



Monitoring Regional Forest Disturbances across the US with Near Real Time MODIS NDVI Products included in the ForWarn Forest Threat Early Warning System

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Introduction



- U.S. forests occupy ~1/3 of total land area (~304 million ha)
- Since 2000, a growing number of regionally evident forest disturbances have occurred due to abiotic and biotic agents
- Regional forest disturbances can threaten human life and property, bio-diversity and water supplies
- Timely regional forest disturbance monitoring products are needed to aid forest health management work
- Near Real Time (NRT) twice daily MODIS NDVI data provide a means to monitor U.S. regional forest disturbances every 8 days
- Since 2010, these NRT forest change products have been produced and posted on the US Forest Service ForWarn Early Warning System for Forest Threats

U.S. ForWarn System for Regional Forest Disturbance Monitoring

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<http://forwarn.forestthreats.org>

CONTACT US

ForWarn

Satellite-Based Change Recognition and Tracking

Home Overview News Highlights Data Support

Monitoring Gypsy Moth defoliation in near real time

By late 2012, forest health monitors in western New York and Pennsylvania knew that they were about to experience a severe outbreak of the non-native Gypsy Moth. Surveys showed an unusually high density of egg masses on the branches and trunks of...

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What is ForWarn?

ForWarn is a satellite-based forest disturbance monitoring system for the conterminous United States. It delivers new forest change products every eight days and provides tools for attributing abnormalities to insects, disease, wildfire, storms, human development or unusual weather. Archived data provide disturbance tracking across all lands since 2000. Interactive maps are accessible via the [Forest Change Assessment Viewer](#). Read more about ForWarn [here](#).

Recent News

[ForWarn highlights report published](#)
09/06/2013 - 07:59 A Forest Service General Technical Report highlighting detections made by the ForWarn system is available online. See [here...](#)
[GTR_SRS180LARGE.PDF](#)

[ForWarn awarded NASA Group Achievement Award](#)
07/08/2013 - 08:01 The ForWarn development team was awarded the NASA Group Achievement Award in recognition for creating the first near real-time forest threat early warning system...

[more news »](#)

Background on ForWarn



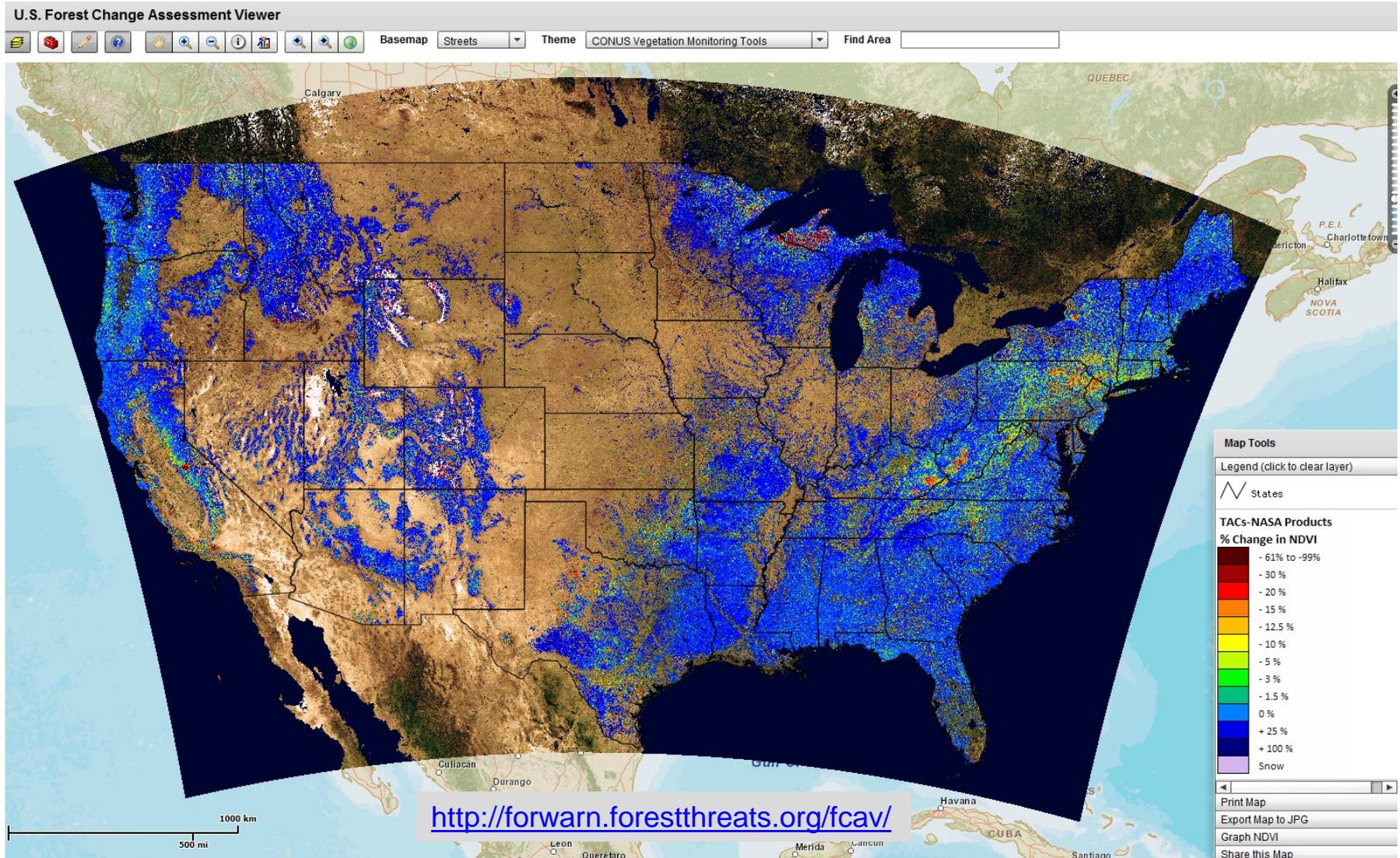
- ForWarn is an on-line geospatial data analysis tool for detecting and tracking regionally evident forest disturbances in the U.S.
- Collaboration of USFS, NASA, ORNL, and the USGS
- Developed per mandate of the 2003 Healthy Forest Restoration Act
- Uses 250m MODIS satellite NDVI data products to compare current vegetation canopy greenness that from a given historical baseline
- Provides a suite of nationwide NRT forest change products, refreshed every 8 days

