Integrative Paper Updates

All Team PINEMAP

February 18, 2016

Pine Integrated Network: Education, Mitigation, and Adaptation project (PINEMAP) is a Coordinated Agriculture Project funded by the USDA National Institute of Food and Agriculture

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

Housekeeping

- Executive committee meeting 2/25 10am ET
- Modeling summit 2/29/16 2pm ET
- Registration for annual meeting May 24-26 now open: http://www.pinemap.org/intranet
- Hotel block at UGa conference center, block code 86668. Please reserve as soon as your plans allow.
- Poster registration will open soon

Working backwards

- By end of No-Cost Extension:
  - DSS populated with appropriate output and tools
  - Short document(s) summarizing PINEMAP's science and outcomes
  - Roll out meeting(s) with stakeholders
- December: Final glossy PINEMAP report with as close to final conclusions as possible, including perhaps some second order integrative science
- May meeting in Athens
  - Finalized first order integrative science
  - Plan second order integrative science
  - Finalize outreach product plans
- Winter/Spring ATPs
  - Talking with each other about first order integrative science and associated outreach products

Format of this meeting

Each integrative paper will show a few slides with:

- key graph or figure showing an important result and
- a summary of progress toward the outreach product.

Feedback from the group:

- High fives on data, questions, connections with other data
- input on outreach product choice, suggestions for collaboration and improvement

Soil respiration, forest productivity and ecosystem health

Outreach Product: Soil respiration information sheet

a) technical

b) simplified

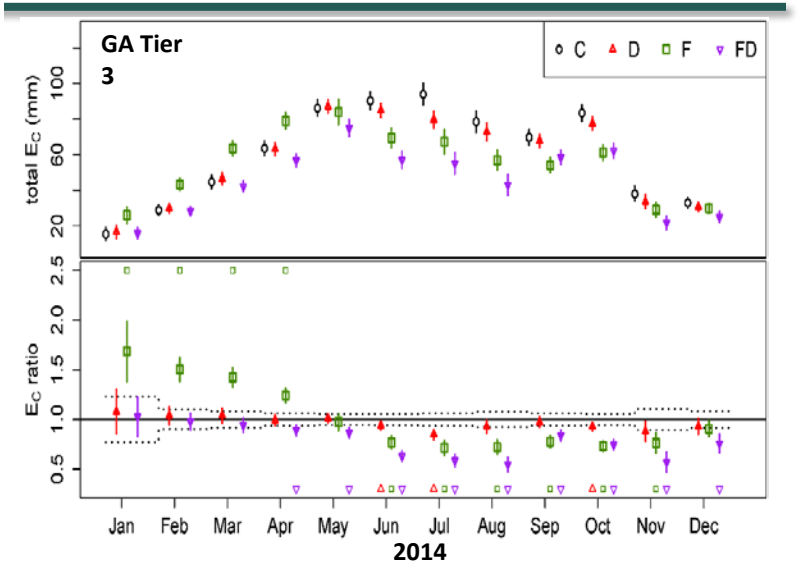
Sections: What it is; Sources of variability; How it can be managed; How it is measured; Relationship with ecosystem health

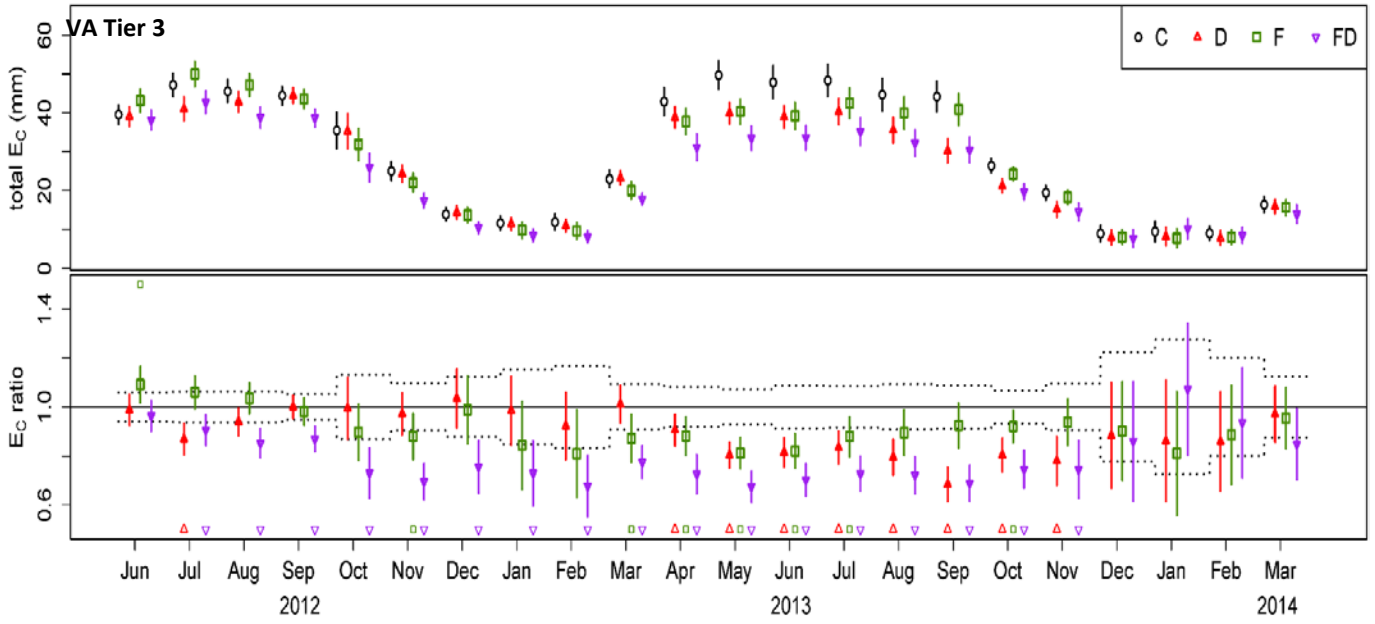
Progress: On track for completing by Feb 28 due date

Authors: Kristin McElligott, Marco Minor, Leslie Boby, Chris Maier

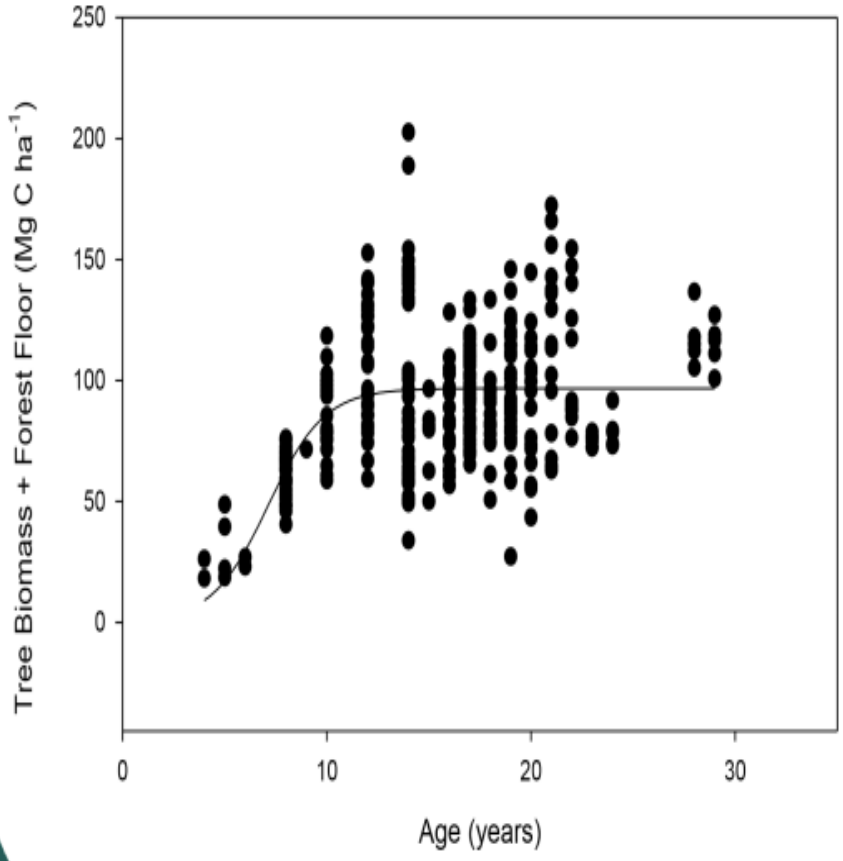
Sap Flux Integration

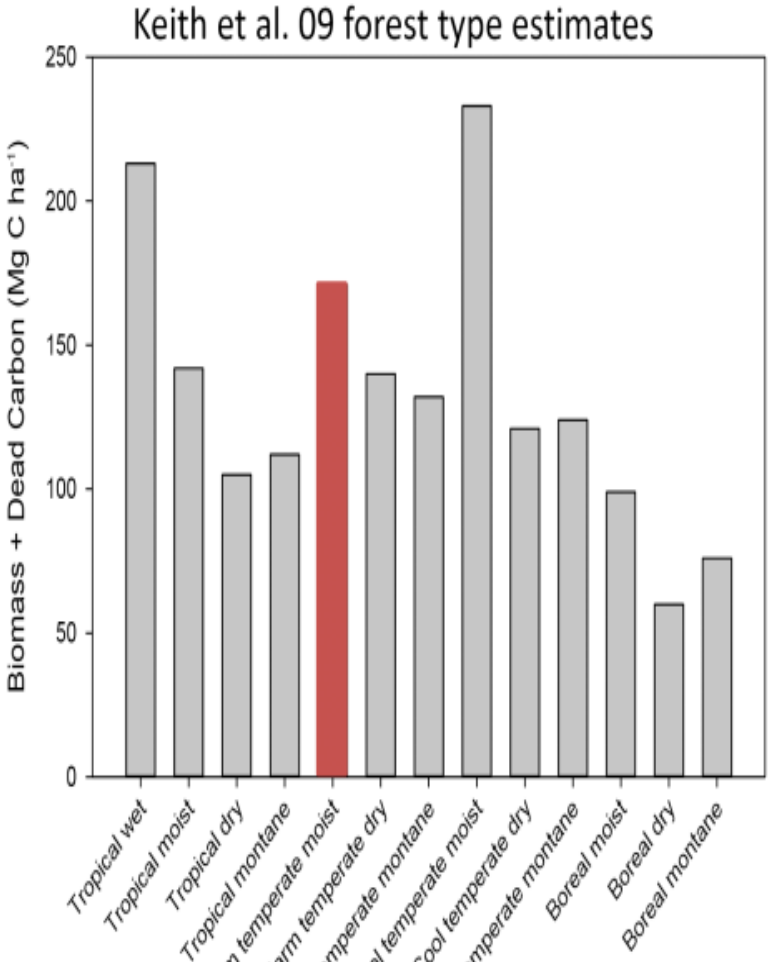
- Ran StaCC for GA 2014 data
- Pattern similar to VA 2012-2013
  - C > D ~ F > FD
- Results ***very*** similar to that of Bartkowiak et al.
  - 2013: 576.7-652.4
  - 2014: 539.8-725.5
- Need to continue with other sites/years
- Capacity for porting data from TerraC formats
- Big Challenges remaining: Soil Moisture, LAI





The effect of forest management on relative changes in biomass, forest floor, and soil carbon across the region – Vogel et al Tier II synthesis





