

Use of MODIS Time Series Data Products to Improve Management of Forest Damage and Recovery from Hurricane Katrina

Project Team

Principal Investigator

David Lewis: Radiance Technologies, Inc.

Co-Investigators

William Graham: NASA

Joseph Spruce: Science Systems & Applications, Inc.

David Evans: Mississippi State University Department of Forestry

Collaborators

Wayne Tucker: Mississippi Institute for Forest Inventory

Patrick Glass: Mississippi Institute for Forest Inventory

Technical Support

Doc Smoot: Science Systems & Applications, Inc.

Daniel Anderson: Radiance Technologies, Inc.

Project Goals and Objectives

Goal: Provide publicly available products based on remotely sensed data to assess forest Damage and Recovery (DAR) from Hurricane Katrina.

Objectives:

- Develop Normalized Difference Vegetation Index (NDVI) and Normalized Difference Moisture Index (NDMI) time series products from MODIS data
- Evaluate tree age and forest thinning products as factors in potential hurricane impact on forested lands
- Incorporate ASTER and Landsat data for reference and validation
- Transition products to the Mississippi Institute for Forest Inventory (MIFI) for public dissemination
- Incorporate feedback from MIFI to enhance products



Background

- Hurricanes are a severe threat to coastal communities
- After landfall a hurricane's impact is felt across the coastal region
- Rapid response by coastal forest managers is needed
- USFS produces preliminary forest damage estimation mapping products after hurricane event
- However, speed of product development is limited
- Rapidly created forest damage assessment products would have been useful after Hurricane Katrina



