

PROJECT NARRATIVE

**USDA National Institute of Food and Agriculture
Climate Change: Regional Approaches to Climate Change, Program Code A3101
Continuation Application—2013**

**Integrating Research, Education, and Extension for Enhancing Southern Pine Climate
Change Mitigation and Adaptation**

Pine Integrated Network: Education, Mitigation, and Adaptation Project (PINEMAP)

NIFA Award number 2011-68002-30185

Table of Contents

Team Plan-of-Work for next year of funding (Year 4).....1

Team Outcomes/Impacts3

Team Outputs.....5

Team Milestones and Deliverables6

Broad Impacts14

Training.....15

Concluding Statement.....15

Appendix A: Team Outputs

Appendix B: Training

Team Plan-of-Work for next year of funding (Year 4)

PINEMAP has six Aim teams (Aim 1: Silviculture & Ecophysiology; Aim 2: Modeling; Aim 3: Genetics; Aim 4: Economics & Policy; Aim 5: Education; and Aim 6: Extension). The preliminary year 4 work plans for each of these Aims is provided in Table 1. In addition, PINEMAP team members are working across Aims on a number of integration platforms to bring interdisciplinary research together to work toward overarching project outcomes. These are described in Table 2.

Table 1. Preliminary year 4 (March 1, 2014-February 28, 2015) PINEMAP Aim work plans.

Aim 1 (Silviculture & Ecophysiology)	Continue data collection at the four Tier III (throughfall exclusion x fertilization) sites
	Continue data collection at Tier II (active experiment) sites
	Conduct quantification of regional variation in soil respiration
	Continue assessment of genotypic and treatment differences in carbon use efficiency (NPP:GPP) and regional variation in carbon sequestration efficiency (NEP:GPP)
	Conduct assessment of Tier III treatment effects
	Conduct assessment of climate, soil, and management impacts on soil GHG flux
	Conduct assessment of regional C, nutrient, and H ₂ O baselines and responses to management from measured Tier II data
	Regionalize estimates of water use efficiency for application in 3-PG and WaSSI
Aim 2 (Modeling)	Continue development of improved process and hybrid models parameterized from network measurements
	Complete predictions of C pool dynamics at varying scales for alternative land use, management, and climate scenarios
	Continue development of improved growth and yield models with climate inputs and C balance
	Continue development of regional map of potential climate or anthropogenic limitations to productivity
	Assess tradeoffs between regional C sequestration, forest products, and maintenance of ecosystem services
	Develop prototype of carbon management decision support system tools to solicit structured feedback (climate scenarios)
	Complete prototypes of decision support system modules (pest, genetics: growth and yield responses, 3-PG, and fire risk)
Aim 3 (Genetics)	Identify new markers for genotypes in ADEPT2, CCLONES, and PSSSS populations
	Identify phenotypes for adaptive traits in ADEPT2 and CCLONES
	Identify phenotypes for growth and growth responsiveness to nutrition in ADEPT2 and CCLONES
	Phenotype wood density and lignin content of ADEPT2
	Discover alleles associated with water relations (existing phenotypes, new markers)
	Discover alleles associated growth and nitrogen responsiveness (existing phenotypes, new markers)
	Discover and validate alleles and genes associated with growth and adaptive traits in 3 populations (new markers)
Aim 4 (Economics & Policy)	Continue assessment of policies and programs that may affect C mitigation in planted pine forests
	Continue documenting landowner adoption of mitigation and adaptation strategies
	Life cycle assessment of wood products within forest and various management strategies
	Finalize NPV and regional market impacts of altered disturbance risks
	Investigate and develop techniques to incorporate landowner survey, ecosystem services, and non-market research into regional market modeling framework
	Synthesize and analyze data from regional survey of family forest landowners and C sequestration
	Bioeconomic modeling of nontimber market ecosystem services

Table 1. Preliminary year 4 (March 1, 2014-February 28, 2015) PINEMAP Aim work plans.

Aim 5 (Education)	Undergraduate Internship Program
	Facilitate and monitor 2014 undergraduate summer fellowships
	Conduct 2014 undergraduate fellowship distance course “Effective Communication Skills”
	Select winners of 2015 undergraduate fellowships and graduate mentor proposals
	PLT Secondary Module
	Complete formative evaluation of module
	Analyze formative evaluation results, revise module
Aim 6 (Extension)	Distribute final module through workshops and trainings
	Implement monthly PINEMAP webinar series
	Finalize, publish manuscript on data from professional foresters survey
	Continue development of PINEMAP Extension web site
	Conduct cyber workshops for continuing education for Extension professionals, practitioners
	Continue DSS development; revise/refine DSS based on feedback from pilot test
	Continue development of and conduct DSS trainings
Administration/ Management	Conduct DSS evaluation
	Continue ongoing Extension product evaluation
	Conduct All Team PINEMAP virtual meetings every other month
	Conduct 2014 Annual Meeting
	Plan and implement national PINEMAP meeting
	Plan 2015 Annual Meeting
	Finalize and publish year 3 annual report
	Write, compile, edit year 4 annual report
	Continue producing quarterly newsletter (<i>PINEMAP Press</i>)
	Plan and lead monthly Executive Committee meetings
	Compile two interim progress reports (Sept. 2014 and March 2015)
	Compile information for annual progress report and submit through REEport system
	Continue updating PINEMAP external web site and intranet site with relevant progress updates, products, etc.
Complete year 5 continuation proposal	
Continue synthesis of team science and integration research data; draft reports and manuscripts	
Conduct research on and develop framework for corporate tech transfer models	

Table 2. PINEMAP Year 4 integration platforms and tasks.