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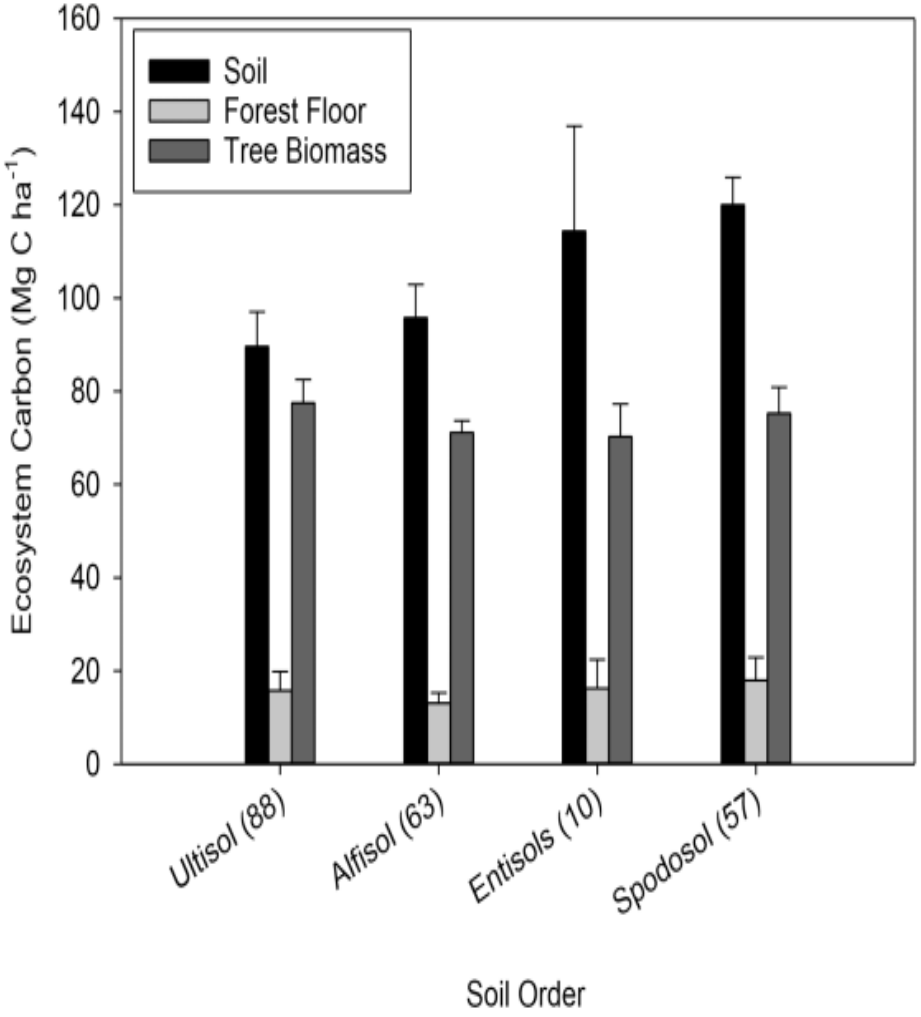
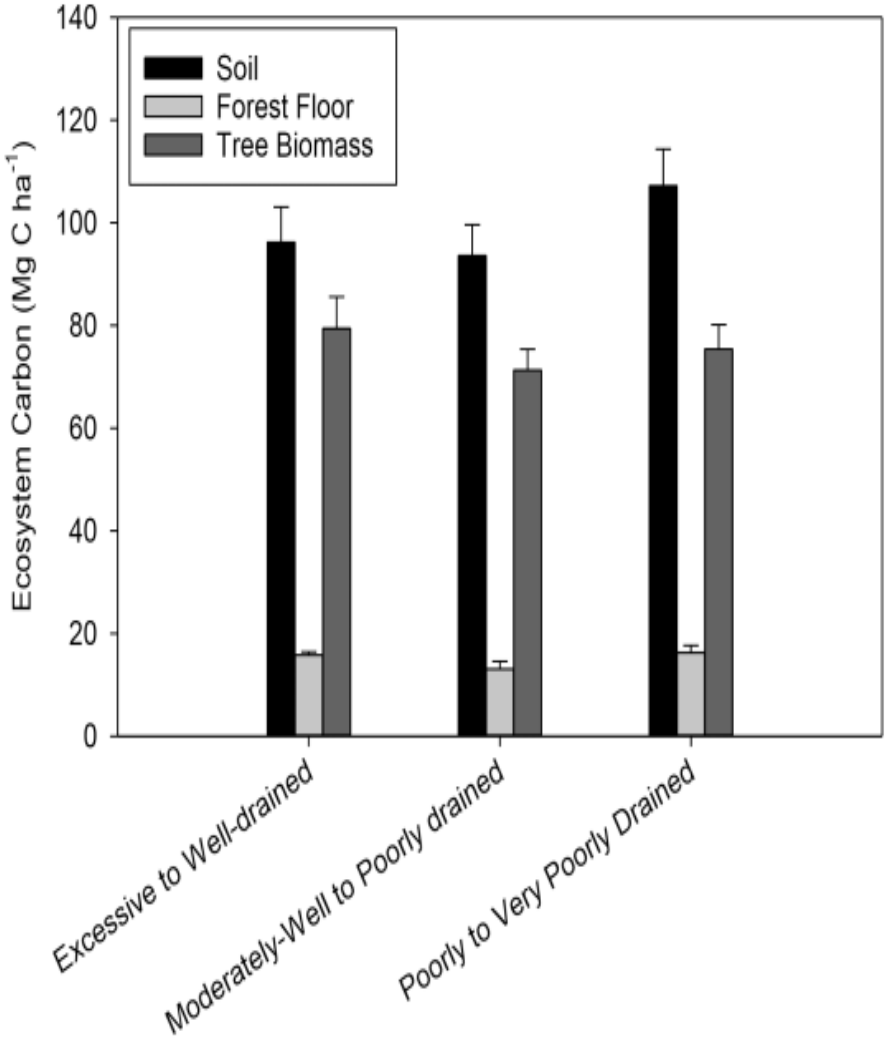




The effects of rainfall reduction and nutrient availability on net ecosystem productivity (NEP).

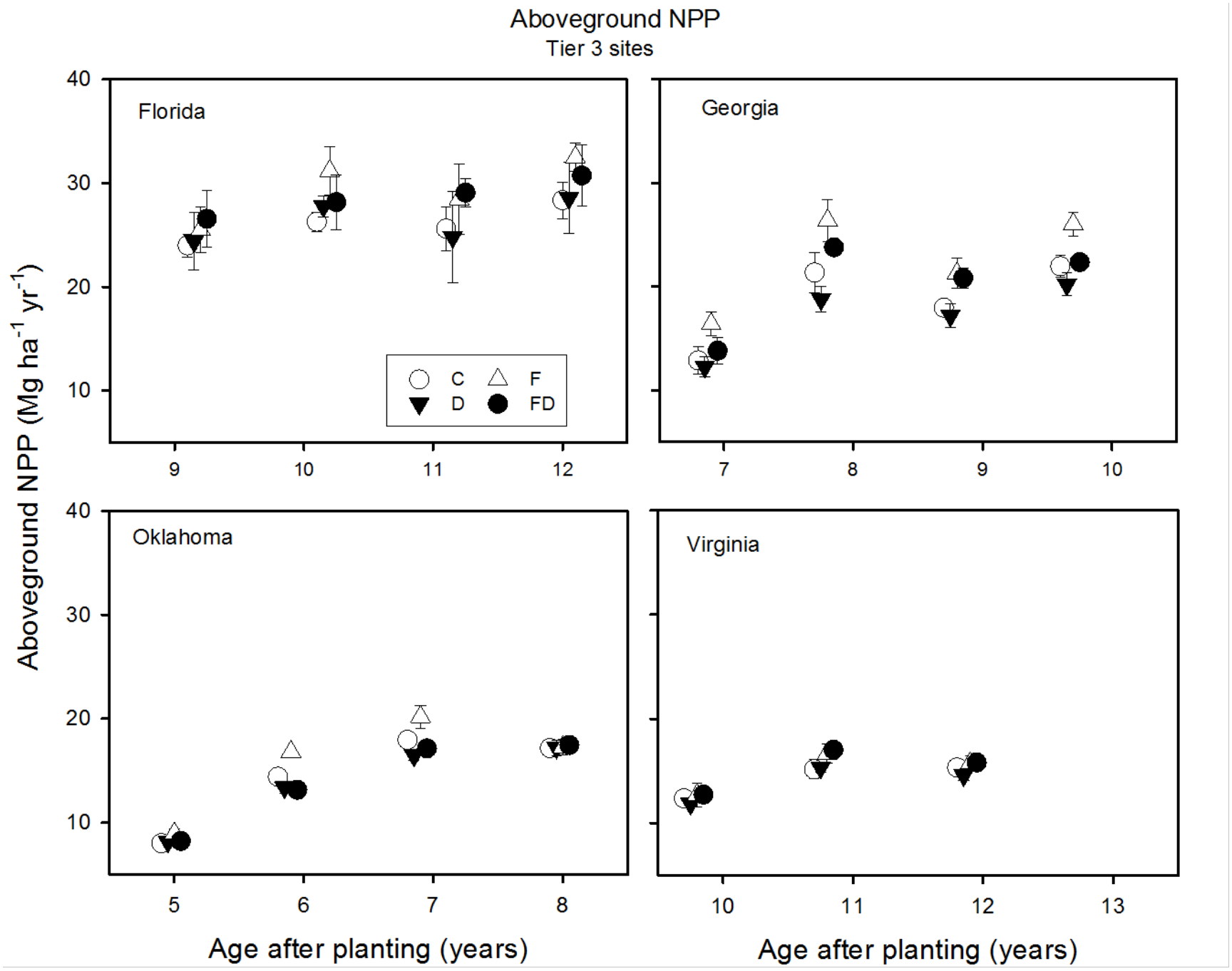
Bracho, Noormets, Gonzalez, Martin, Vogel, Markewitz

$$NEP = NPP - R_H$$

NPP= Net primary productivity
biomass inventories.

R_H= Heterotrophic respiration
Root severing collars

Progress →


Aboveground NPP
Tier 3 sites
Florida
Georgia
Oklahoma
Virginia
C
F
D
FD
Aboveground NPP (Mg ha-1 yr-1)
Age after planting (years)
Age after planting (years)

Soil respiration measurements:

Data from:

Tier3:
All sites with at least one year of R_S including R_H.

Tier2 sites measurements.

Outside the Tier sites.

Data analysis in progress → annual R_H → Annual NEP

Rainfall reduction
Nutrient availability
} effects → NEP

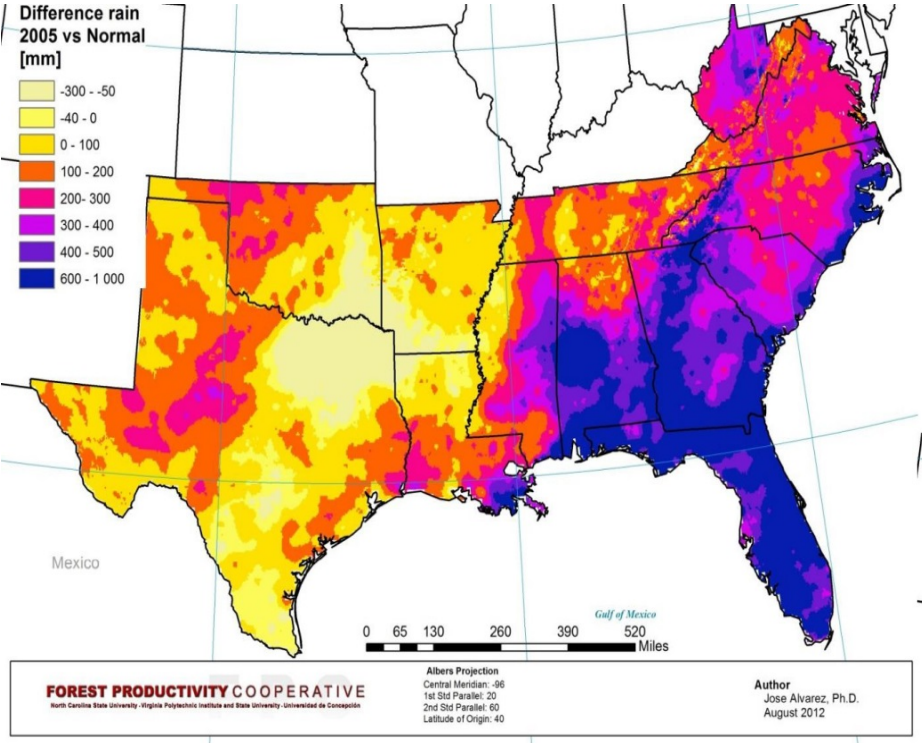
Modeling impact of drought on Growth Efficiency of Loblolly pine

Jose Alvarez
Tom Fox
Tim Albaugh

Climate Change and Forest Productivity

- Precipitation ====➔ Soil water availability
- Maximum temperature
- Frequency of droughts
- Pests

- How these changes are affecting the productivity of forest plantations?
  - *Pinus taeda* Southeastern USA

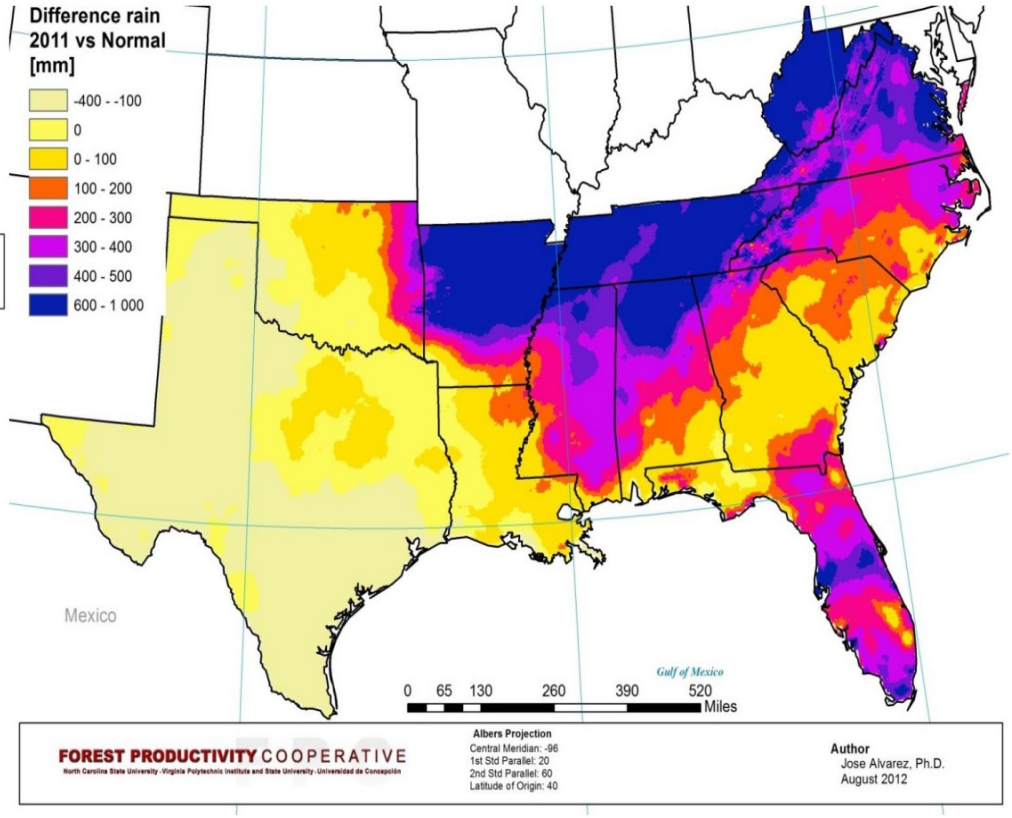


2005 relatively "normal" year:

