



# Landfire Eastern Prototype:

Data and Models to Support Fire and Fuels  
Management

John Hom, Steve Van Tuyl, and Jason Cole

USDA Forest Service, Northern Global Change  
Program, Northeastern Research Station

Northeastern Forest Planners Association, Oct. 18, 2005

# LANDFIRE OBJECTIVES

- Provide consistent, nationwide data describing wildland fuel, existing vegetation composition and structure, historical vegetation conditions, and historical fire regimes
- Identification of areas with hazardous fuel
- Prioritization of hazardous fuel reduction projects
- Improvement of coordination between agencies
- Modeling real-time fire behavior to ensure wildland firefighting capacity and safety
- Modeling potential fire behavior and effects to plan for hazardous fuel reduction and the restoration of ecosystem integrity

# LANDFIRE, Rapid Assessment, FRCC Guidebook

---

We don't really know the total number of acres of hazardous fuels - Fire Regime Condition Class 3 there are in the nation!

**Estimated: somewhere between 90 and 190 million acres on federal lands.**

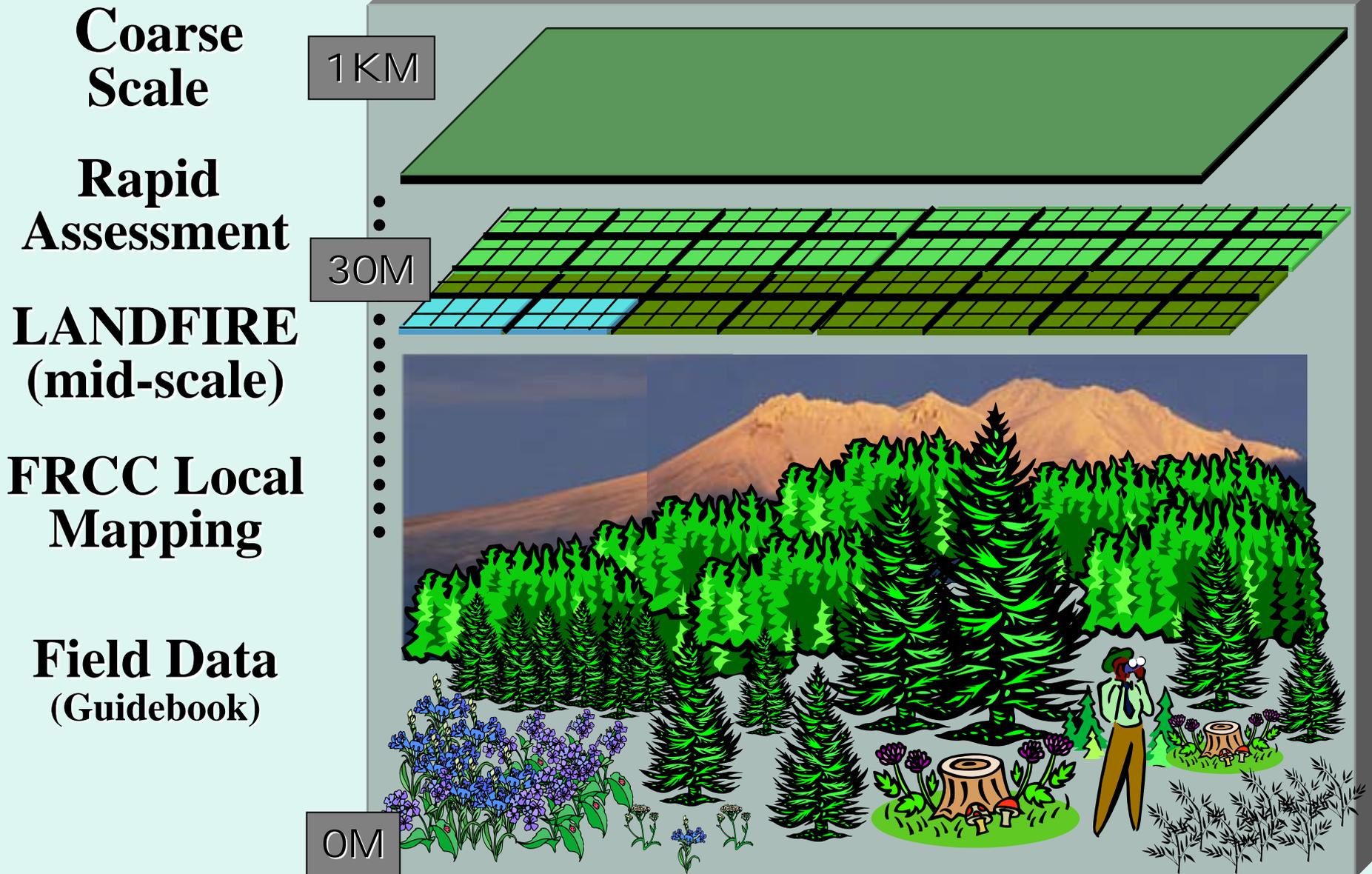
We don't know where they are!

**At best, we have a coarse idea where they are.**

We don't have the data needed to prioritize areas that need fuel treatments!

**Without scientifically sound (Consistent, Cohesive, and Continuous) national data, prioritization will be (at best) guess work subject to appeal.**

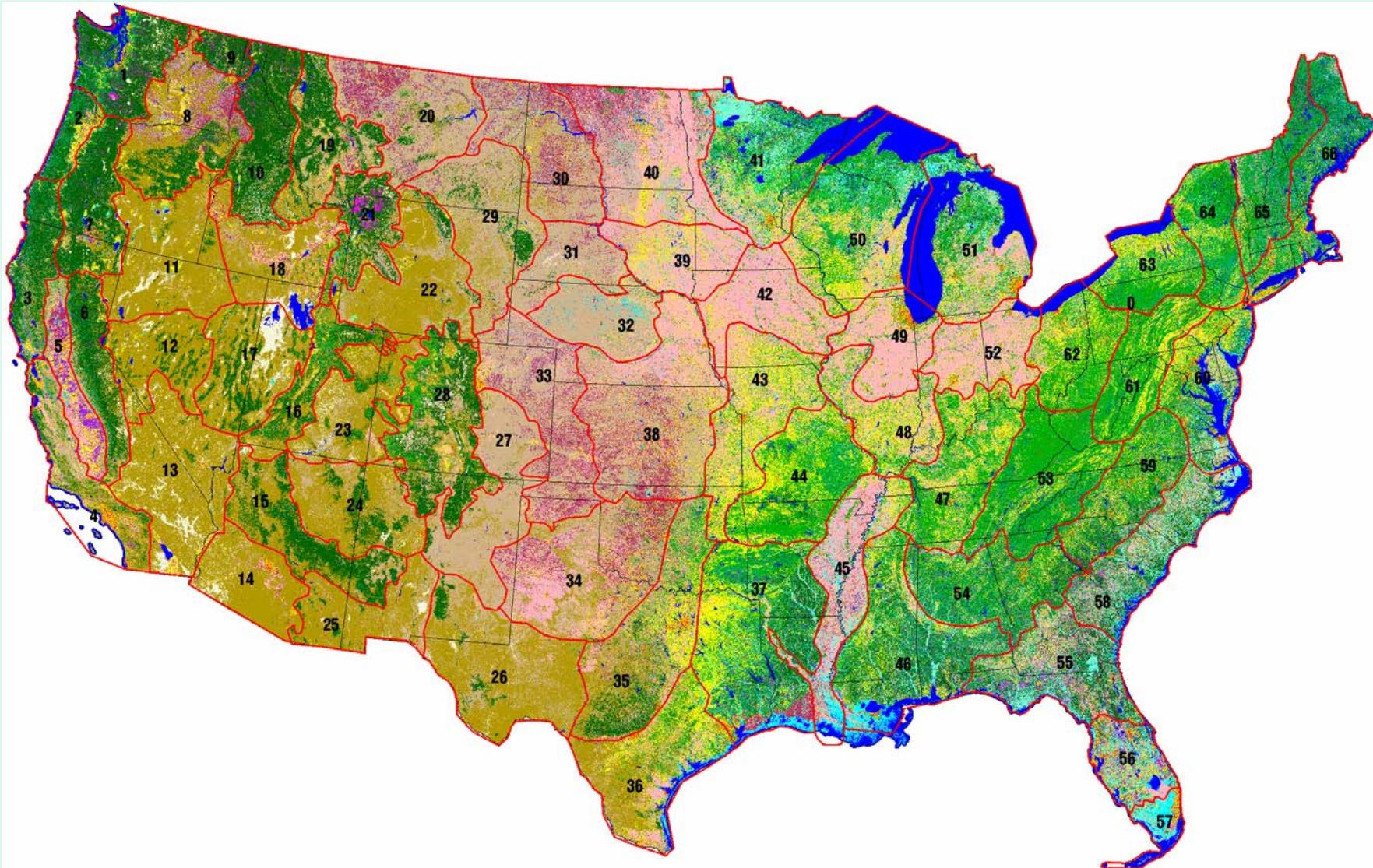
# Projects & Scale



# National LANDFIRE Overview

- National project to create consistent products and tools in support of NFP, HFRA, HFRI, etc.
- Supports prioritization of lands for management at landscape and national scale
- All vegetation types included (forest and non forest)
- LANDFIRE products at as a safety net for managers
- Interagency (USFS, DOI) and external cooperators (TNC, others)
- Data targeted at thematic mapper grain size (~30m pixels) with 60-80% accuracy