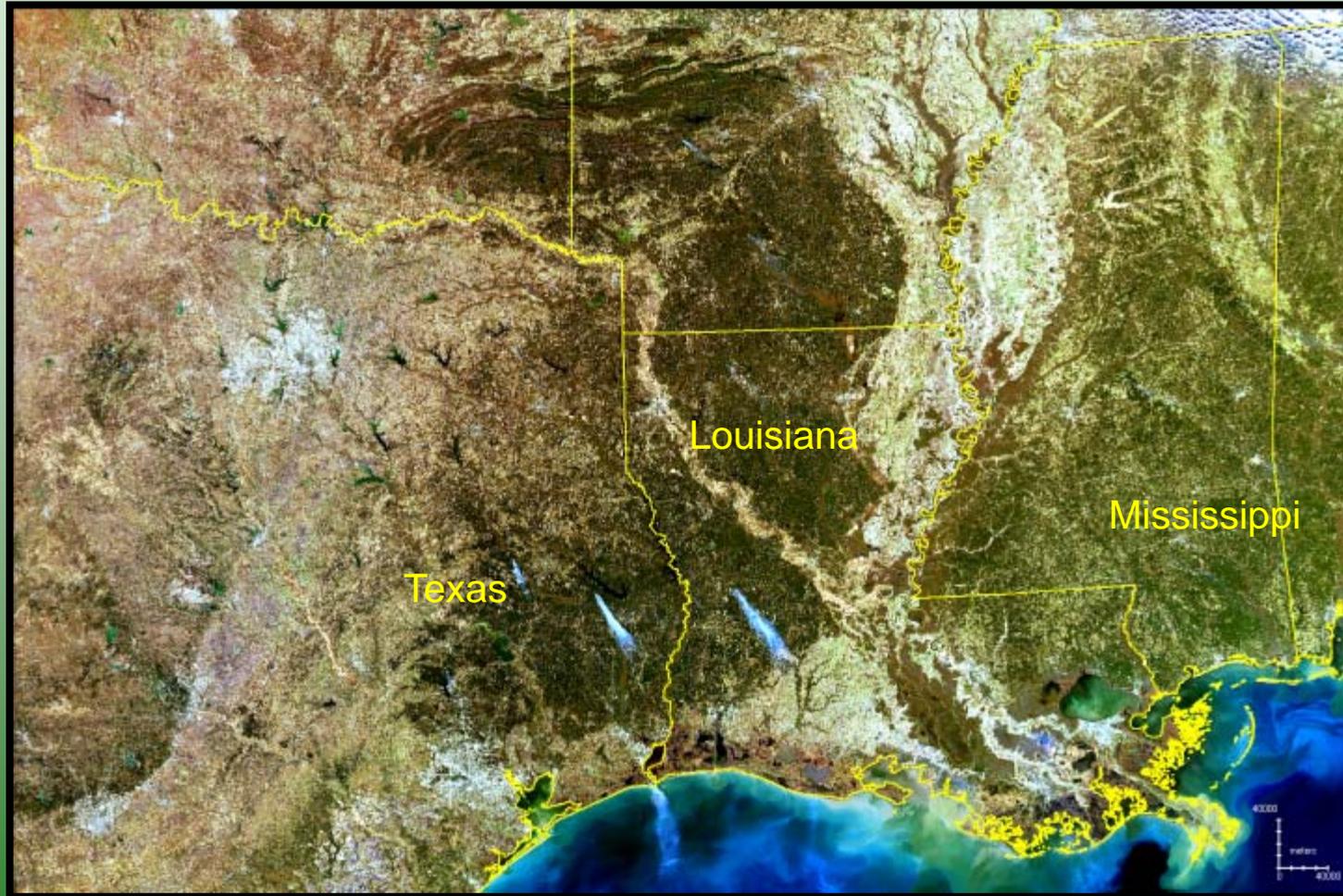
Measurement Indices

- NDVI: Normalized Difference Vegetation Index
 - $NDVI = (Near\ Infrared - Red) / (Near\ Infrared + Red)$
 - Range is (-1 to 1)
 - Measure of photosynthetic activity of plant

- NDMI: Normalized Difference Moisture Index
 - $NDVI = (Near\ Infrared - Middle\ Infrared) / (Near\ Infrared + Middle\ Infrared)$
 - Range is (-1 to 1)
 - Measure of moisture content in plants

