



HEALTHY FOREST

Gulf of Mexico Initiative

Potential of VIIRS Time Series Data for Aiding the USDA Forest Service Early Warning System for Forest Health Threats: A Gypsy Moth Defoliation Case Study

In this RPC (Rapid Prototyping Capability) experiment, we assessed the potential of simulated VIIRS (Visible/Infrared Imager/Radiometer Suite) and MODIS (Moderate Resolution Imaging Spectroradiometer) data for monitoring non-native gypsy moth (*Lymantria dispar*) defoliation of forests. Gypsy moth defoliation of broadleaved forests in the United States is specifically listed as a threat in the HFRA (Healthy Forest Restoration Act) of 2003. The HFRA is considered important legislation for implementing the U.S. Ocean Action plan, since healthy forests can benefit coastal water quality. The HFRA mandates development of a national forest threat EWS (Early Warning System). The USFS (USDA Forest Service) Eastern and Western Forest Threat Assessment Centers are designing and building this system. NASA is helping the USFS to integrate needed satellite data products into the EWS. This activity includes the evaluation of MODIS and simulated VIIRS data sources for supplying EWS forest disturbance monitoring products. This case study focuses on one facet of the EWS: the need for monitoring forest disturbance due to exotic insect defoliation.

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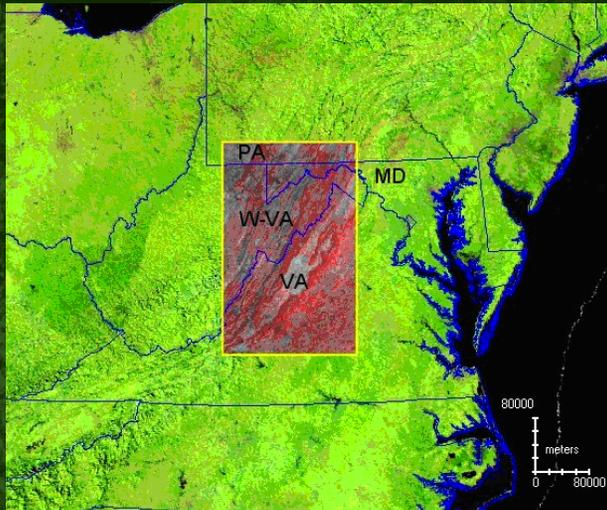
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The study was conducted over a 15.5 million acre mid-Appalachian Highland region during 2000–2006. The study focused on 2001 defoliation because of its extensive occurrence and available reference data during that year. Analysts computed and validated 2001 regional wall-to-wall defoliation maps from simulated VIIRS and multiple MODIS products. Simulated VIIRS products were computed primarily from MODIS data. We determined that both MODIS and simulated VIIRS time series data can accurately map regional historic gypsy moth defoliation once temporal data processing is performed. Temporal processing of MODIS and simulated VIIRS NDVI (Normalized Difference Vegetation Index) time series data from the defoliation period proved effective even though clouds covered the study area about 80 percent of the targeted time.

To generate defoliation maps, we applied MODIS and simulated VIIRS time series data to compute the maximum NDVI for the typical defoliation period of June 10–July 27 for each year and across all 7 years. The latter was used with the maximum NDVI image for the 2001 defoliation season as input to image classification of forest defoliation. The defoliation detection products were validated using Landsat and ASTER satellite imagery. The overall accuracy of the defoliation maps exceeded 85 percent using either the daily MODIS or simulated VIIRS data.

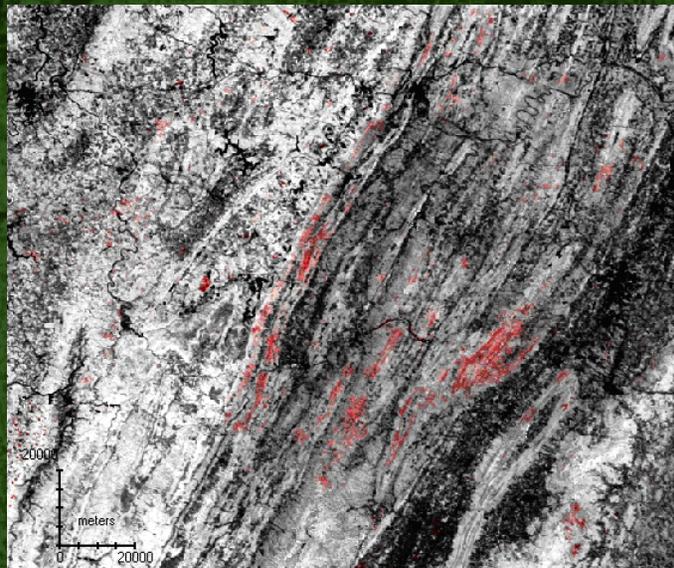
Given these results, MODIS defoliation maps may aid airborne sketch map forest defoliation surveys, either in the planning stage or after the fact in terms of adjusting estimates of total defoliated area. The RPC experiment enabled the USFS to assess MODIS and VIIRS data potential for contributing to a forest threat EWS. More work is being done on other geographic regions and for other years to further assess this promising application. Additional research is also being performed through another project to assess the potential of MODIS data for contributing near-real time products to this EWS.



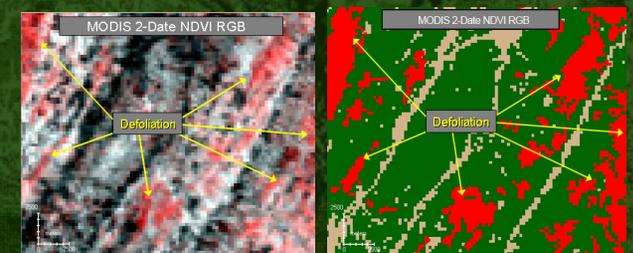
Location of study area in the Eastern United States (study area extent indicated in yellow shown with Landsat mosaic in foreground and MODIS mosaic in background).



Oblique view of gypsy moth defoliation
Photograph acquired by Mark Robinson, USDA Forest Service



< Synoptic visualization of 2001 gypsy moth defoliation using RGB color composite image based on MOD02 maximum NDVI during the defoliation seasons across 2000–2006 era loaded in red plus maximum NDVI during the defoliation for 2001 assigned to the blue and green color guns. The deep red tones indicate defoliation.



MODIS image data shown on left was used to compute final defoliation mapping product shown on right.