Integration Platform	Tasks
Integrating modeling with economic analyses	Aim 2 and 4 researchers will work together to establish and implement methods for integrating biophysical and economic analyses across scales from stand to region.
Seed deployment tool	Aim 3 researchers will work with Aim 6 DSS developers to determine best methods for integrating the seed deployment tool into the DSS. Aim 3 researchers will work with Aim 2 to identify methods for integrating tool with modeling efforts.
PINEMAP scenario development	Researchers from Aims 1-4 and 6 will work together to develop climate and management scenarios to be used for model simulations that will form the framework for evaluating carbon sequestration and nitrogen use for assessment of PINEMAP outcomes.
PINEMAP Decision Support System	Researchers from Aims 1-4 will provide data and tools to be integrated into the online PINEMAP DSS and members of Aims 1-6 will pilot test and provide input.
PLT Secondary Module	Aim 1, 2, 3, and 6 members provide feedback on draft module and develop narrated PowerPoints and/or videos for the module web site to convey PINEMAP research activities to teachers and students.

Table 2. PINEMAP Year 4 integration platforms and tasks.

Tech transfer/outreach	<p>Non-corporate landowners: Researchers from Aims 1-5 provide research for Extension products and assist with the development and implementation of products including workshops/trainings, webinars, fact sheets, etc.</p> <p>Corporate landowners: Conduct a needs assessment to determine what information corporate landowners need regarding climate change and forest management and how PINEMAP research should be disseminated to corporate landowners to ensure maximum impact. A tech transfer model will be developed and used which will help us to meet overall project outcomes.</p>
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Team Outcomes/Impacts

Overview

Pine Integrated Network: Education, Mitigation, and Adaptation Project (PINEMAP) focuses on the 20 million acres of planted pine forests managed by private landowners in the Atlantic and Gulf coastal states from Virginia to Texas, plus Arkansas and Oklahoma. These forests provide critical economic and ecological services to U.S. citizens.

PINEMAP’s overall goal is to create, synthesize, and disseminate knowledge that enables southern pine landowners to

- manage forests to increase carbon sequestration by 15% by 2030;
- increase the efficiency of nitrogen and other fertilizer inputs by 10% by 2030;
- adapt forest management approaches and plant improved tree varieties to increase forest resilience and sustainability under variable climates.

NIFA funded PINEMAP to produce and disseminate the knowledge necessary to better manage planted southern pine forests in a changing world. PINEMAP is charged with producing real-world outcomes, and, accordingly, our research and deliverables are structured around a set of outcome themes which are described below.

- **Increased carbon (C) sequestration from silvicultural and genetic enhancement of productivity and efficiency of fertilizer use, and resilience to climate variability and disturbance.**
Planted southern pine forests already contribute to climate change mitigation by taking up and storing (sequestering) enormous amounts of atmospheric CO₂, both in trees and soil, and in long-lived wood products. PINEMAP produces knowledge necessary to increase the amount of CO₂ sequestered through enhancement of forest productivity, more efficient use of fertilizers, and management of forests for resilience to climate variability and disturbance.
- **Engaged and literate public with the capacity to make informed, practical decisions related to climate, forest ecosystems, and forest management.**
In a democratic society, rational public policy and decision making depend to a large extent on public understanding of and engagement with societal problems. PINEMAP’s education programs are designed to help nonscientists better understand and grapple with the complex issues surrounding climate and forest management.
- **Public policy that supports sustainable management of planted pine under future climate scenarios.**
The biophysical and human dimensions research produced by PINEMAP provides information critical for guiding the development of rational natural resource policy.
- **Enhanced capacity for regional, interdisciplinary collaboration among climate and forest scientists and Extension and education professionals.**
PINEMAP’s unprecedented coalition of over 120 forestry researchers, educators, Extension professionals, and students is building new networks and new infrastructure for cutting-edge, collaborative, outcome-based science.

- **Enhanced connections between corporate and noncorporate forest landowners and forestry and climate researchers and education and outreach professionals.**

Research performed in isolation has little impact on society. PINEMAP strives to strengthen existing and build new connections to on-the-ground forest management so that the science can be quickly translated to outcomes that benefit society.

- **A more robust and resilient forest-based economy in the Southeast U.S.**

PINEMAP research enables pine landowners in the Southeast U.S. to continue producing economic and ecological services that benefit society.

These outcomes will be achieved through integrated research and education programs described in this narrative.

Aim 1 (Silviculture & Ecophysiology)

Aim 1 activities contribute to project-level outcomes and impacts primarily through the establishment and measurement of carbon and nutrient pools and fluxes on a three-tiered monitoring network. The data generated from this network will quantify the climatic, soils, and management impacts on carbon sequestration in planted pine ecosystems and provide data necessary for the Aim 2 (modeling) team to build and verify stand- to regional-level models that simulate pine forest dynamics under varying climate. These data and simulations will form the core of the PINEMAP Decision Support System which will provide landowners and managers the tools necessary to make decisions about managing planted pine for increased carbon sequestration, enhanced fertilizer efficiency, and resilience to altered disturbance regimes.

