PINEMAP

Pine Integrated Network: Education, Mitigation and Adaptation Project

Mapping the future of southern pine management in a changing world

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&

51 co-PIs at 11 Land Grant Institutions

Pinemap.org

USDA United States Department of Agriculture National Institute of Food and Agriculture

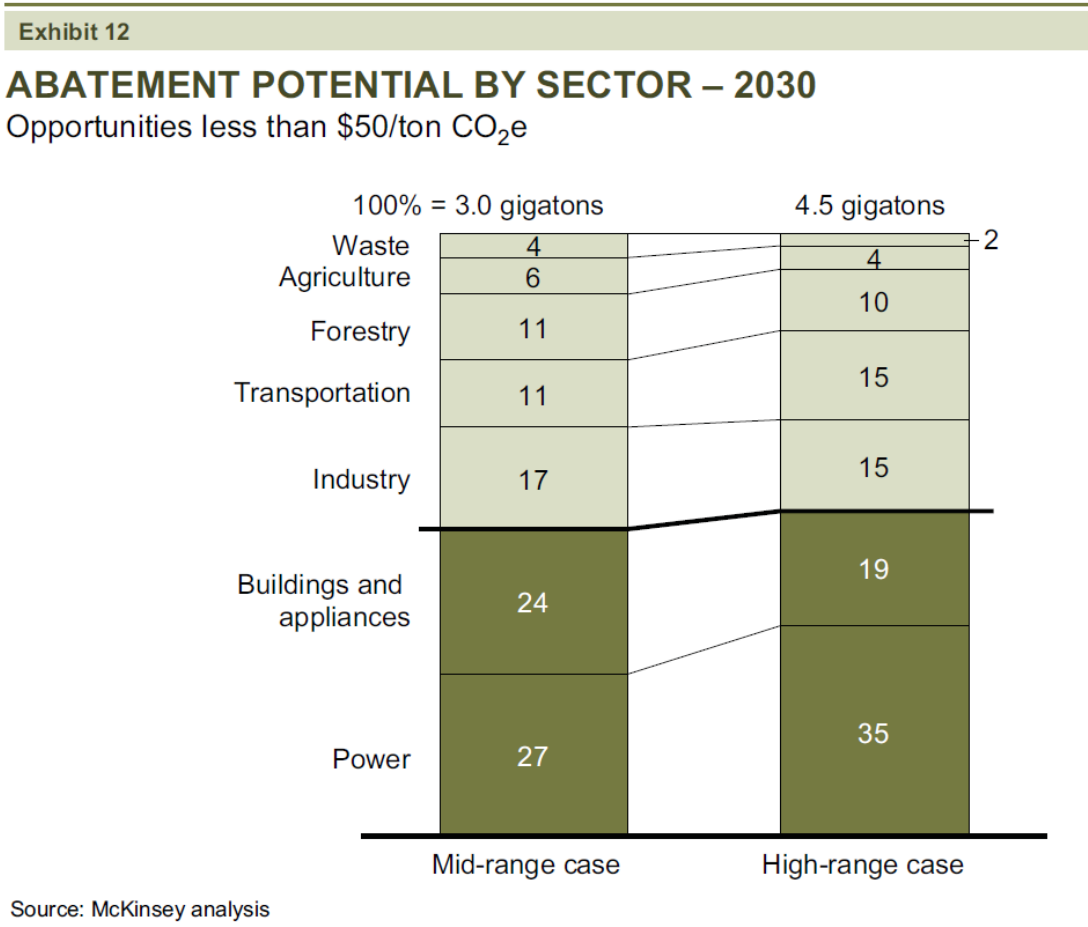
Long-Term Outcome of NIFA Climate Change Program: Reduce the use of energy, nitrogen fertilizer, and water by 10% and increase carbon sequestration by 15% through resilient forest production systems under changing climate by 2030

Provide New Management Methods

- ***Mitigation –*** Reduce greenhouse gas emissions in forestry and maximize carbon sequestration
- ***Adaptation –*** Maximize resiliency and reduce impact of climate change on productivity of forest systems and reduce carbon, nitrogen and water footprints under changing climate
- ***Climate Education and Extension-*** Increase number of scientists, educators and extension professionals with skills to address climate change in forestry

Forestry and CO_2 Mitigation

- Forests and ag lands are net sink
  - > 800 Tg CO_{2eq} / yr
  - 90% on forests
  - Equivalent to 12% of annual emissions
  - Opportunities for increases through improved management
- Forest management approaches are readily implemented and economically viable



Creyts et al. 2007

Overall PINEMAP Goals

To create, synthesize, and disseminate the knowledge that enables southern forest landowners:

