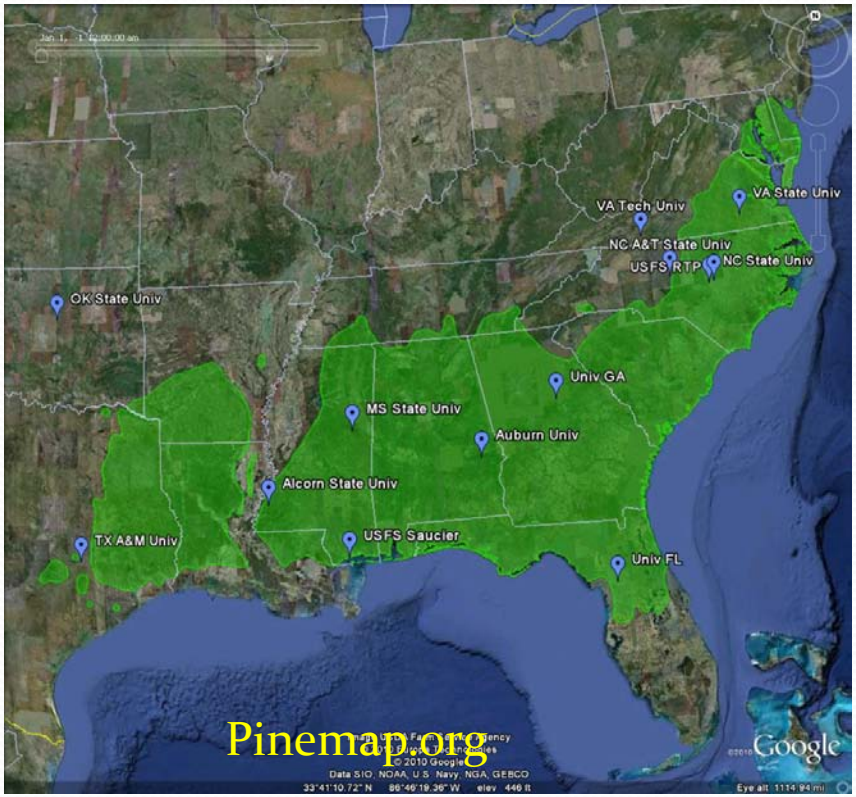
PINEMAP
Pine Integrated Network: Education, Mitigation and Adaptation Project

Mapping the future of pine management in a changing world



Tim Martin – PI

University of Florida

52 co-PIs at 12 Institutions across the southeast

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

PINEMAP

(Five year - $20 million)