Aim 2 (Modeling)

Aim 2 activities contribute to project-level outcomes and impacts by assessing and analyzing how changing management and climate will impact stand and regional carbon sequestration, productivity, and resilience to disturbance. 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. Fine scale measurements are transferred using multiple scale models to extrapolate to the region.

Aim 3 (Genetics)

Aim 3 activities contribute to project-level outcomes and impacts by providing a genetic seed deployment tool necessary for stakeholders to make sound seed deployment decisions under changing climatic conditions and by discovering genes and markers associated with important mitigation and adaptation traits that can be incorporated into future breeding programs. Aim 3 will work closely with Aims 1 and 2 to provide input and benefit from insights gleaned from the stand-level studies and modeling to make tree improvement more efficient. Simultaneously, knowledge of traits varying at the gene level should contribute to the ecophysiology studies.

Aim 4 (Economics & Policy)

Aim 4 activities contribute to project-level outcomes and impacts by providing the economic analysis that will underpin land manager decision-making in future management and climatic conditions. From the stand- to the regional-scale, economic impacts of disturbance, climate, management, and policy alternatives must form the basis of any viable and sustainable management change. Policy analysis will enable PINEMAP stakeholders to better assess management responses to future policy changes. Quantification of different ecosystem services will lead to a better understanding of tradeoffs among carbon, timber, and biodiversity. Finally, the life cycle assessment (LCA) will provide the framework necessary to analyze the stand to regional carbon sequestration implications of changes in management regimes.

Aim 5 (Education)

Aim 5 activities contribute to project-level outcomes and impacts through educating graduate and undergraduate students, along with high school teachers and students, on climate science, forestry, and interdisciplinary research. The PINEMAP distance graduate course, Climate and Forests, was offered again in the 2013 spring semester, with a total of 19 students participating. The course provides a platform for faculty to interact and help students better understand the variety of interdisciplinary research, education, and outreach elements within the PINEMAP project. The PINEMAP Undergraduate Fellowship Program hosted its second year of fellowships with 12 undergraduate interns working with PINEMAP graduate students at host institutions. The draft Project Learning Tree/PINEMAP secondary module was completed, with input from the 2012 Education Advisory Committee and from 25 PINEMAP researchers and external experts who reviewed the activities. The module web site and online training resources were developed, and sixty-five educators throughout the Southeast are participating in the module pilot test. These educators expect to reach more than 4,000 secondary students.

Aim 6 (Extension)

Aim 6 activities contribute to project-level outcomes and impacts through development and dissemination of informational products and tools which provide stakeholders with knowledge and skills needed to address planted pine mitigation and adaptation issues related to climate and climate change. Aim 6 researchers conducted a survey of climate change perceptions among Extension faculty and agents across the region. We are developing partnerships among state climatologists and Extension foresters and establishing a PINEMAP Extension network in the Southeast. These partnerships and networks will be critical to the efficient and effective dissemination of PINEMAP Extension programs and products. Programs and products being developed include a Decision Support System (DSS), a web-based, open-source set of current and future decision support tools directed at the innovative management of southern pine; eXtension modules for the Climate Science and Forests Interaction Community of Practice (CoP); and additional resources such as fact sheets and web-based education modules.

Team Outputs

In year 3, PINEMAP developed and published an annual report containing 24 articles summarizing preliminary research results and education and Extension programs. Hard copies were distributed to partners and stakeholders, and the report is available for download via the PINEMAP web site. In addition, PINEMAP began producing and distributing a quarterly e-newsletter, the *PINEMAP Press*, to inform and educate partners and stakeholders on important project research results and programs. The PINEMAP web site (<http://www.pinemap.org>) is a valuable outreach tool, and is continually updated with project updates, research results, and outreach materials.

The research, education, and Extension efforts of PINEMAP team members resulted in an impressive array of outputs produced during year 3, including products (peer-reviewed publications, fact sheets, white papers, research summaries, and audio/video products) and events/activities (oral and poster presentations, workshops/trainings/courses, and experiments, data collection, and surveys). A complete summary of team outputs produced and disseminated from August 2012 to present can be found in Appendix A.

Team Milestones and Deliverables

Aim 1 (Silviculture & Ecophysiology)

Finalize standardized measurement protocols

Protocols for carbon sampling, tree core collection, biomass sampling, precipitation collection for isotopes, GHG flux, heterotrophic and autotrophic soil respiration, and IPAR-LAI protocols have been finalized and uploaded to the PINEMAP intranet site where they serve as a reference for field work and data collection on Tier II and III sites. Standardized metadata and spreadsheets have also been created.

Assessment of Tier III treatment effects

Leaf-level physiology

Leaf gas exchange, chlorophyll fluorescence, and leaf water potential were measured from July 2012 through June 2013 at the Georgia Tier III installation.

In 2012, no significant interactive effects of treatment or month were observed for any leaf physiological variable. Throughfall exclusion decreased leaf stomatal conductance (g_s) on average by 21%. Light-saturated net photosynthesis (P_{net}), soil moisture, and predawn leaf water potential decreased in response to throughfall exclusion as well. No effect of treatment on midday leaf water potential was observed.