U.S Forest Change Assessment Viewer (FCAV) Resident to ForWarn



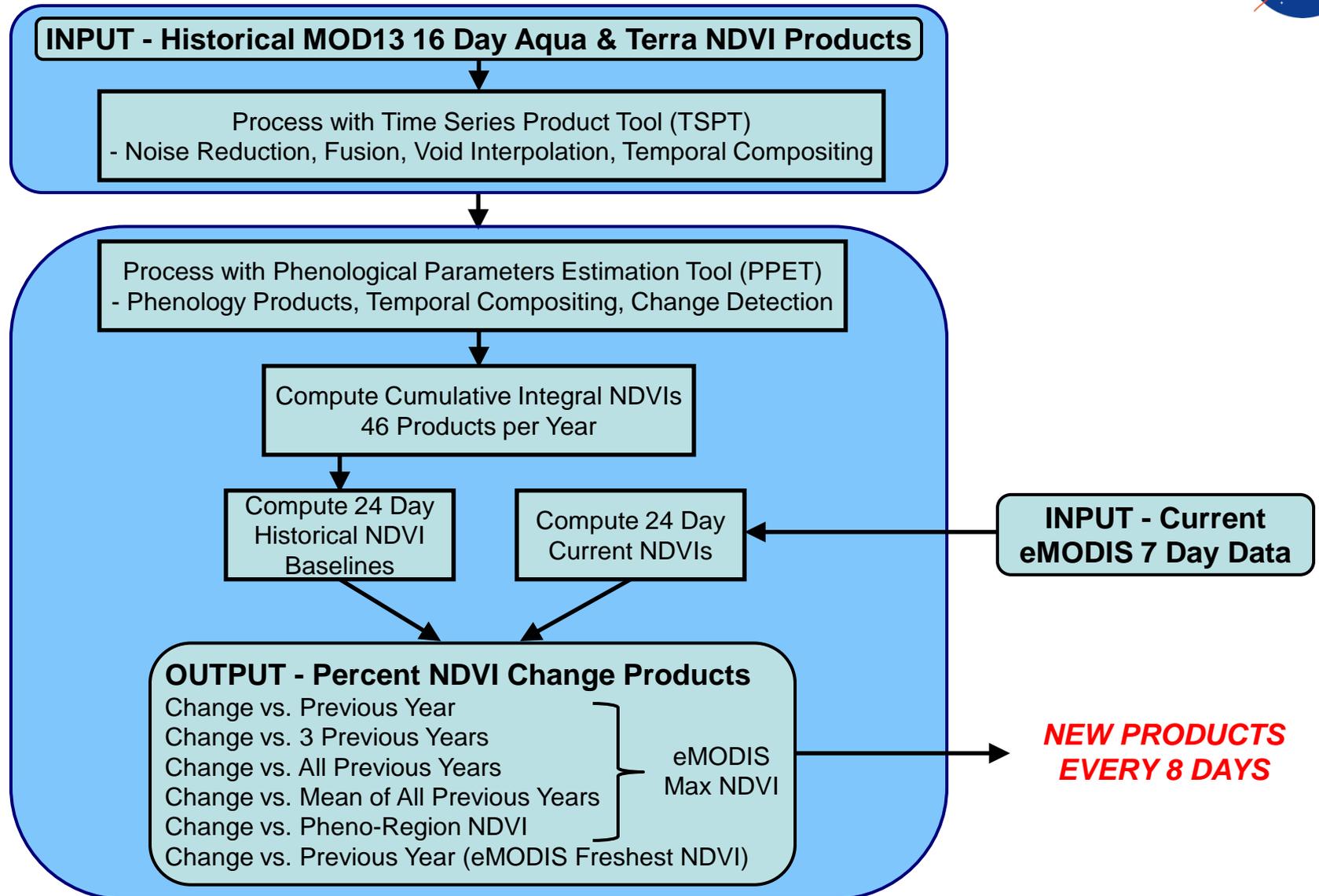
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2013 Forest % NDVI Change versus Previous Year for October 24 - November 16



