**NASA DEVELOP National Program**

****NASA Marshall Space Flight Center

**Summer 2014**

**Southeast U.S. Water Resources II**

*Development of an Alternative Water Withdraw Monitoring System for USGS using NASA Earth Observations to Aid in Irrigation Monitoring in the Southeastern United States*

**Team Lead:** Carrea M. Dye (Eastern Kentucky University), carrea.dye@gmail.com

**Team Members**

Samira Daneshgar Asl (Florida State University)

Cara Estes (Florida State University)

**Advisors & Mentors:**

Dr. Jeffery Luvall (NASA Global Hydrology and Climatology Center)

**Past or Other Contributors:**

Southeast U.S. Water Resources I (Kaylin Bugbee, Sherry Barrett, Samuel Ayers, and Modeste Muhire)

**Applied Sciences National Applications Addressed:**

Water Resources, Agriculture

**Study Area:** Southeastern United States- Alabama and Georgia

**Study Period:** January 2008- December 2013

**Partners/Collaborators**

United States Geological Survey (USGS) Georgia Water Science Center: Mr. Lynn Torack, Groundwater Specialist

**80-100 Word Blurb**

The Southeast United States lost majority of its crops during the early 20th century due to droughts and lack of investment in irrigated agriculture. As a result, a shift in agricultural distribution occurred; making the Midwest and Western United States responsible for the majority of the crop production within the United States. However, water scarcity in the Western United States continues to be of high concern. It is crucial for the Southeast to return to higher agricultural crop production. To do this, our team will develop an easily accessible tool for the Southeast to monitor drought. This in turn will promote more sustainable irrigation practices throughout the region.

**Community Concerns**

* Water stress of crops due to change in precipitation
* Severe drought and extreme precipitation
* Too much crop production in one area
* Limited freshwater resources
* Ad verse economic effects due to increased price of agricultural products

**Current Management Practices & Policies**

The USGS in Georgia currently uses a point source system of water gauges on select irrigation systems to monitor water withdraw. They would like to develop a system that will potentially monitor water withdraw on a larger scale.

**Abstract**

In 2012, limited rain and low soil moisture resulted in a drought which impacted crop fields in the Midwest and Southwest United States. Water scarcity in the Western United States is a high priority concern, which makes it increasingly important for the Southeast United States to develop more sustainable irrigation practices. Understanding evapotranspiration and monitoring potential evapotranspiration (PET) is beneficial in determining areas that are more prone to drought. Evapotranspiration is the sum of evaporation from the land surface plus transpiration from plants. Monitoring evapotranspiration will play a vital role in determining the effects of climate on agricultural ecosystems in the Southeast United States.  An easily accessible tool was developed that monitors drought via drought indices and calculates Arid Index (AI), which is precipitation subtracted from monthly potential evapotranspiration.  The tool allows areas of high productivity to be mapped in order to increase crop yields.

Corn, which is the largest crop in terms of production and consumption, is also a high priority. The Vegetation Drought Index (VDI) is used to monitor agricultural drought in corn fields of the Southeast United States. VDI was developed from normalized difference water index (NDWI) and day-night land surface temperature (LST) difference. Terra and Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) 8 day land surface temperature & emissivity, Land Surface Reflectance products from 2008 to 2013 were collected over the study area. Monthly precipitation and potential evapotranspiration from 2008 to 2013 were utilized to evaluate the potential water input and output of the soil. The purpose of this project was to assist agencies such as the United States Geological Survey (USGS) Southeast United States in developing more efficient water withdraw monitoring system, which in turn will protect future economic endeavors and promote more sustainable irrigation practices.

**Decision Support Tools**

* Evaluation of the Arid Index (AI) in cornfields of the Southeast United States using monthly precipitation and potential evapotranspiration
* Monthly Potential Evapotranspiration estimates for the Southeast U.S. region based on Thornthwaite’s Water Budget Model
* Evaluation of the Vegetation Drought Index (VDI) in cornfields of the Southeast United States using the monthly Water Condition Index (WCI) and Day-Night Temperature Condition Index (∆TCI)
* Automated process for calculating Monthly Potential Evapotranspiration

**Benefit to End-User:**

* Feasible and time efficient method for estimating monthly withdraws from irrigation system
* Assist in identifying areas that are more prone to drier conditions to support more sustainable irrigation practices

**Earth Observations & Parameters**

* Terra, MODIS – Evapotranspiration, Vegetation Drought Index (VDI)
* Aqua, MODIS – Evapotranspiration, Vegetation Drought Index (VDI)

**Future Applicable NASA Missions**

Soil Moisture Active Passive Satellite (SMAP) and Aerial Vehicles

**Ancillary Datasets Utilized**

U.S. Department of Agriculture (USDA) National Agriculture Statistics Service Cropscape – crop identification

National Climatic Data Center (NCSC) – monthly precipitation

**Software Utilized**

ArcGIS - raster manipulation/analysis, model builder, and map creation

Python – raster processing scripts