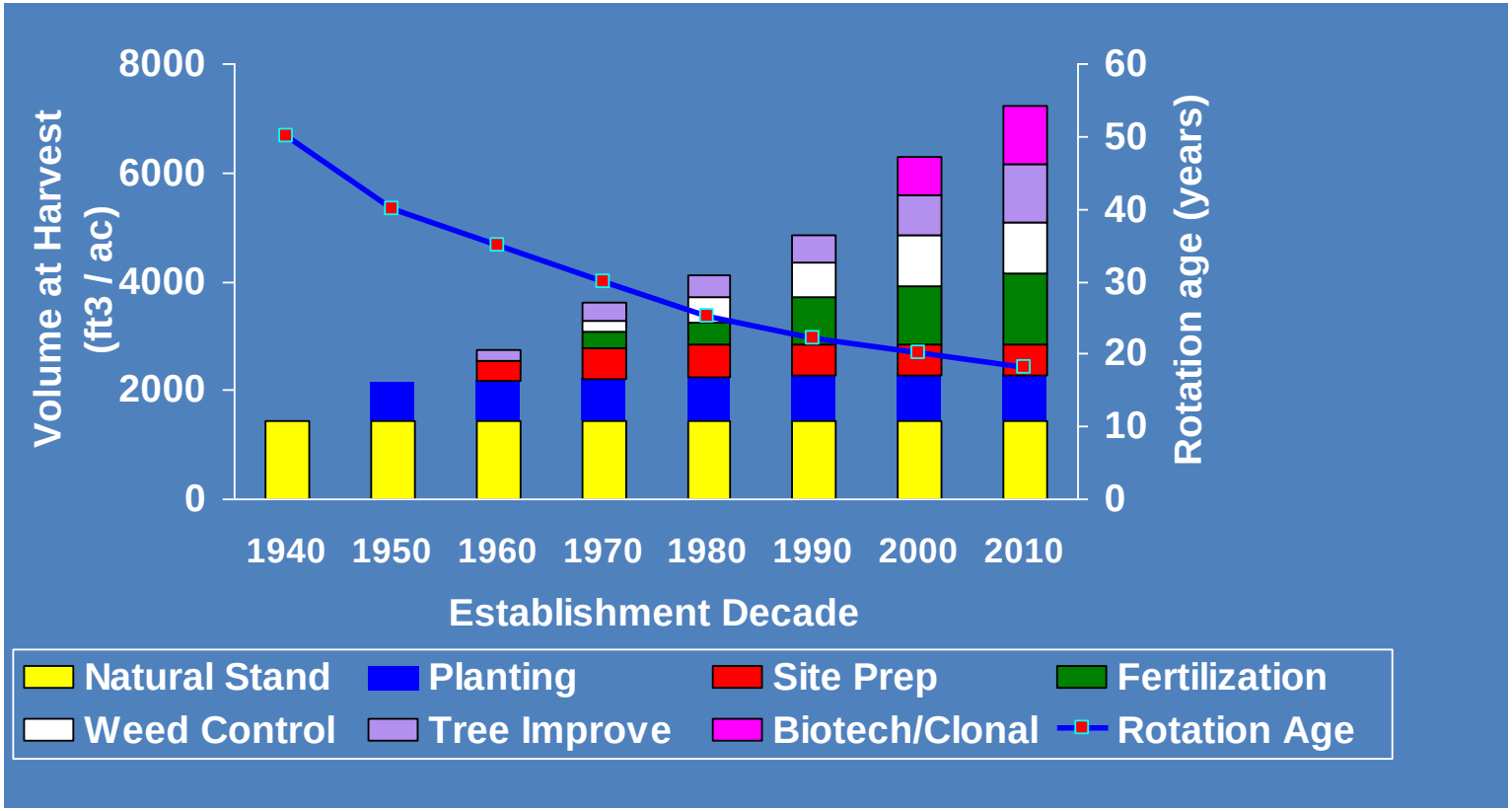
- to harness pine forest productivity to mitigate atmospheric $CO_{2,}$
- to more efficiently utilize nitrogen and other fertilizer inputs,
- and to adapt their forest management approaches to increase resilience in the face of changing climate.

Pine Forests of the Southeastern US

- Forests occupy 60% of the land area, with a large fraction dominated by pines
  - 10 species, loblolly and slash economically important
- Contains 12 Pg of C, 36% of the sequestered forest C in the contiguous United States
- Annually sequester 76 Tg C, equivalent to 13% of regional greenhouse gas emissions
- ~85% of all forestlands are privately owned
- About half the pine forest is naturally regenerated, half planted with genetically improved seedlings
  - About 10 million ha / 25 million ac each
- Produce about 16% of global industrial wood, more than any other country
  - Forestry is in top 3 industries in all 12 southern states – >$200 billion in revenue annually

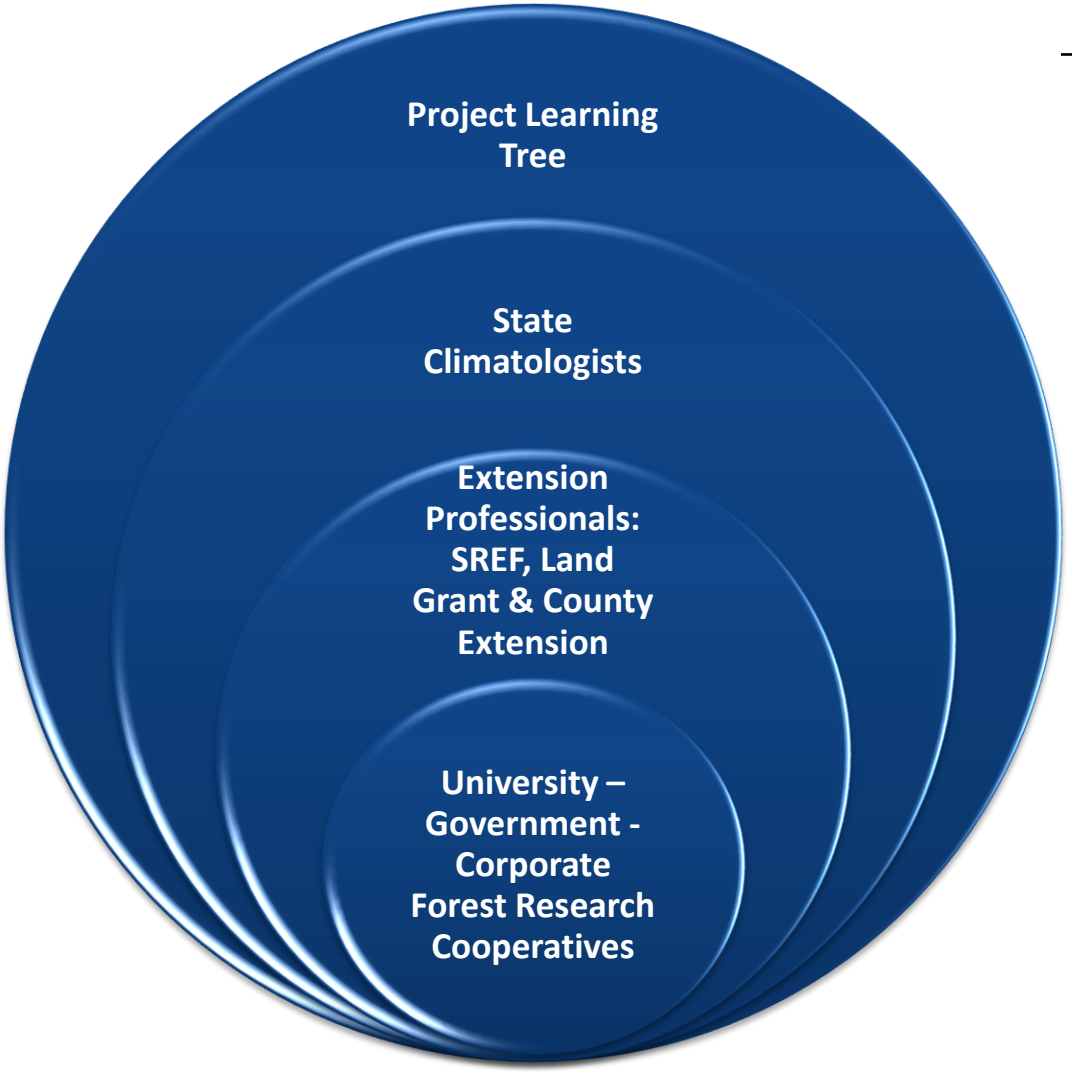
Since 1940s, planted pine productivity has tripled, primarily due to **improved genetic stock** and **silvicultural technology** developed and disseminated by