Process for Computing ForWarn's MODIS NDVI Change Products

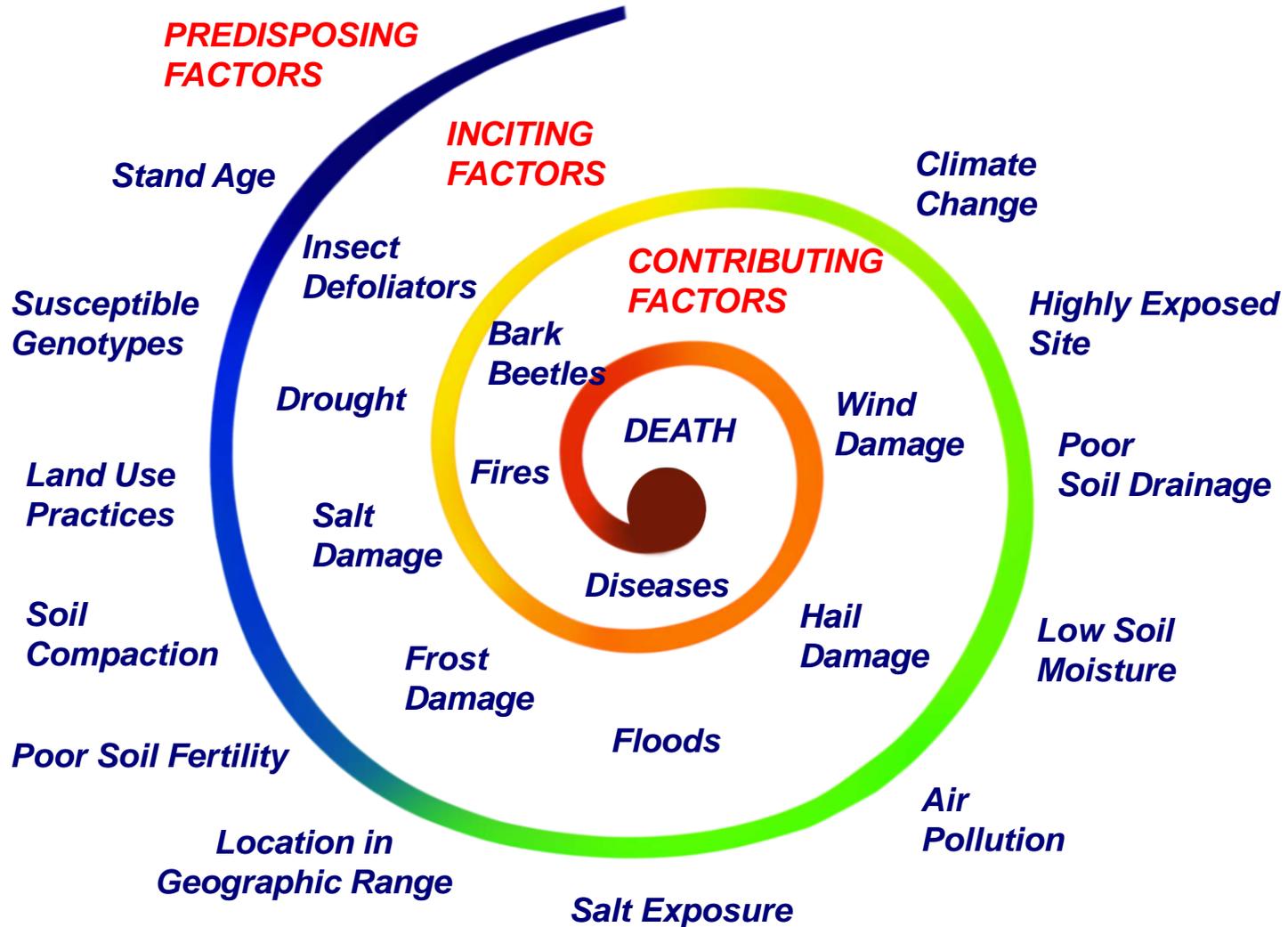
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Complexities in Monitoring Regional Forest Disturbances



Graphic below based on Manion (1981) Forest Decline Spiral Model



Series 1 – Examples of ForWarn NDVI Change Products with Regional Abiotic Forest Disturbances