During the much wetter year of 2013, no significant main or interactive effects of treatment or month were observed for any leaf gas exchange variable. No treatment effects on predawn water potential were observed but midday water potential decreased in response to throughfall exclusion. Soil moisture was decreased by fertilization but not throughfall exclusion.

Leaf area index (LAI) and intercepted photosynthetic active radiation (IPAR)

In 2012 and 2013, fertilization increased LAI and IPAR. As of July 2013, LAI averaged $2.1 \text{ m}^2 \text{ m}^{-2}$ in the fertilized treatment versus $1.5 \text{ m}^2 \text{ m}^{-2}$ without fertilization, and IPAR averaged 72% in the fertilized treatment versus 58% without fertilization. Throughfall exclusion has had no significant main or interactive effect on LAI or IPAR in 2012 or 2013.

Soil heterotrophic and autotrophic respiration

In summer 2012, root severing cores were installed to separate soil heterotrophic and autotrophic respiration at the Virginia Tier III site. Respiration initially increased inside the cores due to the disturbance of installation. After a period of equilibration, however, the respiration inside the core began to decrease relative to outside the core before stabilizing after approximately 65 days. At the point of stabilization, the respiration measured inside the root severing cores was about 25% lower than respiration measured adjacent to the cores. This suggests that the assumed partitioning of soil respiration (R_s) into equal proportions of heterotrophic (R_H) and autotrophic (R_A) may underestimate the amount of C stored in these systems.

Fate of applied fertilizer nitrogen

A research study is being conducted using fertilizers labeled with the stable isotope ^{15}N to track the fate of applied fertilizer N in plantation forests. The use of ^{15}N allows us to calculate how much and how quickly crop trees incorporate N applied from fertilizers. Additionally, because large N losses to the atmosphere can occur when using conventional fertilizers (urea), we are investigating whether enhanced efficiency fertilizers are able to reduce these gaseous losses. Enhanced efficiency fertilizers are treated with polymer coatings to slow the release of N to the soil solution or with chemicals that inhibit the N-releasing enzyme urease. We are also investigating the seasonal timing of fertilization, which is traditionally conducted in late

winter or early spring when plant available N may be less limiting compared to summer months. Finally, we are examining how much fertilizer derived N is retained by understory competition.

Eighteen sites were established near existing research studies across the entire range of loblolly pine plantations in the southern United States. Five fertilizer treatments were applied at two different times (late winter and summer in 2011 and once in late winter in 2012) in 100 m² circular plots with similar characteristics. Five additional plots were installed at the Tier III sites in Virginia and Georgia to investigate the impact of retaining the understory vegetation. After fertilizer application, measurements were taken to estimate gaseous and leaching losses of N. Foliar sampling was conducted every 6 weeks to estimate N uptake over the growing season. All components of the ecosystem were sampled at the end of the growing season to calculate the location of ¹⁵N. The preliminary results from one site near the Virginia Tier III study indicate that ¹⁵N enriched fertilizers are being incorporated in the aboveground of crop trees through the entire growing season. Recovery of ¹⁵N for above ground biomass was greatest in foliage for all treatments, followed by the stem from both summer and winter applications. Uptake of ¹⁵N continued through the entire growing season.

Sap flux density

Sap flux density at each Tier III site is being monitored by a network of thermal dissipation sensor probes. There are five such sensors per plot, for a total of 320 trees monitored across all four Tier III sites. Data from these sensors are measured every 60 seconds and averaged every 30 minutes. Preliminary results from the first nine months of data collection at the Virginia Tier III site indicate that sap flux density (J_S) declines steadily from summer to winter due to falling temperatures and atmospheric evaporative demand, and the lowest canopy conductance (G_C) values are found in July when the trees regulate their water use more tightly. A notable feature of the data is the tendency toward higher J_S and G_C in the fertilized treatment relative to the control in the summer months. At the Georgia Tier III installation, a significant interactive effect of throughfall exclusion and fertilization treatments was detected for monthly daytime averaged sap flux density (J_S), canopy stomatal conductance (G_S), and monthly daytime whole tree transpiration on a ground area (E_G) and leaf area (E_L) basis.

Fertilization increased LAI in both the ambient and rainfall exclusion treatments. However, the associated increase in monthly midday average J_S and the monthly sum of E_G in response to increased LAI from fertilization was observed only in the ambient rainfall treatment, suggesting tighter regulation of leaf water loss under rain exclusion. This is supported by reduced G_S and E_L in response to fertilization found only in the rain exclusion treatment.

Initial C and nutrient baselines estimated from existing Tier I data

Data from the Tier I sites has been included in the TerraC system and is being used by the Aim 2 group to model carbon and nutrient content in the Tier I sites with a range of models.

Assessment of climate, soil, genetics, and management impacts on soil GHG flux

Soil CO₂ efflux (Sf), microbial biomass carbon (MBC), and microbial biomass nitrogen (MBN) were measured in the spring and summer at the Cross Carbon Study near Cross, SC. The effects of clone (high and low growth efficiency) and silviculture (addition of logging residues [LR] to the soil at planting) on Sf, MBC, and MBN were examined using a 2x2 factorial treatment structure. Heterotrophic respiration was estimated by the root exclusion method.