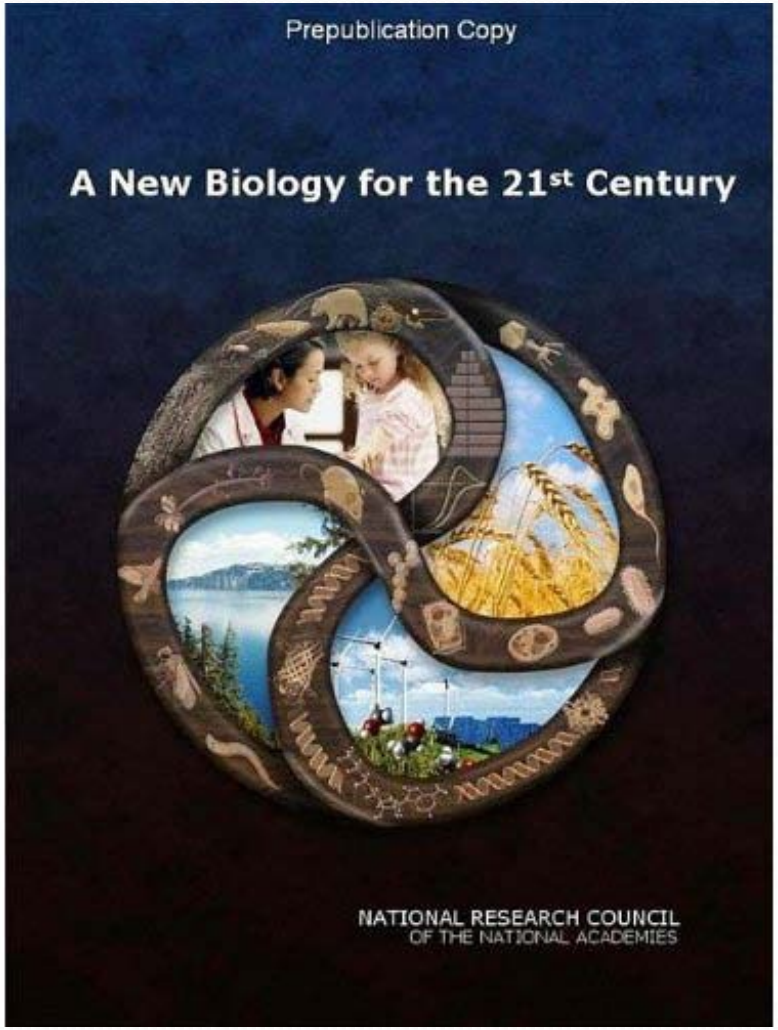
1. Develop Best Management Practices to reduce greenhouse gases by increasing carbon sequestration

2. Develop advanced production systems and new plant cultivars adapted to changing climates

- Provide DSS to forest landowners and policy makers

Pinemap.org

NRC “New Biology” Report



NRC Board of Life Sciences charged to:

“examine the current state of biological research and how best to capitalize on recent technological and scientific advances ……”.

NRC "New Biology" Report

- Proposed four "Grand Challenges" to organize emergence of integrated "New Biology"
  - Generating food plants that can adapt and grow sustainably in changing environment
  - Understand and sustain ecosystem function and biodiversity in the face of rapid change
  - Expand sustainable fossil fuel alternatives
  - Understand individual health

NRC "New Biology" Report

- NIFA Response
  - Keep American ag competitive while ending world hunger
  - Improve nutrition and end child obesity
  - Improve American food safety
  - Secure America's energy future
  - Mitigate and adapt to climate change