*2013 Drought in
Sierra Foothills, California*



Source: USFS

*2013 Rim Fire in Sierra
Nevada Mountains, CA*



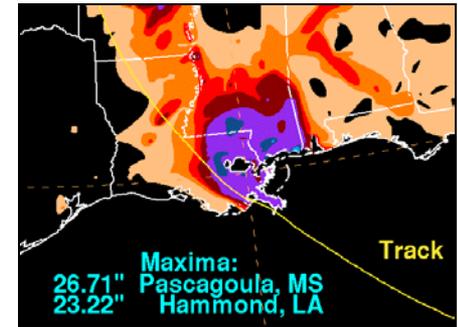
Source: USFS

*2013 Hail Storm at CT,
MA, and NY State Border*



Source: USFS

*2012 Hurricane Isaac in
Southeastern Louisiana*



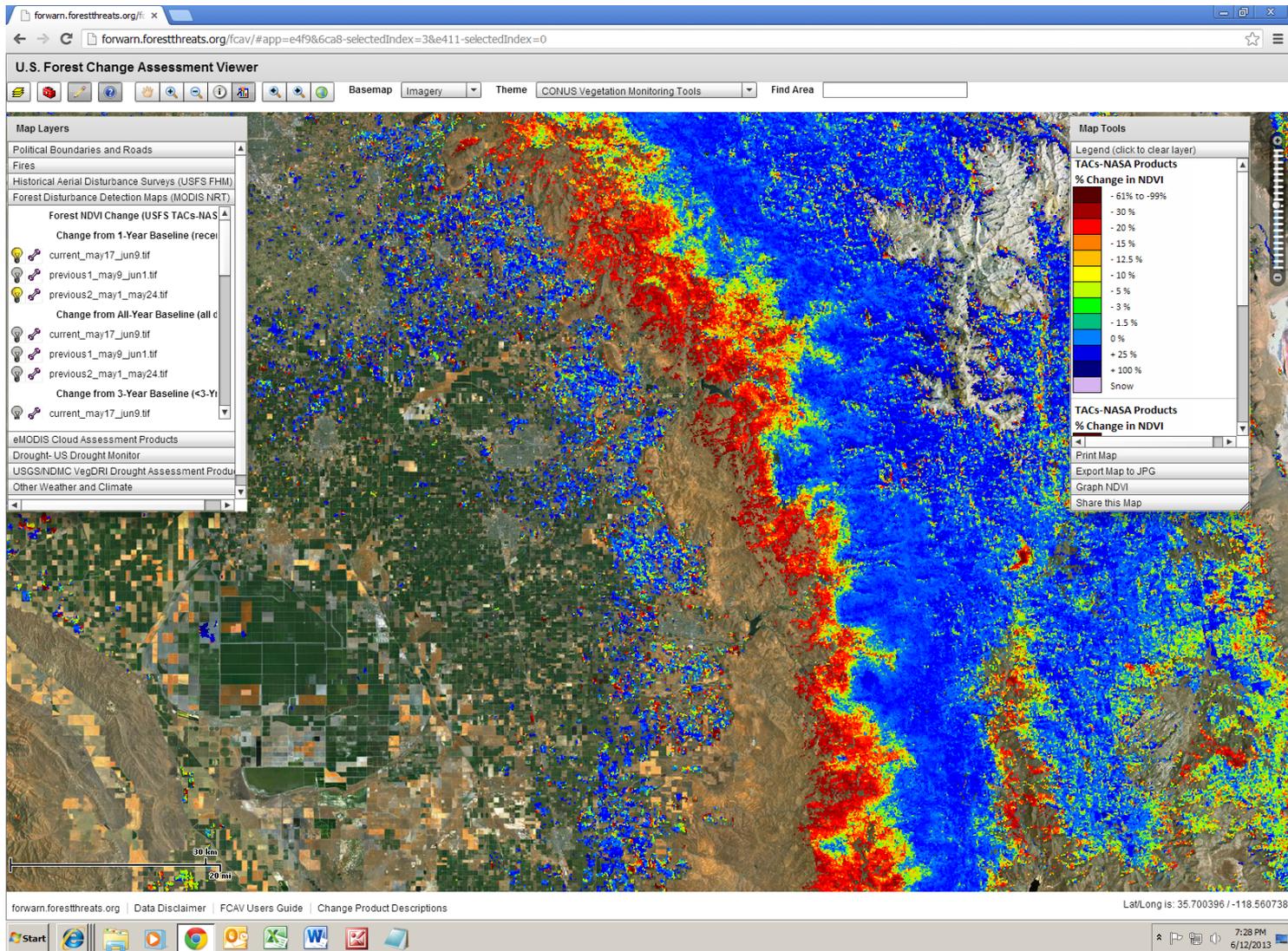
Source: NOAA

Drought Impacts in California's Sierra Foothills



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ForWarn products (e.g., for date ending 6/8/2013) showed drought impacts before the Rim Fire

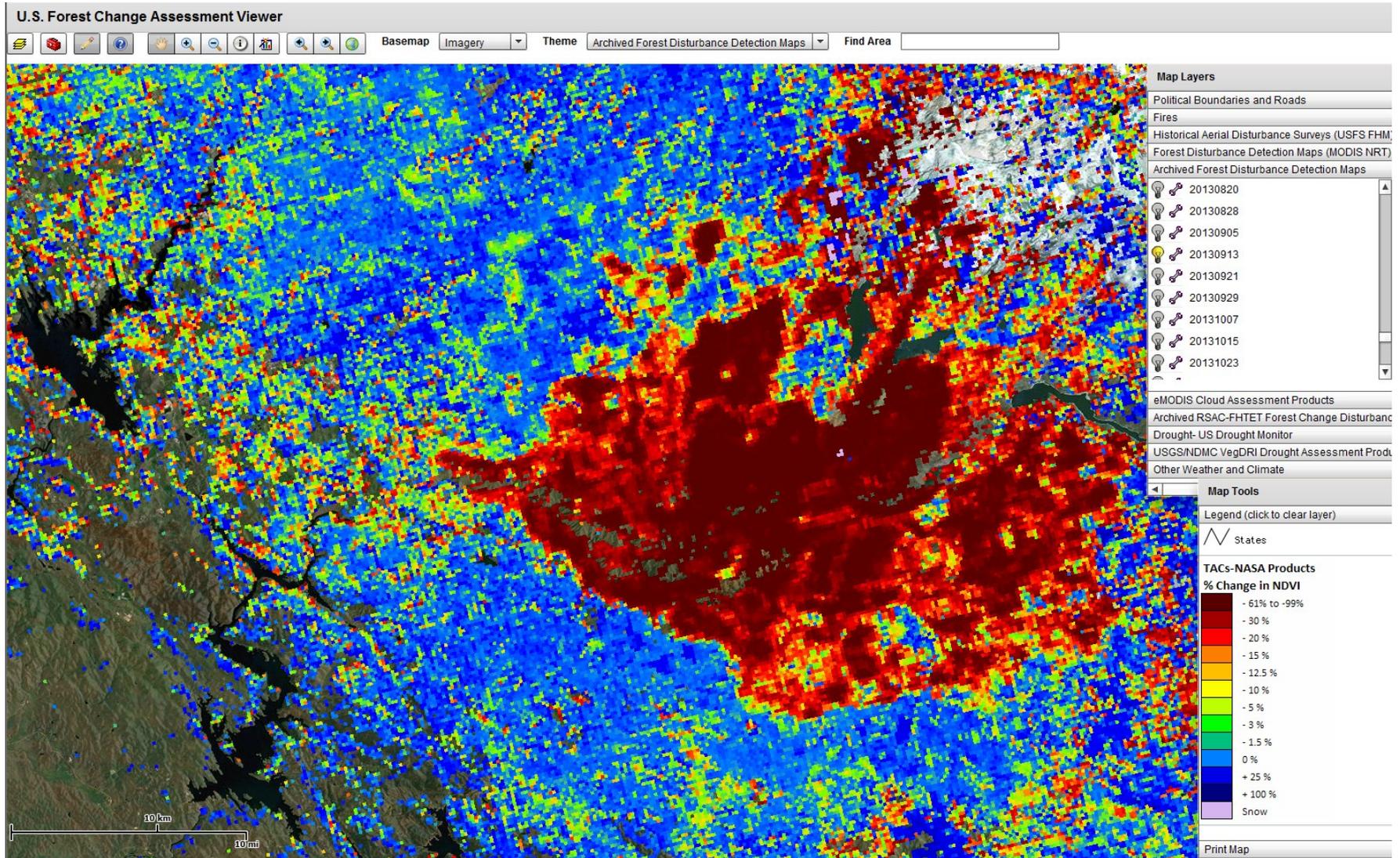


Impacts from Rim Fire in California's Sierra Nevada Mountains



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A ForWarn product for date ending 9/13/2013 gave the first available look at the fire scar

