s STRESS assessments. |
| TRMM PR | Precipitation | Statistical analyses and visualization of precipitation were used to understand trends and inform Mercy Corp’s STRESS assessments. |
| Terra MODIS | Land Surface Temperature, Evapotranspiration | Mapping global land surface temperature and evapotranspiration rates were used to understand trends and inform Mercy Corp’s STRESS assessments. |
| SRTM Version 4 | Digital Elevation Model | Delineation of watersheds and surface flows of water were used to understand the landscape and inform Mercy Corp’s STRESS assessments. |

**Ancillary Datasets Utilized:**

* Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) – global rainfall
* WorldPop – population distribution

**Software Utilized:**

* Google Earth Engine API – image processing and delivery platform
* Google App Engine – platform to create and host Earth Engine dashboard
* Esri ArcGIS – image enhancement and map creation

**Project Handoff Package**

**Transition Plan:**

A transition of project end products will occur between Mercy Corps and the NASA team supporting the partnership. Mercy Corps will be able to implement the digital products as soon as they are available to them, and the NASA team will ensure that the products are included in the resiliency tool being created. In lieu of the software at the end of the term, digital PDF maps will be provided, highlighting hotspots of low resiliency based on physical and socio-economic parameters. The handoff of the PDFs and documentation will take place via telephone conference.

*Software Release Plan*: The team worked with Jamie Favors at NASA to address the delay of software related solutions. The software will be supported through the process by the Team Lead and the Geoinformatics Fellow.

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**Partner POC**: Jamie Favors, james.e.favors@nasa.gov

**Handoff Package:**

* Digital maps in PDF format for precipitation time series, dry spells, and social-economic data
* Technical paper and user’s guide to the Google App

**References:**

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