Desired 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

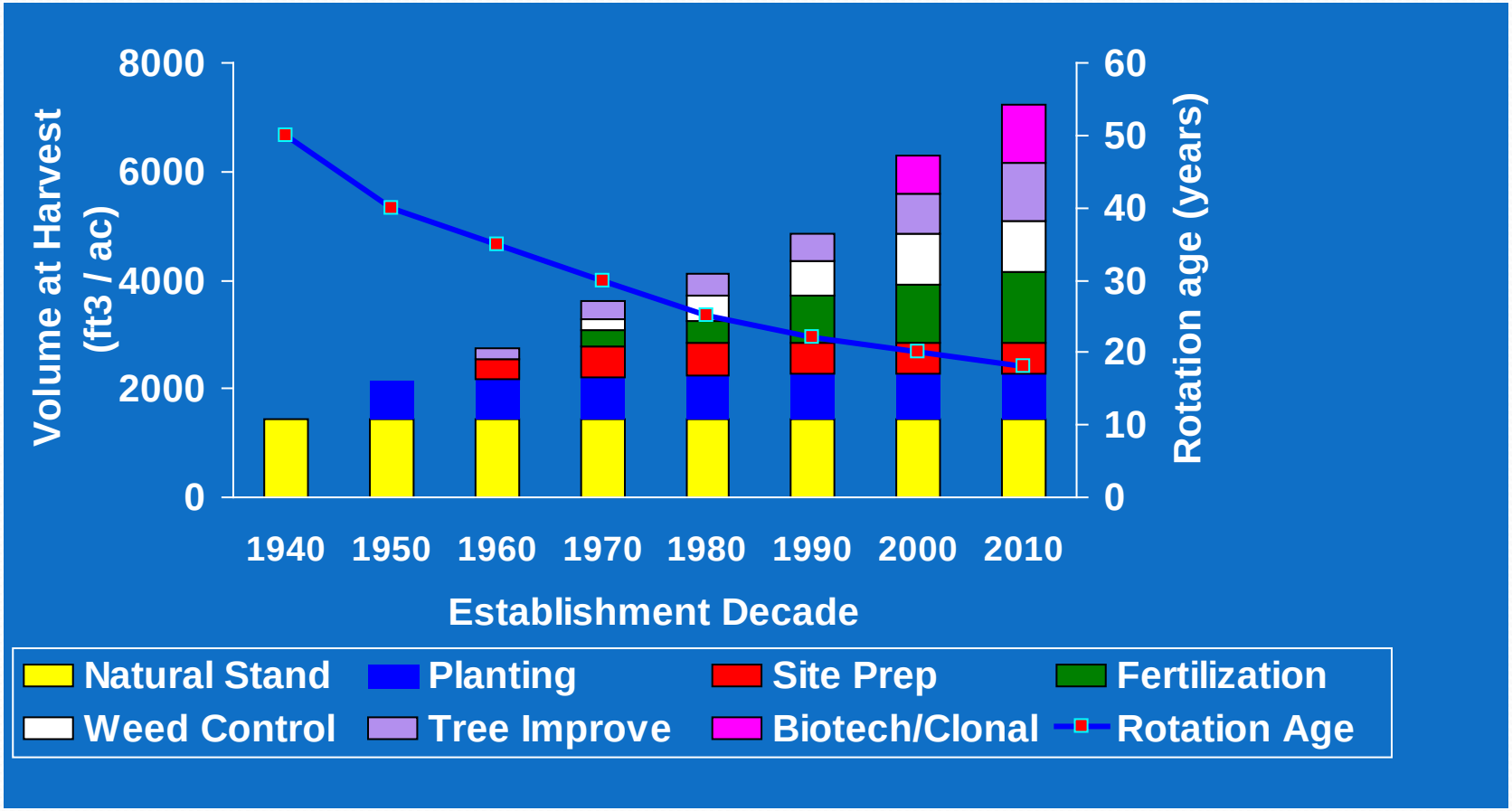
Provide New Management Methods

- ***Mitigate*** – Reduce greenhouse gas emissions in forestry and maximize carbon sequestration

- ***Adapt*** – Maximize resiliency and reduce impact of climate change on productivity of forest systems and reduce carbon, nitrogen and water footprints under changing climate

- ***Educate*** - Increase number of scientists, educators and extension professionals with skills to address climate change in forestry

What makes us think we can do this?



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.

Forests of the Southeastern US

- Occupy 60% of the land area, with a large fraction dominated by pines
  - 10 species, loblolly and slash economically important
- Contain 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
- Important substitution effects