Sf was 19% greater on average in LR treatments compared to Control ($p=0.013$). There was also a significant treatment effect on the reduction of Sf in the root exclusion pipes. Approximately 90 days after pipe installation, Sf was reduced by 38.3% in the Control treatment compared to only 15.3% in the LR

treatments (C vs. LR: $p=0.02$). In the spring, MBC and MBN in the LR treatments were 27% ($p=0.02$) and 31% ($p=0.03$), respectively greater than in Control treatments. Pipe insertion reduced MBC by 20% (pipe vs. no-pipe: $p=0.007$) but had no effect on MBN. These measurements will be taken quarterly.

The +LR treatments increased Sf by 15% ($p=0.04$) compared to -LR treatments. Clone had no effect on Sf and there was no clone x LR interaction; however, there was a strong clone x season interaction ($p=0.008$), where Sf was 17% greater in the BC clone in July. The root exclusion pipe significantly reduced Sf and the response magnitude varied with season. The Ra/Sf was greater in the summer (0.32) than in the spring (0.13) or fall (0.22). There were no clone, LR, or clone x LR effects on R_a . Similarly, clone had no effect on R_h ; however, +LR increased R_h 25% ($p=0.0001$). These early results suggest that genotype and management can alter Sf, R_a , and R_h .

At three of the Tier III sites (VA, OK, and GA), vented static chambers have been installed for the seasonal measurement of soil-atmosphere nitrous oxide (N_2O) and methane (CH_4) greenhouse gas fluxes. Preliminary data from the VA site show an increase in N_2O emissions and a decrease in CH_4 uptake following fertilization that have been sustained through June 2013 (second growing season following treatment). While throughfall reduction alone does not have a significant impact on the soil fluxes of these greenhouse gasses, the interacting effects of fertilization and throughfall reduction appear to exacerbate the increase in N_2O production and decrease in CH_4 consumption.

Regional C, nutrient, H₂O baselines and responses to management from measured Tier II data

Field data was collected on carbon and nutrient content in the first set of Tier II sites using the protocols developed by Aim 1. Carbon efflux measurements that separate heterotrophic and autotrophic respiration are scheduled to begin in Tier II sites in 2013 based on the established protocol.

Regionalize estimates of WUE for application in 3-PG and WaSSI

Wood cores from a subset of the Tier II sites have been collected for ^{13}C isotope analysis to determine water use efficiency (WUE) in the PINEMAP region.

Monthly WUE values were derived for the period 2007-2009 for mid-rotation and young stands at the Parker Track site and 2001-2008 for the Duke Forest site. It appears that WUE had little variation across the year, but WUE varied across stand age; the younger stand has lower values (1.97) than mid rotation values (2.34) at the Parker Track site.

Aim 2 (Modeling)

Improved process and hybrid models parameterized from network measurements

Using Tier I data sets from all states in the Southeast, we have made significant progress validating the 3-PG model across the loblolly pine region. In this analysis we have used the 3-PG physiological parameters published in Bryars et al. (2013). The Fertility Rating in 3-PG was set using site index estimated from 10 year height growth on the sites. Our analysis has shown that 3-PG can accurately estimate aboveground biomass and volume growth using this approach.

Given the importance of the fertility rating to 3-PG, 23 study sites that were part of a loblolly pine fertilization study trial were selected across the southeastern United States from Virginia to Texas. The study sites selected were unfertilized, unthinned, and received no competition control during the study period. Using these site measurements and a volume-SI crosswalk, the relationship between FR and SI was developed as:

$$FR = 1.190 / (1 + e^{(-5.899 + 2.45 * SI)})$$

This relationship was used in 3-PG to predict basal area and volume. When linear regression was carried out between observed and 3-PG-predicted values of basal area and volume using FR predicted using this equation, the R^2 value for basal area was found to be 0.88 and 0.93 for volume.

Analysis of sap flux data for stomatal responses to environmental drivers for Parker Tract Tier II site (Ameriflux Site US-NC2) has been completed for 2007-2009 and has begun for 2010-2012. These results will be analyzed in the same hierarchical Bayesian framework as data from the Duke FACE study (1998-2010) and integrated with those results, as well as those from Tier III sap flux data as it becomes available. These analyses will be used to update leaf area and water use efficiency related parameters in WaSSI, including scenarios for stand density management, fertilization, drought, and future atmospheric CO_2 concentrations.

Improved growth and yield models with climate inputs and C balance (initial prototype)

Basal area and dominant height growth and survival models incorporating general response to silvicultural treatments for loblolly pine stands were developed using Tier I network data. Growth models for treated stands were developed by multiplying baseline growth models with modifier response functions/multipliers accounting for effects of thinning, fertilization, and control of competing vegetation. All growth models were unbiased and had adequate performance in predicting basal area and dominant height following treatments. Models were developed to represent general growth trends in response to treatments.