University / Government / Corporate Research Cooperatives



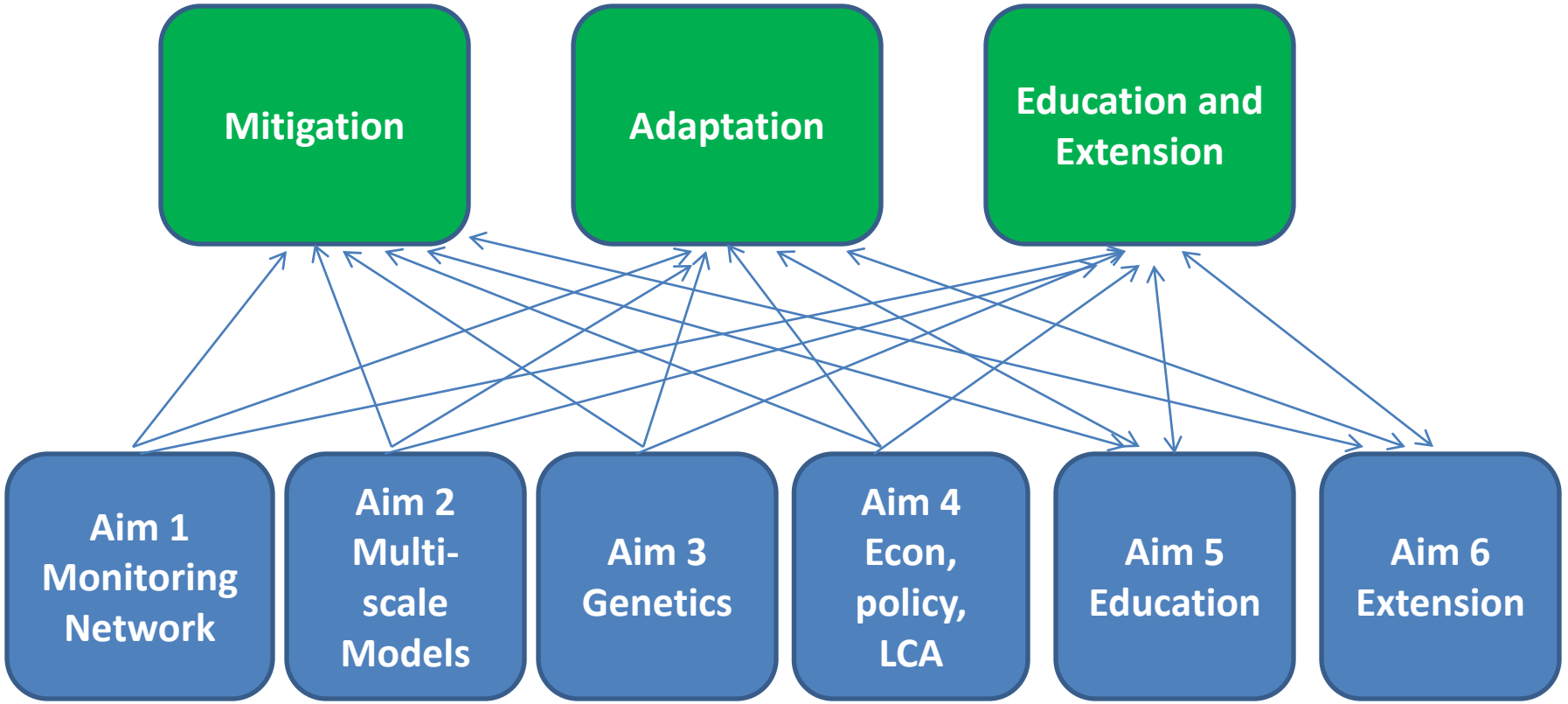
Redrawn from: Fox, T.R., E.J. Jokela and H.L. Allen. 2007. The development of pine plantation silviculture in the southern United States. J. Forestry 105:337-347.

Global Approach: Integrating & Leveraging Existing Networks



Research Cooperative	Host University (year founded)
Cooperative Forest Genetics Research Program	University of Florida (1953)
Cooperative Tree Improvement Program	North Carolina State University (1955)
Forest Biology Research Cooperative	University of Florida (1996)
Forest Modeling Research Cooperative	Virginia Polytechnic Univ. (1979)
Forest Productivity Cooperative	Virginia Polytechnic Univ. / NC State Univ. (1969)
Plantation Management Research Cooperative	University of Georgia (1975)
Southern Forest Resource Assessment Consortium	North Carolina State University (1994)
Western Gulf Forest Tree Improvement Program	Texas A&M Univ. / Texas Forest Service (1969)