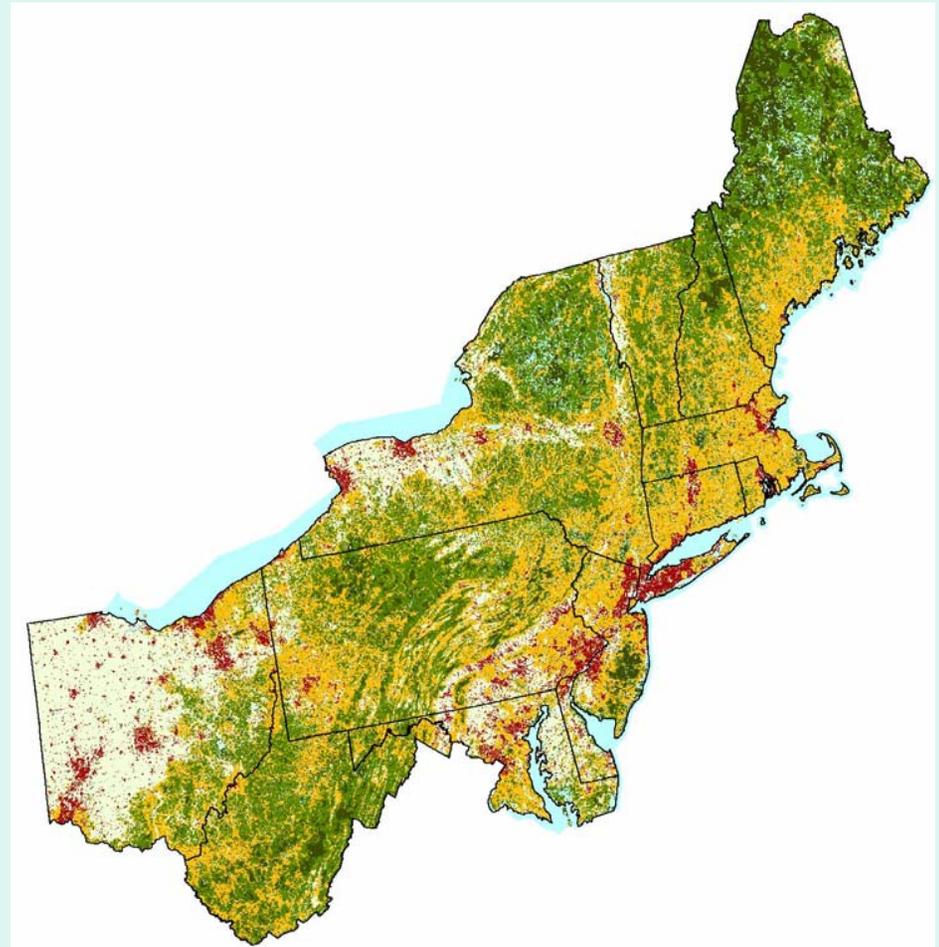
# MRLC mapping zones



# Introduction to Eastern Prototype

The **Eastern LANDFIRE Prototype** complements the ongoing efforts of the national **LANDFIRE** program, to provide a cohesive and consistent national fire management strategy for the United States.