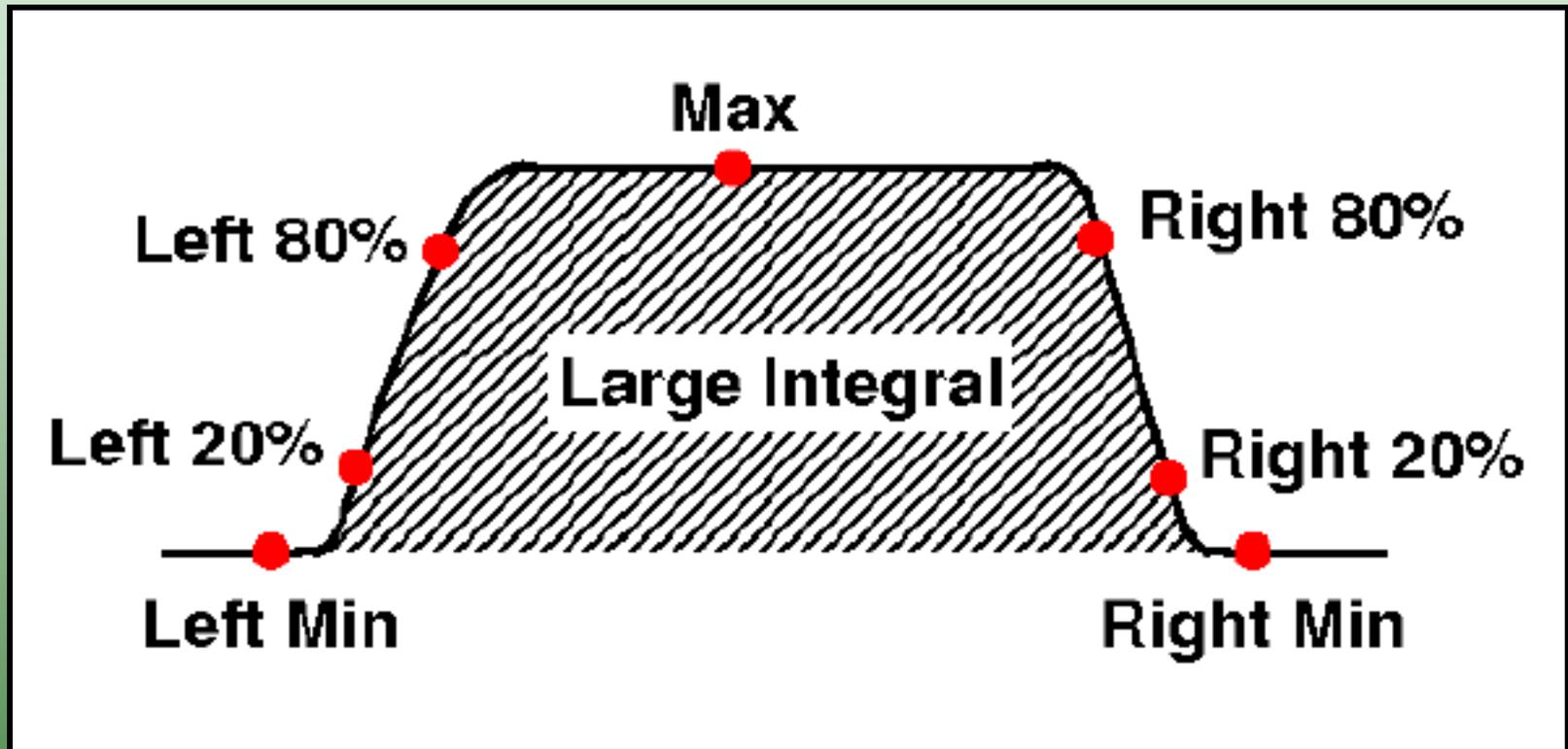


Pre-Hurricane Katrina MODIS Image



From MODIS Aqua Data Acquired 12-19-2003

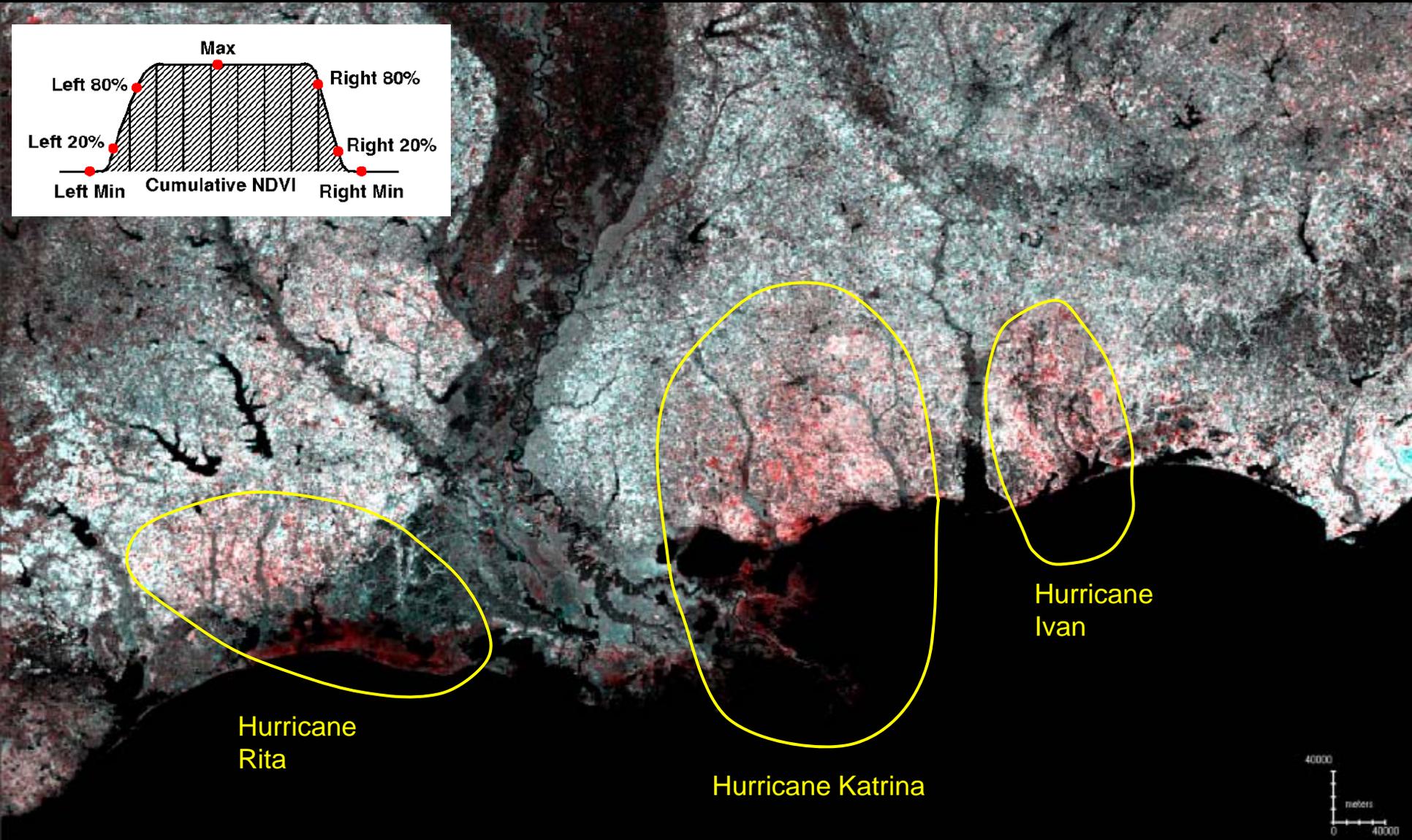
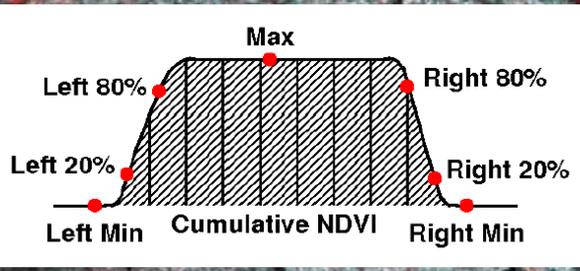
Time Series Phenological Curve