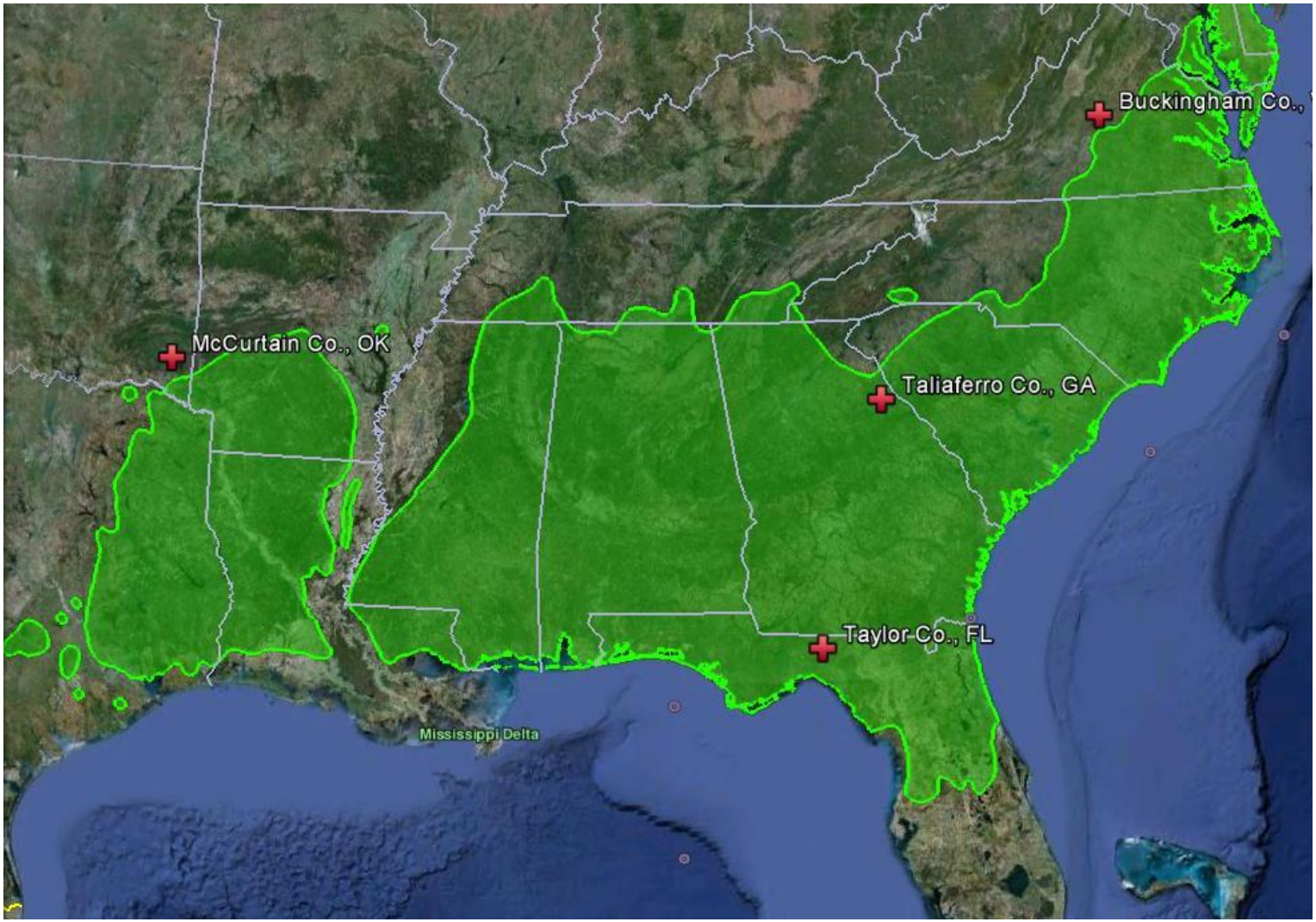
Disciplinary Aims Contribute to Broader Integrated Project Goals



Aim 1 – Silviculture and Field Ecology

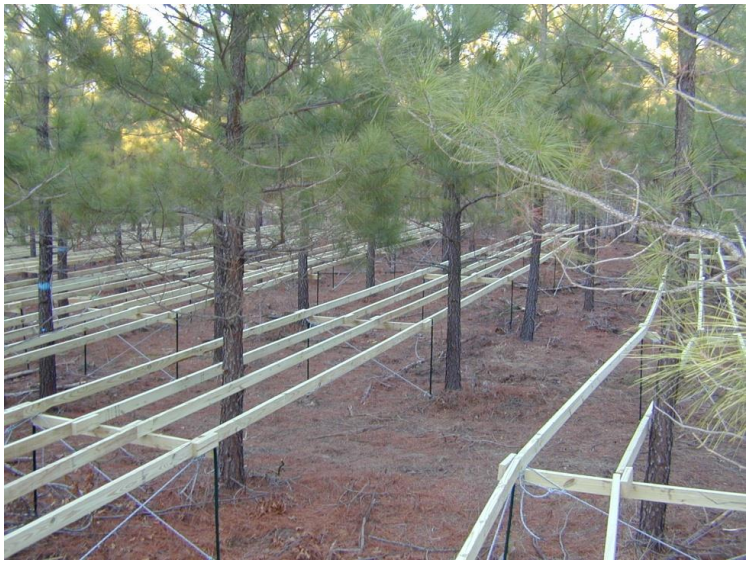
- Establish a regionwide three-tiered monitoring network and develop standardized methods to quantify carbon, water, and nutrient storage and flux baselines and responses to climate and management.
  - Tier I – existing growth & yield monitoring sites measure regional variation in productivity (500 existing sites)
  - Tier II - existing silvicultural experiments plus AmeriFlux eddy covariance stations measure effects of management factors on carbon, nutrient, and water cycles (~140 existing sites)
  - Tier III – "rainfall-exclusion" treatments in factorial design with silvicultural treatments to measure response to changes in water and nutrient availability (4 new sites)

