

Overview of USDA Forest Service Management Goals and Information Needs for Early Warning Systems

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Context

The Environmental Threat Assessment Centers (East and West) are charged with developing tools and information to help predict, detect, and assess environmental threats to the nations forests and grasslands.

- The centers are jointly funded by all three major deputy areas:
 - Research and Development
 - State and Private Forestry
 - National Forest System
- A primary goal for the Centers since their inception has been to design and deploy early warning systems using remote sensing

Relevant USFS strategic goals and objectives

- Goal 1: Sustain our nation's forests and grasslands
 - Foster resilient, adaptive ecosystems to mitigate climate change
 - Mitigate wildfire risk
 - Conserve open space
- Goal 2: Deliver benefits to the public
 - Provide abundant clean water
 - Strengthen communities
 - Connect people to the outdoors
- Apply knowledge globally
 - Advance knowledge
 - Transfer technology and applications
 - Exchange natural resource expertise

Relevance of early warning systems

- Our Nation's forests and grasslands are subject to a wide range of environmental stressors: climate and weather, invasive species, wildland fires, pests and disease, land conversion, and others.
- Accurate and timely assessment of the spatial and temporal extent and intensity of disturbances are essential to active management.
 - Proactive, rapid response
 - Longer term mitigation
 - Restoration
- Historical record of disturbance and recovery offers a broader perspective on landscape resilience and sustainability.

Primary source of early warning system data, information, and tools

- Since 2005, have extensively used moderate resolution, temporally frequent imagery (MODIS and LANDSAT)
 - ForWARN System provides CONUS-wide monitoring every 8 days using MODIS
 - Often use LANDSAT to corroborate and compare detections
 - Recently expanded range beyond CONUS to include more of North America
- More recently have been using Sentinel (10m resolution) as independent assessment of known disturbances and as companion to ForWarn assessments
- Historical ForWarn data being mined to produce LanDAT (Landscape Dynamics Assessment Tools), which provides a retrospective view



4 OF 4

PREVIOUS PAUSE NEXT

Welcome to ForWarn II!

ForWarn II has enhanced sensitivity, now showing even slight disturbances earlier than ever before, and now covers a larger geographic area.

ForWarn II is mostly the same system with which you're already familiar, but now has a totally new production system that offers some exciting new capabilities, including some new products designed for specialized purposes. For example, disturbances within grasses, shrubs and other shallow-rooted vegetation can sometimes dominate the disturbance signal seen in ForWarn maps, particularly in the Western United States. Almost every ForWarn II disturbance map now has a "Muted Grass/Shrub" companion product that concentrates on the disturbance responses of trees, reserving more of the dynamic range in the maps for showing forest impacts.

Most new ForWarn II products are already available for the entire MODIS period starting in 2003 to present. Most of the data viewer features, like the Share-This-Map, the NDVI graphing tool, and the PestProximity tools, will still work just as always. Documentation is still being developed, so please pardon our virtual dust as we continue to carry these improvements throughout the entire Forest Change Assessment Viewer 2 and the ForWarn II website. Enjoy the new features, and we welcome your feedback!

Get Started

ForWarn provides near-real-time tracking of vegetation changes across landscapes in the United States. Useful for both monitoring disturbance events as well as year-to-year variability, derived products can also be used to develop insights into seasonal and inter-annual dynamics.

» [Introduction to ForWarn](#)

» [Data Access](#)

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Forest Change Assessment Viewer

The Forest Change Assessment Viewer provides a vegetation change recognition and tracking system for ForWarn that uses high-frequency, moderate resolution satellite data.



Recent News

[ForWarn improves near-real-time data visualization](#)

05/14/2017 - 09:17

ForWarn has always allowed users to view historical 8-day NDVI data, and this capability provides important long-term context for understanding disturbance impacts, recovery, inherent differences...

[ForWarn featured in NASA Earth Observatory](#)

11/16/2016 - 11:03

Sap-sucking insects called hemlock woolly adelgids are draining the life from a common evergreen tree in the eastern United States. Once the non-native bugs become well-established, the consequences...

[Featured in Compass Magazine: Here Today or Here to Stay?](#)

09/22/2016 - 09:47

Some disturbances come and go, leaving forests no worse for the wear. Hailstorms, insect defoliations, and light prescribed fires, for example, commonly occur early in the growing season, but...