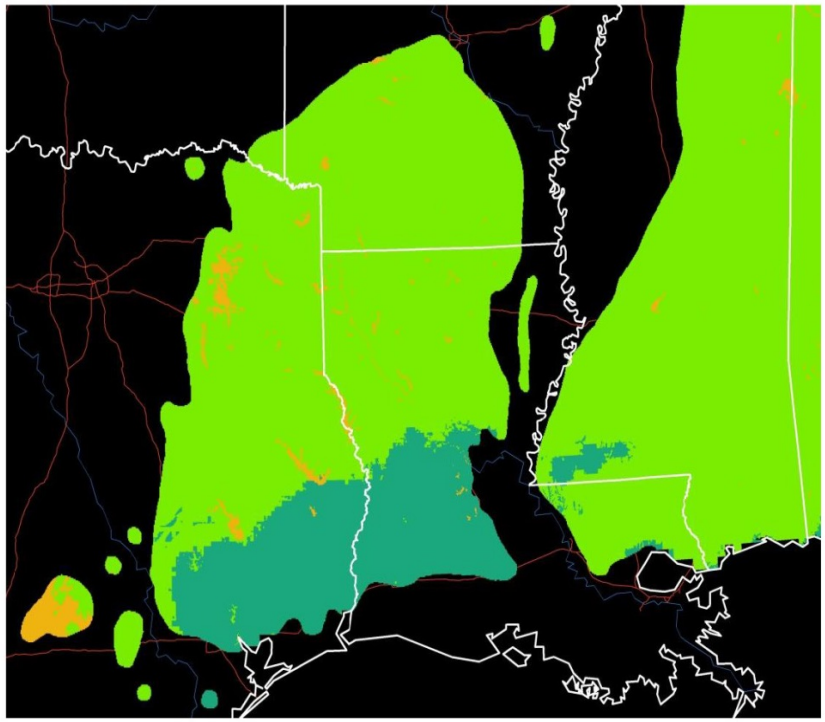
- High temperature
- Low cumulative soil water (low re-charge)

2011 extreme drought:

- High temperature
- Low cumulative soil water (low re-charge)



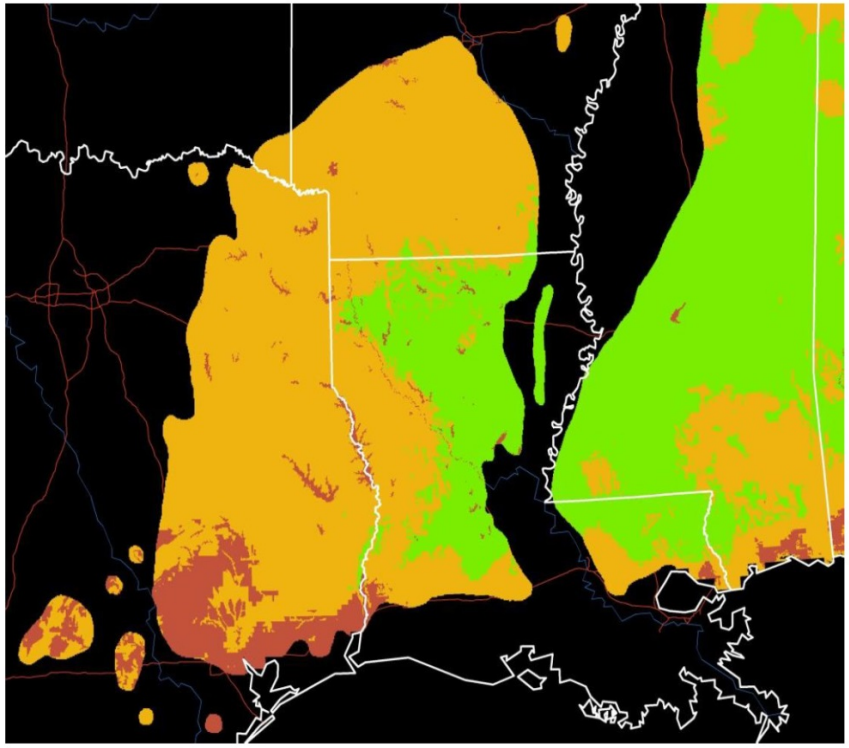
GE 2006

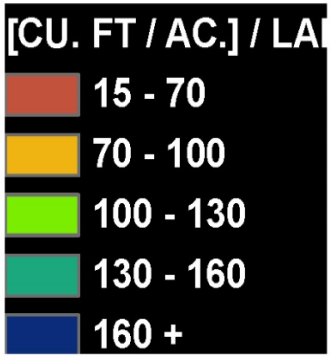


Method:

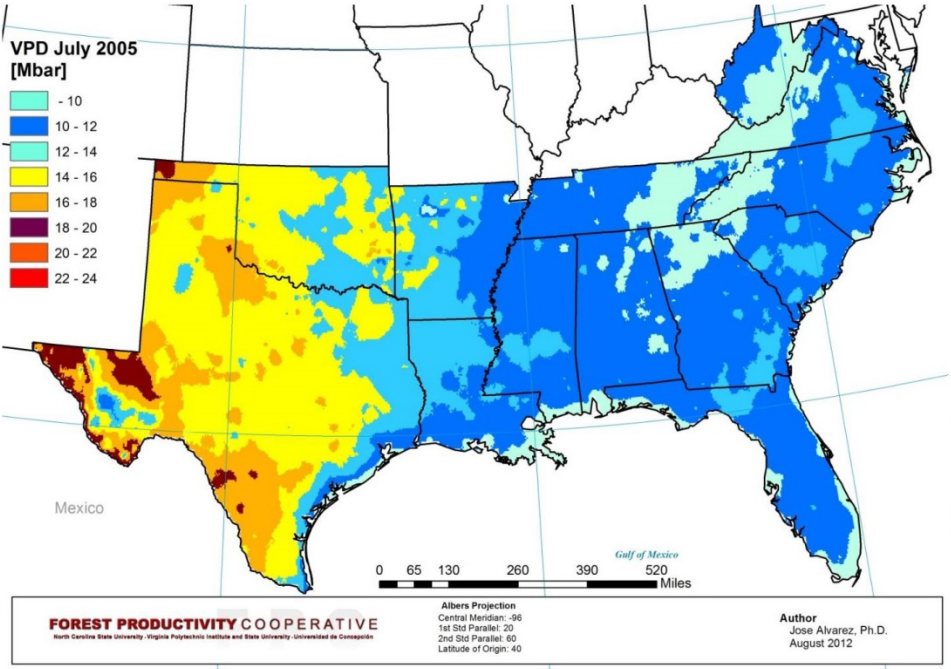
- 3PG
- Climatic data PRISM

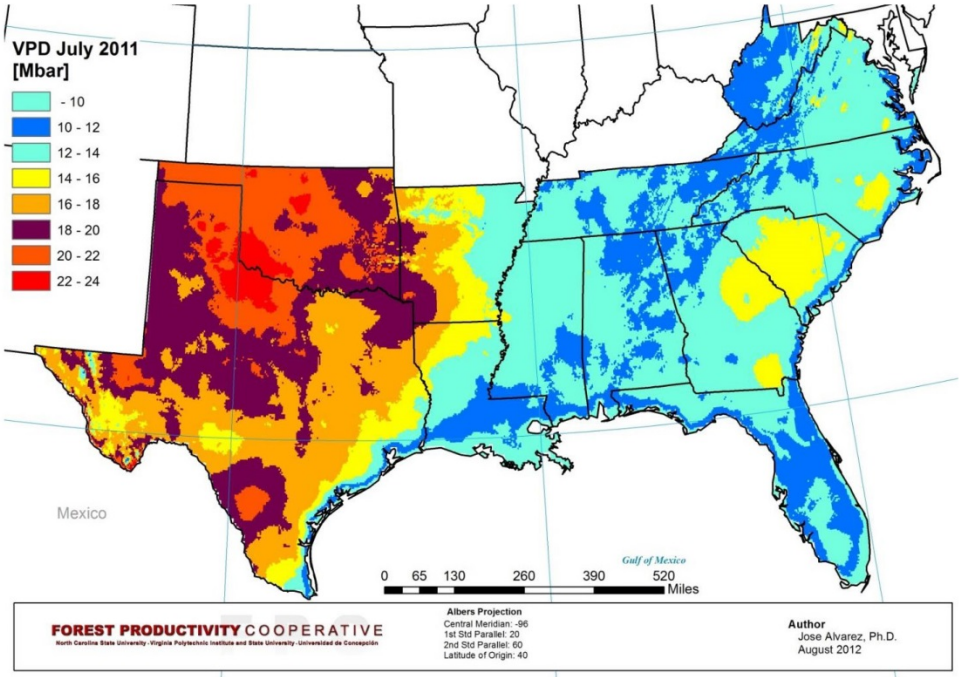
GE 2011





Vapor Pressure Deficit





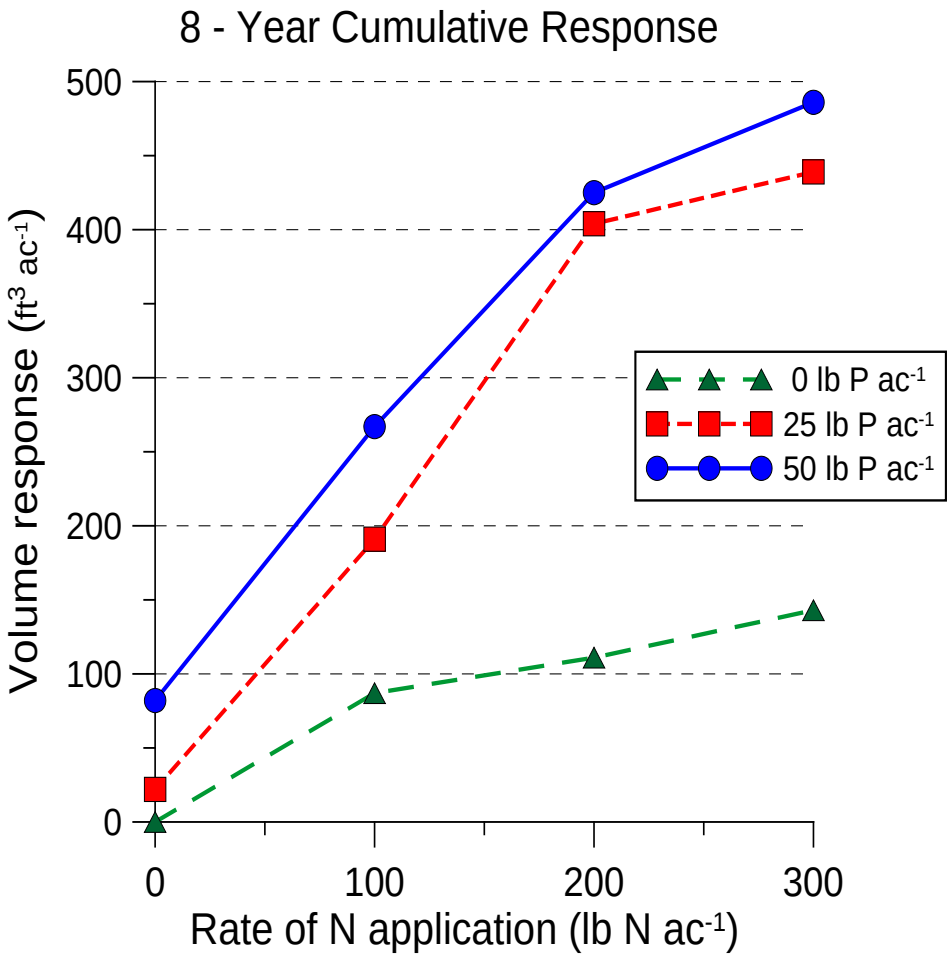
Nitrogen efficiency integrative paper

PINEMAP Goals:

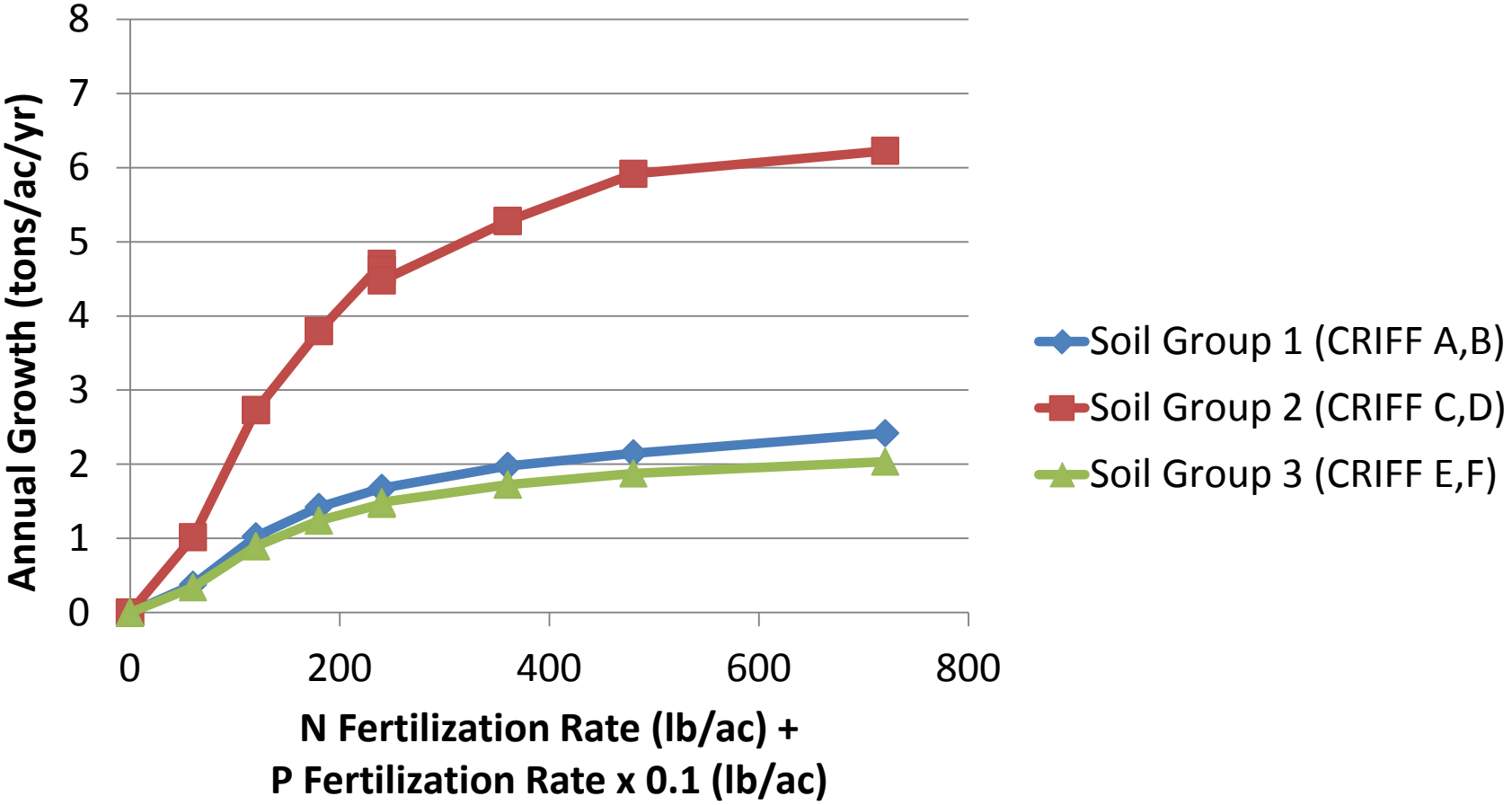
To create, synthesize, and disseminate the knowledge that enables southern forest landowners:

- 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.

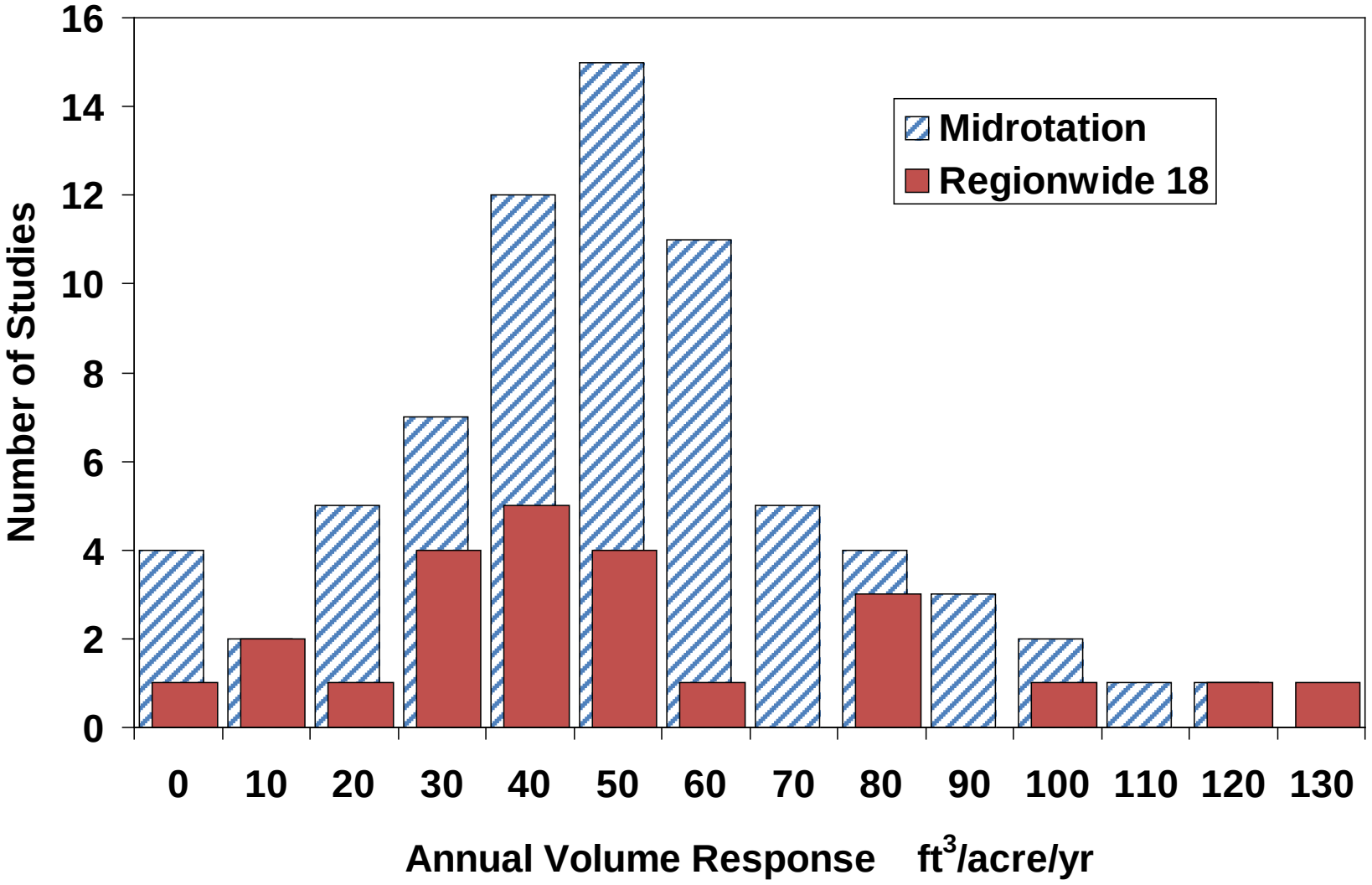
Fertilization Growth Response in Midrotation Loblolly Pine Stands (RW13)



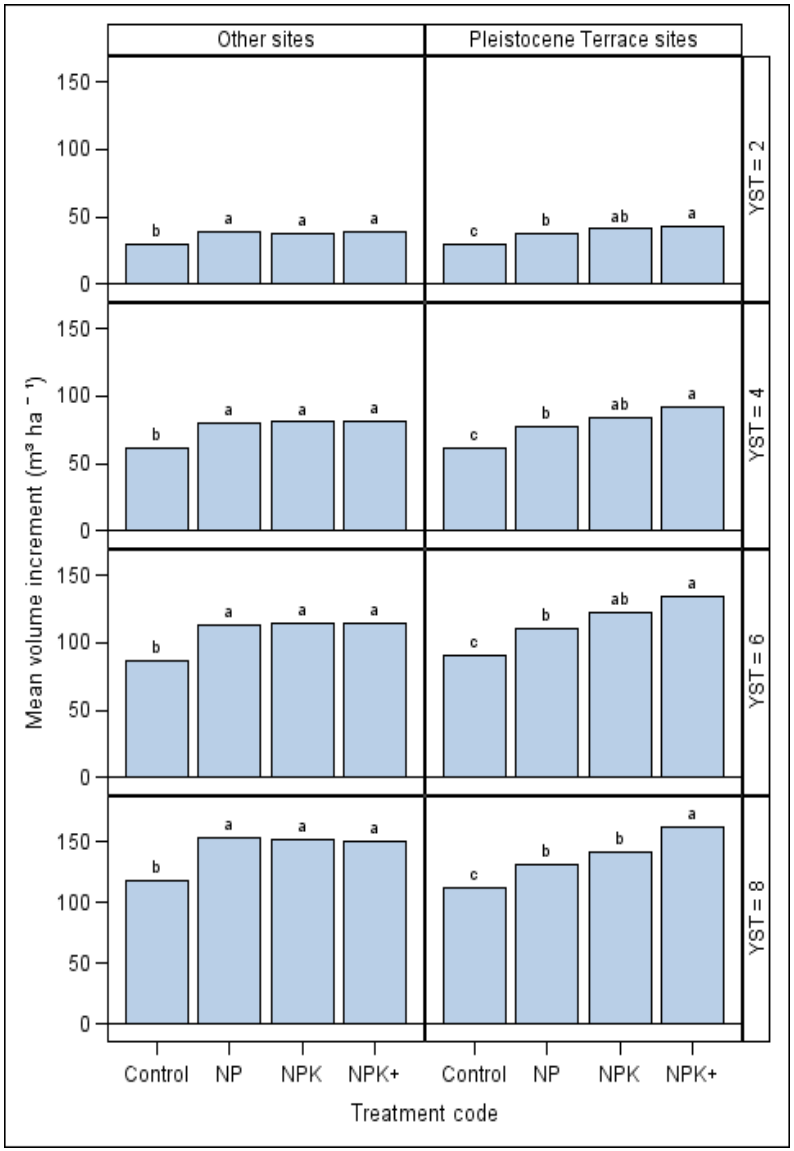
RW18 Juvenile Stand Fertilization
4 to 8 Year Growth Response by Soil Type
(tons/ac/year)



Frequency Distribution of Growth Response



Potassium and Micronutrient Response in Midrotation Loblolly Pine

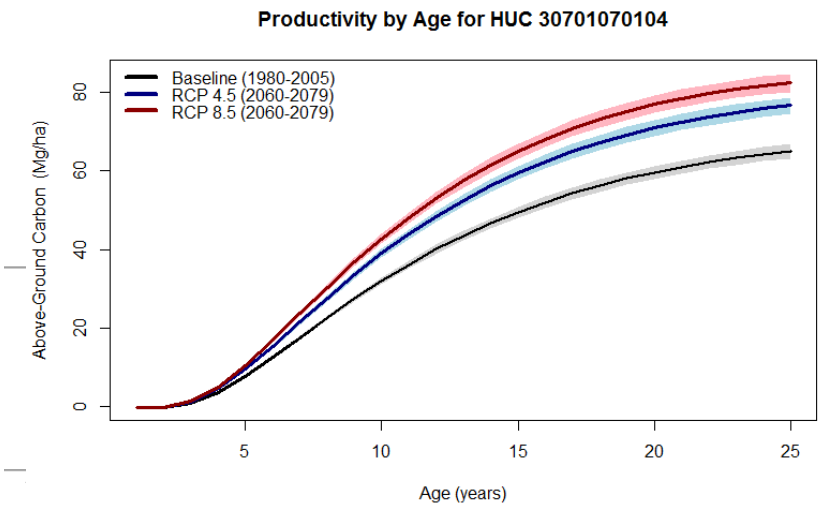


PINEMAP

Loblolly Pine Growth & Yield Regional Simulations
Under Changing Climate Scenarios

Growth & Yield

Key Figures


Productivity by Age for HUC 30701070104
Baseline (1980-2005)
RCP 4.5 (2060-2079)
RCP 8.5 (2060-2079)
Above-Ground Carbon (Mg/ha)
0
20
40
60
80
5
10
15
20
25
Age (years)

+40%
+/-0%
-17%

Next Steps to Outreach

- Many, many .csv files generated, indexed by HUC
  - Maps as well
  - Breakdowns by GCM, RCP, time period, and year
  - SI estimates as well as GENLOB outputs

- Transfer these files to the DSS for use as additional data sources

Data-assimilation of Pine Planation Ecosystem Research (DAPPER) System

Regional validation and improved parameterization of the 3-PG model for *Pinus taeda* stands

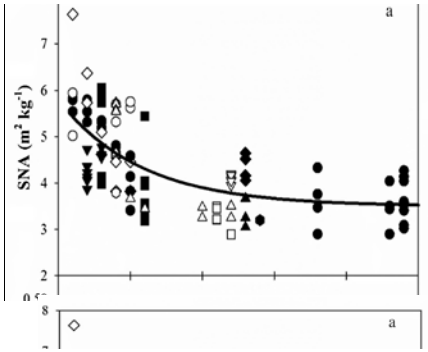
Carlos A. Gonzalez-Benecke [a,*], Robert O. Teskey [b], Timothy A. Martin [c], Eric J. Jokela [c], Thomas R. Fox [d], Michael B. Kane [b], Asko Noormets [e]

[a] Department of Forest Engineering, Resources and Management, 269 Peavy Hall, Oregon State University, Corvallis, OR 97331, USA
[b] Warnell School of Forestry and Natural Resources, 180 E. Green St., University of Georgia, Athens, GA 30602, USA
[c] School of Forest Resources and Conservation, P.O. Box 110410, University of Florida, Gainesville, FL 32611, USA
[d] Department of Forest Resources and Environmental Conservation, 319 Cheatham Hall, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA
[e] Department of Forestry and Environmental Resources, P.O. Box 8008, North Carolina State University, Raleigh, NC 27695, USA

Fixed physiological parameters in the 3-PG model produced accurate estimates of loblolly pine growth on sites in different geographic regions

Charles Bryars [a], Chris Maier [b], Dehai Zhao [a], Michael Kane [a], Bruce Borders [a], Rodney Will [c], Robert Teskey [a,*]

[a] Warnell School of Forestry and Natural Resources, University of Georgia, 180 E. Green St. Athens, GA 30601, USA
[b] US Forest Service, Southern Research Station, SRS-4160, 3041 Cornwallis Road, Research Triangle Park, NC 27709, USA
[c] Natural Resource Ecology and Management, Oklahoma State University, 008C Ag Hall, Stillwater, OK 74077, USA