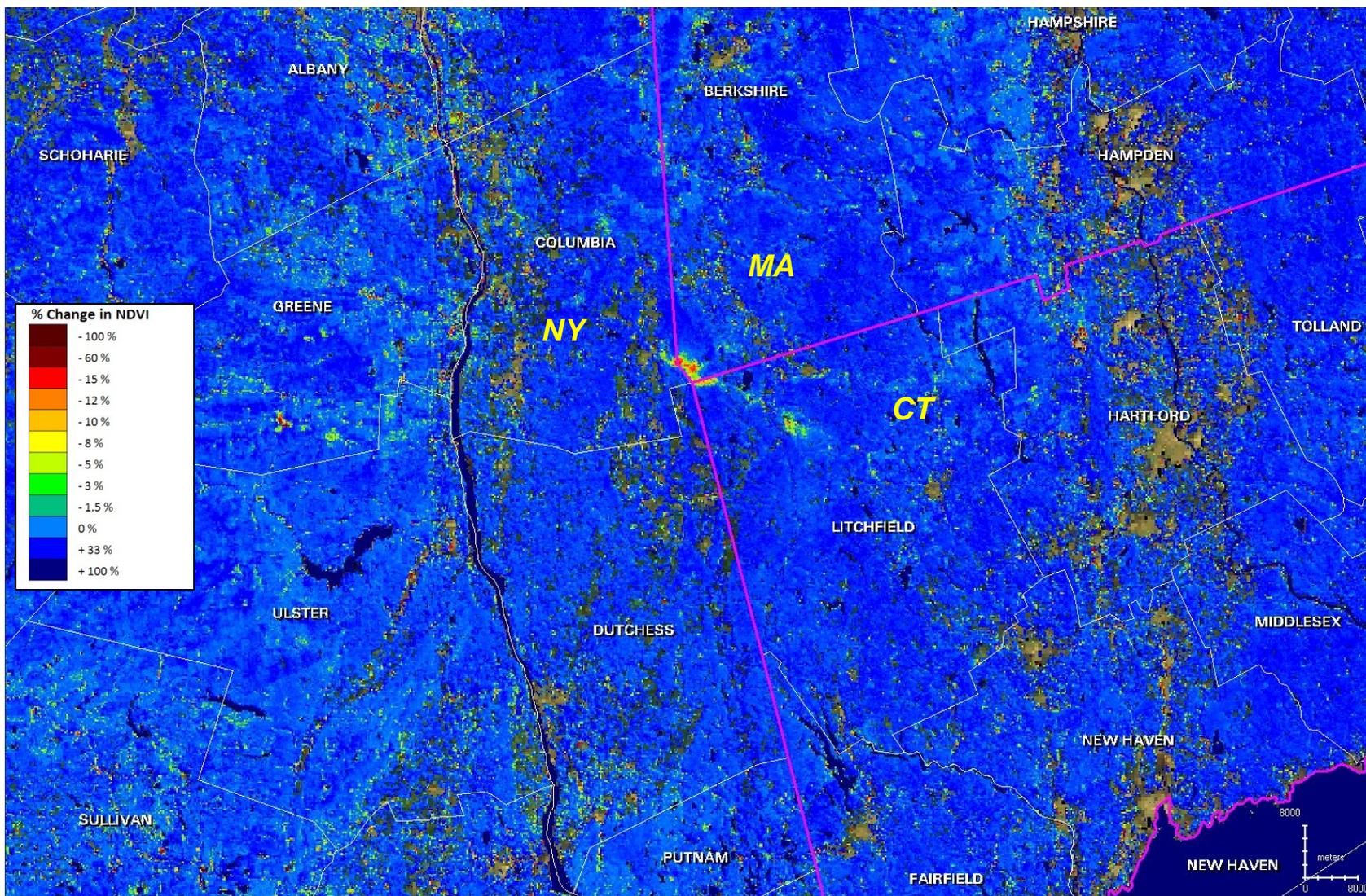


Hail Storm Impacts to Area in Southern New England



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A ForWarn product for date ending 6/8/2013 gave first indication of hail damage (field checked)



MODIS Views of 2012 Hurricane Isaac's Impact on Coastal Louisiana

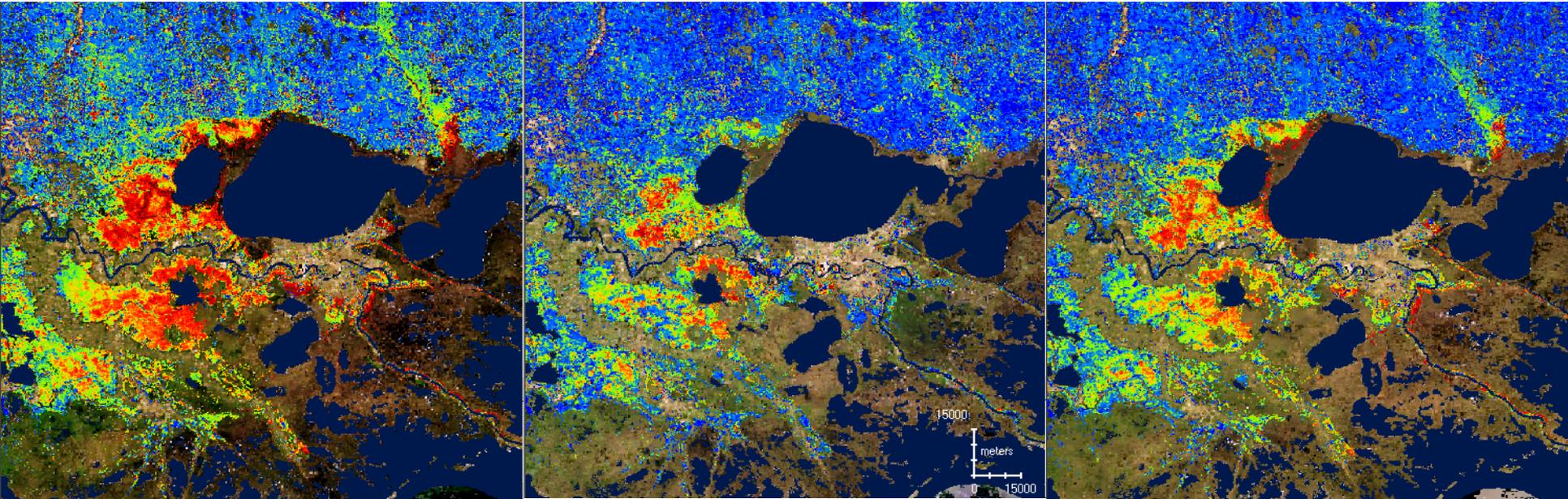
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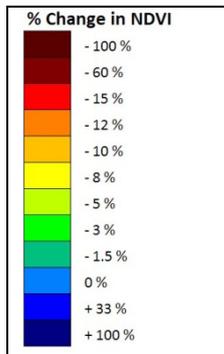
Forest Change 2012 versus 2011
ALC Method for 8/20/12 – 9/12/12

Forest Change 2012 versus 2011
Max NDVI Method for 8/20 - 9/12/12

Forest Change 2012 versus 2011
Max NDVI Method for 8/28 – 9/20/12



Hurricane Isaac hit Louisiana on August 28-29, 2012



ALC = Adaptive Length Compositing. It's use provides a fresher NDVI than the Max NDVI. The ALC product showed more NDVI reduction than the Max NDVI product for 9/12/12. The NDVI drops on the ALC map are related to the improved product freshness. The MVC product for 9/20/12 showed more defoliation than the 9/12/12 MVC product. The ALC 9/12/12 detects disturbance 8 days earlier than the similar MVC result for 9/20/12.

