**NASA DEVELOP National Program**

**2019 Fall Project Proposal**

**North Carolina – NCEI**

**Honduras & Nicaragua Agriculture & Food Security**

*Assessing Vegetation Response to Remote Sensing Drought Indices within the Dry Corridor of Honduras and Nicaragua Using NASA Earth Observations*

**Project Overview**

***Project Synopsis*:** The Honduras and Nicaragua Agriculture and Food Security team will work with in-country partners to enhance their understanding of agricultural drought onset using a drought index derived from remote sensing products. The team will calculate historic measures of the Standardized Precipitation Index (SPI) using the NOAA Climate Prediction Center (CPC) Morphing Technique (CMORPH) precipitation data. Focusing on the Dry Corridor, the team will explore the historic lead-lag relationship between SPI at various timescales and vegetation response measured with the Normalized Difference Vegetation Index (NDVI) from the Terra and Aqua Moderate Resolution Imaging Spectroradiometer (MODIS). The objective of this project is to highlight what measures of SPI are most indicative of agricultural drought onset for partners in Honduras and Nicaragua. Additionally, the team will provide a tutorial on computing near-real time SPI and current NDVI using NASA Earth observations including the Global Precipitation Measurement (GPM) mission Integrated Multi-satellite Retrievals for GPM (IMERG) and the Suomi Near Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS).

***Community Concern:*** The Central American Dry Corridor is home to nearly half of the small producers of basic grain crops in the region. In recent years, the Dry Corridor has experienced unprecedented drought events that have impacted the livelihoods of those communities and agricultural producers. The 2015/2016 drought, associated with a strong El Niño event, is considered the most severe in the region over that past 30 years and left over three million in conditions of acute food insecurity. In anticipation of the 2018/2019 El Niño occurrence, the United Nations Food and Agriculture Organization (FAO) issued a ‘high risk’ warning for drought in Central America. Studying the temporal response of vegetation to precipitation in the Dry Corridor over time and within the context of the regional agricultural cycle will help the partners deepen their understanding of drought in the region to improve future mitigation efforts.

***Source of Project Idea:*** The System of Central American Integration (SICA) is seeking to enhance capacity building efforts with government programs and representatives in Honduras and Nicaragua. The North Carolina DEVELOP node at the NOAA National Centers for Environmental Information houses researchers interested in applying remote sensing drought information and historical climate data on a global scale, especially in drought-prone regions like the Dry Corridor. This project will apply NOAA and NASA data products to expand the understanding of drought to the in-country partners.

***National Application Area(s) Addressed:*** Agriculture & Food Security, Water Resources

***Study Location:*** Honduras, Nicaragua

***Study Period:*** December 2002 – August 2019

***Advisor(s):*** Olivier Prat, North Carolina Institute for Climate Studies, NOAA National Centers for Environmental Information

**Partner Overview**

***Partner Organization(s):***

|  |  |
| --- | --- |
| **Organization** | **POC (Name, Position/Title)** |
| **Partner suggestions** **(sugerencias de socios)** |  |
|  |  |

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The project team will hold bi-weekly partner phone calls to assess end user requirements, communicate project updates, and discuss methods and applications. The phone calls will be set up through a telecom platform, and translation or interpretation services will support communication, if need be. The project lead will serve as the main POC for partner communication.

***Transition Plan*:** During the final partner phone call, the team will discuss their finalize results and conclusions with the partner, as well as showcase their data acquisition and computation tutorial. The project results and tutorial will be written into an atlas/user guide format, which will be shared with the partner via Google Drive or other service.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Terra MODIS** | Vegetation Indices | NDVI from Terra MODIS will be used to measure historic vegetation health in the study area, as the lag variable. |
| **Aqua MODIS** | Vegetation Indices | NDVI from Aqua MODIS will be used to measure historic vegetation health in the study area, as the lag variable. |
| **NPP/VIIRS** | Vegetation Indices  | The team will demonstrate how to acquire and interpret NDVI from NPP/VIIRS for the tutorial product.  |
| **GPM-IMERG**  | Precipitation  | The team will demonstrate how to acquire precipitation data from GPM-IMERG and compute SPI for the tutorial product.  |

***Ancillary Datasets:***

* NOAA Climate Prediction Center (CPC) Morphing Technique (CMORPH). The team will use CMORPH precipitation data to compute historic SPI measurements in the study area, which will serve as the lead variable in the lead-lag analysis.

***Software & Scripting:***

* ESRI ArcMap – map generation, raster analysis, land cover classification
* Google Earth Engine – data acquisition, raster processing
* R – data analysis and visualization
* Python – data analysis and visualization

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Lead-lag Analysis of SPI and NDVI**  | The analysis will show which measures of SPI (e.g. 1-month, 2-month, etc.) relate to vegetation response and at what time lags. This information will also help the partners to anticipate future vegetation decline based on current precipitation measurements.  | Computation of SPI from CMORPH and GPM-IMERG will be related to NDVI from MODIS and VIIRS at various time-lags that relate to the agricultural cycle in the study area.  | N/A |
| **SPI User Guide**  | The partners will learn how to access precipitation data in near-real time and compute SPI and understand the relationship to NDVI for agricultural drought planning.  | GPM-IMERG will provide near-real time precipitation data to compute SPI measurements in the study area. | N/A |

***End-User Benefit*:** The end products will demonstrate the use of spatially comprehensive climate and remote sensing data in the Dry Corridor of Honduras and Nicaragua, where there are few publicly accessible weather stations. The partners will gain an enhanced understanding of how they can use measurements of SPI to anticipate potential decline in vegetation in the study area. The project results will highlight during what seasons, phases of El Nino, and time lags with NDVI that SPI indicates onset of agricultural drought. This project will expand the drought monitoring and planning information available to the partners.

***Related DEVELOP Work:***

Summer 2018 (NC) – Central America Agriculture & Food Security: Utilizing NASA Earth Observations and NOAA Climate Data Records to Monitor Drought and Precipitation Patterns for Coffee Agriculture Management in Guatemala, Honduras, and El Salvador

Summer 2016 (MSFC) – Mekong River Basin Agriculture & Food Security: Utilizing NASA Earth Observation to Enhance Drought Management Decision within the Mekong River Basin’s Agricultural Fields

**Notes & References:**

***References:***

Beguer S, Vicente-Serrano SM, Reig F, Latorre B. 2014. Standardized precipitation evapotranspiration index

(SPEI) revisited: parameter fitting, evapotranspiration models, tools, datasets and drought monitoring. International Journal of Climatology 34(10): 3001-3023.

Chronology of the Dry Corridor: The impetus for resilience in Central America. *Food and Agriculture*

*Organization of the United Nations.* 01 June 2017.http://www.fao.org/in-action/agronoticias/detail/en/c/1024539/

Dutta, Dipanwita & Kundu, Arnab & R, Patel. (2013). Predicting agricultural drought in eastern Rajasthan of

India using NDVI and standardized precipitation index. *Geocarto International*. 28. 192-209.

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Joyce, R. J., J. E. Janowiak, P. A. Arkin, and P. Xie, 2004: CMORPH: A method that produces global

precipitation estimates from passive microwave and infrared data at high spatial and temporal resolution.. J. Hydromet., 5, 487-503.

Kattelus, M., Salmivaara, A., Mellin, I., Varis, O. and Kummu, M. (2016), An evaluation of the Standardized

Precipitation Index for assessing inter‐annual rice yield variability in the Ganges–Brahmaputra–Meghna region. International Journal of Climatology, 36: 2210-2222. doi:10.1002/joc.4489