**NASA DEVELOP National Program**

****International Research Institute for Climate and Society

**Spring 2016**

**Short Title: Uruguay Agriculture III**

**Subtitle:** 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

**VPS Title:** Droughts and the Factors that Made Them: Using NASA Earth Observing Satellites to Monitor Drought from Space

**Project Team & Partners**

**Project Team:**

Jerrod Lessel (Project Lead), jerrod.lessel@gmail.com

Andrew Kruczkiewicz

**Advisors & Mentors:**

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

**Past or Other Contributors:**

Alex Sweeney

**Partner Organizations:**

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

**Project Details**

**Applied Sciences National Applications Addressed:** Agriculture, Disaster

**Study Area:** Uruguay

**Study Period:** January 2003 - December 2014

**Earth Observations & Parameters:**

Aqua, MODIS – land surface temperature and vegetation indices

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 – passive microwave for CMORPH precipitation estimates

**Ancillary Datasets Utilized:**

* INIA Soil Water Balance – percent available water

**Software Utilized:**

IRI Data Library – manipulate/download/present DSI data and maps

SAS JMP Statistical Software – Statistical work and preliminary ternary diagram creation

**Project Overview**

**80-100 Word Objectives Overview:**

The first objective is to improve the previously created drought severity index by changing the scaling of the algorithm to better suit the end user needs. The second objective is to create an interactive system of ternary diagrams for the 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.

**Abstract:**

The importance of monitoring drought is indispensable for countries whose economic viability is strongly tied to agriculture. Droughts are a major concern for the country of Uruguay, affecting their agricultural and energy sectors. The development of an accurate and reliable remotely sensed drought-monitoring tool that can aid government agencies in disseminating drought information to local stakeholders will be helpful in sustaining these important economic sectors. This study built on the Drought Severity Index (DSI) from previous terms by modifying the scaling method within the model as well as adding a ternary diagram showing the values of each of the parameters within the DSI. The DSI itself is based off of methodology from Rhee et al. (2010), which uses the climatological anomalies of NASA’s Moderate Resolution Imaging Spectrometer (MODIS) daytime land surface temperature (LST) data, precipitation data from NOAA’s Climate Prediction Center’s Morphing Technique (CMORPH), and MODIS Normalized Difference Water Index (NDWI) data. This modified DSI as well as the parameter ternary diagrams have the potential to aid INIA and the Ministry of Agriculture in informing land managers, insurance providers, and policy makers in drought preparation and mitigation practices.

**Community Concerns:**

* Droughts are a major economic concern for the country of Uruguay, affecting their agricultural and energy sectors.
* A 2009 multi-month drought in Uruguay caused an estimated 400 to 450 million U.S. Dollars to be lost, according to the Uruguayan Agriculture Programming and Policy Office (OPYPA).
* Much of Uruguay’s power is generated by hydroelectric sources, making them susceptible and sensitive to droughts, as evidenced by a drought in the late 1980s, which reduced the hydroelectric output so much petroleum was imported, and the country had to adopt strict energy conservation strategies in order to keep up with the country’s energy demand.

**Current Management Practices & Policies**:

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.

**Decision Support Tools & Benefits:**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Ternary Diagrams Presented within the DSI Map | Aqua, MODIS;  Terra, MODIS;  DMSP-13, 14, &15, SSM/I;  NOAA-15, 16, 17, &18 | An improved drought severity index with the ability to have more information about the drivers of the drought in their particular region. |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)

**Software Release Requirements**

What category do the tools your project is creating fall within?

No software development involved

**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.