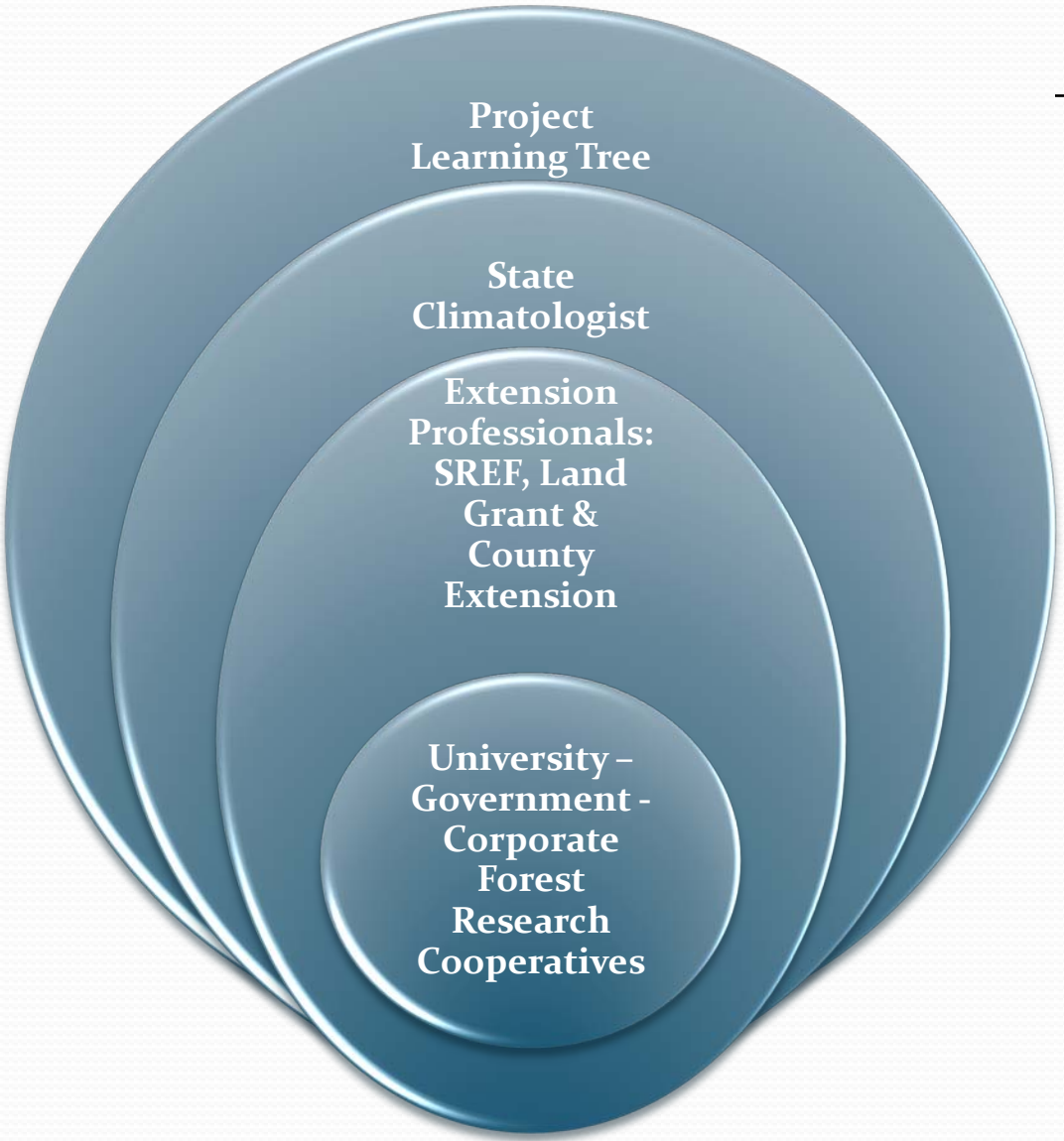
Forests of the Southeastern US

- ~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

General Milestones Expected

- Measure and monitor stores and fluxes of C, N, H_2O
  - Standardize methods for estimating C, N, H_2O footprints
  - Feedbacks from human behavior and decision making
- Establish baselines for C fluxes and N, H_2O, energy use
  - Inventory existing production practices that impact C,N,H_2O, and determine links to current management practices
- Develop sustainable management practices that lead to net decrease C footprints or increase C sequestration
- Conduct comprehensive Life Cycle Analysis (LCA)
- Demonstrate adoption

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)

Aim 1
(monitor and model at the stand level)

- Establish a monitoring network and develop methods to quantify carbon, water, and nutrient storage and flux.
  - Tier I – existing growth & yield test sites
    - measure regional variation in productivity
  - Tier II - existing silvicultural experiments plus AmeriFlux eddy covariance stations
    - measure effects of management factors on carbon, nutrient, and water cycles
  - Tier III – "rainfall-exclusion" treatments
    - measure response to changes in water and nutrient availability