Series 2 – Examples of ForWarn MODIS Change Products Showing Regionally Evident Biotic Forest Disturbances

2013 Swamp Forest Defoliation in Coastal LA from 2 Caterpillar Species



Source: LSU

2012 Spruce Beetle Mortality in Rio Grande NF of Colorado



Source: CSU

2013 Pine Forest Defoliation in AZ due to Pandora Moths



Source: USFS

2013 Hardwood Forest Defoliation in NY and PA from Gypsy Moths



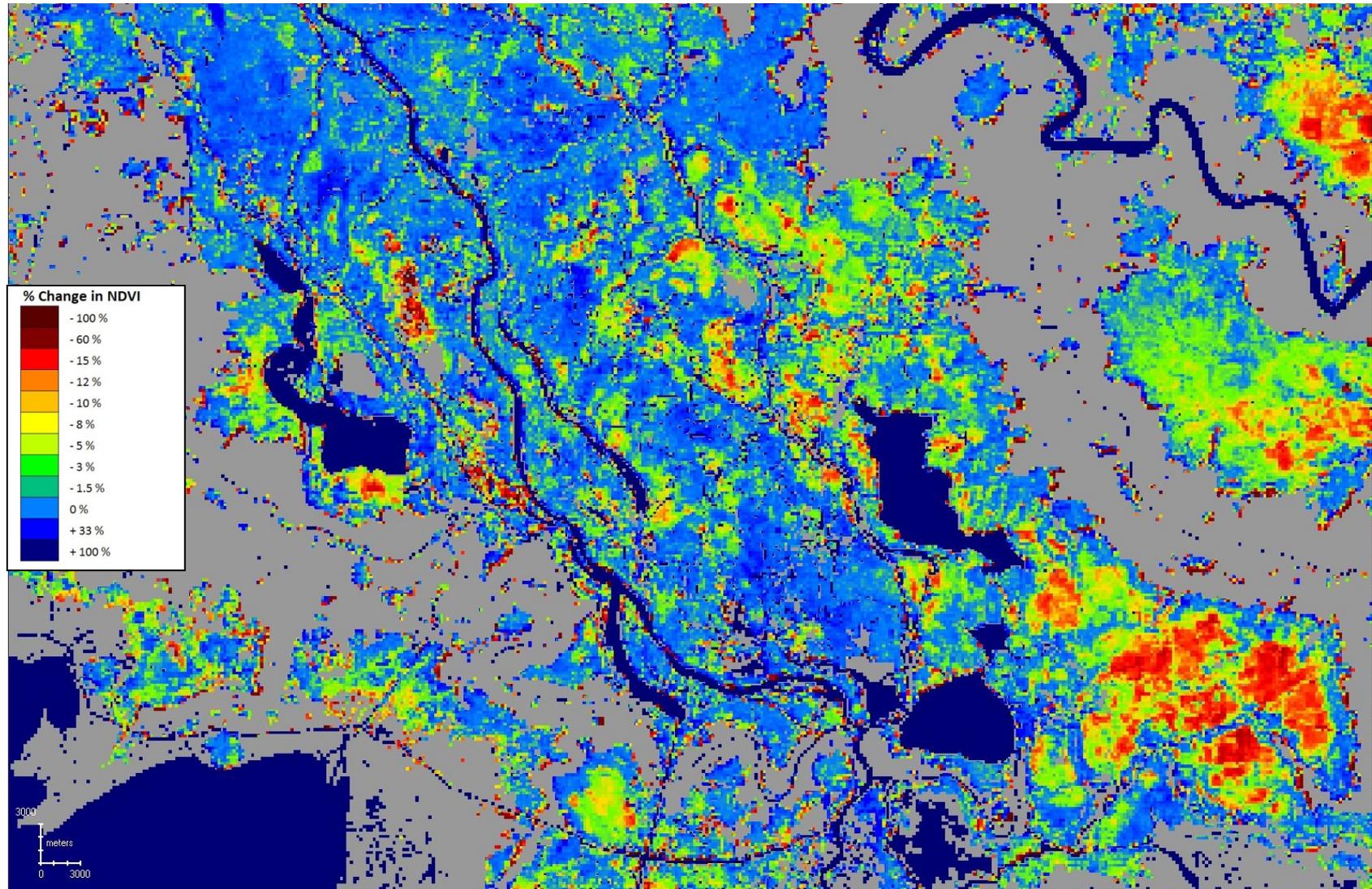
Source: PA DCNR

2013 Swamp Forest Defoliation in Southeastern Louisiana

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A ForWarn product for 4/22/2013 gave earliest detection of an annual defoliation event