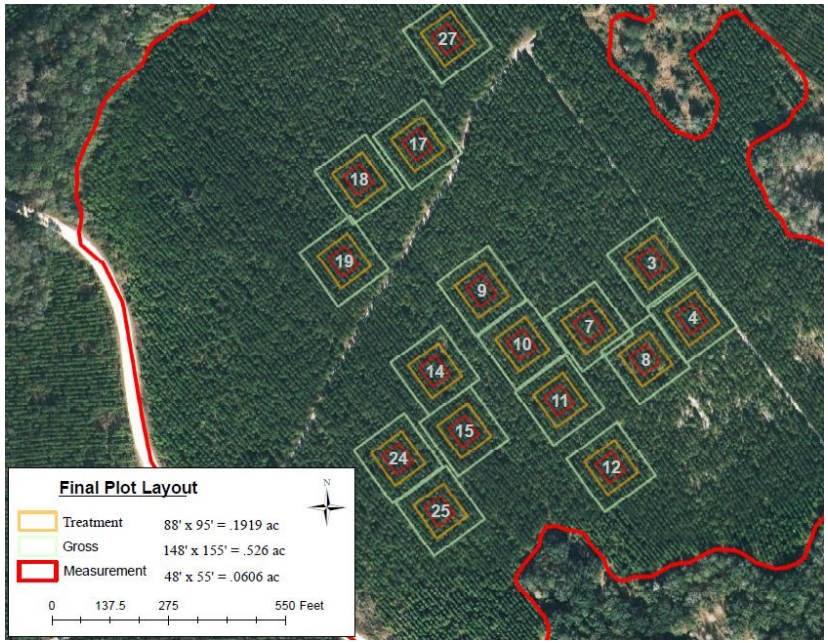
Tier III Installations



Tier III Study Design

- 2x2 factorial
  - 33% throughfall diversion
  - Fertilizer
- 4 replicates
- Plot area ~ 10 acres