Aim 3 (Genetics)

Version 1 of genetic deployment tool with provenance information

Texas A&M University: Analysis of the data has been conducted with a focus on age 15 height and diameter measurements and planted tree volume. Mean minimum temperature of the coldest month (MMIN) and aridity index (AI) were used as independent variables. The modeling efforts provided robust support for current and future seed deployment guidelines at the provenance level. Moreover, with focus primarily upon the climate at the seed source as a common evolutionary background, additional gains could be made from taking advantage of the considerable tree-to-tree genetic variation. Change in climate between provenance and the test site as the sole controlled parameter with other environmental factors assumed constant (e.g. site preparation, fertility, drainage) leaves room for further improvement of future loblolly pine productivity through application of better silvicultural methods, targeted seedling deployment supported by continued breeding and progeny testing and the integration of the two efforts.

North Carolina State University: Growth (height at age 8) and climate data were analyzed for 19 field test sites of the Plantation Selection Seed Source Study using multiple regression approaches. Main effects and higher order terms were fit to growth data to develop prediction models under climate change scenarios for the Southeast. A model with 19 predictors explained about 68% of the variation in height growth. Cross-validation showed that the predictive power of models was low, indicating that the problem is ill-conditioned due to co-linearity in the climate variables. In order to find parsimonious models that are stable, different approaches for model selection and parameter estimation were explored, namely the stepwise method combined with ordinary least squares (OLS), ridge regression, and LASSO regression. The results suggested that local seed sources perform very well in the Georgia-Florida coastal plains, and their estimated growth decreases as the seed sources are moved to the north. On the other hand, South Carolina seed sources exhibited a more robust performance relative to local seeds, specifically in North Carolina. We observed a rapid decline in performance of Virginia seed sources under the climate change scenarios when they were moved to southern regions. The models developed can be used as quantitative tools to predict the norm of reaction of seed sources under climatic (minimum temperatures) change scenarios.

University of Florida: Analysis of provenance progeny trials with 15 year height has been conducted with two sets of climate data (PRISM and SECC) using a multiple regression approach. The multicollinearity of the climate data was dealt with by first using LASSO, a Bayesian variable selector, to identify the most significant climate parameters. With the PRISM data, the most significant parameters are site mean winter monthly temperature, site mean coldest monthly temperature, site mean annual precipitation, provenance mean coldest monthly temperature, and provenance longitude. These explain 52% of the variation in height. With the SECC data, the same 5 climate variables were significant as well as an additional variable, site mean annual radiation. These six variables also explained 52% of the variation in height. To test the stability of the models, the height for Atlantic Coastal and Florida provenances was predicted based on climate variables across the Southeast. Overall, the ACP shows increased growth in the north with the tallest trees in central Georgia, Alabama, and Arkansas. The predictions in South Carolina are more variable. Somewhat unexpectedly, the Florida provenance shows a similar pattern with better growth north but extends further south into Florida. These preliminary results will be further validated.

Version 2 of genetic deployment tool with progeny information

All three institutions identified some measurement of winter temperature and water availability as key elements in the development of explanatory models. The next steps are to convert these to predictive equations and to produce regionally appropriate representation software.

Determine appropriate genome reduction methods for genotyping by sequencing (GBS)

The University of Florida is in the process of GBS of the CCLONES population using Agilent's SureSelect target enrichment in collaboration with a USDA-funded plant breeding training grant. In all, 850 individuals are being sequenced at 14,729 target loci. Libraries and selection are 80% complete.

North Carolina State University has collected 1,600 tissue samples from the PSSSS test site in Screven County, GA and completed DNA extraction and quantitation of those samples. Library construction for sequencing of PstI-MspI double-digest restriction fragments is complete, and data are in hand. In parallel, software development efforts are underway to create a pipeline for expedient analysis of the sequencing reads, including calling SNP haplotypes based on comparison to the loblolly pine reference genome sequence and haplotype-based analysis of the genomic basis of phenotypic variation measured at the Screven County, GA test site. SNP genotype calling is underway using the 660 billion basepairs of DNA sequence obtained from the Georgia PSSSS site, using both existing and novel software tools. Development of a haplotype-based method of analysis will follow in turn.

At Texas A&M University, application of the Agilent SureSelect Target Enrichment method led to the following conclusions: 1) multiplexing strategies worked well for capturing targeted sequences and SNP discovery; 2) higher multiplexing level reduces the coverage of each sample, but still provides high number of SNPs for efficient genotyping; and 3) sequencing depth for each sample can be increased by decreasing number of targeted genes. The DNA isolation work for the 387 trees we are going to genotype is completed, and we are moving to the library construction step now.

Aim 4 (Economics & Policy)

Assess policies and programs that may affect C mitigation in planted pine forests

We have completed a draft summary of market-based programs and policies that are likely to impact C mitigation, and have started work summarizing federal and state programs and policies. We have also identified and mapped forest carbon storage hotspots (areas of high carbon storage) and coldspots (areas of low carbon storage) in the state of Florida and the biophysical and forest management characteristics that are driving these hot/coldspots.

Regional market impacts based on business-as-usual assumptions

We have added welfare calculations to the regional timber market model (SRTS).

NPV analysis and regional market impacts of adaptation strategies

An economic framework has been developed and will be applied as soon as we have the information about predicted pine productivity change and carbon accounting under climate change from other Aims.

Document landowner adoption of mitigation and adaptation strategies

We have completed a first wave of surveys to estimate willingness to accept carbon offset payments by non-industrial private forest landowners in the Southeast, and data has been analyzed.