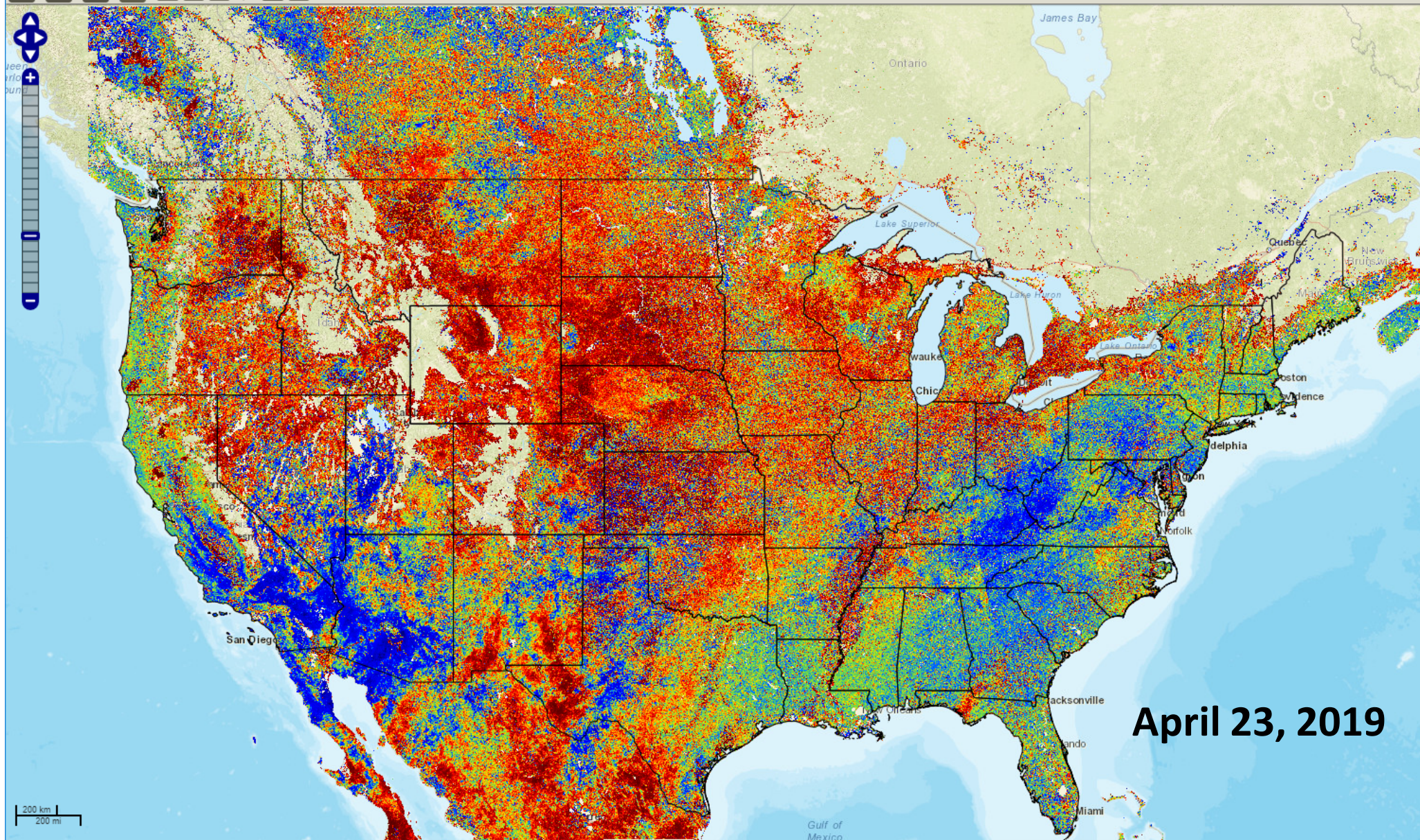
[more news »](#)



- MODIS 240m
- NDVI (MOD13)
- Systematic, every 8-days
- Multiple baselines
- All-Lands
- Web-based, Forest Change Assessment Viewer

U.S. Forest Change Assessment Viewer

Base Map: Streets Theme: N. American Vegetation Monitoring Tools Find Area:



Storm damage
(Spring 2019)

