**NASA DEVELOP National Program**

****NASA Marshall Space Flight Center

*Spring 2017*

**Short Title: Alabama Agriculture**

**Subtitle:** Using NASA Earth Observations to Assess Vegetative Stress of Row Crops in Irrigated and Non-Irrigated Plots in Alabama

**VPS Title:** O Water, Where Art Thou? Assessing the Capacity of Irrigation on Crops in Alabama during Droughts

**Project Team & Partners**

**Project Team:**

Chris Ploetz (Project Lead), ploetcj@gmail.com

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**Advisors & Mentors:**

Dr. Jeffrey Luvall (NASA Marshall Space Flight Center)

Dr. Robert Griffin (University of Alabama in Huntsville)

Leigh Sinclair (University of Alabama in Huntsville, Information Technology and Systems Center)

Cameron Handyside (University of Alabama in Huntsville, Earth System Science Center)

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Alabama Office of the State Climatologist | Dr. John Christy, Alabama State Climatologist | End-User | Yes |
| University of Alabama in Huntsville, Earth System Science Center (ESSC) | Cameron Handyside, Research Engineer | Collaborator | No |

**Project Details**

**Applied Sciences National Application Addressed:** Agriculture

**Study Area:** AL

**Study Period:** 2009, 2011, and 2016 (March – September)

**Earth Observations & Parameters:**

Landsat 5, Thematic Mapper (TM) – Surface Reflectance

Landsat 8, Operational Land Imager (OLI) – Surface Reflectance

Sentinel 2, Multi-spectral Instrument (MSI) – Surface Reflectance

**Ancillary Datasets Utilized:**

* GriDSSAT Crop Model (POC: Cameron Handyside, Research Engineer) – comparison to indices
* United States Department of Agriculture (USDA) CropScape – data layer
* ESSC Center Pivot Survey – data layer

**Software Utilized:**

* ESRI ArcGIS – Raster manipulation/analysis, image enhancement and map creation

**Project Overview**

**80-100 Word Objectives Overview:**

In Alabama, drought affects agriculture in numerous ways, such as reducing crop yields, water shortages, and next season’s insects and diseases. This project aims to research drought conditions in Alabama and assist the Alabama Office of the State Climatologist (AOSC) in drought monitoring efforts across the state. The project analyzes Green Normalized Difference Vegetation Index (GNDVI), Normalized Difference Vegetation Index (NDVI), and the Normalized Difference Water Index (NDWI) to determine an index that clarifies drought impacts on corn, soybeans, and cotton (row crops). The project focuses on the most recent droughts in 2011 and 2016, and the growing season months of March through September.

**Abstract:**

Over the past decade, drought in Alabama has had a major impact on agriculture, causing crop yields to fall well below normal levels. The Alabama Office of the State Climatologist (AOSC) monitors drought using a myriad of data types and sources, and compiles the information into a weekly drought-monitoring map, the United States Drought Monitor (USDM). This project explored using two vegetation indices, Green Normalized Difference Vegetation Index (GNDVI) and Normalized Difference Vegetation Index (NDVI), and one water index, the Normalized Difference Water Index (NDWI), from high-resolution satellites, Landsat 5 TM, Landsat 8 OLI, and Sentinel 2 MSI to increase the level of detail in drought depiction for the USDM. Additionally, the project considered whether farms with center pivot irrigation fared better than farms relying solely on precipitation during the 2011 and 2016 drought using data provided by the Earth System Science Center (ESSC) at University of Alabama, Huntsville. The results were compared to the USDM output and the crop’s water stress index, which was provided by the ESSC’s Gridded Decision Support System for Agrotechnology Transfer (GriDSSAT) crop model. The project resolved that although higher-resolution satellites do provide information on when a crop is under vegetative stress before the USDM depicts drought conditions, the resolution of Landsat 5 and Landsat 8 was not high enough to analyze crops at a field level scale.

**Keywords:**

Alabama, center pivot irrigation, corn, drought, GNDVI, Landsat, NDVI, NDWI, remote sensing, row crops

**Community Concerns:**

* In 2016, the US Drought Monitor classified all of Alabama as being in severe or worse drought conditions, with nearly 5 million people living in drought affected areas
* In 2012, precipitation was 15 inches below normal in Alabama
* 1,172 Alabama farms had to abandon production or had failed harvests
* Many famers needed federal aid, thus the USDA extended the usual cattle grazing period due to the severe 2016 drought

**Current Management Practices & Policies**:

Under the Alabama Water Resource Act, the Office of Water Resources (OWR) is responsible for drought monitoring, publishing a new drought plan at least every five years under the advice of the Alabama Drought Assessment and Planning Team (ADAPT). ADAPT is comprised of several state representatives, including the Alabama Office of the State Climatologist. The AOSC also contributes a weekly map of drought conditions to the United States Drought Monitor (USDM), which utilizes Earth observations from NASA, NOAA, and commercial land remote sensing imagers. The USDM then distributes the drought condition maps to policymakers and the media.

**Decision Support Tools & Benefits:**

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| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software Release** |
| NDVI Time Series | Landsat 5 TM and Landsat 8 OLI, Sentinel 2 MSI | The time series allows for analysis of row crops’ vegetative stress throughout the growing season during a drought period. | N/A |
| Drought and Vegetation Indices Assessment | Landsat 5 TM, Landsat 8 OLI | This assessment allows for a comparison among the different indices to determine the most accurate index for monitoring drought in Alabama. | N/A |
| Irrigation vs Rain Fed Crop Comparison Map | Landsat 5 TM and Landsat 8 OLI | This product analyzes the values of drought and vegetation indices at known irrigated areas in the state. This will aid the project partner’s decision-making process by highlighting areas that have experienced severe drought conditions during the study period. | N/A |