3PG Model

Prior knowledge

Data

Bayesian statistics, High-performance computing

Model parameters and uncertainty

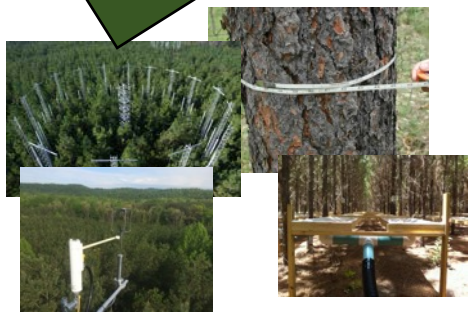
Climate Scenario

Climate predictions

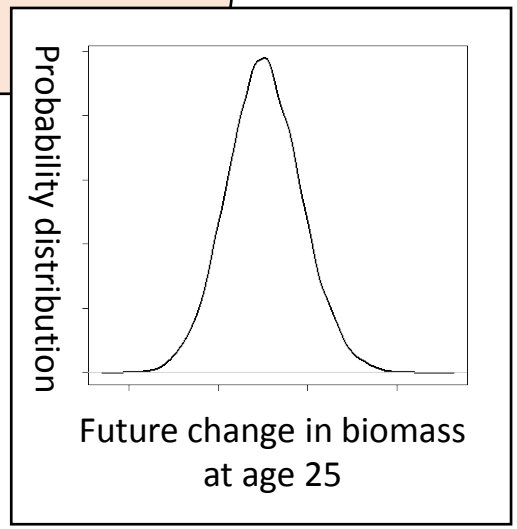
Relative fertility

Forecasting System

Predictions with uncertainty



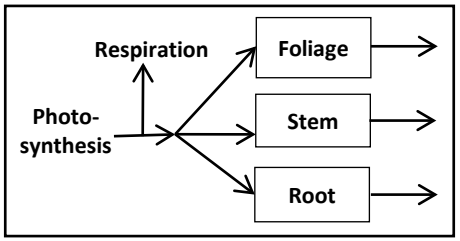
Tier 1(Thinning)
Tier 2 (RW18)
Tier 3
Duke FACE
Duke flux
NC2 flux



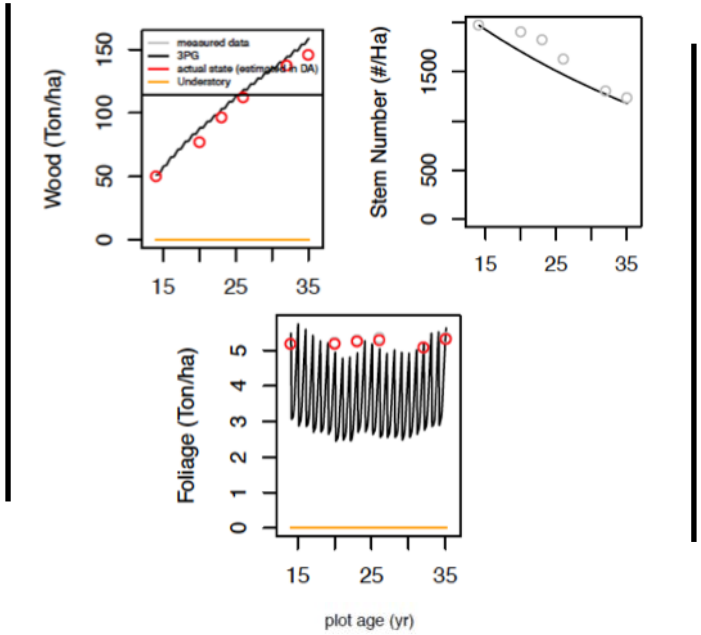
GEP, ET, Stem Biomass, Foliage Biomass, LAI, Litterfall, Stem count, hardwood biomass

Synthesis paper 1:
Leveraging 35-years of forest research in the Southeastern U.S. to constrain carbon cycle predictions: regional data assimilation using observations and experiments

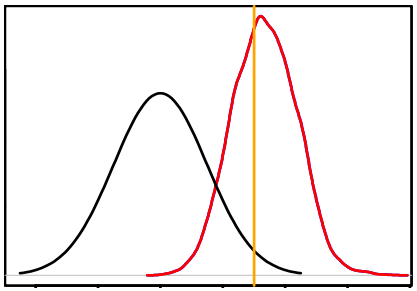
Forest growth model



Plot level model-data comparison



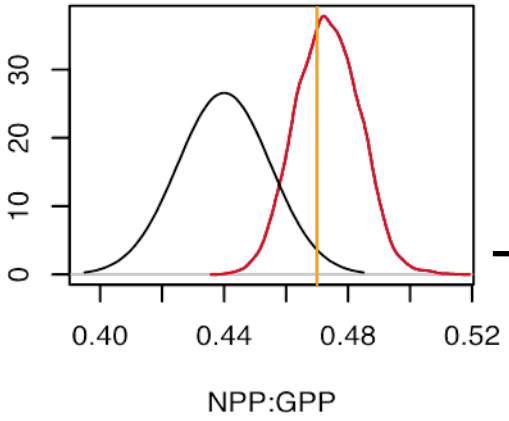
Parameter distributions



Key question: How do parameter distribution change with the different types of data integrated?

Regional biometric observations vs. regional nutrient addition experiments vs. high frequency flux tower measurements

Regional Parameter set



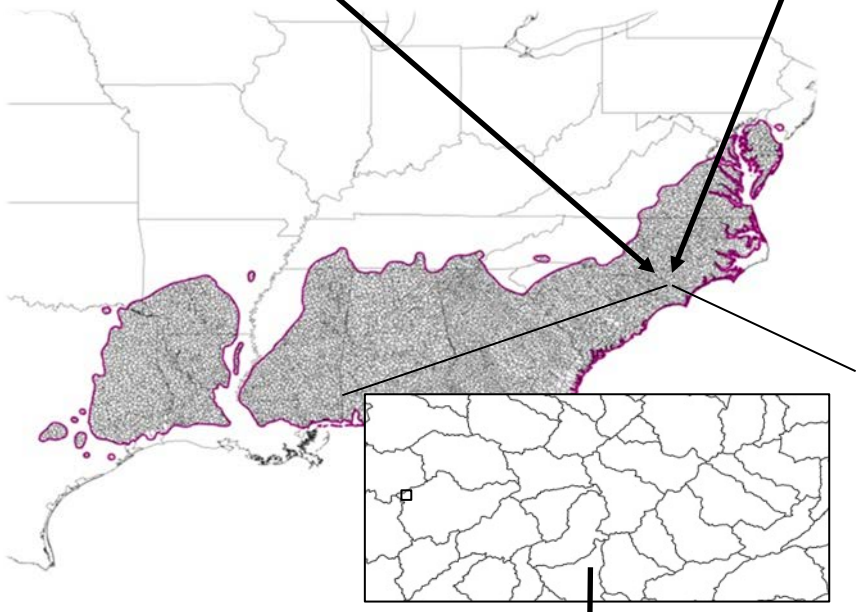
Three fertility scenarios

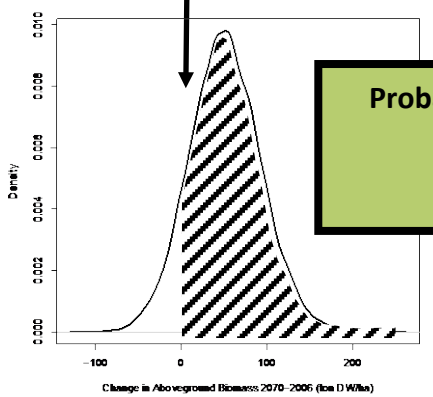
- High
- Best estimate of current
- Low

User defined climate scenario

- RCP 4.5
- RCP 8.5

20 different climate models

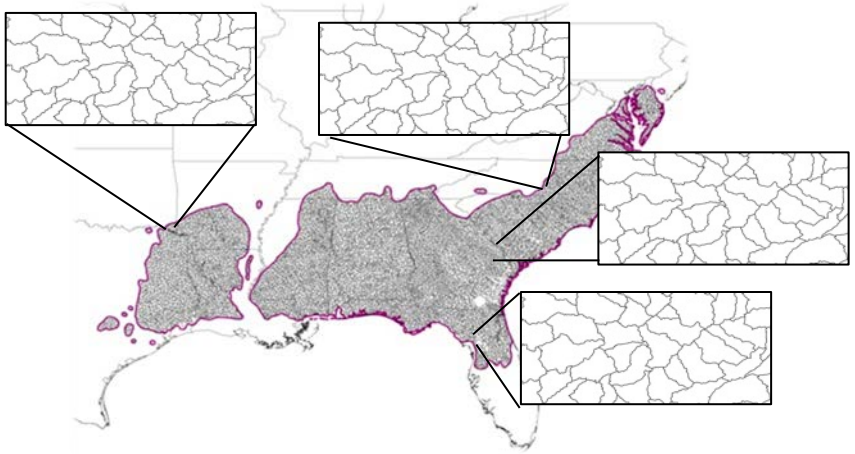




Probability of growth increase

90%

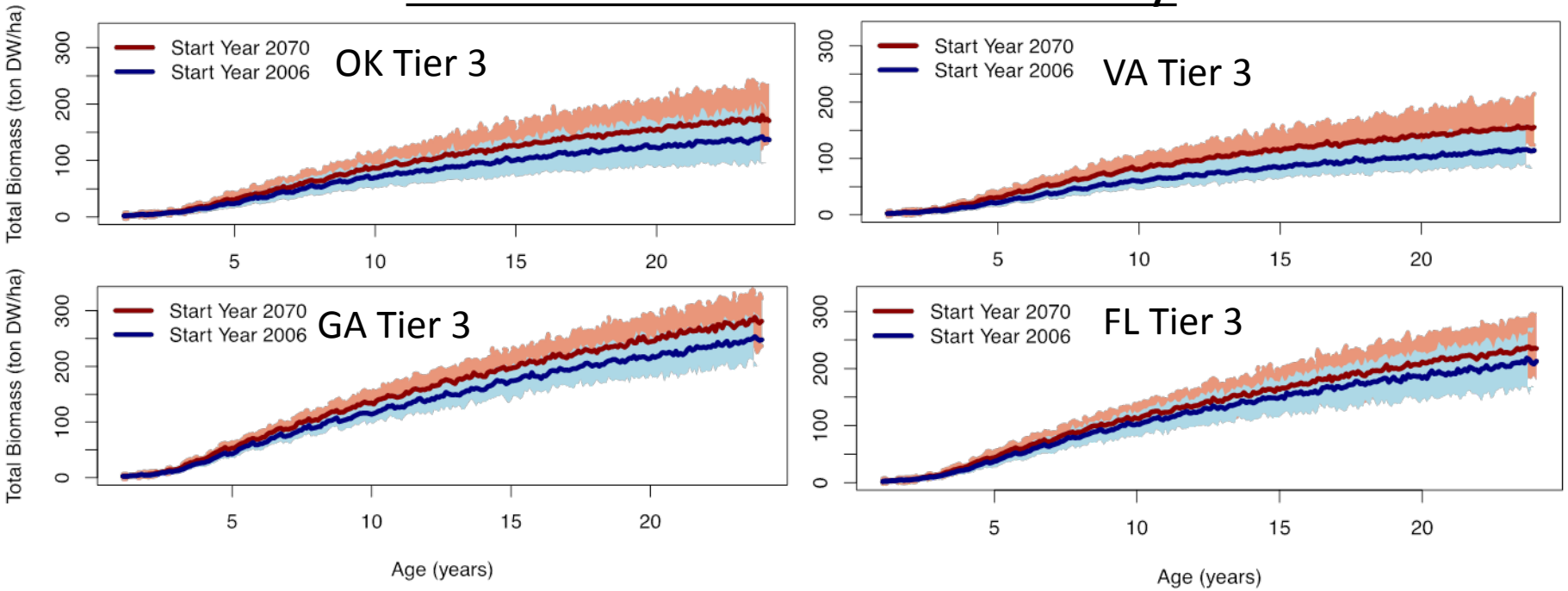
Synthesis paper 2:
Data-constrained forecasts of future pine productivity across the Southeastern U.S.