Systematic monitoring with *ForWarn II*
captures all types of disturbances

Beauregard Tornado
(Mar. 3 2019)

Columbus

Logging

AL

Logging

GA

Logging

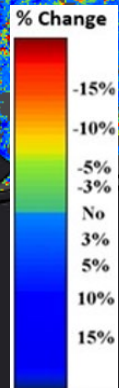
Logging

Logging

High water

Logging

Logging



Hurricane Michael
(Oct. 2018)

Jacksonville

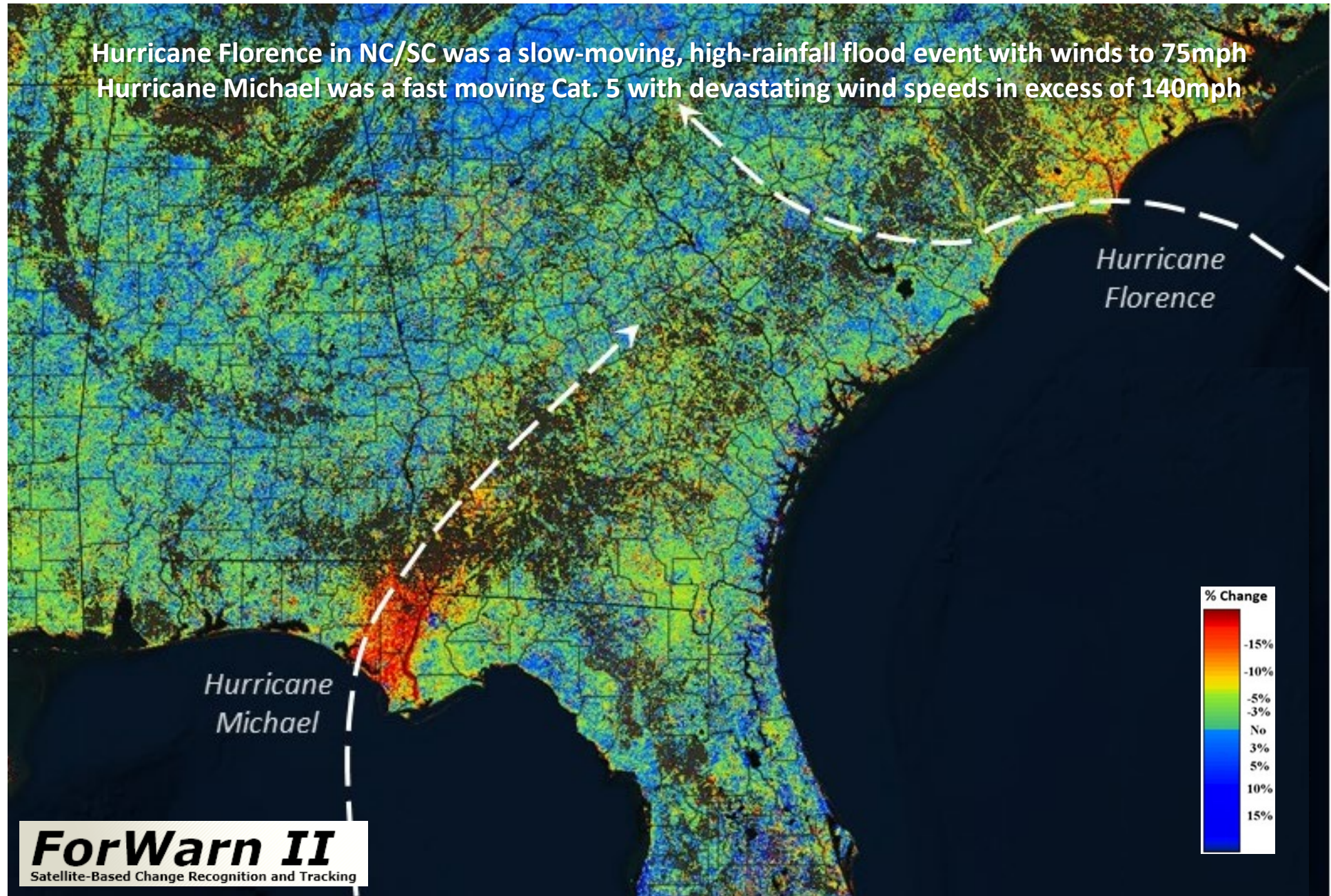
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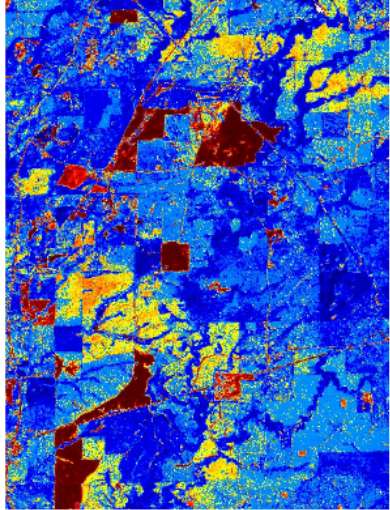
Unknown