Funding from **NFP**, not **LANDFIRE** National implementation



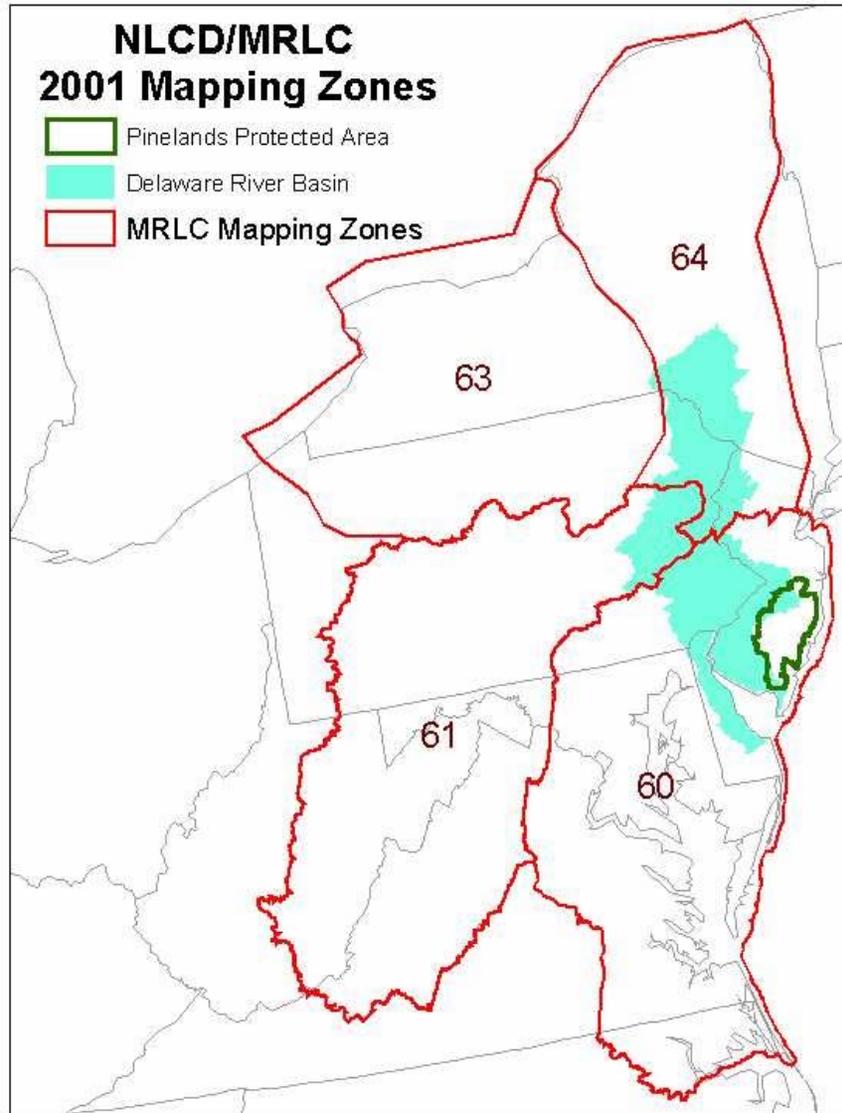


# NLCD/MRLC 2001 Mapping Zones

 Pinelands Protected Area

 Delaware River Basin

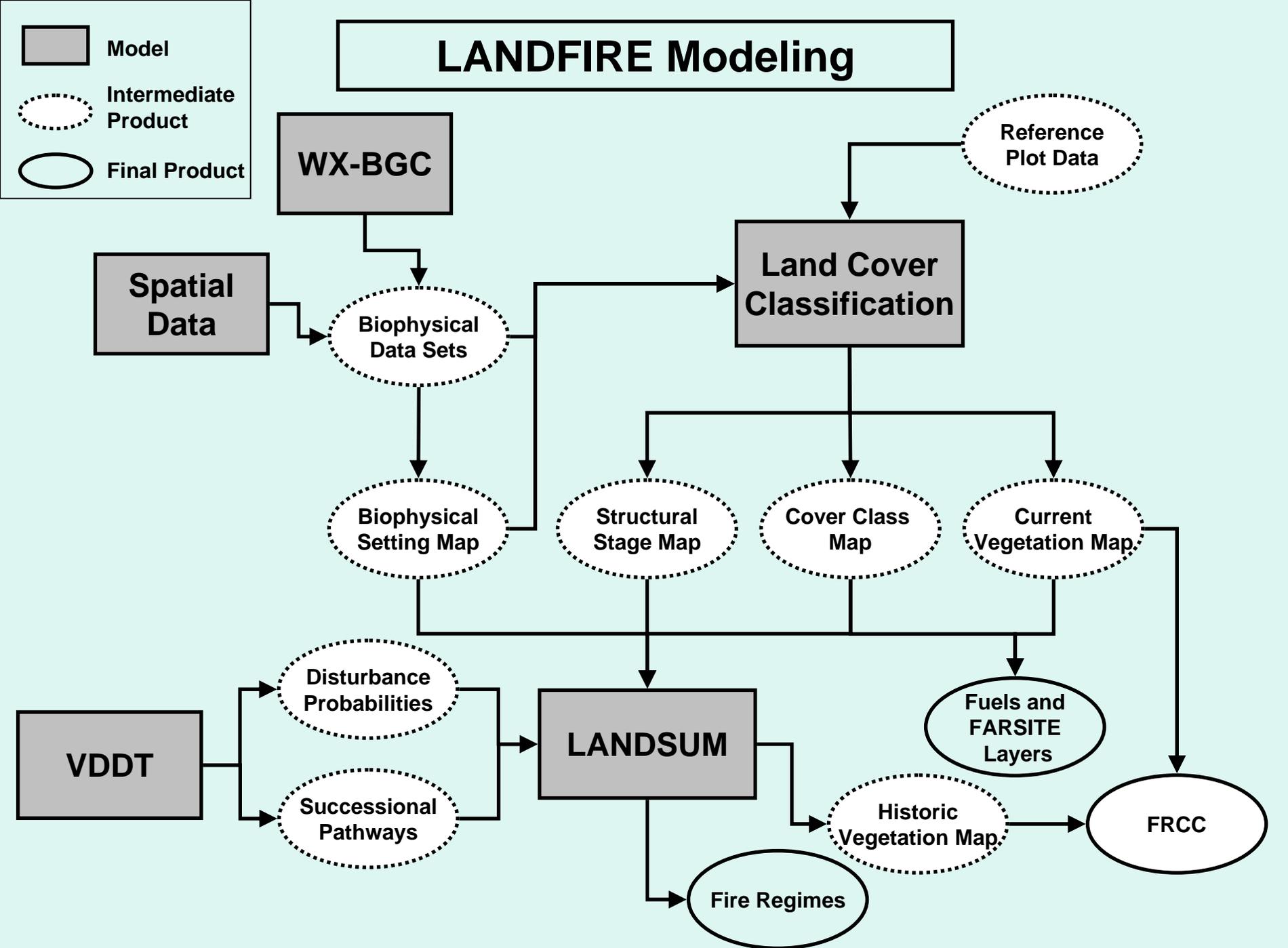
 MRLC Mapping Zones



# Distinguishing features for the Eastern LANDFIRE Prototype

- Extensive reference data and field validation with sites that represent eastern forest conditions
- Models and spatial tools parameterized with eastern forest types
- Large amount of private lands in the East
- Extensive wildland urban interface.

▪



# LANDFIRE Methods

## *Reference Database*

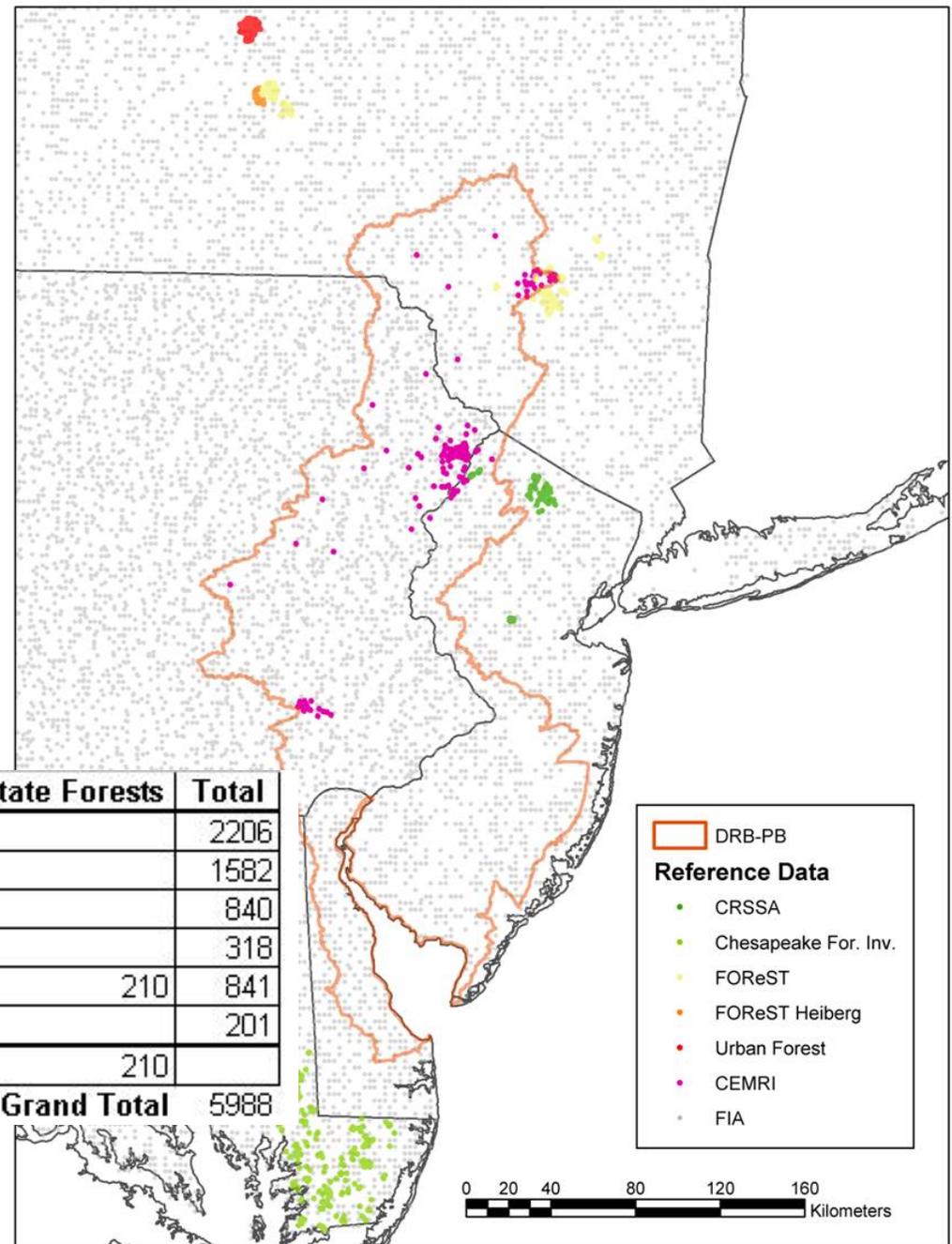
- **Reference data is the heart of the LANDFIRE project**
  - **Drives classification process for vegetation maps**
  - **Allows for validation of some products**
  - **Can act as a stand alone product**
- **Database contains geo-referenced plot-level data that include some or all of:**
  - **Canopy height**
  - **Percent cover**
  - **Species lists**
  - **Fuels**
- **Data come from many sources:**
  - **Forest Inventory and Analysis (FIA)**
  - **Gap Analysis Program (GAP)**
  - **Other state and federal inventories (e.g. Heritage programs)**
  - **University research projects (e.g. ESF Forest)**

# Eastern LANDFIRE Prototype Field Reference Data

- **Reference data** used for;
  - Vegetation classification
  - Model building and validation
- **Data acquired from;**
  - Federal
  - State
  - Institutional