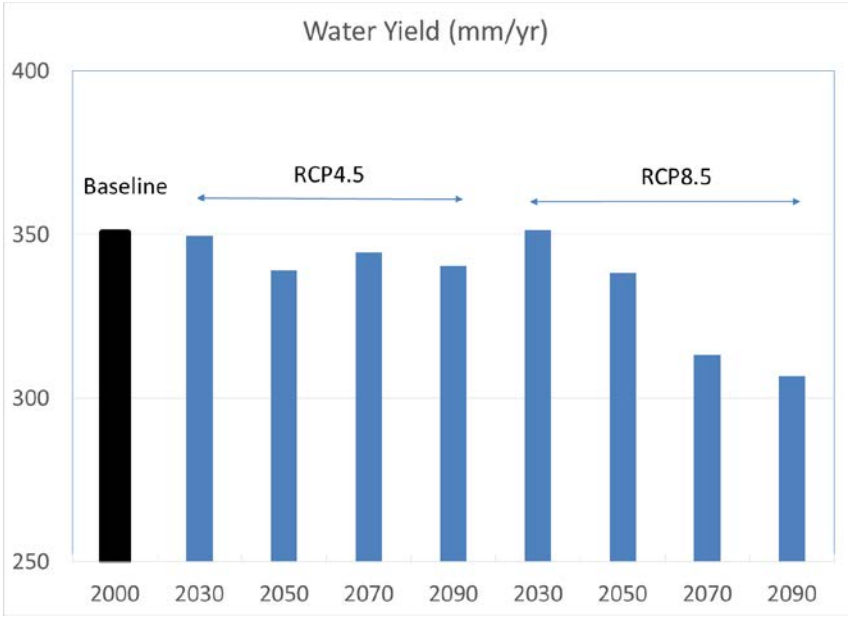
Each HUC

- Median predicted change for each climate model and scenario (with 95% CI)
- Median predicted change across climate models (with 95% CI)

CCSM4 - RCP 8.5 – Estimated current fertility

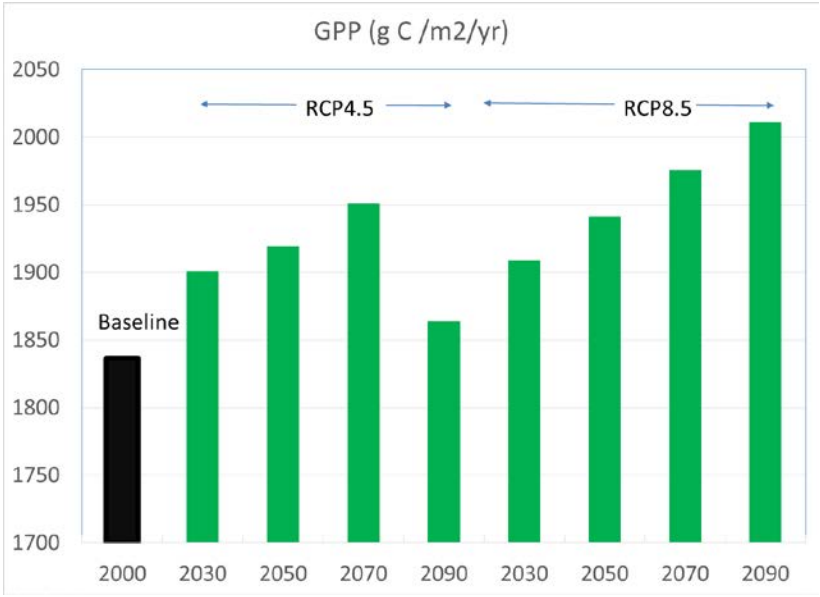


WaSSI Modeled Mean Changes (all GCMs)

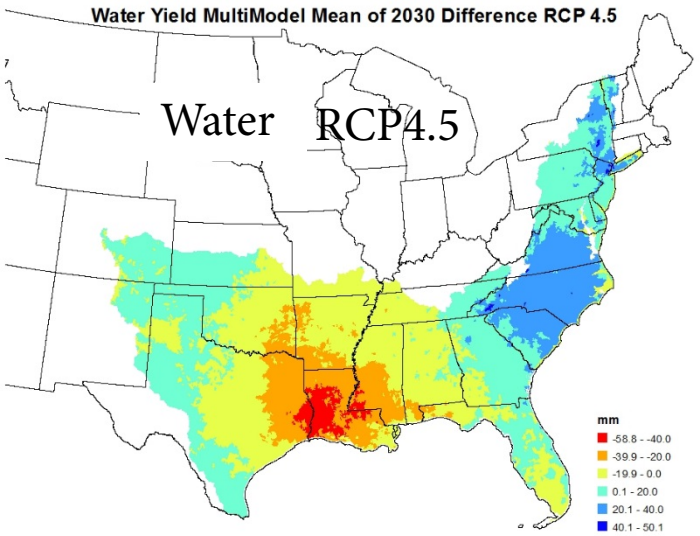


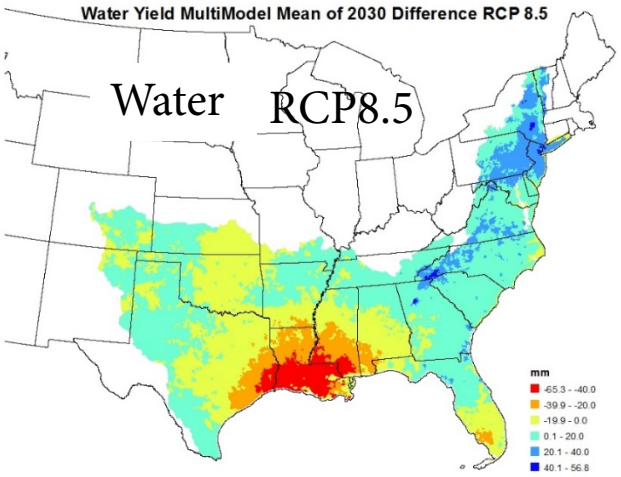
Water

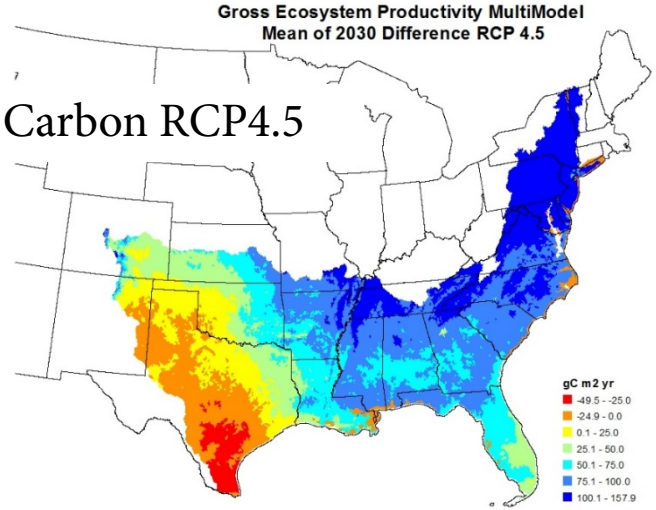
Carbon

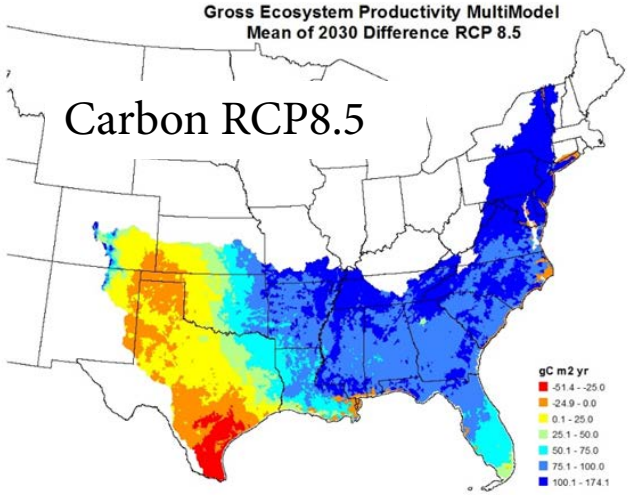


WaSSI Modeled Mean Changes by 2030 (all GCMs)









Aim 4 Integration Paper

- Progress:
  - Summary of Aim 4 work
  - Draft outline of paper
  - Draft plan to complete the writing
- Example figure:

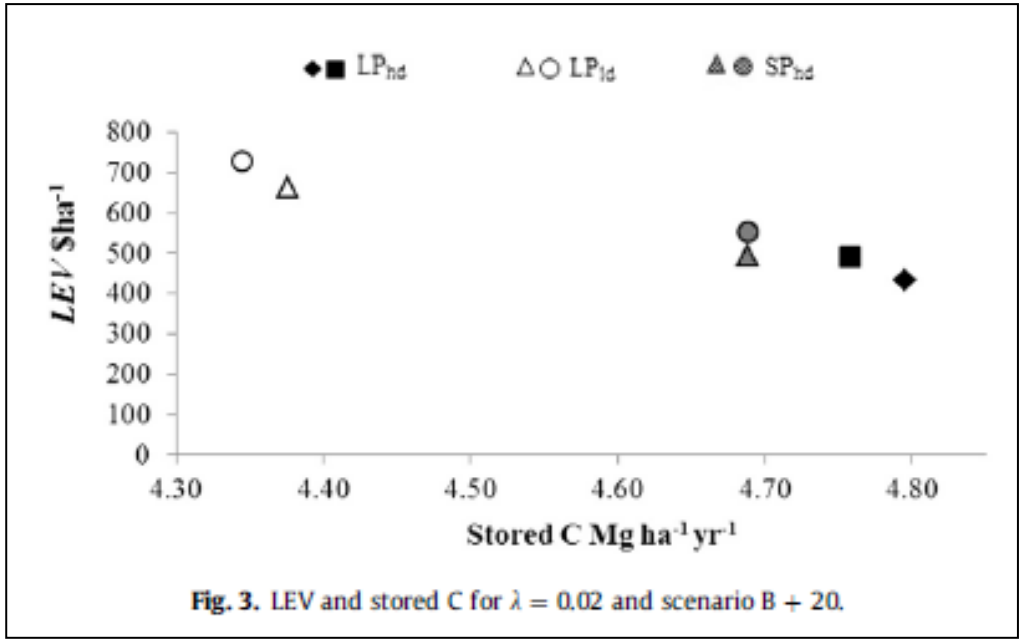


Fig. 3. LEV and stored C for $\lambda = 0.02$ and scenario B + 20.

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Paper Outline

- Review main studies: <u>4 broad areas</u> of research related to the impact of climate change on forestry, etc. (there may be better ways to organize this – please suggest). *Led by primary researcher of each study.*

  A. Market analysis
     - a.1. stumpage/carbon prices
     - a.2. Supply and demand analysis (also fits in forest/regional level analysis)
     - a.3. Land use

  B. Stand level modeling
     - b.1. land values
     - b.2. optimal forest management, efficiency
     - b.3. risks

  C. Forest/regional level modeling
     - c.1. Ecosystem services production
     - c.2. Policy impacts on ES
     - c.3. Regional risk (SPB, fire, wind damage)

  D. Public attitudes towards climate change
     - c.1. WTP for forest based mitigation strategies
     - c.2. Socio-economic drivers

  – Discussion of each broad area, and identification of gaps to be addressed- future work.
  – Conclusions