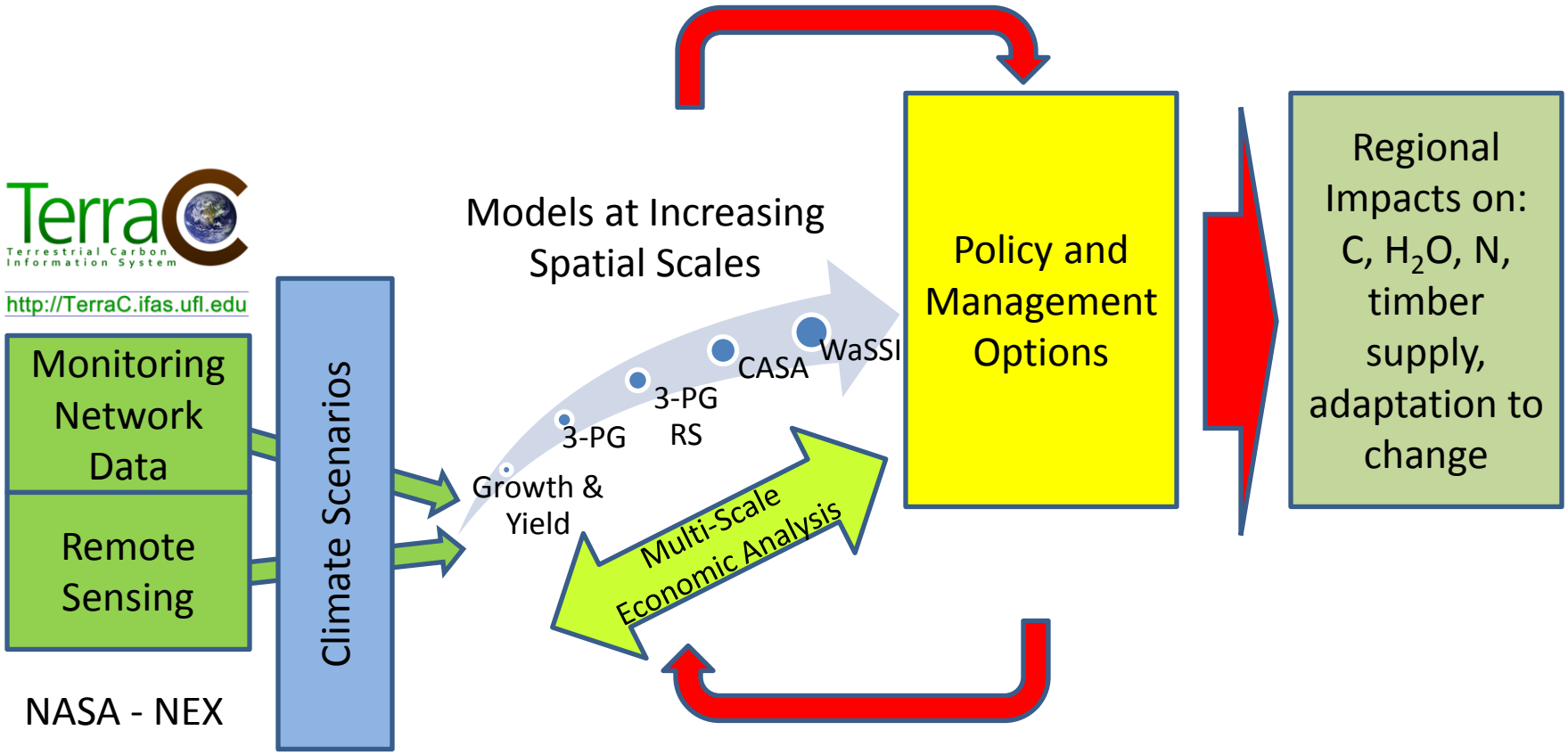




Aim 2 – Modeling

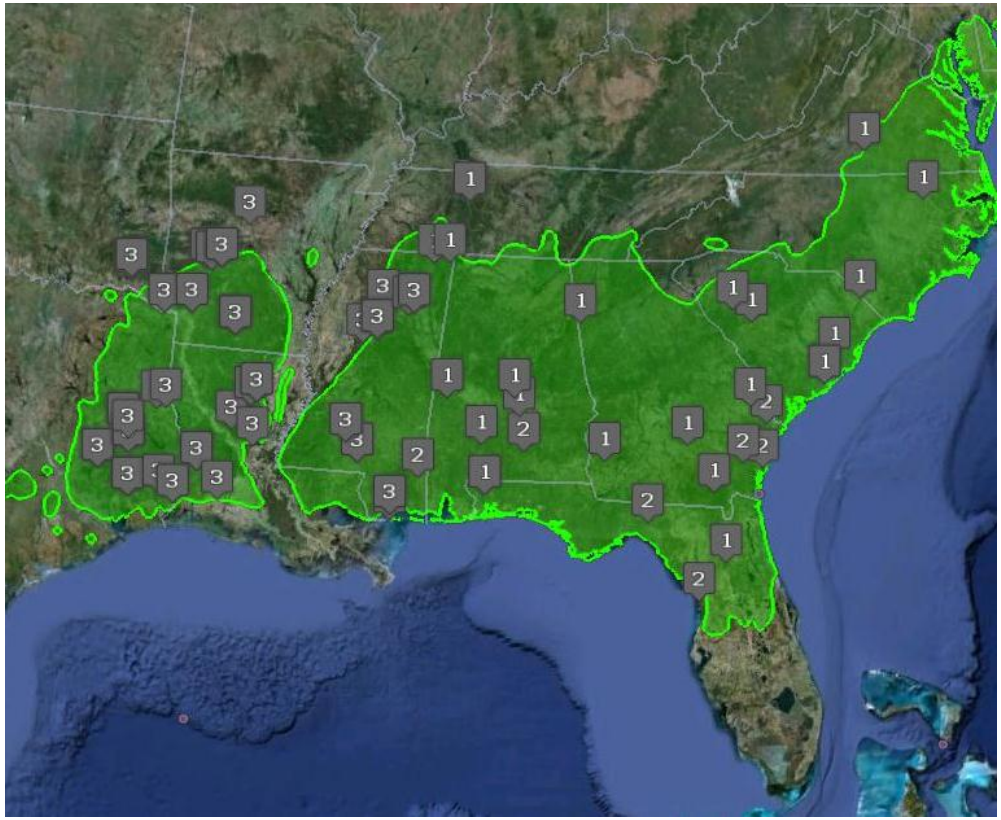
- Develop a multi-scaled modeling program using data from the monitoring network; incorporate
  - empirical growth and yield models
  - stand-level biophysical carbon balance modeling
  - watershed to regional scale carbon and water models driven by remote sensing
- Assess alternative forest management systems for sustainable increased mitigation of greenhouse gases, adaptation to changing climate and associated disturbances
- Because climate and management effects on forests span such large spatial and temporal scales, modeling approaches remain the only method available to assess outcomes and impacts for the entire region

Models Assess Scenarios and Estimate Regional Impacts



Aim 3: Genetics of Adaptation

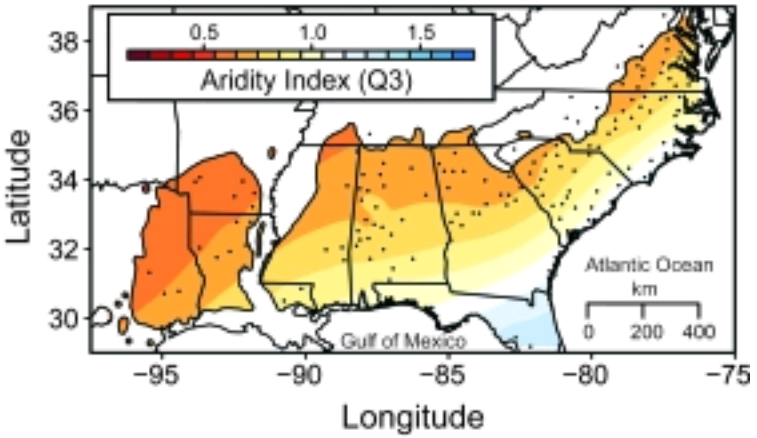
- Seed deployment guidelines
  - Uniform Response Function approach using existing progeny trials
  - Match advanced genetics with potential climate change scenarios in a spatially explicit manner
  - Develop module for DSS

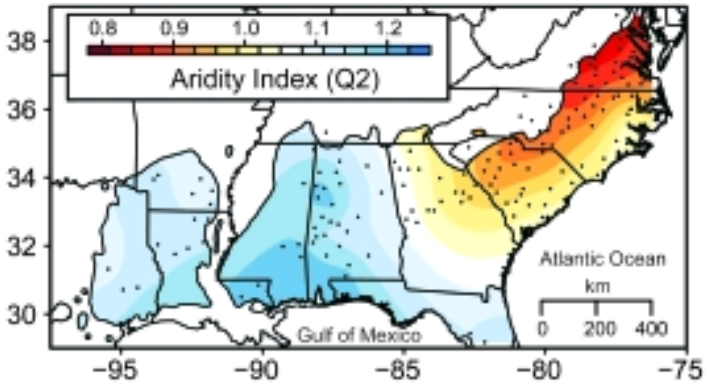


Regionwide progeny trials for URF

Aim 3: Genetics of Adaptation

- Discover alleles in genes critical for adaptation to climate variables and increased variability, including pest and disease pressures
  - Use alleles & markers for improving breeding strategies





Aim 4: Economics and Policy

- Comprehensive life cycle analyses of regional forest management systems;
- Multi-scale policy and economic analysis of market and non-market forest benefits and services;
- Evaluate regional tradeoffs and interactions among policy, climate scenarios, resource footprints, forest management, and genetic deployment; and
- Assess adoption of alternative approaches by private landowners.