Can be created from NDVI or NDMI Time Series Data

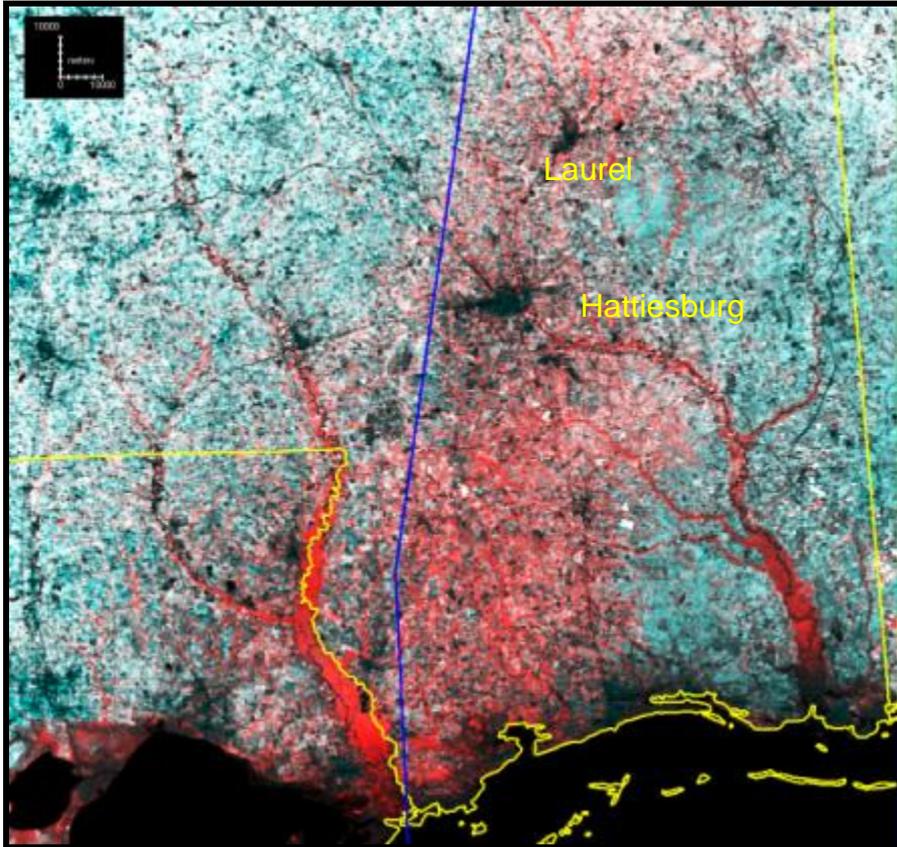
Viewing Hurricane Impacts from MODIS NDVI Phenological Parameter Products