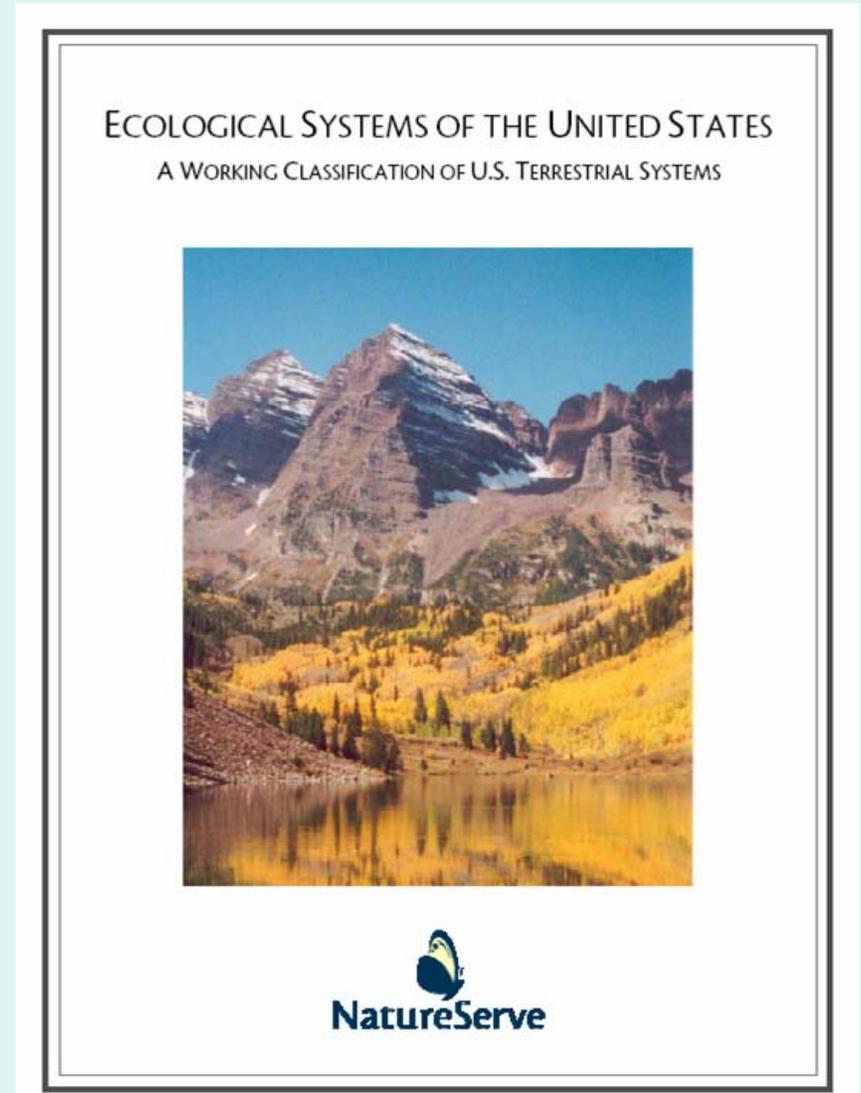
State	FIA	FHM	UF Forests	CRSSA	FOReST	State Forests	Total
NY	1132	31	199		844		2206
PA	1307	275					1582
NJ	675	15		150			840
DE	247	71					318
MD	429		202			210	841
DC			201				201
<b>Total</b>	<b>3790</b>	<b>392</b>	<b>602</b>	<b>150</b>	<b>844</b>	<b>210</b>	

**Grand Total 5988**



# Eastern LANDFIRE Prototype Vegetation Classification

- NatureServe Ecological Systems
- Consistent with National LANDFIRE
- Gives National LANDFIRE a head start on development of keys for northeastern US



# List of Ecological Systems developed for study area by NatureServe

- 47 Ecological Systems in the study area
- 26 final Ecological Systems
  - 12 forest
  - 4 forest/wetland
  - 4 wetland
  - 2 riparian
  - 2 woodland
  - 1 grass/shrub
  - 1 barren



Atlantic Coastal Plain Northern Upland Pitch Pine Barren



Appalachian Pine-Oak Woodland

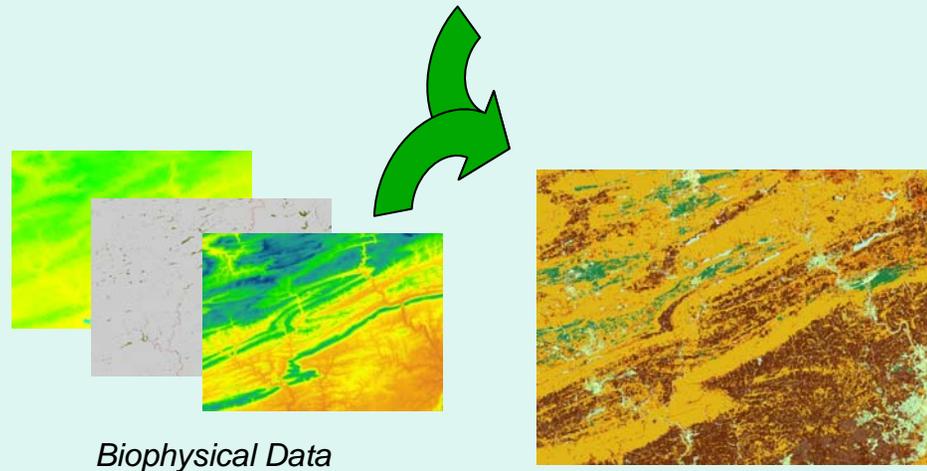
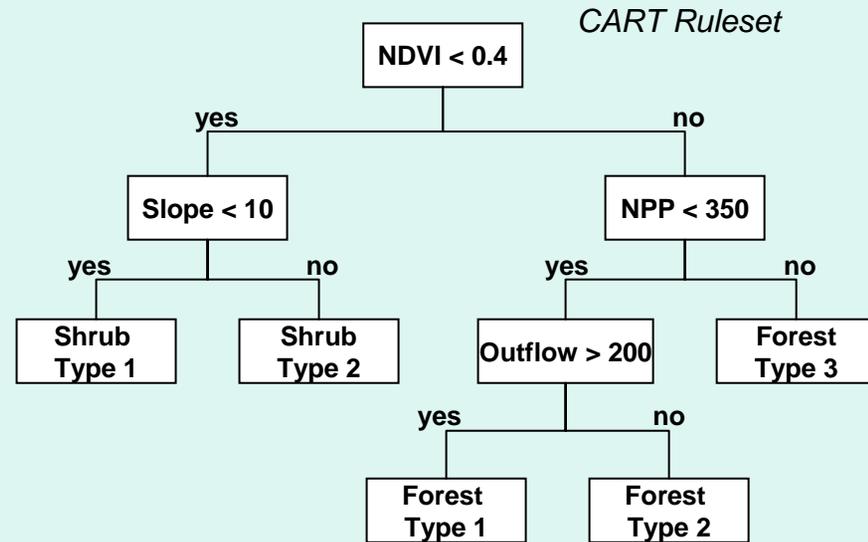


Laurentian-Acadian  
Northern Hardwoods Forest

# LANDFIRE Methods

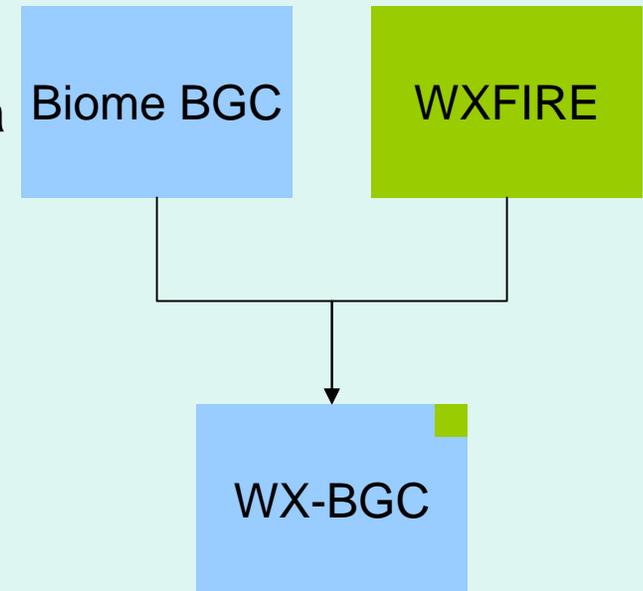
## *Vegetation Mapping*

- Many of the initial maps for LANDFIRE (existing vegetation, structure, etc.) produced using CART modeling
- CART models use point data (reference database) linked to spatial inputs (biophysical data) to map
- Biophysical data from WXBGC, elevation derivatives, climate derivatives, soils layers are used for modeling
- Model ruleset is then used to map data.