Tier I

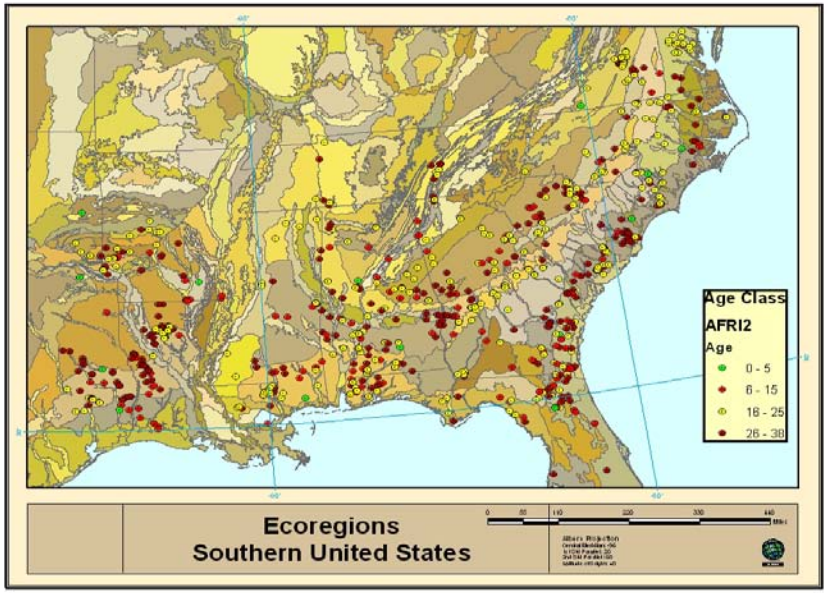
- Data from ~500 of the thousands of existing growth and yield plots across the region will be used to
  - Characterize climate and geographic effects on tree productivity
  - Validate models
  - Improve growth and yield models

Tier II ~140 sites from existing experiments

- Measure biomass, C & N pools, fluxes, and key ecophysiological model parameters

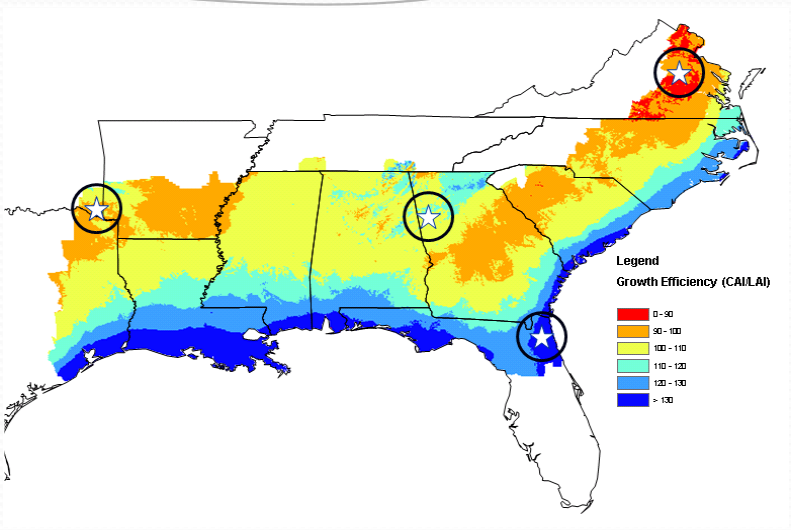
- Determine how above- and below-ground C and N pools and key ecophysiological modeling parameters vary with climate, soils, stand development, and management factors

- Parameterize growth and yield and carbon models



Tier III

- 4 sites to represent contrasts in climate and potential productivity across the full loblolly pine range
- Factorial combination of fertilization and precipitation
- Same measurements as Tier II, plus intensive C, N and H_2O ecophysiology
- Same questions as Tier II Extension to climatic conditions not experienced within the historic loblolly pine range
- Verification and validation of growth and yield, carbon, and water models