NPV and regional market impacts of altered disturbance risks

We have assessed economics of loblolly pine under the risk of climate change. Specifically, we have assessed: 1) the effect of potential changes in forest productivity coupled with increased disturbances due to climate change on the expected economic returns and optimal rotation age for southern non-industrial private forest landowners; 2) the impact of silvicultural strategies such as managing tree density to ameliorate the impact of disturbances on optimal forest management; 3) the effect of disturbance-resistant tree species on optimal forest management; and 4) the impact of climate change in the supply of C stored in commercial timber.

We also have integrated climate extremes and adaptations into the modeling of southern pine beetle (SPB) infestations. We are working on incorporating the predictions of future climate extremes under various IPCC emissions scenarios into the estimation of future SPB infestation risk.

Bioeconomic modeling of nontimber market ecosystem services

We developed an FIA database with plot-level understory species richness data from Timilsina et al.'s (2013) species richness predictive model which is now available in the TerraC database, and we are identifying biophysical and forest management characteristics to model ecosystem services (e.g., modeling carbon storage and species richness) for Florida. We are also developing an economic framework to assess changes in forest management and biophysical characteristics due to climate change and their impacts on ecosystem services.

We have also developed an ecosystem service provision level classification framework to examine, in a spatially explicit manner, output levels of carbon sequestration, timber production, and water yield provision and their interactions (i.e., synergies vs. tradeoffs) in slash pine ecosystems in North Florida. Literature on ecosystem service tradeoffs and synergies has been compiled as well as on the effect of biophysical drivers (e.g., age, basal area, tenure, silvicultural treatments, and disturbance regime) on these interactions.

Aim 5 (Education)

Report of audience assessment for PLT module

We completed a survey of secondary science teachers in the Southeast. The information gleaned is providing justifications for the Project Learning Tree/PINEMAP module and helping us prioritize activities and resources. These results have been shared with the Education Advisory Committee and PINEMAP collaborators through a research summary, PINEMAP newsletter article, and PINEMAP internal webinar.

Report of research on climate change education strategies

Data were collected at two summer science programs to determine whether connecting carbon lessons to climate change affects student interest and knowledge gain, whether student's attitudes about climate

change are influenced by their perception of their parents' opinions of climate change, and whether a discussion or a role play is more effective in getting students to discuss the variety of opinions about climate change.

Draft module and training ready for formative test

The final draft of the Project Learning Tree/PINEMAP secondary module was completed. The module contains 13 activities that are designed to introduce students to the relationship between southeastern forests and climate change, echoing every dimension of PINEMAP's research. Specifically, the goals of the module are to help students

- Understand how climate change could impact forests in the southeastern U.S.;
- Understand how forests can be managed to address changing climate conditions and to reduce greenhouse gas emissions;
- Enhance decision-making skills to make informed choices as consumers to mitigate climate change;
- Develop systems-thinking skills to see connections between climate change, forests, and people;
- Recognize that individual and community actions can help mitigate and adapt to climate change; and
- Become part of future community conversations about climate change and potential solutions.

More than 80 people helped develop the module through writing and editing, serving on the Education Advisory Committee, reviewing the module content for scientific accuracy, and developing online resources to help teachers use the materials. A new Education Advisory Committee, consisting of 8 formal and non-formal educators or curriculum specialists, was established in January 2013. This group will help guide the development of the online module resources and the formative evaluation.

A module web site was developed to provide teachers with online access to the module materials and to provide training to introduce activities and support teachers in using them

(<http://sfrc.ufl.edu/extension/ee/climate/>). We created the following teacher tools for online training:

- Tour the Activity: An overview of the activity and tips for leading the activity with students.
- Check Your Knowledge: A short quiz teachers can use to gauge their readiness to teach the activity.
- Explore More: Videos and interactive tools to learn about the topic or research related to the activity.

Finally, the formative evaluation plan was drafted and revised with input from the Education Advisory Committee.

Web-based course in multidisciplinary research for graduate students completed

The second and final offering of the course occurred in spring 2013 term. Nineteen students from 8 universities participated in the course.

Undergraduate research internships completed

Twelve undergraduate fellows began working at their mentors' host universities in mid- to late-May 2013. Interns remained at their host university through the 12 week internships. After internships concluded mid-August, students returned to their home universities for the fall semester and to participate in the undergraduate *Effective Communication Skills* course.

Undergraduate teaching and communication distance course completed

The undergraduate distance-delivered course, *Effective Communication Skills*, ended in December 2012. The course met this milestone with five of six students earning credit for completion. The course is in progress for the 2013 fellows.

Aim 6 (Extension)

Implement and strengthen forestry Extension/climatologist partnership

Aim 6 members attended the Southeast Climate Consortium meeting in November 2012, which provided an opportunity to network with and engage more climatologists and other researchers and Extension personnel in PINEMAP work.

Aim 6 is partnering with state climatologists Melissa Griffin and Pam Knox to develop climate-related information for fact sheets on climate and forestry interactions, including: 1) climate oscillations, 2) weather and climate, 3) climate change, 4) drought, 5) climate overview, and 6) extreme events. In addition, climatologists from various states are also assisting with PINEMAP Extension webinars and trainings.