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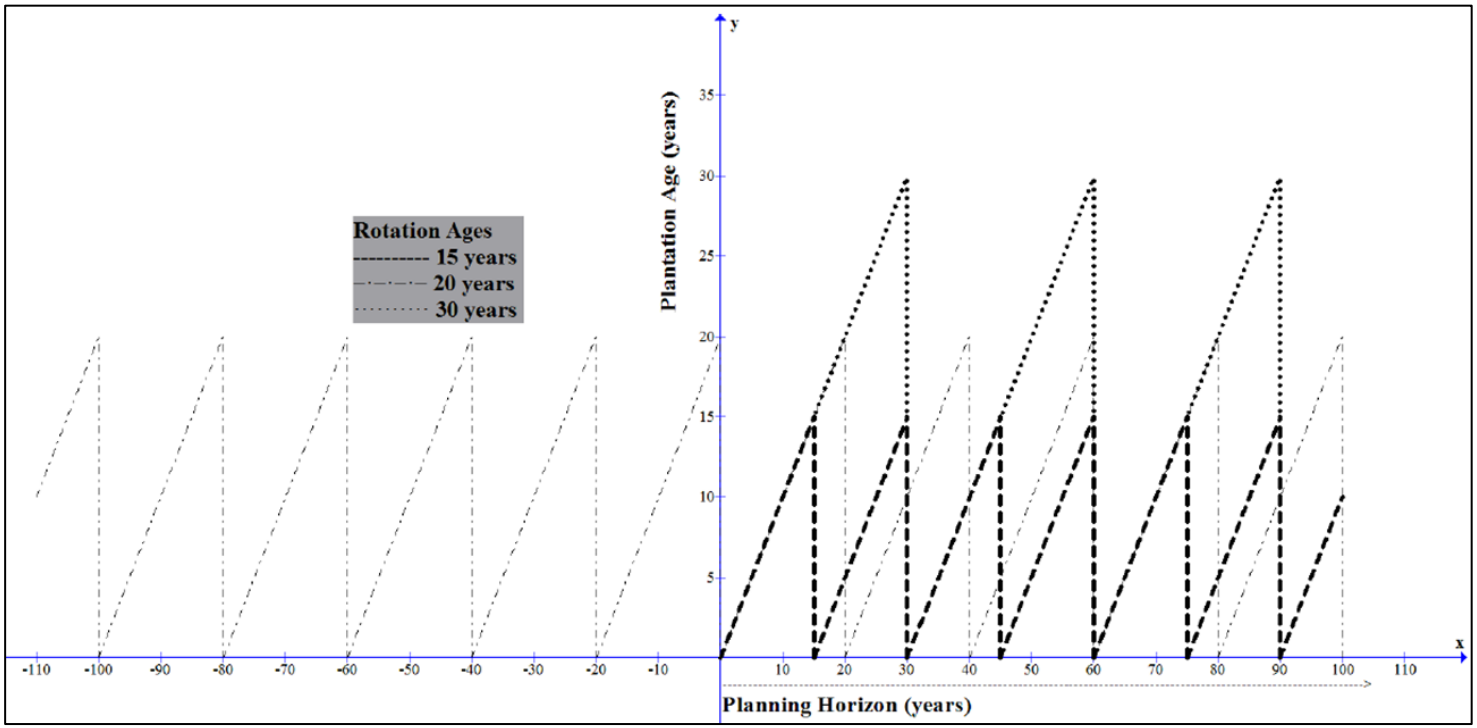
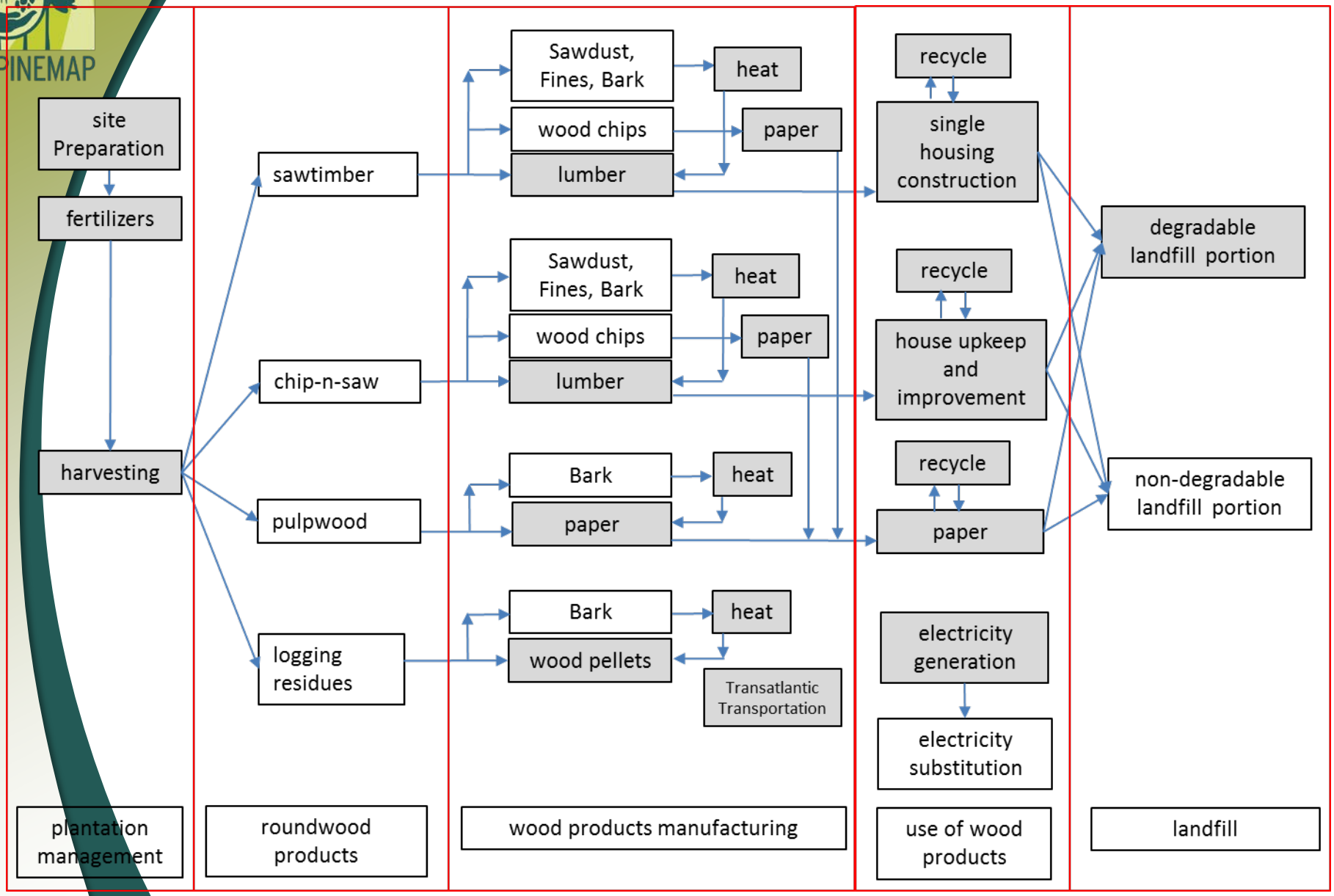
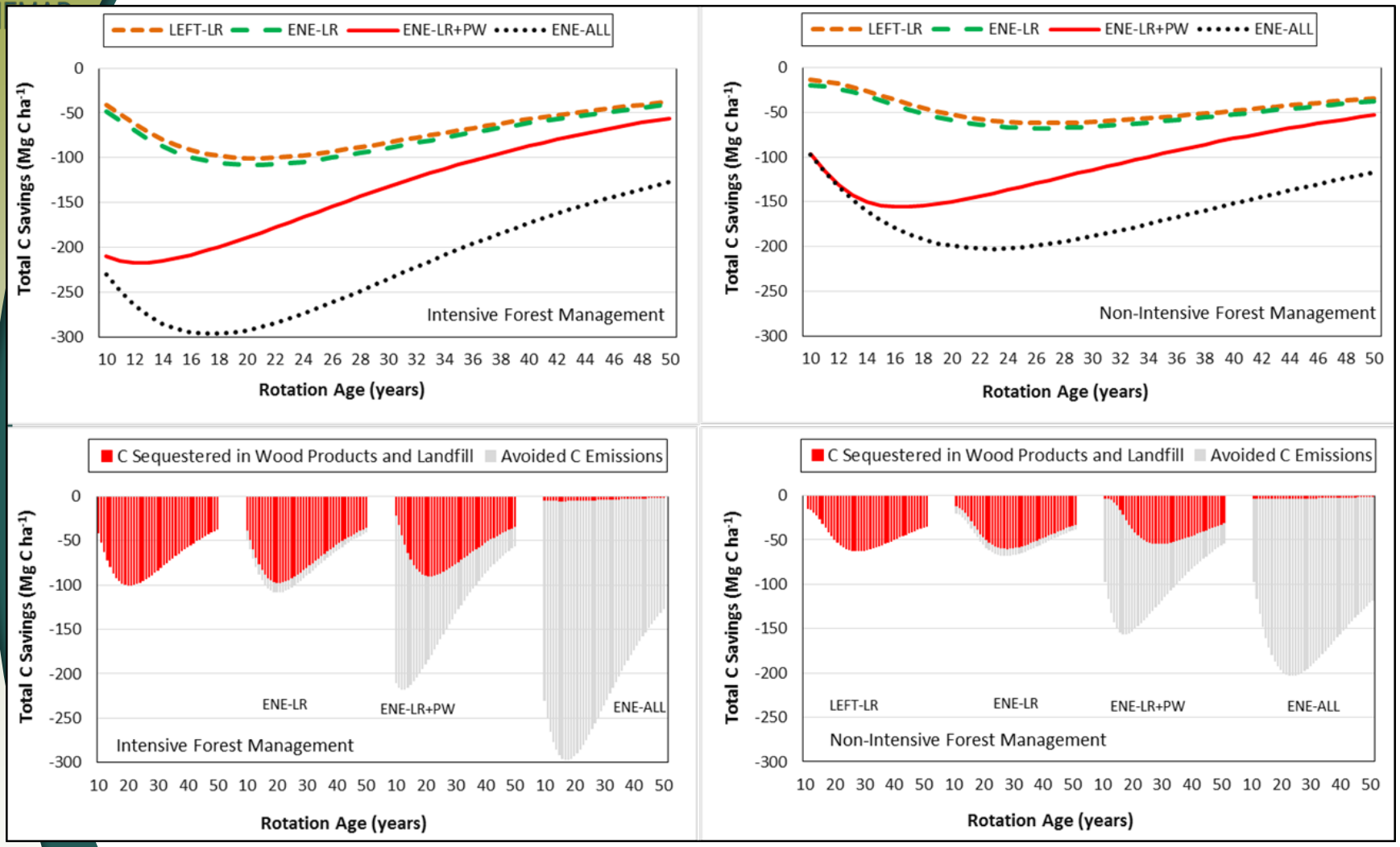
Efficacy of Carbon and Bioenergy Markets in Mitigating Carbon Emissions on Reforested Lands: A Case Study from Southern United States

Scenarios	sawtimber	chip-n-saw	pulpwood	logging residues
LEFT-LR	Lumber	Lumber	Paper	Left on the ground
ENE-LR	Lumber	Lumber	Paper	Wood pellets*
ENE-LR+PW	Lumber	Lumber	Wood pellets	Wood pellets*
ENE-ALL	Wood pellets	Wood pellets	Wood pellets	Wood pellets*

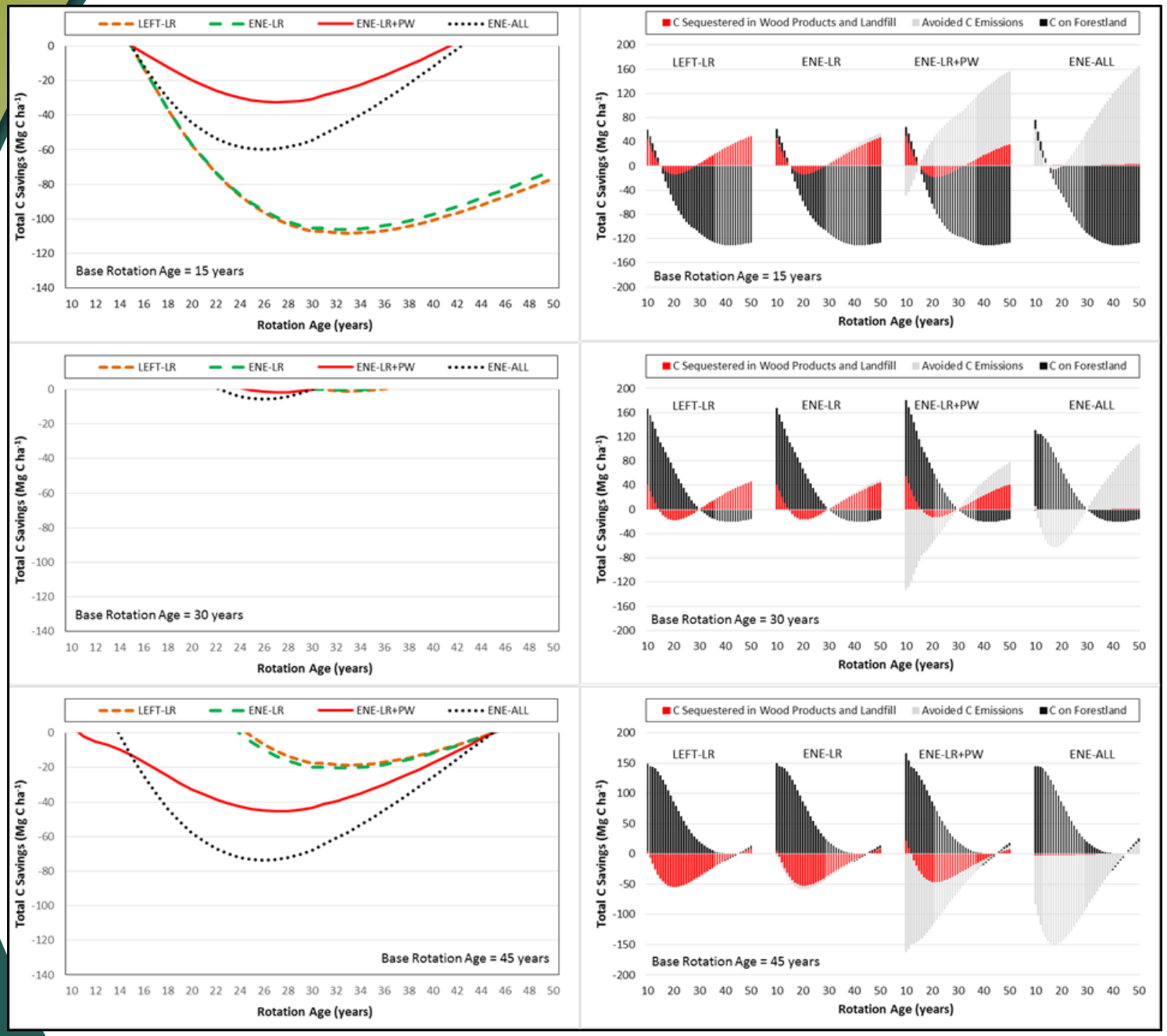


Puneet Dwivedi
Warnell School at UGA

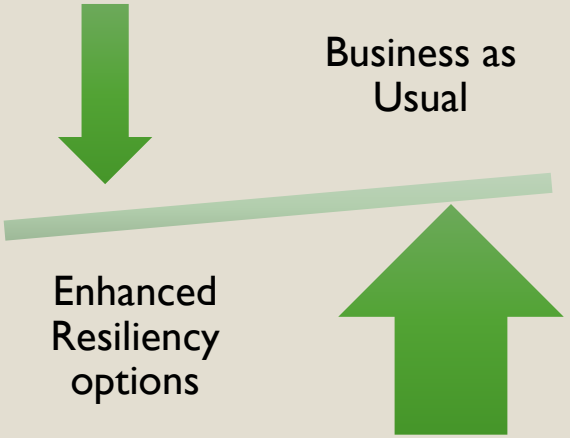

site Preparation
fertilizers
harvesting
sawtimber
chip-n-saw
pulpwood
logging residues
Sawdust, Fines, Bark
wood chips
lumber
heat
paper
Sawdust, Fines, Bark
wood chips
lumber
heat
paper
Bark
paper
heat
Bark
wood pellets
heat
Transatlantic Transportation
recycle
single housing construction
recycle
house upkeep and improvement
recycle
paper
electricity generation
electricity substitution
degradable landfill portion
non-degradable landfill portion
plantation management
roundwood products
wood products manufacturing
use of wood products
landfill


LEFT-LR
ENE-LR
ENE-LR+PW
ENE-ALL
Total C Savings (Mg C ha-1)
Intensive Forest Management
Rotation Age (years)
Non-Intensive Forest Management
C Sequestered in Wood Products and Landfill
Avoided C Emissions

