A Spatially-Explicit Landscape Modeling Approach to Assess the Growth of Loblolly Pine Forests

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Introduction

Loblolly pine (*Pinus taeda L.*) forests provide important economic and ecological benefits, especially in the Southeastern US. These pine forests contain about 1/3 of the contiguous US forest carbon, supply 16% of global industrial wood, 5.5% of the jobs, and 7.5% of the industrial economic activity. Nevertheless, loblolly pine forests have faced challenges from environmental stressors such as climate change. These changes can affect the structural and functional traits, which in turn will reduce forests productivity and alter CO_2 exchange. It is profoundly important to investigate how loblolly pine forests will adapt to various environmental conditions, specifically global climate change; hence, necessary efforts to maintain healthy pine forests can be implemented.

Research Objectives

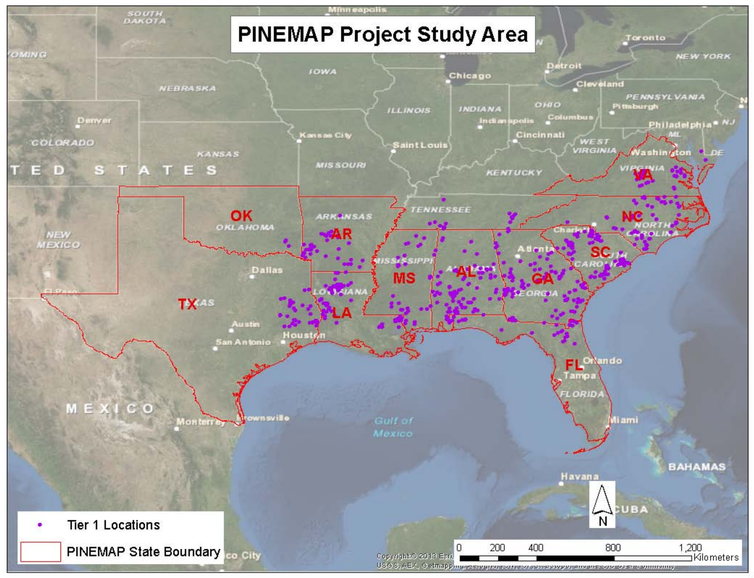
To examine the spatially-explicit interrelationships between loblolly pine response (growth) and environmental/ biophysical properties (e.g., climatic, pedogenic, and topographic variables) across the Southeastern US.

Research questions:

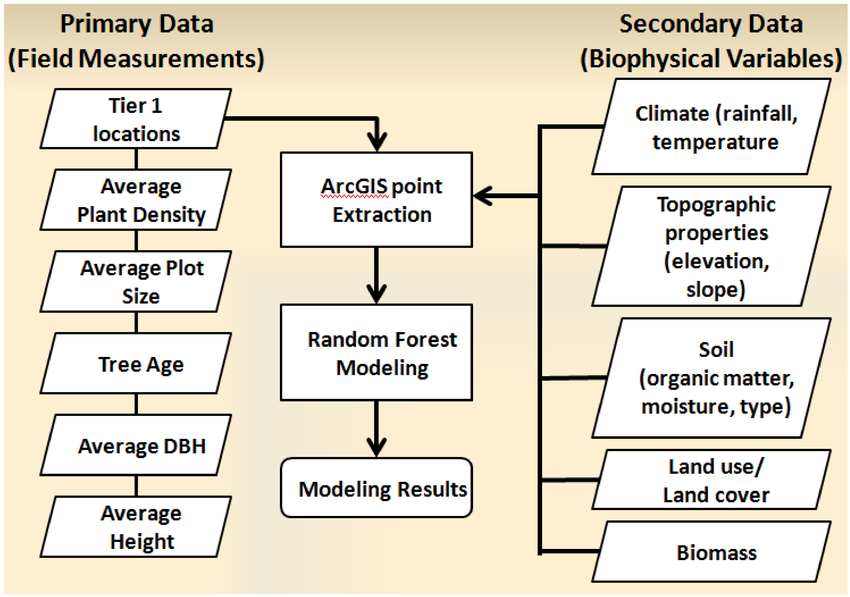
1) What biophysical factors have the most influence on loblolly pine forests productivity?
2) How does the encountered variability of environmental/biophysical properties impact loblolly pine forests functioning and growth?

Methods

Study Area

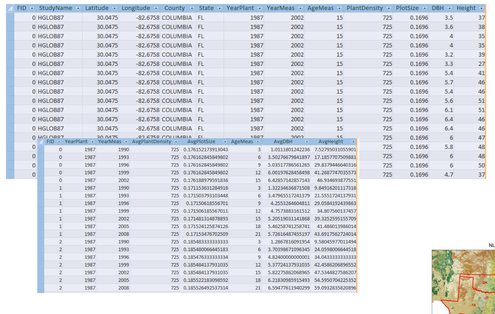


Work Flow

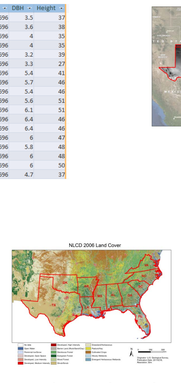


Tier 1 locations (defined by latitude/longitude) will be extracted to biophysical variables using ArcGIS and remote sensing techniques (see the diagram above). There are 750 locations spread across 11 states in the Southeastern US. Statistical analysis, including ensemble regression tree methods, such as Random Forest, will be used to determine the relationships between environmental/biophysical variables and the growth of loblolly pine forests and develop spatially-explicit landscape models. We are interested in modeling the average tree height and DBH (diameter at breast height) as a function of climate, topographic properties, soil, land cover, and biomass.

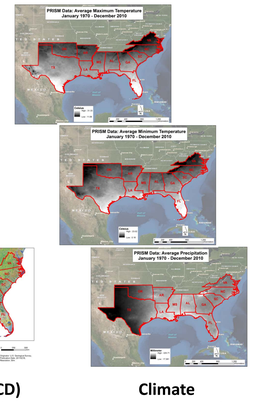
Examples of the Datasets



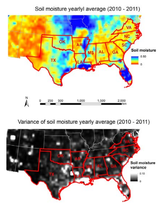
Tier 1 Field Measurements
(Source: Western Gulf Tree Improvement Cooperative, Forest Biology Research Cooperative, Plantation Management Research Cooperative, NC State Tree Improvement Cooperative, Forest Productivity Cooperative, and Forest Modeling Cooperative.)



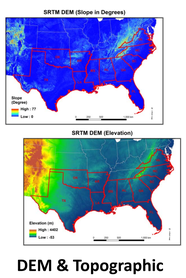
Land Cover (NLCD)
(Source: USGS)



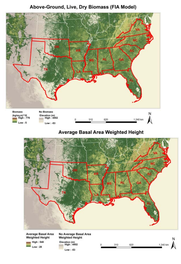
Climate
(Source: PRISM)



Soil Moisture (SMOS CP 34)
(Source: European Space Agency)



DEM & Topographic Properties (SRTM)
(Source: NASA and CGIAR)



Biomass
(Source: Woods Hole Research Center)

Expected Results

Based on the literature such as (Coops, et al., 2010; Zerpa, et al., 2010), we hypothesize that climate and soils impose the highest influence on tree growth, whereas other biophysical factors have less influence.

Acknowledgements:
Tier 1 data were provided by Western Gulf Tree Improvement Cooperative, Forest Biology Research Cooperative, Plantation Management Research Cooperative, NC State Tree Improvement Cooperative, Forest Productivity Cooperative, and Forest Modeling Cooperative.