RGB: 2004 20% Left Maximum NDVI in Red; 2006 20% Left Maximum NDVI in Blue and Green



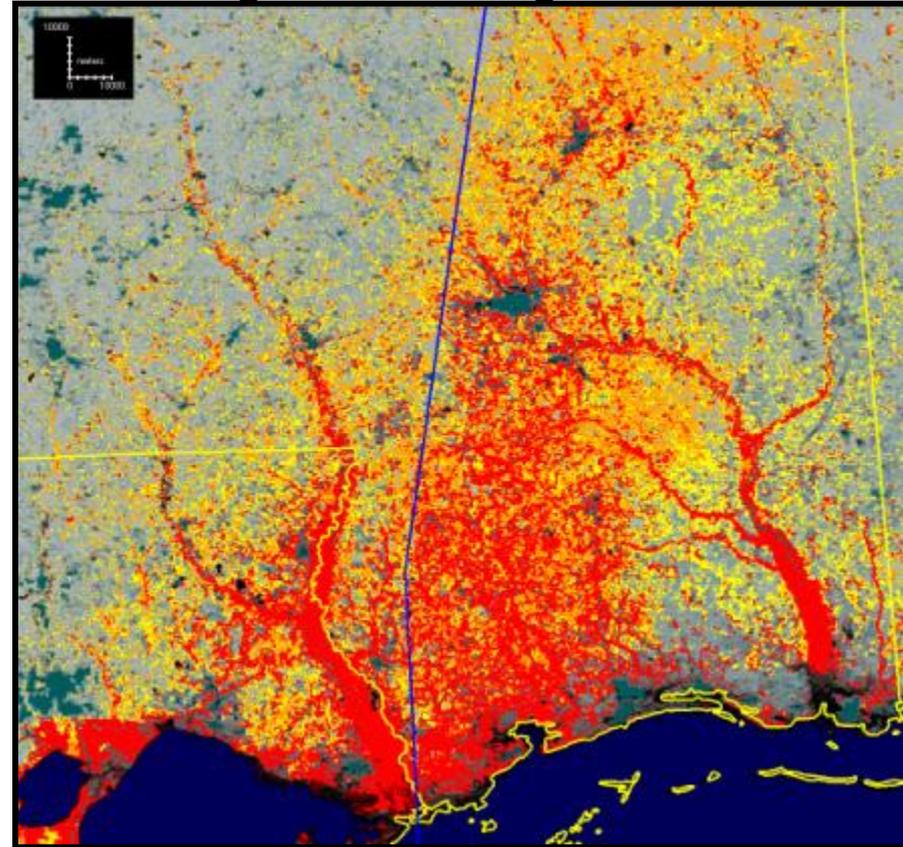
Preliminary MODIS Products Depicting Hurricane Katrina Vegetation Damage