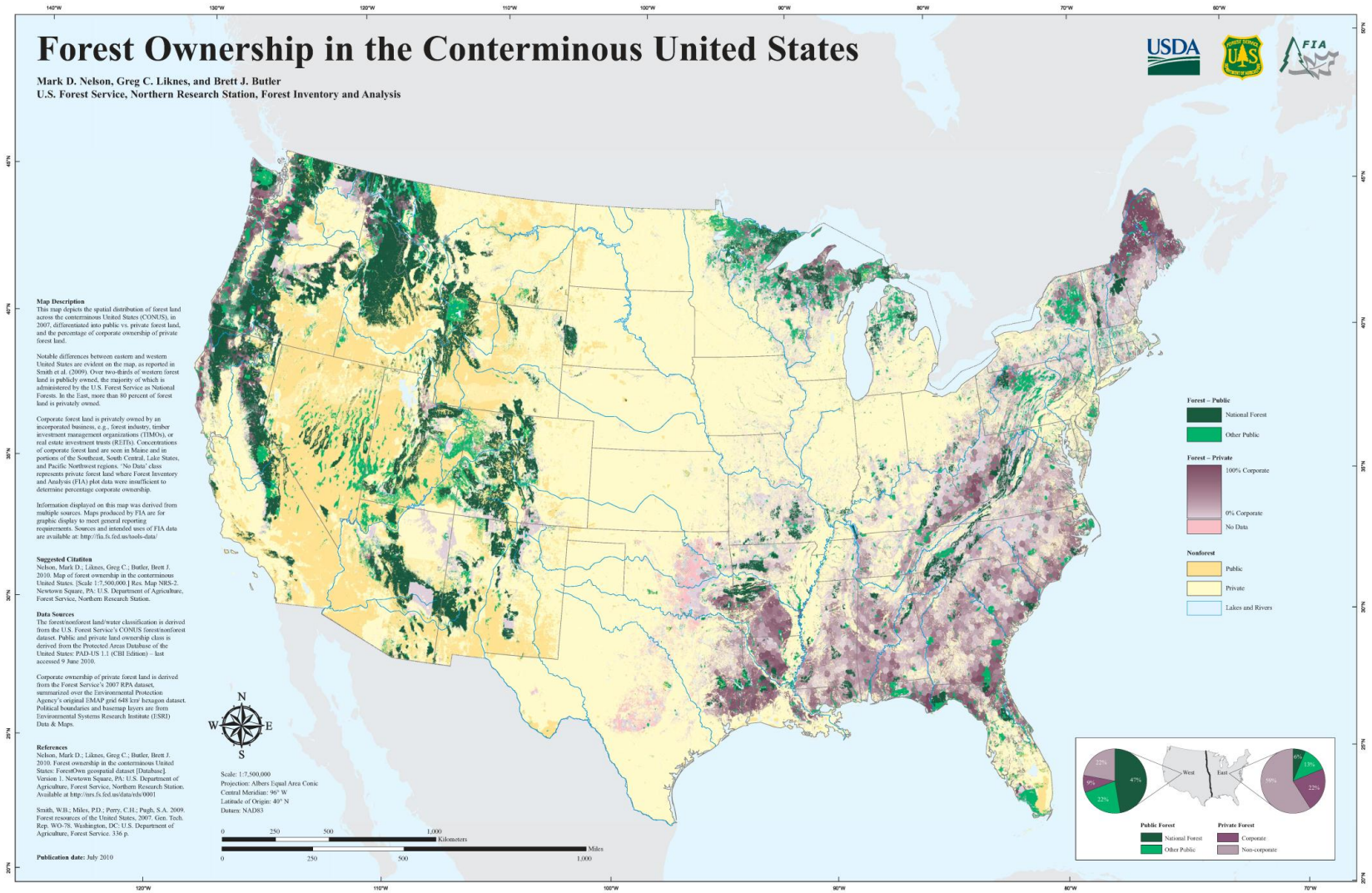
Aim 5: Education

- Graduate Student Training
  - Course to provide common foundation and interdisciplinary experience
  - Experience with education and extension projects
- UG Student Intern Program
  - Creating summer internship for UG students
    - work with grad students on research projects
    - learn about science inquiry education (fall class)
    - make presentations and facilitate activities in local secondary classrooms
  - Recruiting students across region, esp. from 1890 schools
  - Including Grad student mentoring training
- Project Learning Tree Secondary Module
  - Biology, AP Env Science, Ag Ed PLT coordinators and educators
  - Activities to parallel PINEMAP objectives
    - Climate impacts on forest ecosystem, Forest plantation impacts on climate, Consumer choices and LCA of wood options, Role of landowners and communities in climate

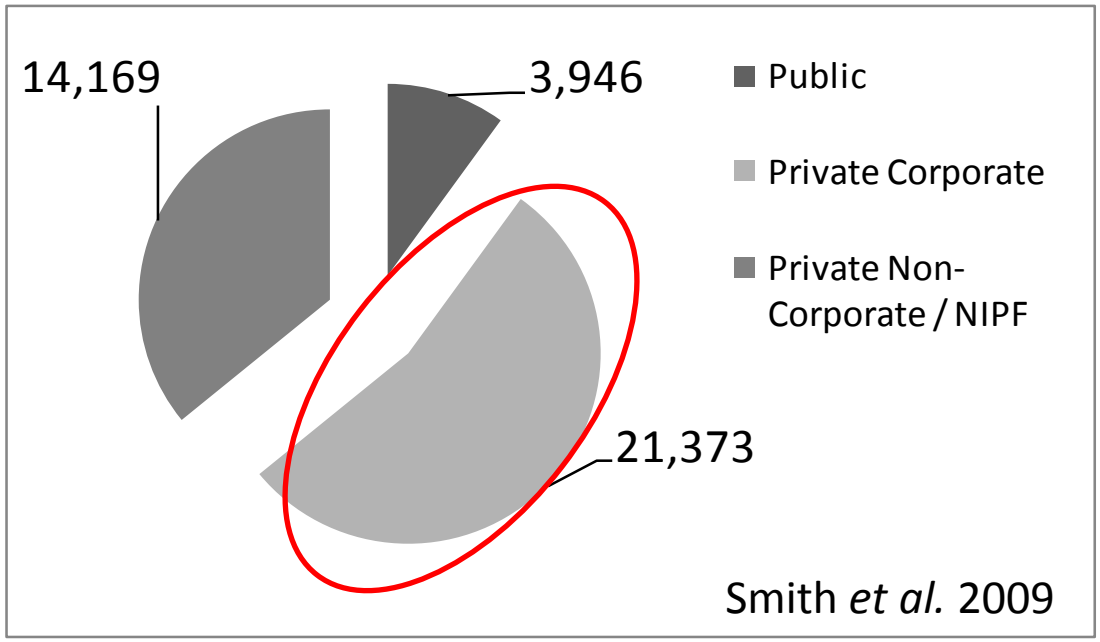
Aim 6: Extension

- Engaging stakeholders and measuring impact
  - Target a diverse group of landowners and assess their perceptions, information and decision-making needs and current practices;
  - Develop audience-specific, field tested educational strategies; and
  - Develop formative and summative assessments of stakeholders' understanding and behavior change related to climate/forest adaptation and mitigation strategies.
  - Extension effort includes both "traditional" and research cooperative corporate models