PINEMAP


LEFT-LR
ENE-LR
ENE-LR+PW
ENE-ALL
Total C Savings (Mg C ha-1)
Base Rotation Age = 15 years
Rotation Age (years)
C Sequestered in Wood Products and Landfill
Avoided C Emissions
C on Forestland
Base Rotation Age = 30 years
Base Rotation Age = 45 years

SOUTHERN PINE FOREST RESILIENCE MANAGEMENT GUIDEBOOK



- Summarize good forestry management *and* PINEMAP results
- Make useable for foresters/layman
- Link to the DSS
- Provide Enhanced Resiliency Options)
- Provide Specifics
- *Working on more detailed outline for circulation*

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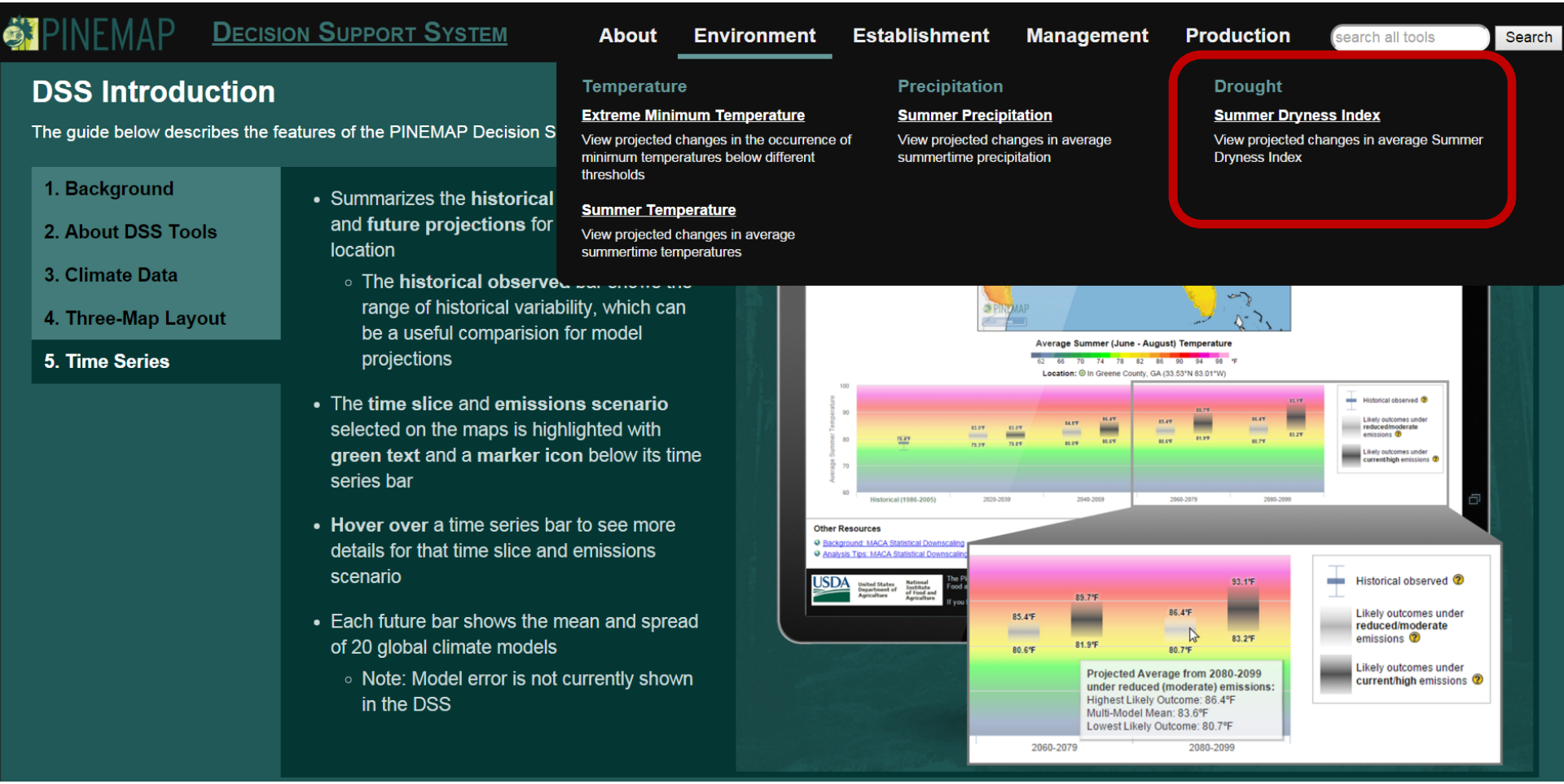
NEED YOUR HELP!!!

- What do you think should be in this book?
- What can you say now of these topics below? (some of these questions can be answered by the DSS)
  - Drought impacts and responses
  - Fertilizer impacts and responses
  - What can we suggest in terms of genetics?
  - Yield information (used with different genetics plus stressors)
  - Risks
  - El Nino Year establishment- any suggestions
  - Cost estimates for establishment?
  - Education group- we will need your help with flow and continuity!



Also…

- Updates to seedling deployment tools
- HUC 2-12 border overlay available
- MACA / DSS FAQ webpage

Summer Precipitation

FAQ: What can this tool be used for? (click to view the answer)

hide FAQs | expand tooltips

Map Display: (•) Historical Observed ( ) Projected Change ( ) Projected Average (Historical Observed + Projected Change)

Historical Observed Summer (June - August) Precipitation

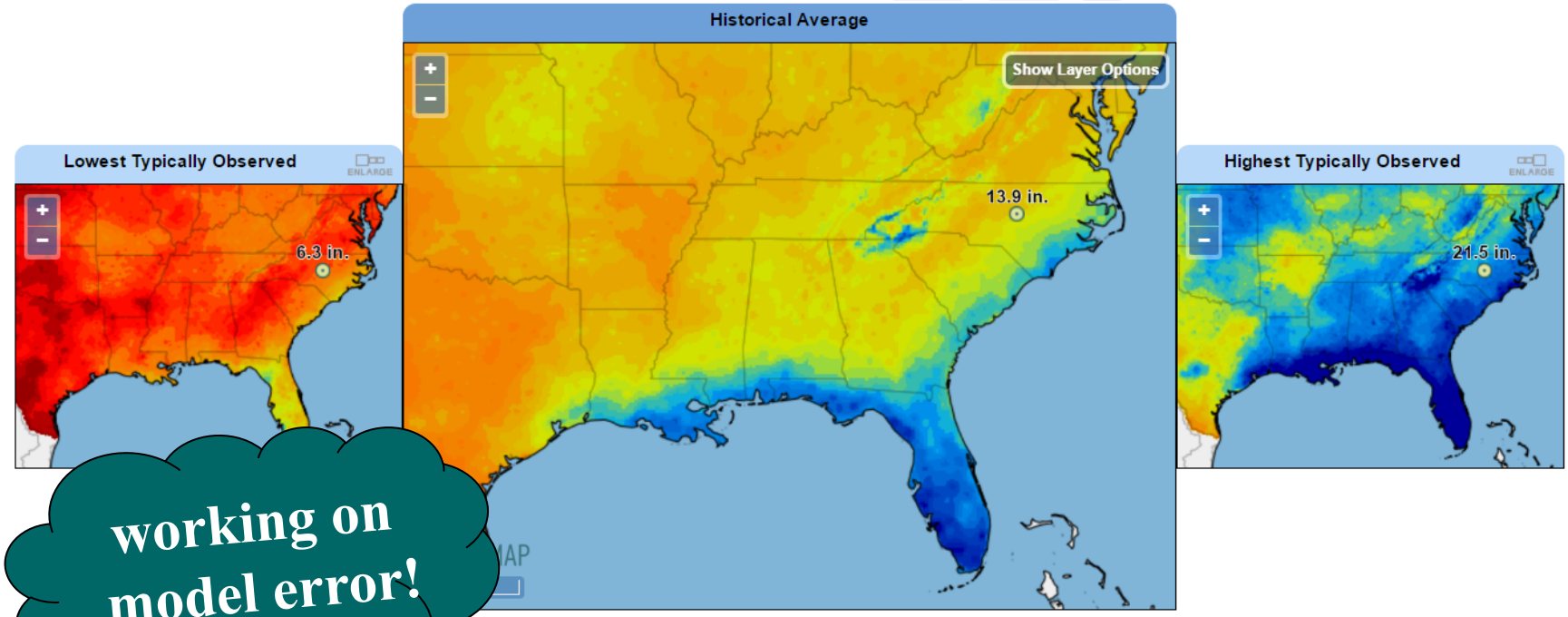
FAQ: How do I use the maps? (click to view the answer)

Time Period: 1986 to 2005

0 4 8 12 16 20 24 28 inches

Location: In Chatham County, NC (35.67°N 79.13°W)

To select a location, click on the map or enter your coordinates: 35.67 °N, 79.13 °W Go



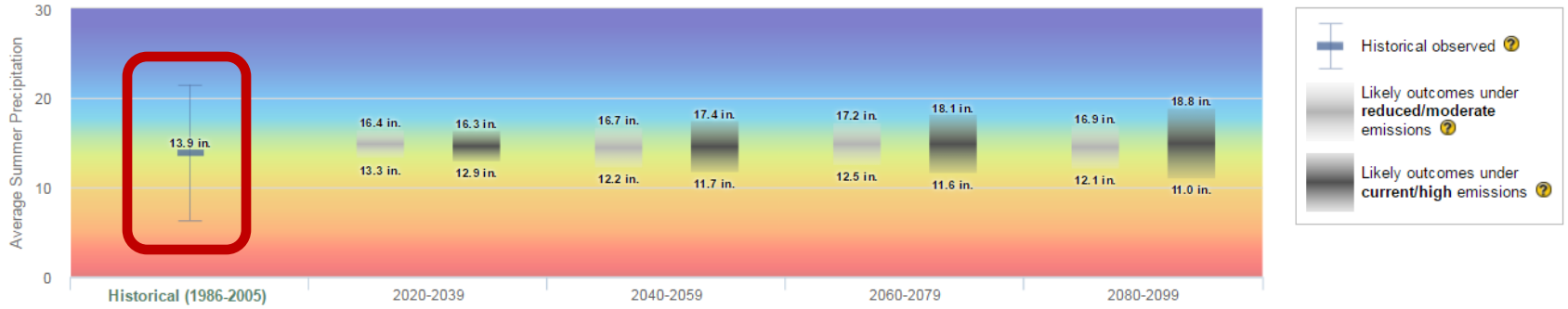
working on model error!

Average Summer (June - August) Precipitation

0 4 8 12 16 20 24 28 inches

Location: In Chatham County, NC (35.67°N 79.13°W)

FAQ: What does this graph show? (click to view the answer)



PINEMAP DECISION SUPPORT SYSTEM

About | Environment | Establishment | Management | Production

search all tools | Search

Green Weight

FAQ: What can this tool be used for? (click to view the answer)

Map Display: Sample Output

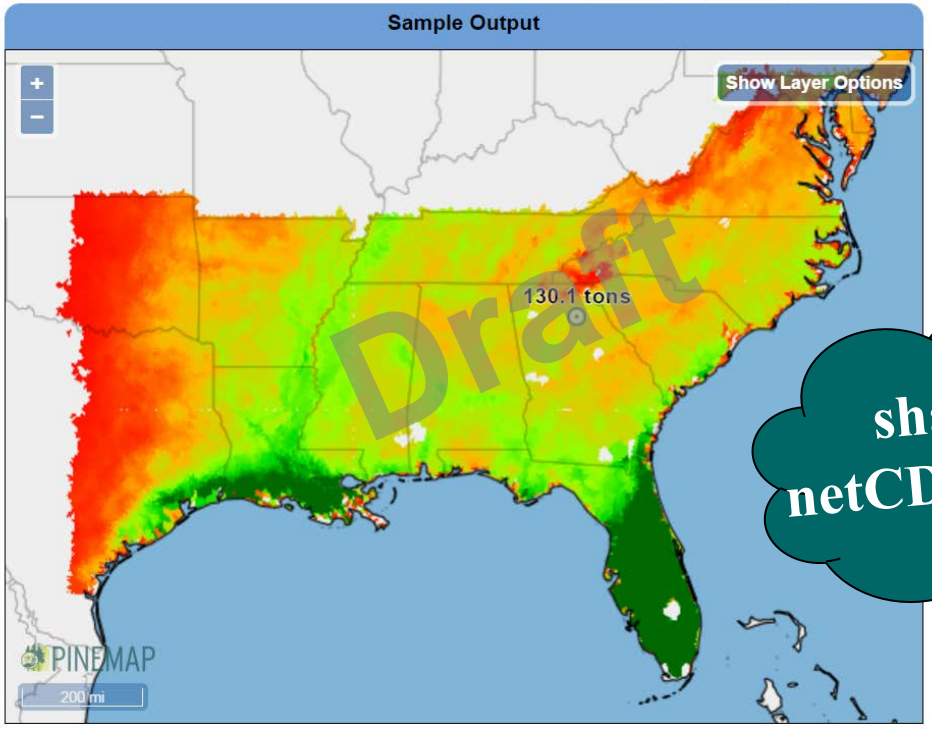
Growth and Yield

Green Weight

View modeled projections for green weight output, in tons

Location: In Jackson County, GA (34.18°N 83.66°W)

To select a location, click on the map or enter your coordinates: 34.18 °N, 83.66 °W Go



shapefiles or netCDFs are useful!

Tools coming soon:

- *growing season length*
- *drought and flood risk*
- *forest productivity model outputs*

- *gross and net primary productivity*
- *net ecosystem productivity*
- *merchantable volume*
- *carbon above ground*
- *water stress*

Questions/ comments/ discussion