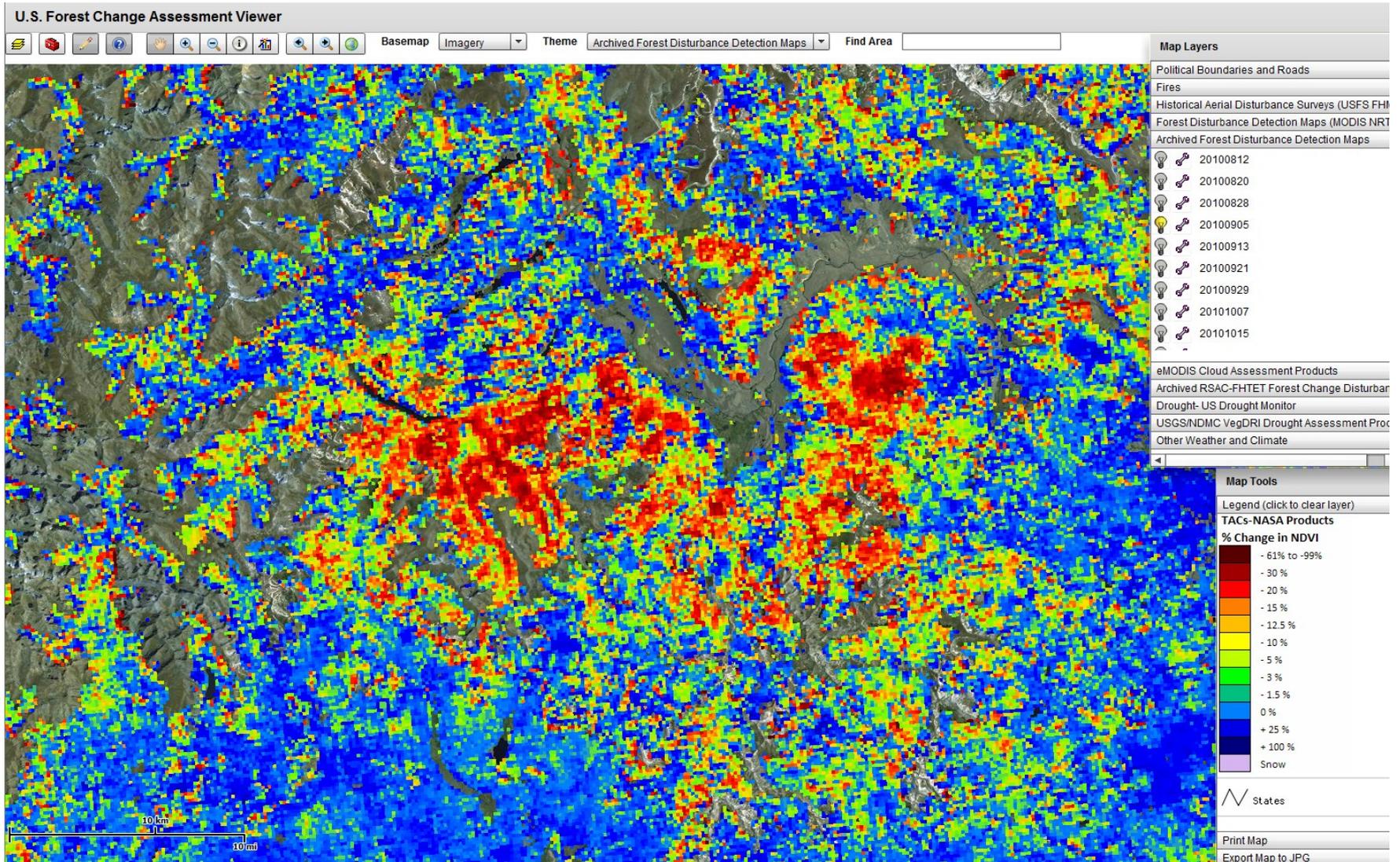


2013 Spruce Beetle Mortality in Southern Colorado



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Hot spots on this 3 year change product for 9/5/2013 show "recent" spruce beetle damage

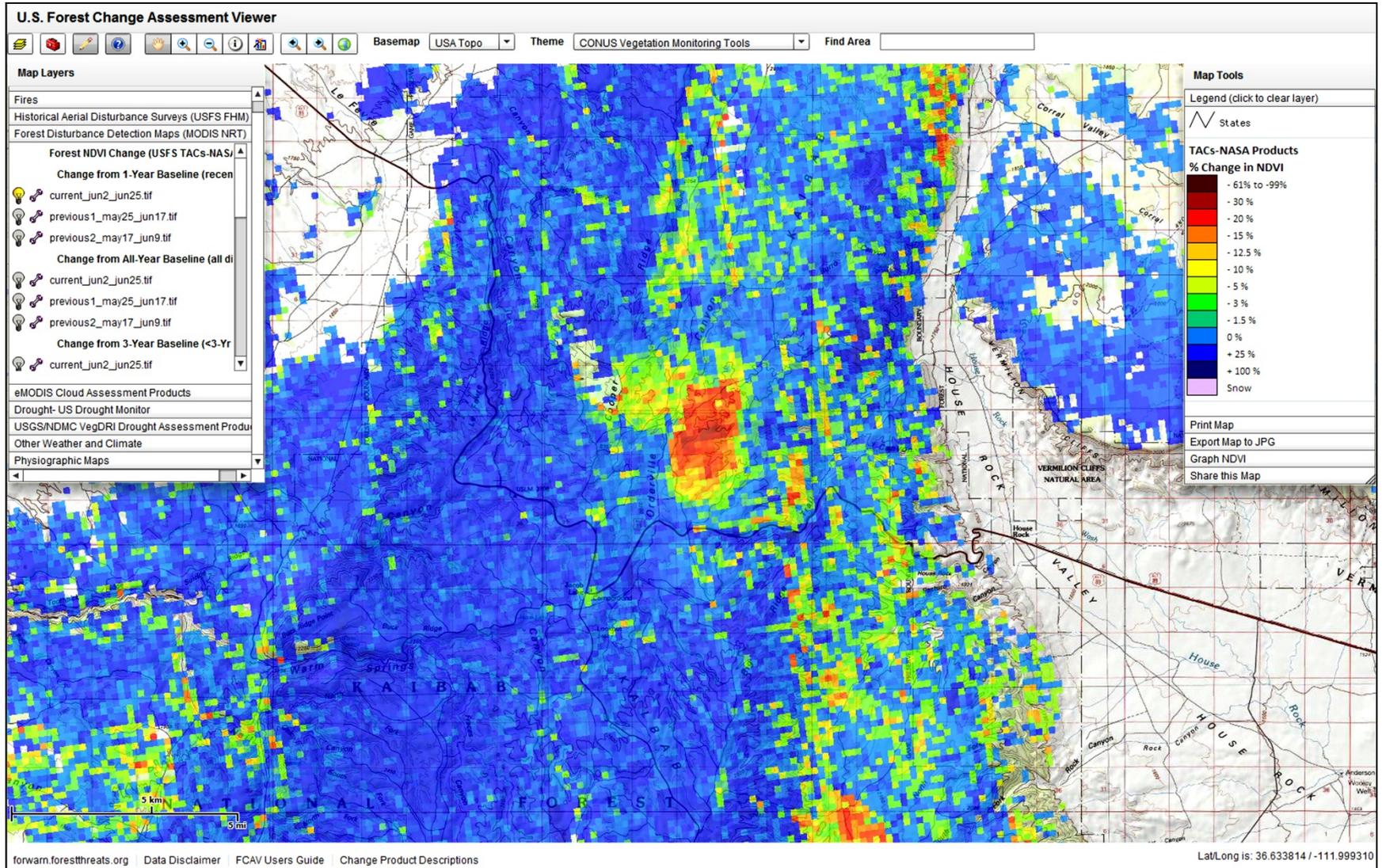


2013 Pine Forest Defoliation in Arizona from Pandora Moths



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Red area in center on ForWarn product for 6/25/2013 was field verified as Pandora moth damage