# What is WX-BGC?

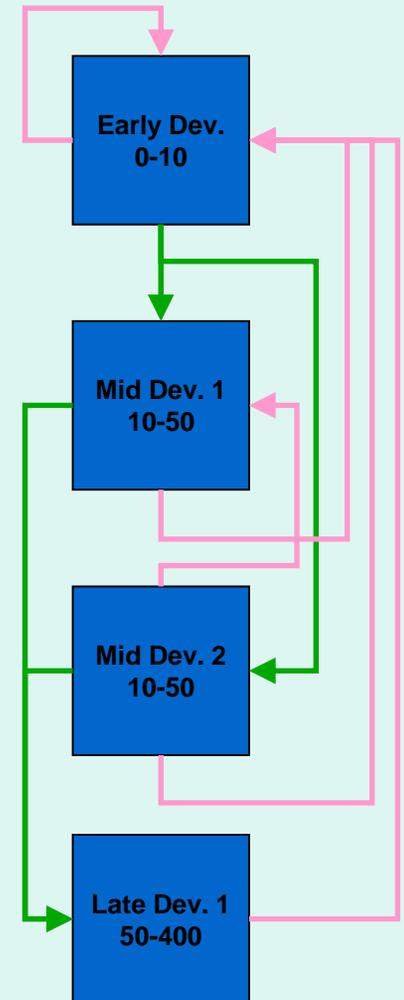
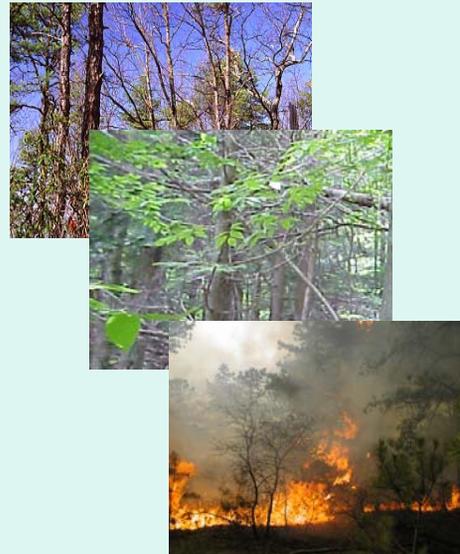
- **Hybrid of two models:**
  - **WXFIRE** – climate downscaling
  - **Biome-BGC** – model for simulating terrestrial ecosystems
- **WXFIRE**
  - Developed for LANDFIRE by Missoula Fire Sciences Laboratory
  - Produces some biophysical data, downscales and summarizes climate data
- **Biome BGC**
  - Developed by University of Montana NTSG et al.
  - Models energy, water, carbon, and nutrient fluxes in vegetation and soil
- **WX-BGC is simply Biome-BGC with a few WXFIRE climate summaries tacked on**



# LANDFIRE Methods

## *Succession and Disturbance Parameters*

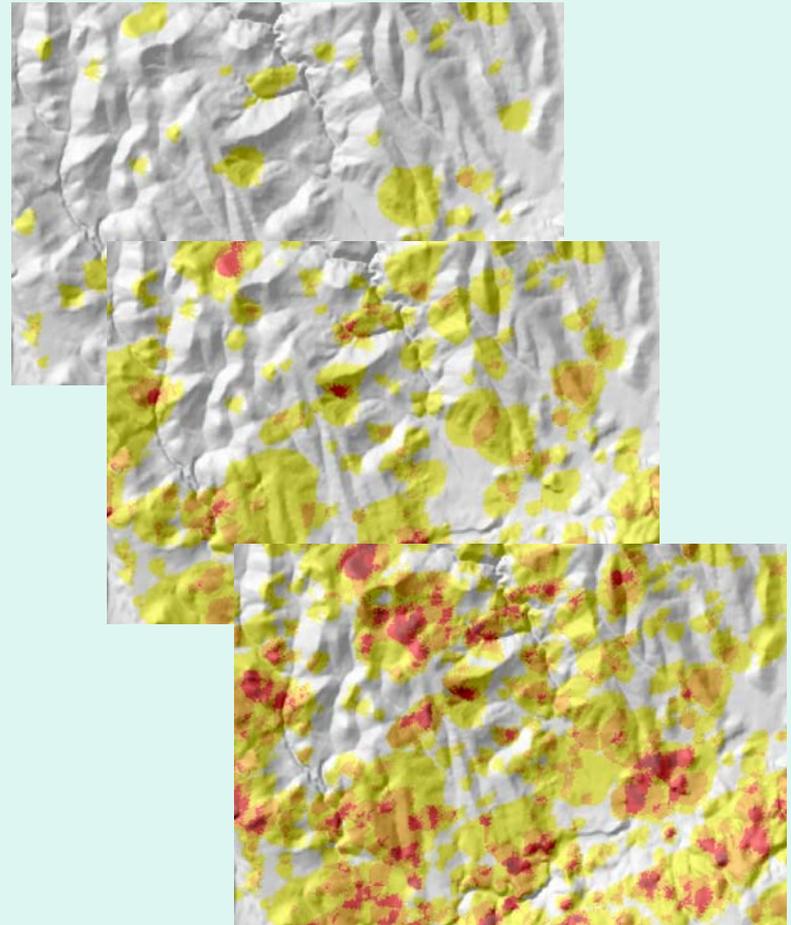
- **Succession and disturbance determined for each vegetation type (e.g. Appalachian Oak Forests)**
- **Regional conferences held to garner expert opinion (peer reviewed) on succession and disturbance dynamics**
- **Modeling done in VDDT**
  - **Aspatial vegetation dynamics simulator**
  - **Customizable for most vegetation, succession, and disturbance types**
- **VDDT output is used to parameterize LANDSUM**
  - **Disturbance frequencies**
  - **Succession classes**
  - **Succession timing**



# LANDFIRE Methods

## *Spatial Succession/Disturbance Modeling*

- **LANDSUM model used to simulate succession and disturbance spatially**
- **Biophysical setting, vegetation classifications, and VDDT output feed LANDSUM**
- **Additional model parameters:**
  - Basic climate
  - Elevation
  - Wind
  - Fire size/shape
- **Grows and disturbs vegetation as defined by VDDT models**
- **Outputs include:**
  - Historic Range and Variability of vegetation types/classes
  - Simulated historic fire regimes

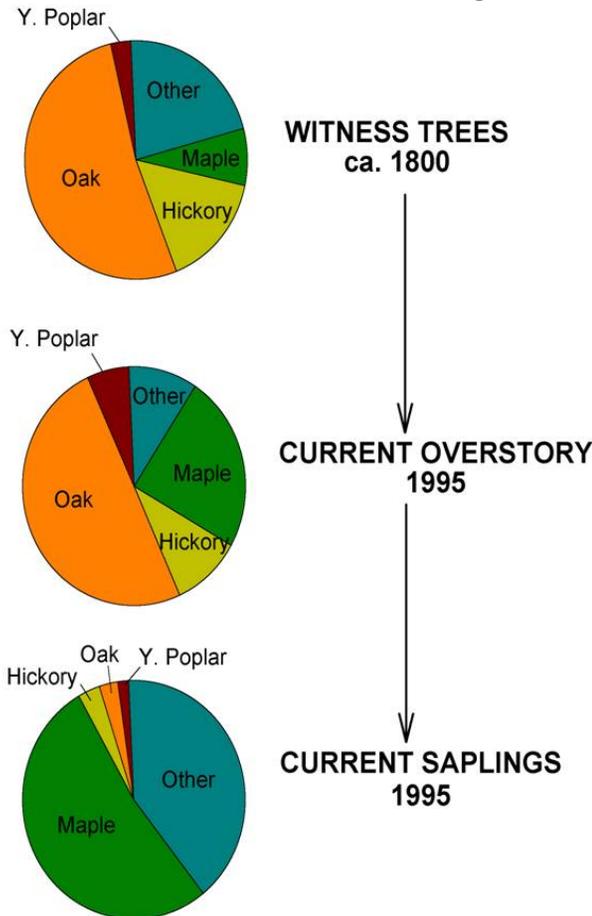


# Eastern Issues

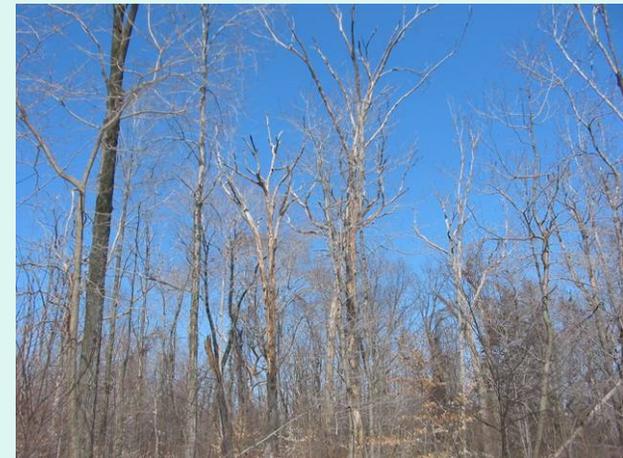
- Disturbance, in addition to fire
- Lost of historic tree species to disease: chestnut, elm, others
- Invasive species
- Herbivory and loss of oak
- Large amount of Wildland Urban Interface
- Climate Change and tree species distribution migration
- Atmospheric pollution and multiple stress

