**NASA DEVELOP National Program**

****Stennis Space Center

**Fall 2014**

**Southern US Disasters**

*Assessing the Potential to Use VIIRS 375m Data for Detecting Forest Disturbances*

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**Applied Sciences National Applications Addressed:**

Disasters

**Study Areas:**

Northeastern US, including: New York, Massachusetts, and Connecticut

Winston County, Mississippi

Black Hills, South Dakota

**Study Period:** June 2013 – September 2014

**Partners/Collaborators**

USDA Forest Service: William “Bill” Hargrove, Research Ecologist

Oak Ridge National Laboratory: Forrest Hoffman, Computational Climate Scientist

NASA Land Product Evaluation and Analysis Tool Element (PEATE): POC TBD

**80-100 Word Blurb**

The spring 2014 team compared Visible Infrared Imagine Radiometer Suite (VIIRS)-based forest disturbance monitoring products to those generated from Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS) NDVI data. This project continued that work by comparing VIIRS-based NDVI to Aqua MODIS NDVI, and explored alternative indices that could provide additional information about forest disturbances. In consideration of work on both federal and state levels to manage, monitor, and protect the nation’s forests from numerous factors that threaten forested lands, this project concentrated on three different disturbance types: mountain pine beetle-induced forest mortality, tornado damage, and hail storm damage.

**Community Concerns**

* Forest managers need to be able to accurately detect and evaluate biotic threats (e.g., caterpillar-caused defoliation) and abiotic threats (e.g. droughts, fires, or tornados).
* MODIS, which is pivotal in meeting the above need, is now over ten years old.
* It is essential that new methods and alternative data products are created for the use of VIIRS.

**Current Management Practices & Policies**

For years, MODIS data has been used by forestry management in monitoring and protecting forest resources. The MODIS-based forest change recognition and tracking tool ForWarn, a forest threat early warning system, along with its ancillary datasets, are used by forest resource managers to help identify forest disturbances and determine the cause of disturbance. These warning systems also address how to allocate resources in order to mitigate damage to forested areas. The organizations that produce these warning systems rely largely on products derived from MODIS data. These products are in danger of becoming outdated, as the MODIS sensor is years past its expected expiration date.

**Abstract**

Both federal and state agencies work to manage, monitor, preserve, and protect the nation’s forests. Although abiotic factors, such as droughts, fire, hail, and tornadoes, are commonly recognized as dangerous for our nation’s forests, biotic factors such as predatory insects and diseases pose an equally alarming threat. Over the past decade, Moderate Resolution Imaging Spectroradiometer (MODIS) sensors aboard the *Terra* and *Aqua* satellites have played a pivotal role in regional forest monitoring; since these sensors have now exceeded their life expectancy, it is essential that new methods and alternative data products are developed to ensure continuity. This project expanded on the previous term’s work by focusing on research comparing Normalized Difference Vegetation Index (NDVI) products created using data from the Visible Infrared Imaging Radiometer Suite (VIIRS) and Aqua MODIS, which are both instruments that collect data in the afternoon hours. NDVI products using Landsat 8 data will also be used in order to augment VIIRS and MODIS data. In addition, alternative vegetation monitoring indices were explored that may potentially offer additional information on forest disturbances, such as Normalized Difference Water Index (NDWI), Normalized Difference Moisture Index (NDMI), and Enhanced Vegetation Index (EVI). Biotic and abiotic disturbances in varied environments were analyzed. Study areas included mountain pine beetle-induced forest mortality in Black Hills, South Dakota, tornado damage in Mississippi, and hail storm damage in the northeastern United States.

**Decision Support Tools**

* VIIRS Band Ratios - Target disturbance mitigation efforts and which mitigation efforts use
* VIIRS Vegetation Indices and Vegetation Health Anomalies - Target disturbance mitigation efforts and which mitigation efforts to use
* VIIRS versus MODIS forest change products - Determine when and where a change(i.e., disturbance) has occurred

**Benefit to End-User:**

* Demonstrate continuity of forest monitoring decision support systems that use MODIS 250m data through use of VIIRS 375m data
* Promote inclusion of VIIRS NDVI (and other alternative indices) data into online monitoring systems such as ForWarn

**Earth Observations & Parameters**

Suomi NPP, VIIRS - Moderate Resolution Band Ratios, Vegetation Indices, and Change Detection Products

Aqua MODIS - Moderate Resolution Band Ratios, Vegetation Indices, and Change Detection Products

Landsat 8, OLI - High Resolution Band Ratios, Vegetation Indices, and Land Use/Land Cover Products

**Future Applicable NASA Missions**

HyspIRI - Land cover, spectral vegetation indices, and environmental monitoring indices

**Models Utilized**

Clark Labs – IDRISI Land Change Modeler for ArcGIS

**Ancillary Datasets Utilized**

USGS National Land Cover Dataset (NLCD) - Land Cover

NOAA Coastal Change Analysis Program (C-CAP) - Regional Land Cover

**Software Utilized**

ERDAS Imagine - Raster Calculations/Manipulation, Processing, and Analysis

ArcGIS - Raster Calculations and Map Creation