2. The Tier II Network: Estimating the Response of Regional Loblolly Pine Carbon Dynamics to Management

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This interdisciplinary, regional research is aimed at gaining a better understanding of how environmental factors and silvicultural treatments affect ecosystem carbon accumulation and storage, enabling us to develop a scientific analysis of the role of loblolly pine plantations in regional carbon dynamics. Research is being conducted on established research sites managed by the University-Corporate-Governmental Research Cooperatives partnering with PINEMAP, which can enhance connections between researchers and corporate forest landowners.

The Tier II network of sites was drawn from established research installations maintained by the industry-university research cooperatives participating in PINEMAP. The network of 125 sites and 458 measurement plots encompasses a wide range of environmental conditions (Figure 2.1) and silvicultural treatments. The purpose of the Tier II network is to evaluate how ecosystem carbon (C) accumulation is affected by silvicultural decisions, soils, and climate, and, thus, contributes to increased C sequestration, one of PINEMAP's outcome themes.

When pine ecosystems are managed to maximize wood production, managers also maximize the rate of C sequestration into plant biomass. This C uptake into pine biomass is the goal of the forest industry, and as a result it is a well-measured and well-modeled component of ecosystem C dynamics. Also important to ecosystem C accumulation or loss are the other C pools, such as the forest floor, soil, coarse woody debris, and understory, which when combined are larger than the pine tree C pool. For these nontree pools, it is not clear whether they will increase, decrease, or remain unchanged with an increase in pine productivity or biomass.

Forest manager decision making is less about maximizing ecosystem productivity than it is about whether a forest management decision is profitable. Often a means to increase profitability is to maintain the forest at a tree density below the maximum possible tree density by either reduced initial stocking or by thinning. This management approach increases average tree diameter growth, which more quickly moves tree size from less (e.g., pulp) to more profitable (e.g., lumber instead of pulp) timber products. At near optimal stocking densities, the larger proportion of thinned forest harvests that is converted into long-lived lumber products increases whole cycle C sequestration. However, if tree stocking is reduced below optimal levels, a net ecosystem C loss on an area basis is more likely.

Fertilization and competition (or weed) control increase pine growth, and therefore increase the amount of C stored in pine biomass. For other ecosystem C pools, increased pine biomass may or may not translate to increased C storage because these pools are heavily affected by how microorganisms responsible for organic matter decomposition respond to treatment. Fertilization with nitrogen (N) has been shown to suppress the activity of specific decomposer microorganisms; however, the effects of other fertilizer nutrients on microorganism activity are less well studied. In planted pine forests across the region both N and phosphorus are consistently added to relatively young forests. Weed control can change aggregate litter chemistry and microclimate, but it is unclear if these effects will result in significant changes in decomposer microorganism activity.

An exciting aspect of the Tier II network is that the breadth of treatments in the experimental sites encapsulates most management approaches used, and the network spans the range of climactic factors present on the landscape. The most common treatment category in the network is fertilization (fert) + chemical (chem) weed control (Figure 2.2), which is a common management approach used

The exposed profile of a Spodosol (Pomona series) at a Tier II location in Alachua County, Florida. Photo by Allan Bacon.

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in the industrial forests of the southeastern United States. The next largest category is where thinning (thin), fert, and chem are included in an "all" treatment. Each category of treatment has within it at least 32 individual research plots, and the plots are present across the range of loblolly pine (Figure 2.1), allowing a robust assessment of treatment effects across the full range of climate and soils across the region.

The final estimates of ecosystem C accumulation in the Tier II network will enable us to quantify the combined effects of management, soils, and climate on planted pine carbon dynamics. In addition, data from the Tier II network will be compared to ongoing modeling efforts by other PINEMAP groups. Model parameters describing tree growth and allocation among plant parts, litter production, and heterotrophic respiration can be examined within the context of the measurements in the Tier II network. These measurements are expected to improve estimates of forest productivity and ecosystem C accumulation at the regional level under future climate scenarios and ultimately, inform decision makers about the management strategies that will enhance carbon storage.

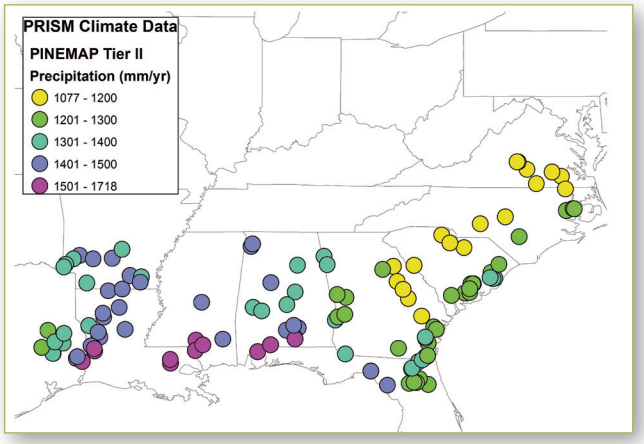

Figure 2.1. Precipitation estimated from PRISM historic climate data (1991–2010) for each Tier II research installation. Each dot represents a research installation where multiple treatments are being examined.

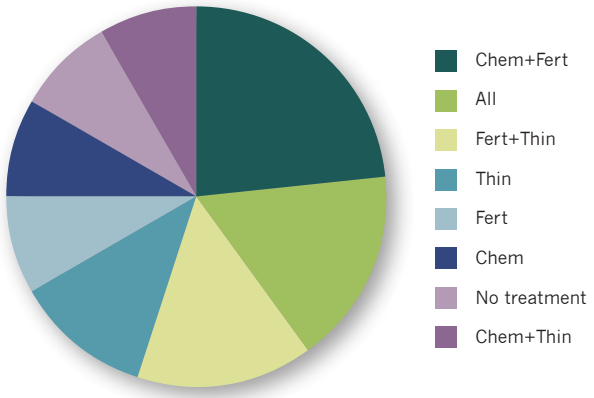

Figure 2.2. Distribution of plots in the Tier II network having different combinations of experimental treatments including fertilization (fert), chemical weed control (chem), thinning (thin), all treatments, and no treatment.