# Historic, species changes and non-fire disturbances for eastern forests

## Regeneration and Species change

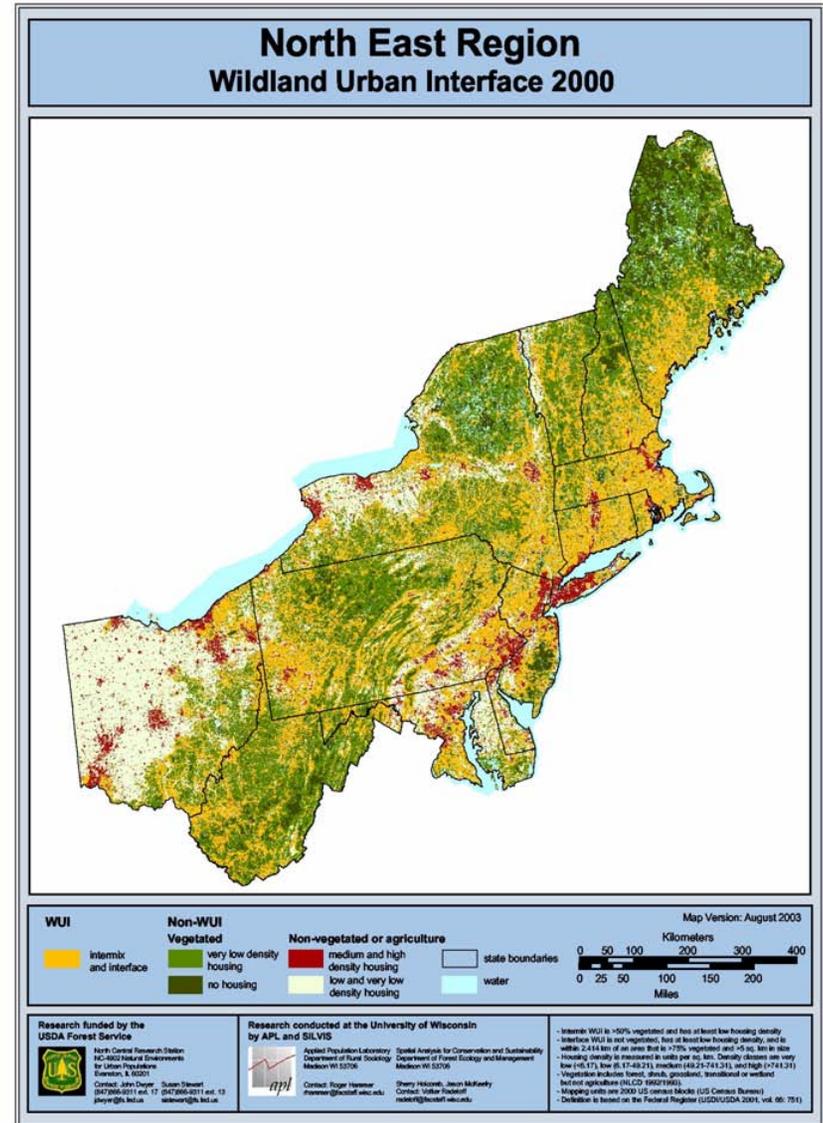
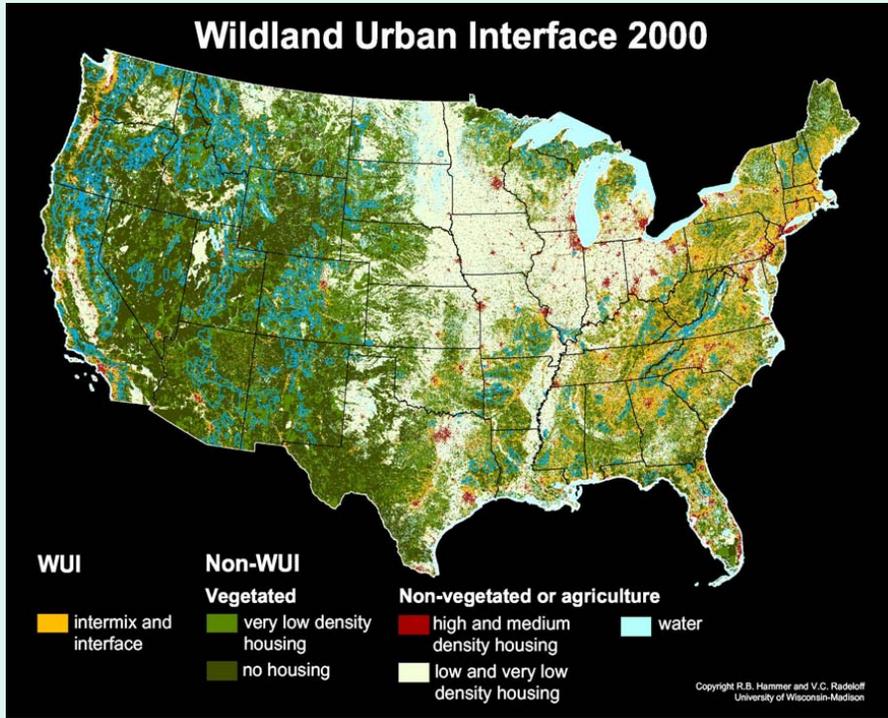


Ice storm damage

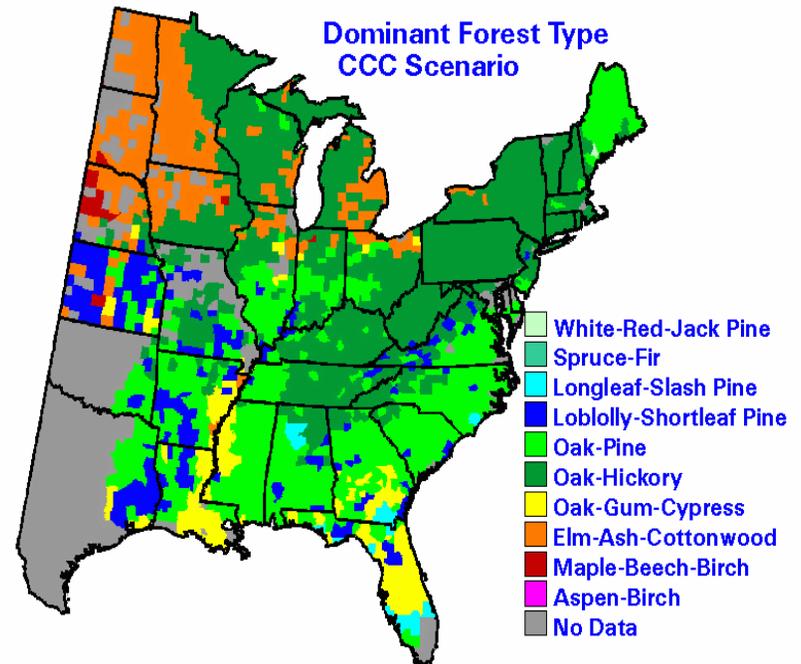
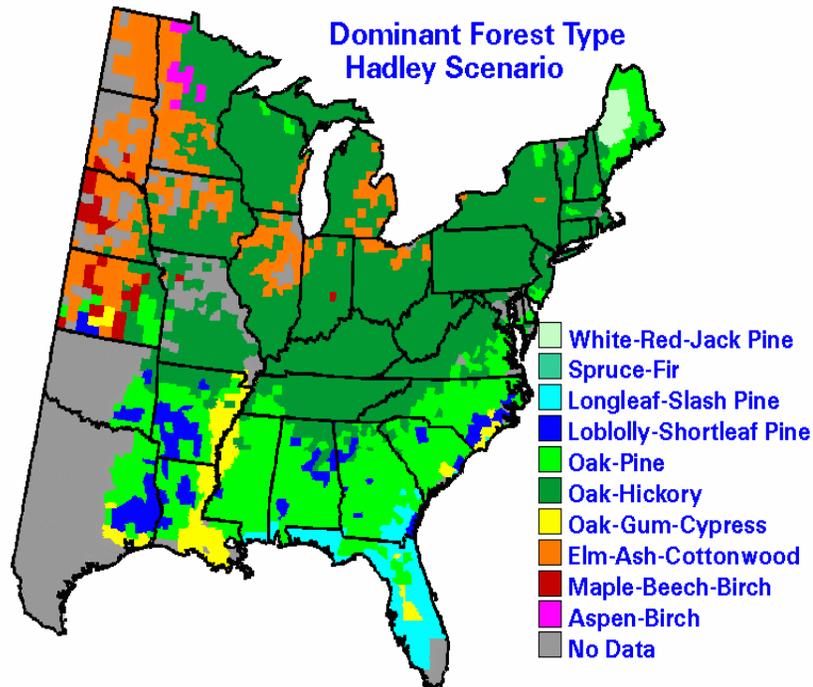
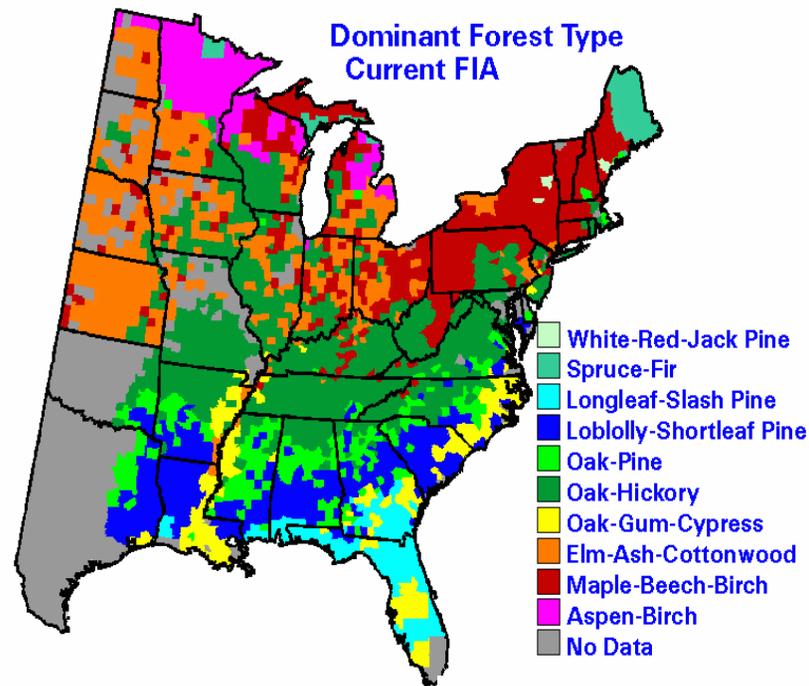