Aim 2 *(scale-up)*

- Develop a multi-scaled modeling program using data from the monitoring network
  - empirical growth and yield models
  - stand-level biophysical carbon balance modeling (3-PG)
  - watershed to regional scale carbon and water models driven by remote sensing (CASA Express, WaSSI-CB)
- Assess alternative forest management systems for sustainable increased mitigation of greenhouse gases, adaptation to changing climate and associated disturbances

Aim 3: Genetics of Adaptation

- Seed deployment guidelines
  - Match advanced genetics with climate change scenarios in a spatially explicit manner
  - Develop module for DSS

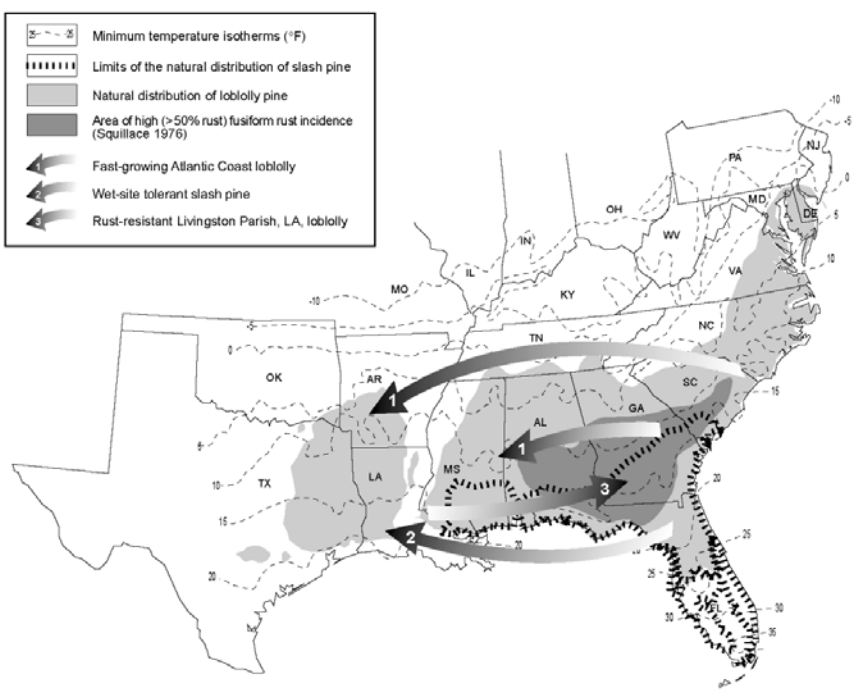
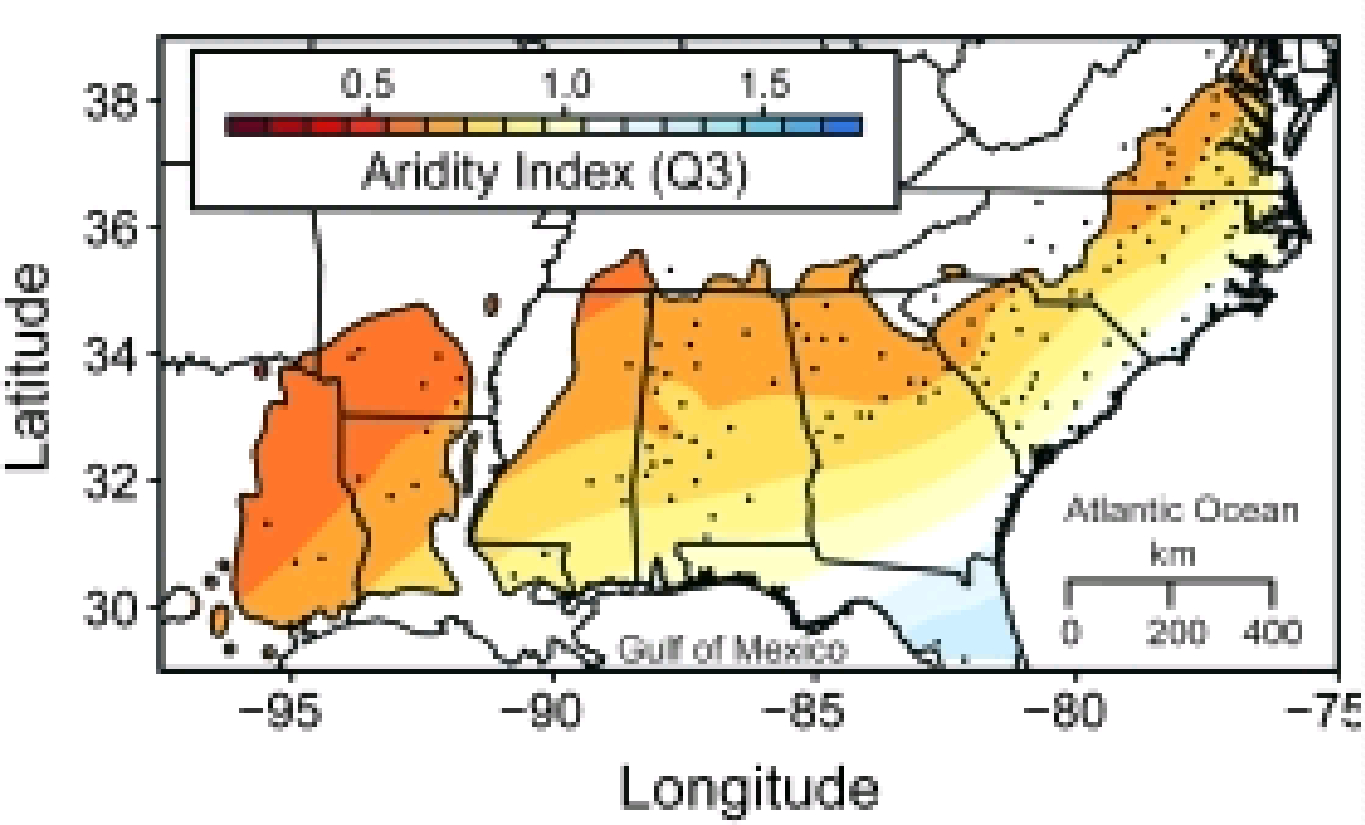


