**NASA DEVELOP National Program**

**** Wise County Clerk of Court’s Office

**Fall 2014**

**South East United States Energy**

*NASA Earth Observation Detection of Burned and Blighted Areas for Creation of* *an* *Unhealthy Forest Index to Prioritize Forest Harvest for Biofuel Production*

**Team Lead:** Rajkishan Rajappan, rajkishan16@gmail.com

**Team Members:**

Jordan Bates

Zachary Tate

Rohini Swaminathan

**Advisors & Mentors:**

Dr. Kenton Ross (NASA DEVELOP National Advisor)

Dr. Dewayne Cecil (Global Science Technology Inc.)

**Past or Other Contributors:**

Dieudonne Dusenge

Asongayi Venard

Andrew Foxx

Jessica Huff

**Applied Sciences National Applications Addressed:**

Energy, Agriculture, Ecological Forecasting, Disasters

**Study Area:** Southeast United States: Texas, Alabama, Florida, North Carolina, South Carolina, Mississippi, Louisiana, Arkansas, Virginia, Georgia

**Study Period:** January 2010 – Present

**Partners/Collaborators**

U.S. Forest Service: Mr. Tim Sexton

EnviraCarbon Incorporated: Dr. Steve Hooper  
Wise County

**80-100 Word Blurb**

The mountains in the Southeast United States region are known for their natural beauty and dense forest cover. However, these forests are under threat from wildfires, diseases, droughts and pests. In addition to these natural factors, urbanization, recreation, logging, and biomass energy production are also destroying healthy trees. This project’s objective was to utilize NASA’s Earth observations to detect unhealthy forests that are recently burned or contain active blight. The results can help prioritize harvest of timber stocks on public lands in order to decrease deforestation of healthy trees.

**Community Concerns**

* Forests are under threat from human activities such as residential development, agriculture and logging
* They are also affected by drought and invasion of pests such as Gypsy Moth and Engraver Beetles
* Biomass energy production destroys a large amount of healthy trees
* Harvesting the infested trees helps to decrease the spread of that infestation and protect healthy forests

**Current Management Practices & Policies**

The Forest Service actively monitors each of the four threats through a variety of methodologies, many including NASA Earth observations. It conducts multiple activities relating to forest health through remote sensing such as forest health indices, fire risk, disease and insect mapping. However, it does not combine them into a comprehensive forest index aimed at pinpointing areas to target on public lands for biofuel production.

**Abstract**

The Southeast United States region is known for its natural mixed forests biome. However, these forests are under pressure from biofuel production. This project focused on identifying unhealthy forests that had been affected by invasions of pests, drought, forest fires and other natural factors. These regions could be used for biofuel production without affecting the healthy part of the ecosystem.

This project utilized data from the Landsat 8 Operational Land Imager (OLI) and the Landsat 5 Thematic Mapper (TM) to generate Normalized Differential Vegetation Index (NDVI) for identifying unhealthy forests. Aqua and Terra’s Moderate Resolution Imaging Spectroradiometer (MODIS) and PERSIANN data were combined to generate Scaled Drought Condition Index (SDCI) to determine the severity of drought. Landsat images allowed targeted high resolution analyses for areas, which were demonstrated by MODIS as having potential for being affected by infestation or drought. All the identified dead wood trees were combined to produce an unhealthy forest map which could be used in several decision making processes.

**Decision Support Tools**

* NDVI maps were used to identify the forest areas which were unhealthy
* Defoliation Index was created and used to determine the extent of change in defoliation in the area

**Benefit to End-User:**

* This project will help our partners to identify the unhealthy forests using satellite images without having to go to the field to do the inspection
* Damaged areas could be used for biofuel production without disturbing the healthy part of the ecosystem
* The results from this project can be used by the US Forest Service for identifying regions of pest infestation and take necessary steps to mitigate its spread

**Earth Observations & Parameters**

Landsat 8, Operational Land Imager (OLI) - Land cover/ vegetation analysis

Landsat 5, Thematic Mapper (TM) - Land cover/ vegetation analysis

Aqua MODIS MYD13Q1 dataset- Vegetation indices

**Ancillary Datasets Utilized**

USDA Forest Service, Insect & Disease Detection Survey Data Explorer – Insect maps

USDA National Agricultural Statistics Service, CropScape – Crop cover

U.S. Drought Monitor Map Archive – Drought Coverage and Severity Maps

National Drought Mitigation Center – Groundwater and Soil Moisture Conditions from GRACE Data Assimilation

Center for Hydrometerology and Remote Sensing - Precipitation Estimation from Remote Sensing Information using Artificial Neural Network (PERSIANN) Rainfall Data

**Software Utilized**

ArcGIS - Raster manipulation/analysis, image enhancement & map creation of Landsat 5 (TM), Landsat 8 (OLI), Aqua/Terra (MODIS)

Python- batch processing for Landsat and MODIS data products

MODIS Reprojection Tool MRT – MODIS reprocessing and reprojection