FL

ForWarn II
Satellite-Based Change Recognition and Tracking

Systematic monitoring with *ForWarn II* captures two very different Hurricane Events





Forest mapping technologies are evolving in ways that will revolutionize forest monitoring. These changes include the ability to map and monitor forest change at higher spatial detail and frequency than ever before, thanks to the availability of new satellites and cloud computing. This brings great promise for mapping forest structure and composition, tracking forest health and understanding seasonal dynamics, disturbance impacts and recovery, but only if this flood of new data can be channeled in ways that make sense to those who can benefit. With this applied need in mind, this initiative is designed to foster development of map products that demonstrate what is now possible, to research ways that these can be best adapted for management use, and along the way, to learn more about eastern US forests as revealed by these remarkable technological advances.

Due to its high spatial detail and temporal frequency, our work heavily relies on 10-meter resolution Sentinel 2 imagery from the European Space Agency. We also include landscape applications of LiDAR and ways to integrate diverse data to understand forest dynamics and patterns of forest diversity. Our emphasis is on eastern US forests, with particular emphasis on the Southeast and Appalachians.

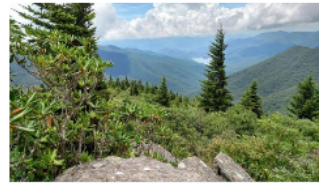
Projects



Severe Weather



Appalachian Fire



Landscape Diversity

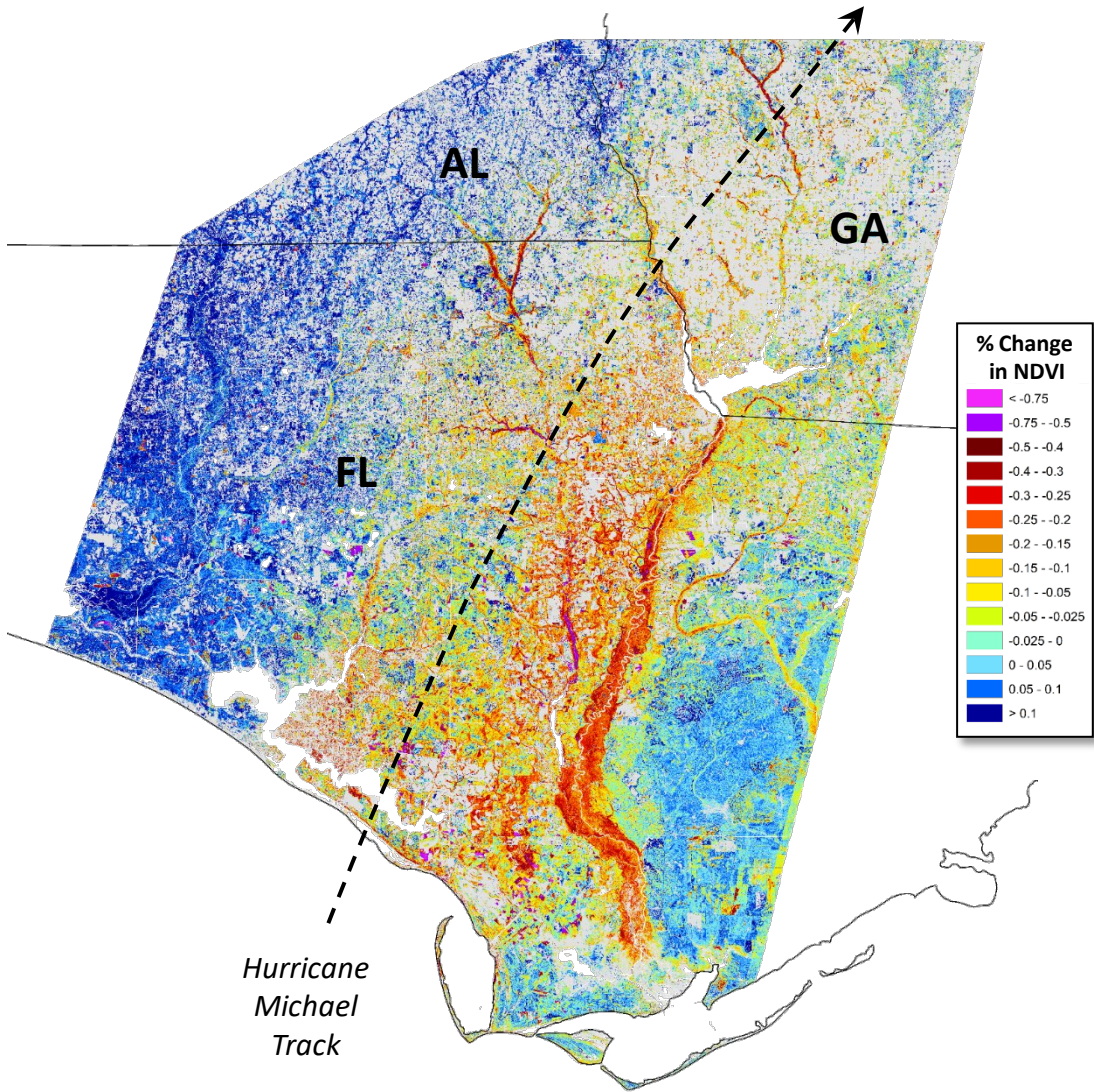
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- Sentinel-2 10m
- Event focused
- Used for Validation
- No Viewer
- Cloud-based via Google Earth Engine
- Custom compositing and baselines
- Answers a different set of questions