Figure 1—Major seed movement of southern pines since the Great Depression. Natural distributions of species adapted from Critchfield and Little (1966); minimum temperature isotherms from USDA (1990).

Aim 3: Genetics of Adaptation

- Discover genes critical for adaptation to climate variables and pest and disease pressures
- enable future tree breeding strategies

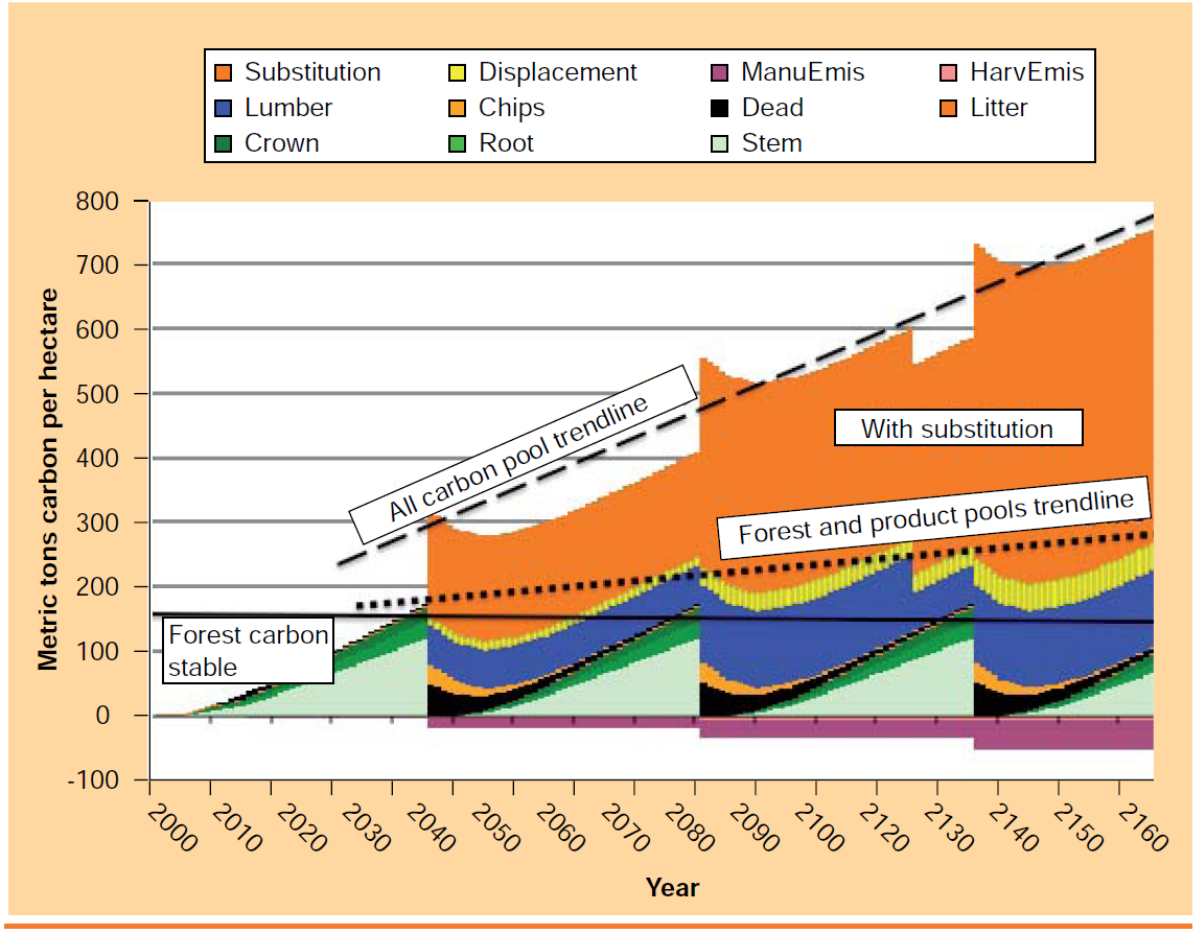


Aim 4 *(tools for policy makers)*

- Conduct life cycle analyses (LCA) of multi-scale policy decisions to evaluate regional tradeoffs and interactions

  - Policy and climate change scenarios
  - Carbon/water/nutrient/energy footprints
  - Forest deployment and management strategies
  - Landowner adoption of alternative approaches

Example of Life Cycle Analysis



Lippke et al. 2011

Aim 5 *(teach the new guys)*

- Create educational resources and training programs for teachers and extension agents
  - Convey the value and relevance of southern forests to climate change
  - Engage undergraduate interns in research and teaching
  - Contribute to a national educational network for middle and high school curriculum
  - Develop and conduct graduate education across disciplines

Aim 6 *(teach the old guys)*

- Develop extension programming that combines regional climate expertise and forest management outreach
  - deliver knowledge and state-of-the-art management decision support tools to forest landowners

Long-term Outcomes:

Mitigate, Adapt, Educate

- *Grow more wood with less water and less nitrogen*
  - *Monitor and model CO_2 storage*
  - *Scale up to regional values*
  - *Improve the planting stock*
  - *Provide landowners and policy makers with DSS*
  - *Educate and train*

Campbell WQE Varietals Age -2

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Funding Distribution (Total)