**NASA DEVELOP National Program**

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

**Summer 2014**

**Appalachian Energy I**

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

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**Team Members:**

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**Advisors & Mentors:**

Dr. Kenton Ross (NASA DEVELOP National Advisor)

**Applied Sciences National Applications Addressed:**

Energy, Ecological Forecasting, Disasters

**Study Area:** Central Appalachian Mountains in the states of North Carolina, Virginia, West Virginia, Kentucky and Tennessee

**Study Period:** January 2004 – January 2014

**Partners/Collaborators**

U.S. Forest Service: Mr. Tim Sexton

Virginia Department of Agriculture and Forestry: Mr. Todd Haymore

EnviraCarbon Incorporated (boundary organization) : Dr. Steve Hooper
Wise County, through EnviraCarbon, Inc.

**80-100 Word Blurb**

The Appalachian Mountains are known for their natural beauty and dense forest cover. However, these forests are under threat from wildfires, diseases, 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**

The US Forest Service (USFS) identifies four threats to the health of the Nation’s Forests and Grasslands: a) fire and fuels, b) invasive species, c) loss of open space, and d) unmanaged recreation. Synoptic analysis that monitors and detects unhealthy forest areas can provide industry with optimal material for creation of new biofuel technologies. There is a need for a system to locate unhealthy forest and prioritize areas optimal to harvest.

**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. The Virginia Department of Forestry currently monitors forest health in cooperation with the USFS through surveys and annual evaluations of 100 permanent forest plots established throughout the state.

**Abstract**

The Appalachian Mountains are known for their natural forests. However, these forests are under pressure from human activities such as residential development, agriculture and logging. The forests are also increasingly affected by forest fires, invasions of pests such as the gypsy moth and Hemlock woolly adelgid and other natural factors. In addition, biomass energy production destroys a large amount of healthy trees. During the last 20 years, tens of thousands of acres of natural forest have been logged, many of them replanted as pine tree plantations. As a result of these threats, ecosystems are collapsing and species are being rendered extinct.

This project utilized data from Landsat 8, Operational Land Imager (OLI) for forest monitoring to derive indices like Normalized Differential Vegetation Index (NDVI) and Relative Differenced Normalized Burn Ratio (RdNBR) to identify unhealthy forests. Pan sharpened Landsat 8 images provided targeted higher resolution analyses for areas demonstrated by Aqua and Terra’s Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) to have potential for harvest. MODIS and VIIRS provided vegetation dynamics and phenology products, along with fire-related datasets like fire occurrences and scarring. Partnering with Wise County and the Virginia Department of Agriculture and Forestry, this project facilitated the use of NASA Earth observations to identify unhealthy forests in this region.

**Decision Support Tools**

* Unhealthy Forest Index
* NDVI maps
* Vegetation Health Index
* Normalized Burn Ratio maps

**Benefit to End-User:**

* Help to identify and prioritize timber harvesting which will lead to reduced deforestation of healthy land cover and also increase biofuel production efficiency.

**Earth Observations & Parameters**

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

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

Aqua/Terra, MODIS - Vegetation indices

Suomi National Polar Orbiting Partnership (NPP), VIIRS – Fire scar, land cover, vegetation dynamics/ phenology

**Ancillary Datasets Utilized**

US Forest Service Burned Area Reflectance Classifications (BARC)

2012 National Insect and Disease Risk Map

USDA Forest Health Protection Mapping and Reporting’s Disease and Insect Conditions maps and reports

National Land Cover Datasets
FORWARN Forest NDVI Change

**Software Utilized**

* ArcGIS - Raster manipulation/analysis, image enhancement & map creation of Landsat 5 (TM), Landsat 8 (OLI), Suomi NPP(VIIRS), Aqua/Terra (MODIS)
* Python- batch processing for MODIS data products
* MODIS Reprojection Tool MRT – MODIS reprocessing and reprojection