Forest impacts from Hurricane Michael



Florida Forest Service

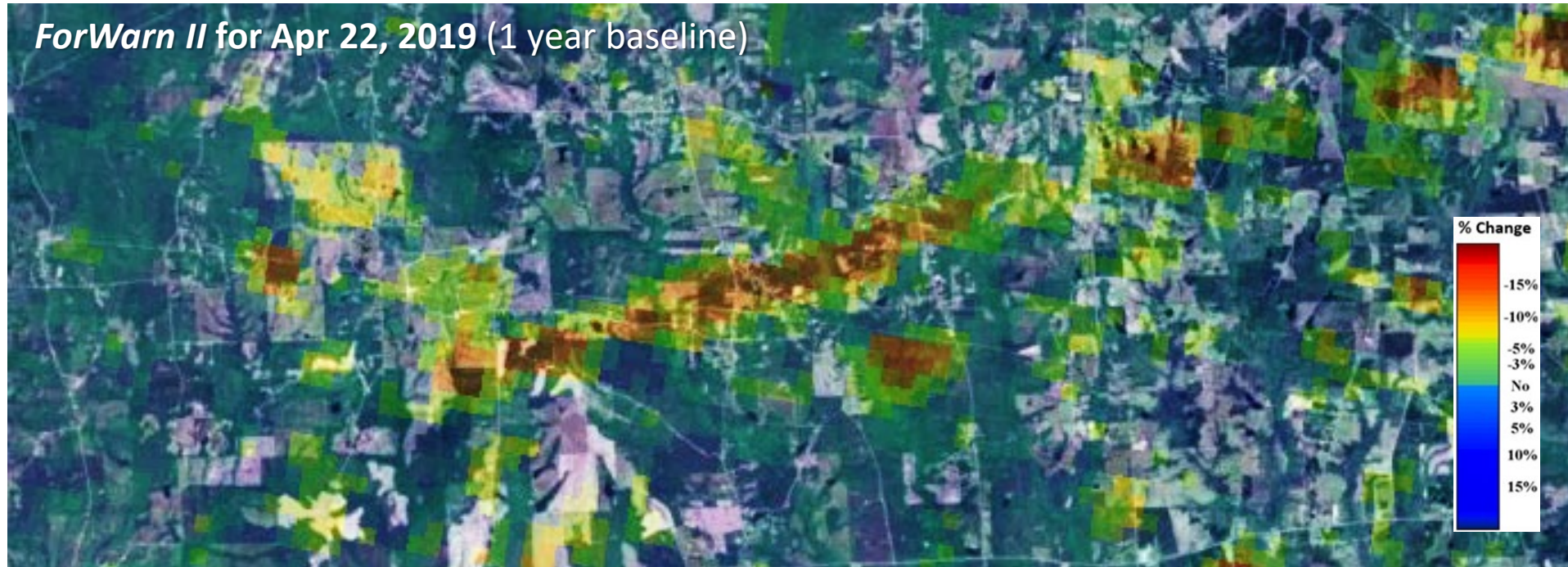


Alabama Forestry Commission

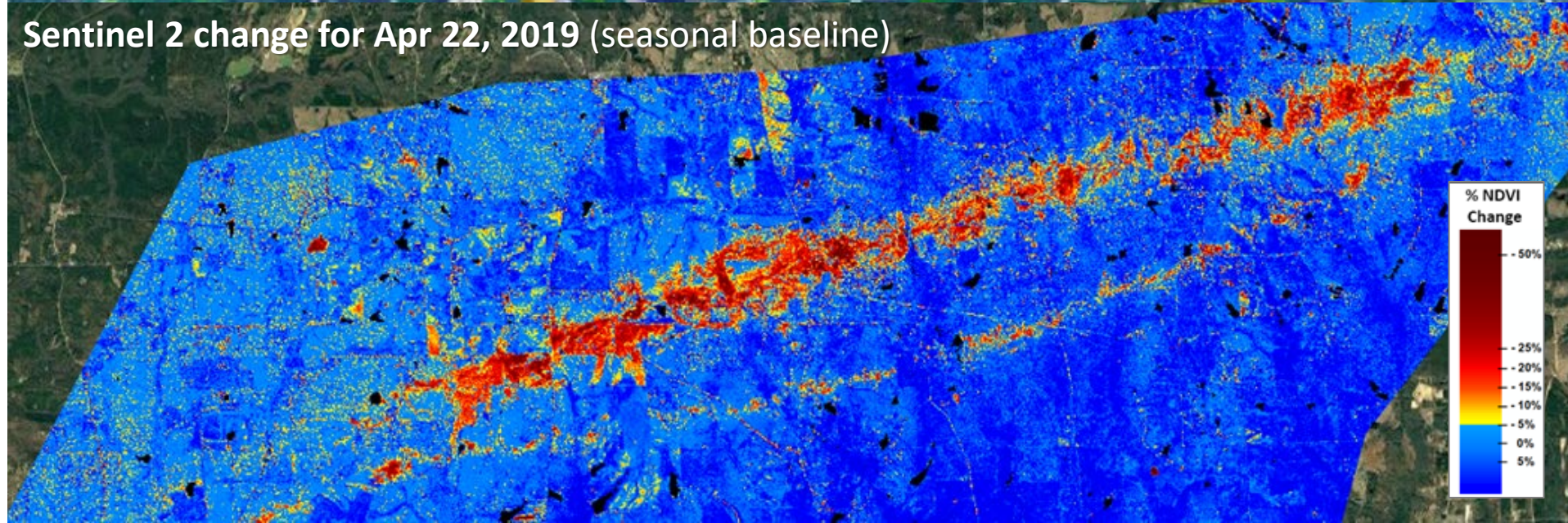
This map compares the highest forest NDVI observed from Oct. 17 to Nov. 30, 2017 with Oct. 11–Nov. 15, 2018 using 10m Sentinel 2 composites.

MODIS efficiently isolates major change, but lacks the resolution for deep interpretation

ForWarn II for Apr 22, 2019 (1 year baseline)



Sentinel 2 change for Apr 22, 2019 (seasonal baseline)



Top 3 challenges in using remote sensing data

- Separating the signal from the noise
 - Systemic problems with clouds, snow, shadows, and other issues
- Identifying the best baseline for comparison
 - It's all about detecting change—but change from what?
 - Most useful baseline depends on context
- Computational and storage issues with massive data sets

All three of these issues are areas of active research and technological advances. Challenges are less than they used to be, but expectations are increasing.