ABSTRACT

Hurricane damage to forests can be severe, causing millions of dollars of timber damage and loss. To help mitigate loss, state agencies require information on location, extent, and intensity of forest damage. NASA MODIS Normalized Difference Vegetation Index (NDVI) time series data products offer a potential resource for state agencies to predict hurricane-induced forest damage and recovery across a regional forest. In response, a project was conducted to produce and assess 250 meter forest disturbance and recovery maps for southern Mississippi inventory districts (MIFI). The products and capabilities from the project were compiled and are now available for the Mississippi Institute for Forest Inventory (MIFI).

BACKGROUND

• Hurricane Katrina was one of the most powerful and deadliest storms ever to impact landfall in the United States.
• It was also the costliest in U.S. history, causing estimated damages in excess of $110 billion.1,2
• The initial disturbance footprint of the storm was a tropical cyclone, now classified as a tropical storm.
• Hurricane Katrina caused widespread damage to property and over 150,000 fatalities.3
• The storm also severely impacted the forest lands along the southern Gulf of Mexico, especially in Mississippi.
• The forest products industry in Mississippi generate over $1 billion in revenues and contribute 6% of all state tax revenue.
• Timber is an important agricultural crop in the local economy of every Mississippi County outside the Delta.
• In any year, sawtimber log value for the three most valuable agricultural crops in the 37 counties out of 81 total count.
• Forests play a vital role in forested watersheds and support commercial and recreational uses.
• MODIS time series data products are a low-cost alternative to in-situ high resolution optical sensor data.
• Identification of fire-affected forest areas can precipitate more directed and efficient ground sampling campaigns.
• MODIS offers a source of high temporal resolution data for monitoring vegetation changes at regional scale.4
• Phenological data trending provides rapid identification of disturbance between successive time steps (in this case year).

METHODOLOGY

• MODIS/MODIS MODIS Normalized Difference Vegetation Index (NDVI) 16-day temporal composite data were used to generate forest disturbance products.
• MODIS NDVI mapping provides the benefits of estimating cloud cover found in daily images as well as mitigating spectral noise.
• Focused on annual comparisons with the specific 16-day “Window” defined by the dates 28 August to 23 September 13 because it is immediately after the hurricane event. This period is referred to as “Window 1” (see Table 1).
• Disturbance/damage products were generated by calculating normalized NDVI percent change from pre-Katrina dates (based on post-Katrina dates, each time comparing the same annual Window.
• Pre-Katrina MIFI is defined as the minimum NDVI value for the years 2003 and 2004. Normalized percent change was calculated and the resulting data were then classified into disturbance/damage categories.
• Developed model solutions with 1:20 MIF Data Spatial Filter. These models generated disturbance/damage products. The model takes in this model.
• Calculation percent NDVI change between pre-Katrina and post-Katrina data.
• Developed model solutions with 1:20 MIF Data Spatial Filter. These models generated disturbance/damage products. The model takes in this model.
• Calculation percent NDVI change between pre-Katrina and post-Katrina data.

REFERENCES

4. Non-forested area
Class 1 10% < mod index < 10% (mod index = 0.5)
Class 2 10% < mod index < 10% (mod index = 0.5)
Class 3 10% < mod index < 10% (mod index = 0.5)
Class 4 10% < mod index < 10% (mod index = 0.5)
Class 5 <0% < mod index < 10% (mod index = 0.5)

CONCLUSIONS

Validation efforts support the technique of using MODIS-based NDVI percent change products to quantify the effect of Hurricane Katrina on coastal forests. Furthermore, this technique is extend to evaluations of other natural events to forest ecosystems such as droughts, wind storms and forest fires. While the spatial resolution of MODIS may be too coarse for some applications, the reported approach can be used to extend more spatially directed timber inventories with ground sampling. Since ground sampling timber inventory activities can be costly, this MODIS-based approach can create significant cost savings by reducing man power and labor.

Figure 1: Study Area: The 15 Mississippi counties of MIFI Southeast Inventory District. The blue line is hurricane Katrina’s track on August 28, 2005.

Figure 2: Window 15 2005 disturbance of the MIFI southeast inventory district with detail data.

Figure 3: Table of 16 disturbance/damage maps for the window 2003-2005 in Mississippi.

Figure 4: Measured of Window 15 disturbed area by damage class for Hancock County for 2003-2005 in Mississippi. Refer to Figure 2 for damage class key.

Figure 5: Composition of MIFI's Southeast Inventory District at age and forest type. These products were originally computed from digital data.

Figure 6: Validation scatter plot comparing MODIS with Landsat

Table 1: Comparison of the age characteristics and NDVI change classes for all southern forests in the Southeast Inventory District.

Table 2: Comparison of the age characteristics and NDVI change classes for all southern forests in the Southeast Inventory District.

Table 4: Comparison of the age characteristics and NDVI change classes for all southern forests in the Southeast Inventory District.

Table 5: Comparison of the age characteristics and NDVI change classes for all southern forests in the Southeast Inventory District.