**NASA DEVELOP National Program**

**Spring 2016 Project Proposal**

**International Research Institute for Climate and Society**

**Uruguay Agriculture III**

Deconstructing a Drought Severity Index Based on NASA Earth Observations into its Components for Better End-User Assessment of the Driving Factors Behind Local Scale Drought

**Project Overview**

***Objective:*** To create an interactive system of ternary diagrams for the previously created drought severity index components—precipitation, land surface temperature, and a vegetation index—and research how distinct regions are differently affected by the various factors of a given drought.

***Community Concern:*** End-users and stakeholders have expressed interest in having the ability to visualize the various components within the DSI to see how exactly the driving factors in the drought affect different regions, crops, and livestock. The DSI is based on precipitation, land surface temperature (LST), and a vegetation index (VI). When computed, a map is created showing levels of drought severity. Due to the sensitivity of different crops and varieties of livestock, users currently are not able to customize the drought preparations and mitigation methods based on the given factors within the DSI. We have proposed the creation of a set of ternary diagrams (see figure 1), which can be displayed when clicking on a desired region of the map.



**Figure 1.** Preliminary ternary diagram showing the different components of the DSI. When in operation the user would be able to select a region of interest on the DSI map and a ternary diagram would be displayed showing where that specific region lies on the ternary diagram and thereby revealing the main driver of the drought severity for the given area.

***National Application Areas Addressed:*** Disasters, Agriculture, Water Resources

***Study Location:*** Uruguay

***Study Period:*** January 2003 to December 2015

***Advisors:*** Dr. Pietro Ceccato (Research Scientist, Lead Environmental Monitoring Program, International Research Institute for Climate Society, The Earth Institute, Columbia University)

***Source of Project Idea:*** When discussing the use of the DSI with project partners and collaborators they expressed interest in knowing what the specific drivers were for the drought severity in a given region. Through further discussions, the idea of inserting the ternary diagram into the IRI/INIA data library over top of the DSI map seemed to meet the needs of the end-users.

**Partner Overview**

***Partner Organization:***

Instituto Nacional de Investigaion Agropecuaria (INIA) (End-User, POC: Guadalupe Tiscornia, Research Scientist)

***End-User Current Decision Making Process:***

Currently the end-user uses the DSI created from the previous terms to assess the severity of drought for their given regions, but they have no method of determining the specific weights for the drivers in a reasonable way. The current DSI has been used alongside other drought analysis tools to determine important factors for the health of the country, including the state of emergency status with regards to a recent (February 2015) dry-spell. Currently, the DSI used is based on remotely sensed products and was validated by *in-situ* station data in the preceding term. The end-user is familiar with, and frequently uses, NASA Earth observations as their institute has recently created a data library similar to the IRI data library. This project would help illustrate how the various drivers of drought severity are received by NASA Earth observations and how those Earth observations can be used to make better decisions regarding the health of the country.

***NASA Earth Observations Capacity:***

End-User INIA – INIA is very familiar with NASA Earth observations as they have used them numerous times in the past and continue to use them. This project helps build their awareness of the capabilities of NASA Earth observations because it shows the diversity of NASA Earth observations and how useful they are for researchers and for society at large.

***Communication Plan & Transition Approach:***

INIA and IRI have a very close relationship and we will likely be communicating with our end-user on a weekly basis. The initial hand off will likely be through email for immediate use but some members of INIA are visiting the IRI over the summer so we will able to do an in person hand off and presentation for them at that time.

***End-User Benefit:***

This novel application would help illustrate how the various drivers of drought severity are received by NASA Earth observations and how those Earth observations can be used to make better decisions regarding the health of the country. This will therefore have the benefit of saving the end-user time as well as money. If they have the ability to better understand the nature of the drought severity, they can better prepare by taking different steps in the planning process. For example, if LST is deemed an important driver in the drought severity then different steps might be taken in preparing their livestock for the coming months than if the VI was a major driver. Research into how these drivers affect the various aspects and economics of agriculture in Uruguay is essential to this project.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform** | **Sensor** | **Geophysical Parameter** |
| **Aqua/Terra** | MODIS | Land Surface Temperature and Vegetation Indices |
| **DMSP 13, 14, & 15** | SSM/I | Passive microwave for CMORPH precipitation estimates |
| **NOAA-15, 16, 17, & 18** | AMSU-B | Passive microwave for CMORPH precipitation estimates |

***NASA Earth Observations Use:***

MODIS – The spectral bands from the MODIS sensors on board Aqua and Terra are important for many aspects of Earth observing. For this project we use the MODIS sensors to measure LST over the country as well as create various VI’s using different spectral bands for the drought severity index. The VI’s for the DSI are useful for showing plant chlorophyll activity and water activity within the plant.

**Decision Support Tool & End-Product Overview**

|  |  |  |
| --- | --- | --- |
| **Proposed End Products** | **Decision to be Impacted** | **Current Partner Tool/Method** |
| Ternary Diagrams Presented within the DSI Map | Resource allocation and crop/livestock management practices due to knowledge of knowing drivers of drought conditions | None |

*Ternary Diagrams Presented within the DSI Map – The MODIS and CMORPH sensors will go into creating the DSI. From there the ternary diagrams will be creating by splitting up the DSI into its three components and plotting them onto the ternary diagram. This will be followed by research into how the factors affect agriculture in various ways in order to better prepare end-users for use. Finally the ternary diagrams will be coded into the data library so that they can appear when any region of the map is selected.*

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Terms: Spring 2016

***Previous Related DEVELOP Work:***

2013 Fall (IRI) – Uruguay Agriculture: Using Terra MODIS Land Surface Reflectance, MODIS-Vegetation products and Tropical Rainfall Measuring Mission - Precipitation to Assess Local Scale Drought in Uruguay Term

2015 Spring (IRI) – Uruguay Agriculture II: Comparing a Terra MODIS Land Surface Reflectance, MODIS-Vegetation products and Tropical Rainfall Measuring Mission (TRMM) - Precipitation Drought Index to Soil Water Balance and Testing a Replacement for TRMM

**Project Needs/Requests**

***Participants Requested:*** 3

***Software & Scripting:***

IRI/INIA Data Library – Manipulate and present data

SAS JMP – Statistical work and preliminary ternary diagram creation

**Notes & References:**

***Notes:*** N/A

***References:***

Rhee, J., Im, J., & Carbone, G. J. (2010). Monitoring agricultural drought for arid and humid regions using multi-sensor remote sensing data. Remote Sensing of Environment, 114(12), 2875-2887.