Gypsy moth damage

# WUI in the Eastern Area

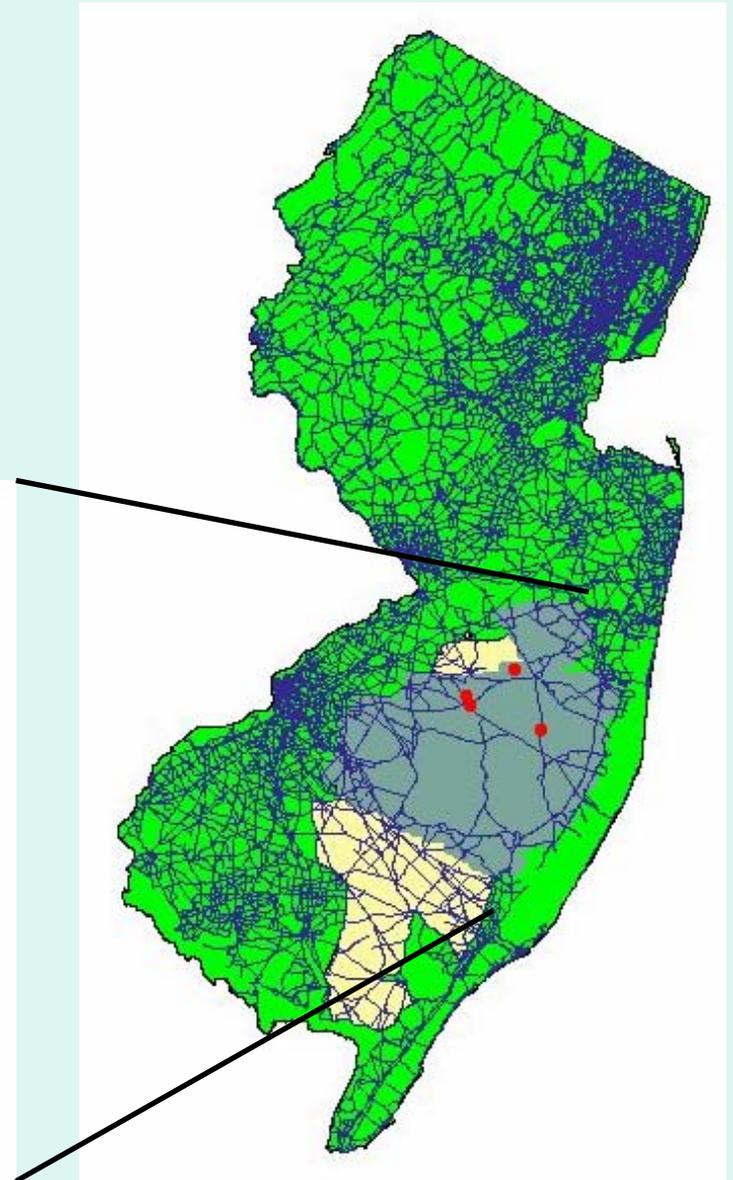
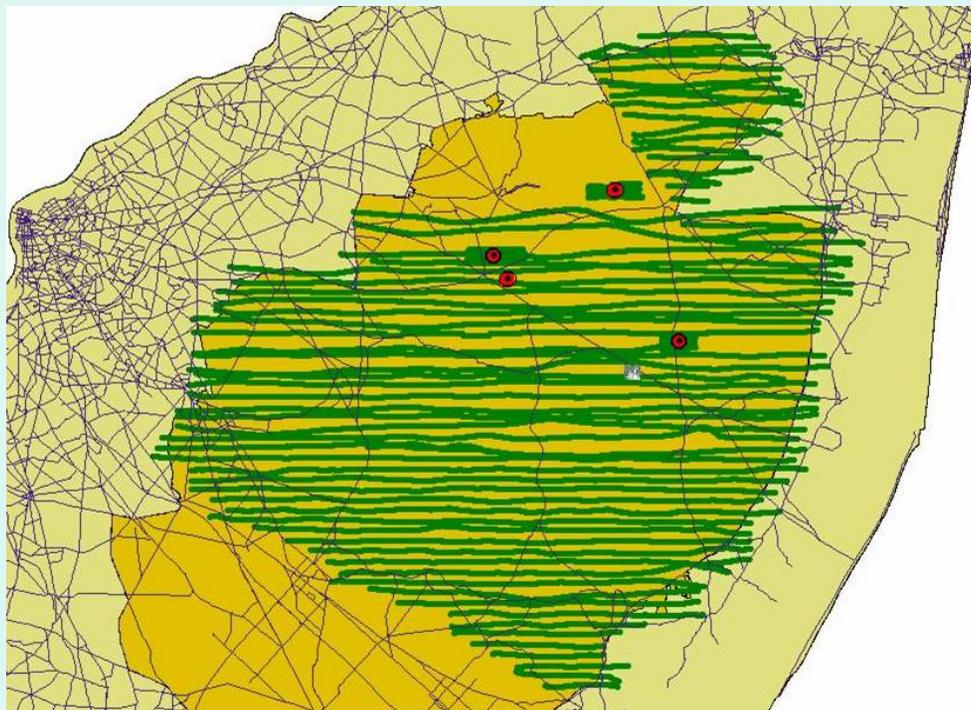


# Future forest distribution ???

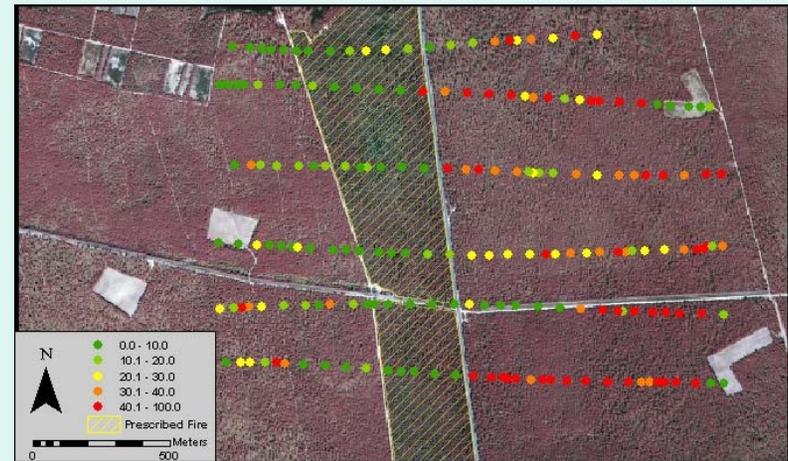
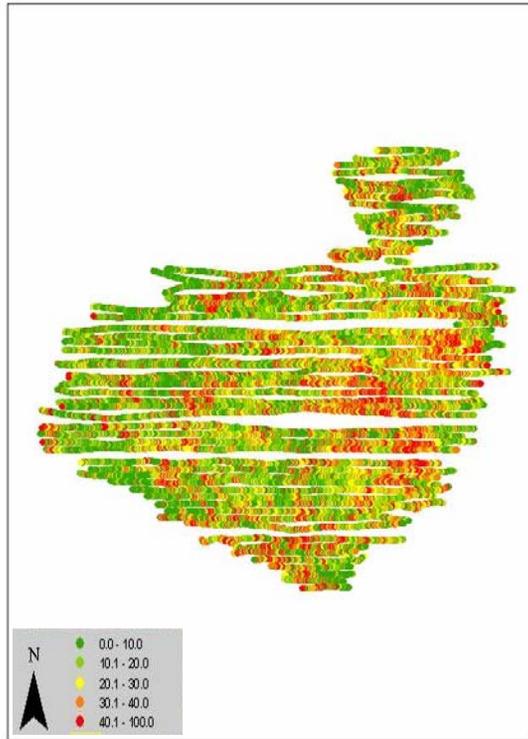