Multi-Date MODIS NDVI Data



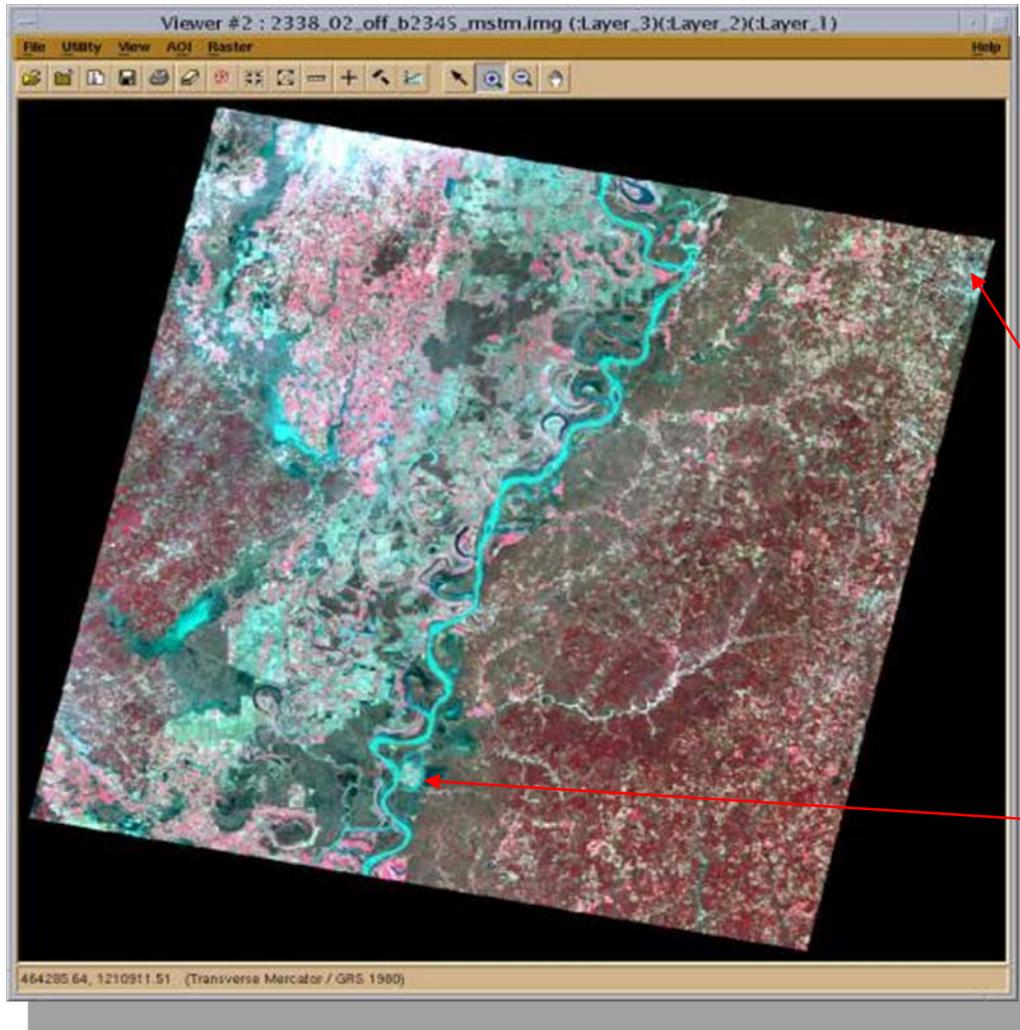
- State Boundaries
- Hurricane Storm Track

MODIS Vegetation Damage Classification



- Low Vegetation Damage
- Moderate Vegetation Damage
- High Vegetation Damage

Higher Resolution Imagery for Validation



- Landsat 7
Scene 23-38
- Forest / Nonforest
delineation

Jackson

Natchez

Potential Data Products

- MODIS NDVI and NDMI time series comparisons between years before Katrina and years after Katrina
- Incorporate of other products such as tree age and forest thinning practices that weaken tree canopy strength before hurricane events
- Use Landsat and ASTER data to validate data products
- Feedback from users of MIFI products will be used to enhance and develop new derivative products based on remotely sensed data



Developed Products Contribute to Forest Inventory

- Forest inventory is an assessment of the state's assets
- Understand how much resource there is currently
- Understand where the resource is located
- Project how much resource will be available in the future
- These assets are important in ensuring sustainable
 - Timber Harvest
 - Air Quality
 - Water Quality
 - Recreation



Mississippi Institute for Forest Inventory (MIFI)

- Recommended by the Task Force for Strategic Initiative for Forest-Based Economic Development
- Legislation passed by the 2002 Legislature to
 - start the inventory process
 - submit the findings in writing and by way of a web site
 - develop a continuous forest inventory
- Develop and implement a continuous, statewide forest resource inventory necessary for the sustainable forest based economy
- Manage and distribute forest inventory based information for economic and public policy development