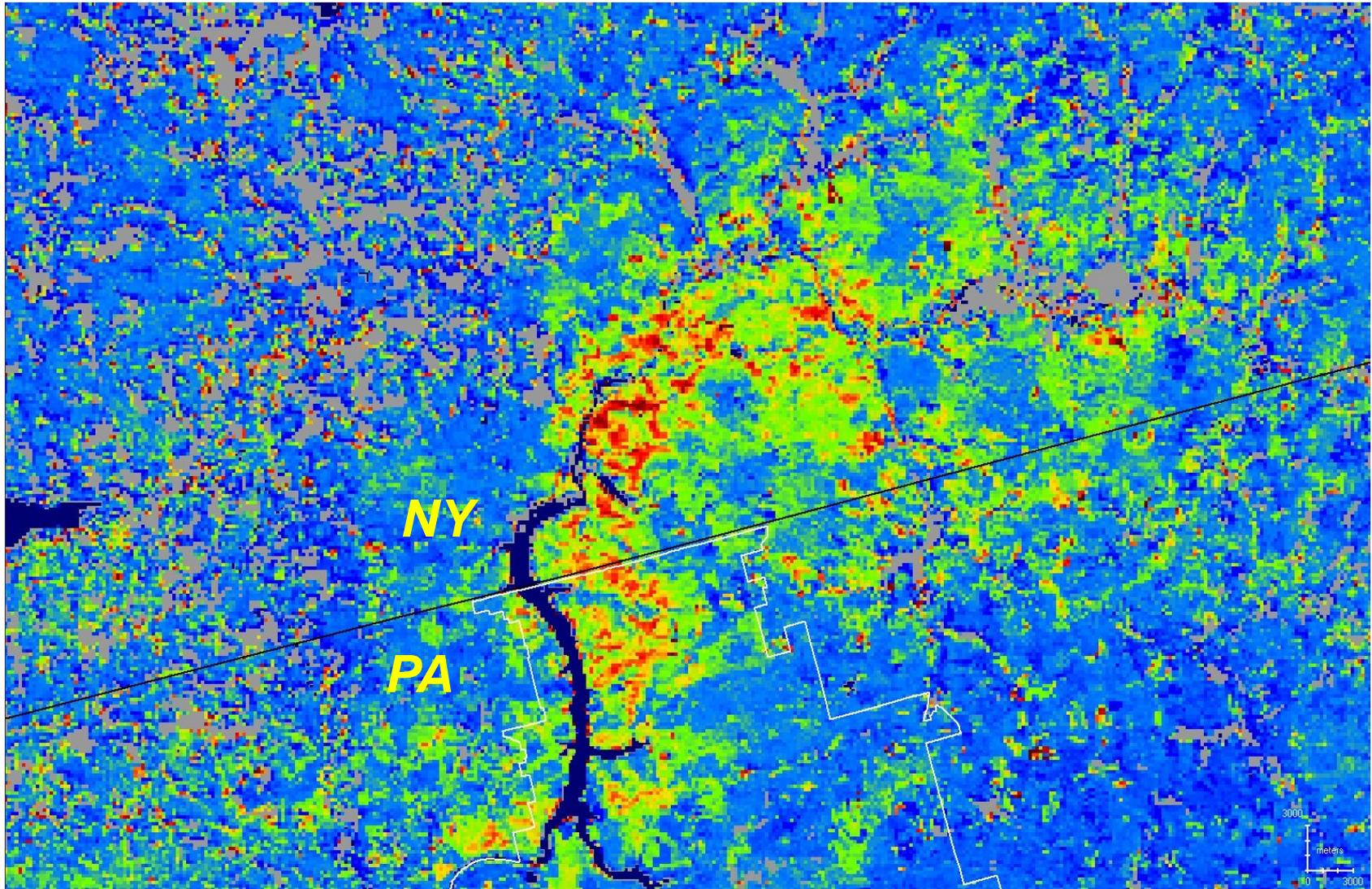


2013 Hardwood Defoliation in PA and NY State from Gypsy Moths

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"Hot spots" on ForWarn product for 6/25/2013 was field verified as gypsy moth defoliation



Comments on Example Results



- NRT MODIS NDVI forest change products enabled detection of multiple regional forest disturbance events
 - *Including abiotic, biotic, and anthropogenic disturbances in multiple forest types and locations*
 - *New disturbances were best detected using the previous year NDVI as the baseline*
 - *Multiyear disturbance events were best assessed using all three previous year NDVI baselines (previous 1, 3 and all years)*
 - *The “freshest” (ALC) NDVI change product usually detected events 1 week earlier than the other products*
- Disturbance detections were checked using news accounts, aerial surveys, Landsat data, and fire maps
- ForWarn disturbance detection results were conveyed to Federal and State forest health monitoring community

Conclusions



- Since 2010, NRT MODIS % NDVI change products have been produced for the U.S. every 8 days, usually posted on ForWarn 1-2 days after the last collection date
- ForWarn disturbance detection products requires use of daily data from both MODIS Aqua and Terra
- Future work
 - *Expand ForWarn change products to include all land areas*
 - *Development of damage agent attribution capabilities*
 - *Develop means to process and integrate VIIRS data*
- For more information, see: <http://forwarn.forestthreats.org> or else email: joseph.p.spruce@nasa.gov



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