Ongoing research for developing future LANDFIRE methods: LIDAR measurements for fuel loads and fuel structure

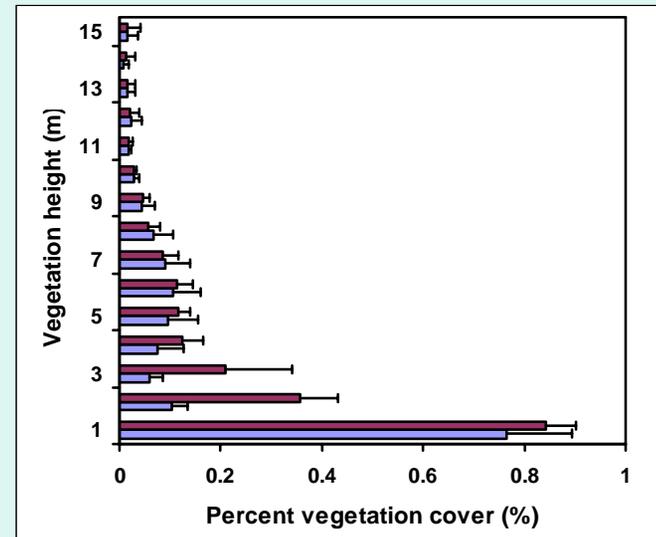
Transects spaced a 1 km with intensive measurements at each tower site (200 m transects)

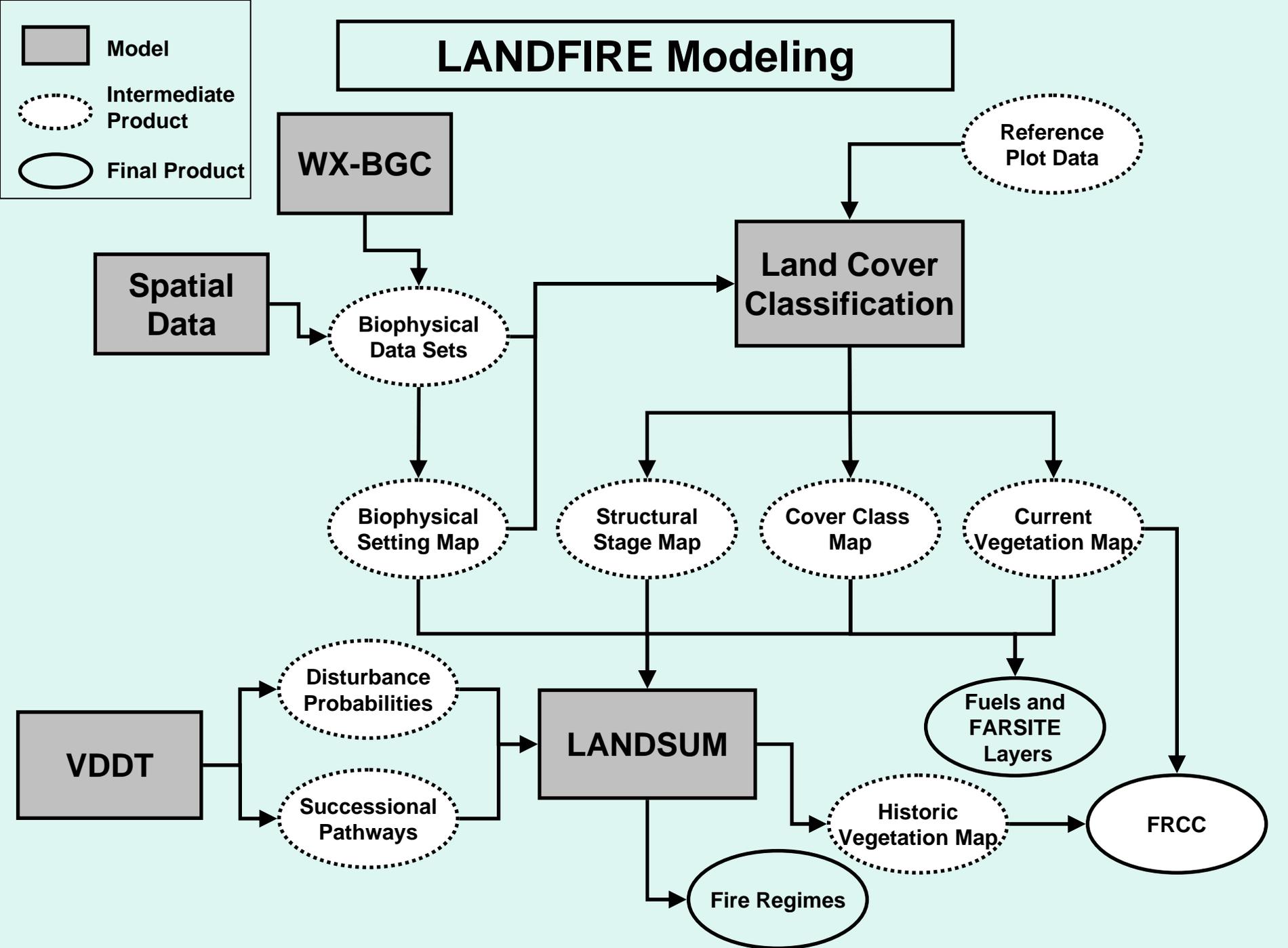


# Lidar: canopy, structure, and fuel loading



Percent cover between 1 and 4 meters (ladder fuel height) across the pinelands. Binning of heights for ladder fuels and effectiveness of prescribed burns for reducing fuels.





# LANDFIRE Primary Products

- Reference Database
- Existing Vegetation Map (Ecological Systems)
- Vegetation Structure (height classes)
- Potential Vegetation (Ecological Systems)
- *Historic Fire Regime*
  - Fire Frequency
  - Fire Severity Type I
  - Fire Severity Type II
  - Fire Severity Type III
- *Fire Regime Condition Class (1, 2, 3)*
- Index of Departure (0-100%)
- Departure Significance
- *FARSITE Data Layers*
  - Fire Behavior Fuel Models
  - Crown Base Height
  - Crown Bulk Density
  - Stand Height
- Fuel Loading Models
- Fuel Characterization Fuelbeds

# LANDFIRE Data Layers

- [LANDFIRE Reference Database](#)
- [Existing Vegetation Map](#)
- [Vegetation Structure Map](#)
- [Potential Vegetation Type Map](#)
- [Simulated Historical Fire Regime Maps](#)
- [Fire Regime Condition Class \(FRCC\) Map](#)
- [HRVStat Departure Map](#)
- [Departure Significance Map](#)
- [Fire Behavior Fuel Model Map](#)
- [Canopy Fuel Maps](#)
- [Fuel Loading Model Map](#)
- [Fuel Characterization Classification System \(FCCS\) Fuelbed Map](#)
- **National Map website**
- [www.landfire.gov](http://www.landfire.gov)
- [www.frcc.gov](http://www.frcc.gov)

# Eastern LANDFIRE Prototype study

- This effort will **complement the National LANDFIRE effort** in order to provide a cohesive and consistent national fire management strategy.
- **Eastern prototype site will help develop the fuel, fire risk and biophysical layers** as outlined in the LANDFIRE-US Program.
- **Coordinating, consulting and collaborating with the LANDFIRE teams** and other federal agencies
- This effort will provide **land classifications that are consistent with the national program**, and include the multiple-scale products that are useful to fire and land managers.
- **Provide new research protocols and validation of LANDFIRE methodology for eastern regions**

# Call reference data: LANDFIRE examples

- **Plot Geo-referenced plot location**
- **Sampling date**
- **Vegetation Type (e.g., NVC Alliance)**
- **Species list**
- **Cover by species**
- **Cover by life form (tree, shrub, herb)**
- **Height by species**
- **Heights of individual trees**
- **Crown ratios (individual trees)**
- **Crown classes (individual trees)**
- **Diameters (individual trees)**
- **Tree density**
- **Fuels Fine (1-, 10-, and 100-hour)**
- **Coarse (1000-hour)**
- **Cover of live and dead shrubs**
- **Cover of live and dead herbs**
- **Base height of canopy fuels**
- **Height of shrubs**
- **Height of herbaceous vegetation**