Mississippi Forest Inventory Pilot Program

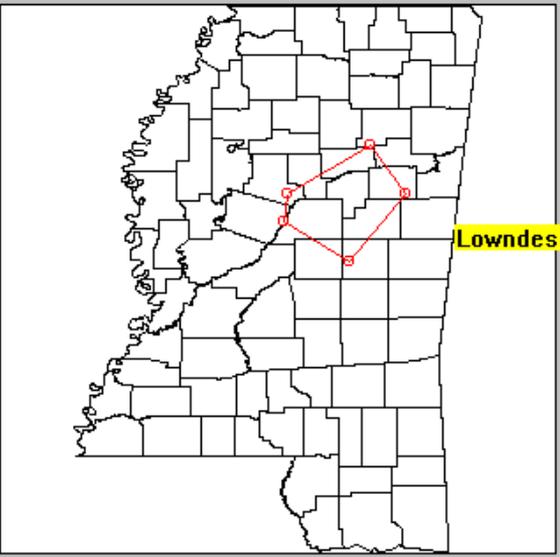
- Project will build on previous work done by Mississippi State University and MIFI
- Pilot program developed forest inventory based on remote sensing, GIS, and GPS technologies
- Incorporated field data collection and computation techniques
- Developed data products that will allow users to estimate timber supplies and monitor forest resource change
- Utilized computer technology to make original and derived data products available with on-line technologies



MIFI Forest Monitoring and Information System

Dynamic Report Selector - Forest Monitoring and Information System

County select - deselect



Lowndes

Species groups or Tree species

Group or Tree basis

Species groups:

- Longleaf and slash pine
- Loblolly and shortleaf pine
- Other yellow pines
- Cypress
- Other softwoods
- Select white oaks
- Select red oaks
- Other white oaks
- Other red oaks

Tree species:

- Misc. pine*
- Loblolly pine
- Shortleaf pine
- Longleaf pine
- Slash pine
- Baldcypress
- Eastern redcedar
- Other red oak*
- Cherrybark

Forest types

- Longleaf pine
- Slash pine
- Loblolly pine
- Shortleaf pine
- Eastern redcedar - hardwood
- Longleaf pine - scrub oak
- Shortleaf pine - oak
- Loblolly pine - hardwood
- Slash pine - hardwood
- Other oak - pine
- Oak - Hickory

Ownerships

- National Forest(USFS)
- Indian Lands
- Other Federal
- State
- County and Municipal
- Forest Industry
- Farmer
- Farmer Owned-Leased
- Other Private-Corporate

Select all counties Unselect all counties Select region Use server

Stand sizes

- Reproduction*
- Seedling-sapling
- Poletimber/Pulp
- Sawtimber
- Non-stocked

Stand origins

- Natural stands
- Planted stands

Tree products

- Reproduction
- Sub-merchant
- Pulpwood
- Saw Timber
- Peeler
- Pole
- Railroad Tie
- Cull

Logging operabilities

- Year Round*
- Summer/Fall*
- Crawler*
- High Lead*
- Inoperable*

Tree damages

- None
- Insect
- Disease
- Fusiform
- Fire
- Storm
- Ice
- Mechanical

Stand damages

- None
- Insect
- Disease
- Fusiform
- Fire
- Storm
- Ice
- Salvage

Physiographics

- Xeric
- Xeromesic
- Mesic
- Hydromesic
- Hydric

Minimize dialog box Save selections Retrieve selections Clear selections Prepare report Download data