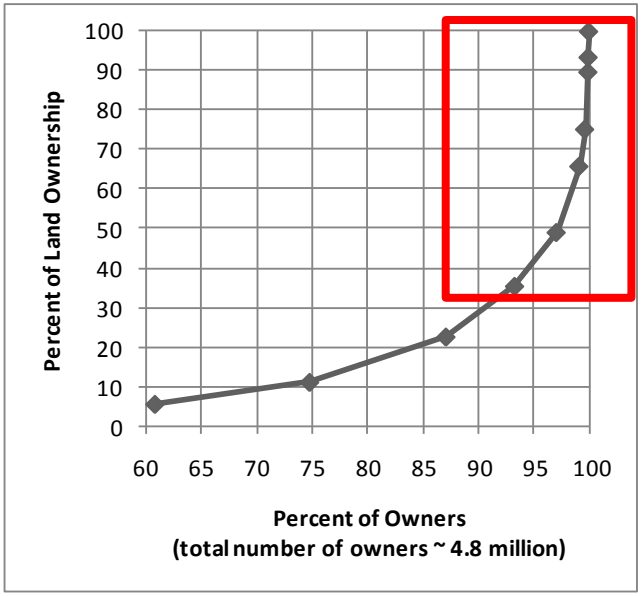
Ambitious Outcomes will Require Implementation on Millions of Acres



Planted Pine in the Southern US (thousands acres)



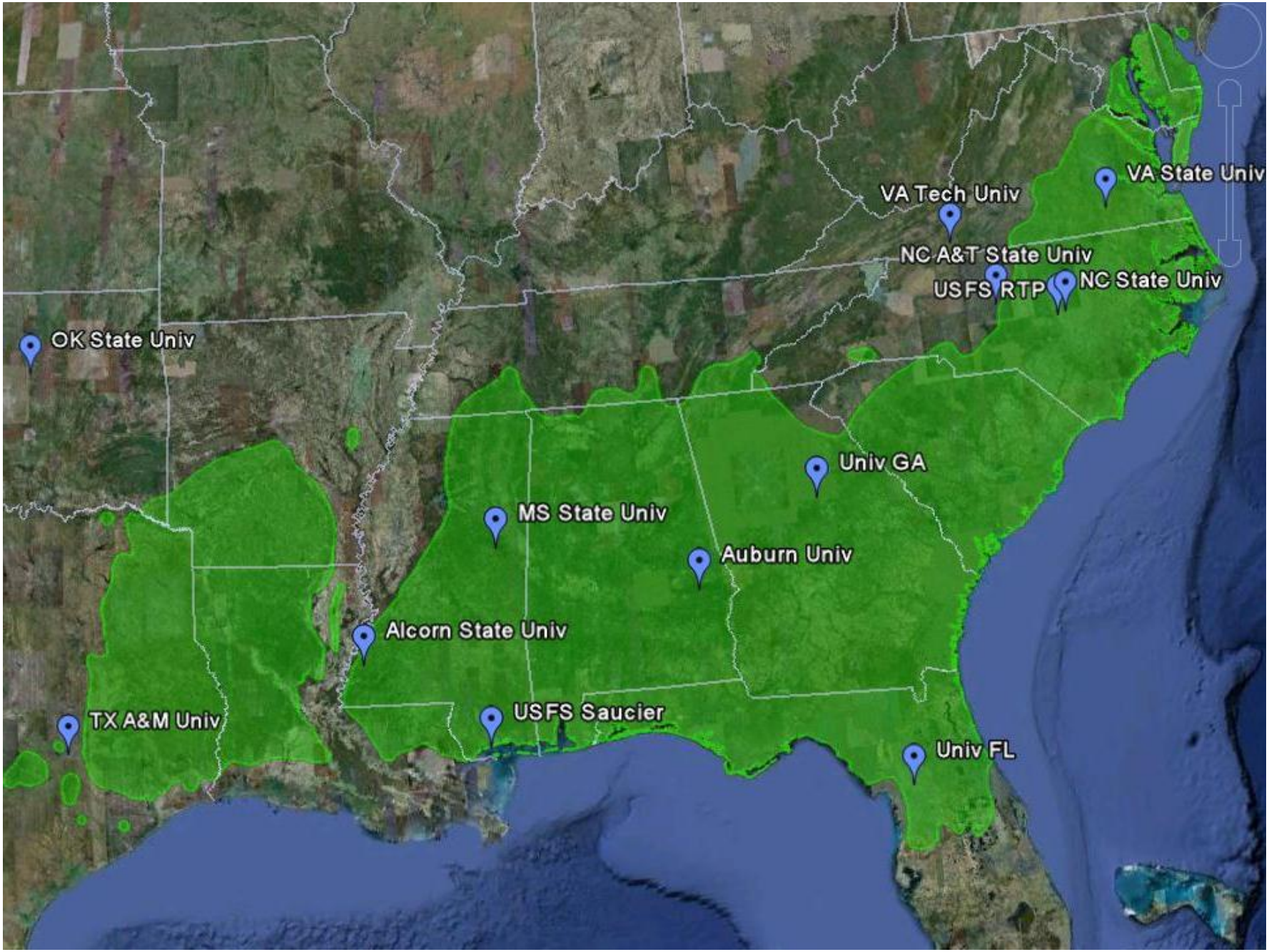
- > 20 million acres managed by our industrial cooperators
- > 95% of pine seedlings are produced by cooperators
- Long-established record of successful tech transfer in cooperative framework



- 10% of NIPF owners manage 70% of acreage
- Adoption of altered management by larger landowners will deliver largest impact

Decision Support System for PINEMAP (*Following lead of SECC & Agroclimate*)

- Extend scientific models into decision tools
- Focus for interaction between users and scientists
- Vehicle to link research, extension, education efforts
- Every research group and aim team will have input & models to contribute
  - All research should influence a DSS tool
  - Some research will directly lead to new tools in the DSS
- Final Product: Web-based tool box that provides guidance based on CAP research
  - Interactive models, maps, education materials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