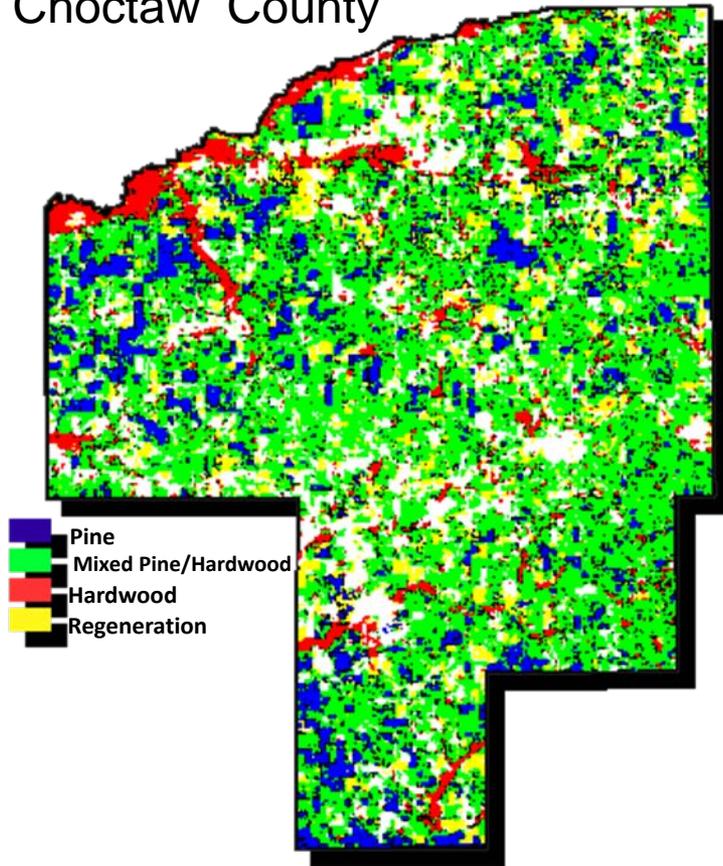
Year selection: 1992 Report selection: Volume by dbh class



Final Remote Sensing Product Examples

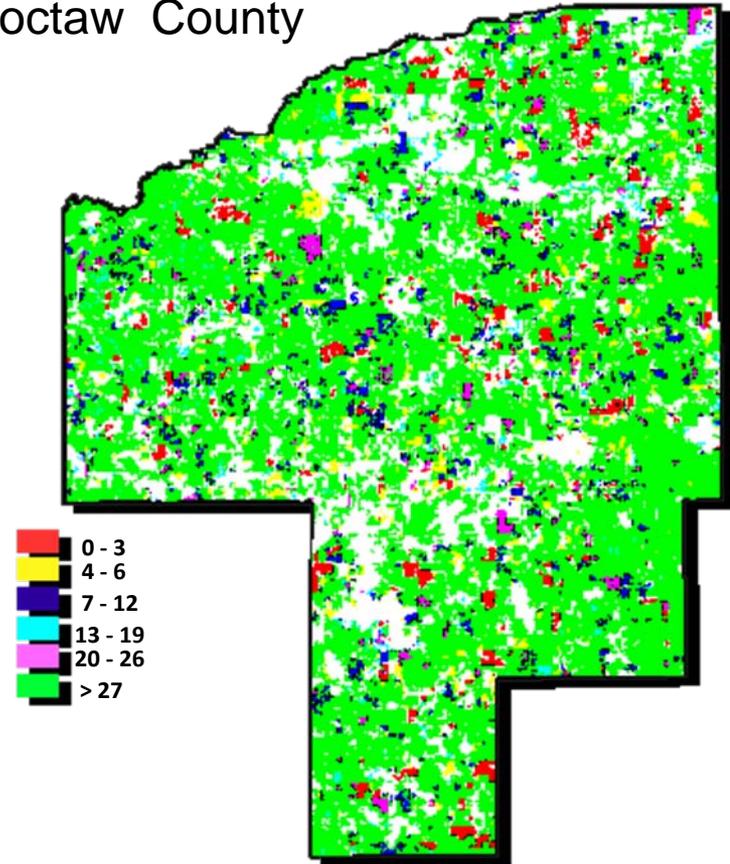
Cover Types

Choctaw County



Age Classes

Choctaw County



MIFI Data Products

- MIFI creates spatially relevant products from remotely sensed data for various purposes:
 - Forest cover mapping
 - Forest age
 - Forest composition
 - Deforestation
 - Wind damage
 - Fire damage
 - Biomass availability
 - Growth and Yield estimates



Project Summary

- Forest damage and recovery products will be created through combined activity of NASA, Mississippi State University, MIFI and Radiance Technologies
- Products based on NDVI and NDMI MODIS time series data
- Disseminated to public through MIFI
- Products enhanced through feedback from MIFI customers



Discussion

Questions?
Comments?