Audience/needs assessment for Extension programs

We have completed the Texas FRESH (Forest Resources, Ecosystem Services, and Health) survey. The data has been analyzed and the draft report has been sent out for review. Aim 6 members also conducted a survey of professional foresters across the Southeast (includes consulting foresters, Extension foresters, and others). The 24 question survey was completed by more than 1,700 foresters yielding a 27% response rate. This survey examined forester and natural resource professionals' needs for continuing education programs on increasing forest productivity (particularly pine plantation productivity) and resilience to extreme weather, climate variability, and climate change with a focus toward developing the best approach for meeting perceived and actual needs. Survey questions were developed to glean information related to personal experiences and understanding of current and future effects of climate change on forestry management; attitudes and knowledge about climate change, climate variability, etc.; and climate resiliency and forest "weather-proofing" areas they are interested in learning more about. We are continuing analysis of survey data to identify which demographic variables influence climate change attitudes and whether climate change attitudes influence management actions.

In addition, Joshua Idassi conducted an inquiry of the 1890 Agroforestry consortium leadership to determine information needs for planning a PINEMAP climate change basics training held in May 2013.

Extension programs delivered

We have ongoing extension programs as listed in Appendix A. We are also planning four regional workshops on forest resiliency, which will incorporate PINEMAP information and will be supportive of PINEMAP goals. We will include feedback from completed audience assessments and evaluations as we continue to develop these workshops and more extension programs. A workshop was held in Huntsville, Alabama in May 2013. Twenty-five Extension specialists from 1890s Universities in the Southeast attended. The focus of the workshop was climate science, climate change, forestry and climate tools, and PINEMAP developments. In addition, PINEMAP AIM 6 members collaborated with Clemson University and University of Georgia's Forestry Extension Faculty to deliver a webinar based program for forest landowners in fall 2012. Topics included: 1. Introduction to Natural Resource Conservation; 2. Natural Resource Enterprise Considerations; 3. Wildlife Conservation (Introduction to Master Wildlifer); 4. Forest Management on Your Land (Introduction to Master Tree Farmer); and 5. Natural Resources Appreciative Values and Uses. Approximately 75 people attended each session, for a total count of 375 people; however, there were also 'viewing sites', where additional attendees watched the webinars.

Decision Support System (DSS) development

During January/February 2013, DSS developers gathered research results from Aim teams that could be used within the DSS.

In addition, a prototype DSS web site has been developed. The group is developing a list of land management decisions derived from the survey of professional foresters and by using internal knowledge of Aim 6 members. Eric Taylor has also been getting feedback on the DSS layout and design from a pilot group of about 12 professional foresters in the western Gulf region. This group plans to pilot test the DSS this summer.

DSS developers are working with the DSS subcommittee to determine how aim team research results can fit into the stakeholder decisions. We are prioritizing 3-5 items that can be developed comprehensively by the end of the project. Data from TerraC will be fed into the DSS using an interface that PINEMAP Data Manager Brandon Hoover developed. The PINEMAP data use agreement is being carefully considered during this process. Also, example code has been developed to display TerraC datasets on maps and time series graphs. The DSS will query and display data for gridded datasets using the THREDDS Data Server at the North Carolina State Climate Office.

Collaborations with other PINEMAP colleagues have been developed for the DSS, including the following:

- Francisco Escobedo and Nilesh Timilsina: carbon hotspot dataset and species richness data.
- Steve McNulty, Ge Sun, and other USFS colleagues: incorporating WaSSI carbon sequestration projections and TACCIMO GIS viewer into DSS.
- Damian Adams and Don Grebner: quantifying loss of trees per acre due to drought risk as related to certain management practices and forest types.
- Tom Byram and Ross Whetten: seed deployment tool.
- Tom Fox and the Forest Productivity Cooperative: DSS developers attended their meeting in June 2013 to learn more about their Lob DSS tool.

Broad Impacts

In a project of this scope, many broad impacts are built into our work plan. However, additional impacts arise that are not anticipated. Examples include:

- Opportunities for research on the PINEMAP Undergraduate Fellowship Program and similar research experiences for undergraduates. This analysis would categorize, define, and describe current summer undergraduate research experiences and/or internships within the natural resource discipline.
- Involving many people from many expertise areas in our secondary module development process through the advisory committee, expert review, pilot test, and incorporating student projects into undergraduate environmental education courses. These connections have provided opportunities to introduce PINEMAP research and to build relationships that will help us distribute and train educators to use the final module.
- Organization of an “Extension Climate Leadership Academy” training program with members of two other NIFA sponsored projects (one on Crops and the other one focused on animal agriculture) which will include training on climate science and how to understand/interpret it, as well as specific topic-based information on mitigating effects from climate change in three topic areas: crop production, animal production and forestry.
- Partnering with the ANREP CSI team to organize the National Extension Climate Science Initiative Conference during October 2013 in Minnesota.

Training

As of August 2013, 48 graduate students, 27 undergraduate students, 12 postdoctoral research associates, and 20 professional and technical staff have been trained under the PINEMAP project. Names and roles of these individuals are listed in Appendix B.

Concluding Statement

The southern pine ecosystem is one of the most economically and ecologically important forest ecosystems in North America. The PINEMAP project is integrating key research, education, and outreach networks to create and disseminate the knowledge that enables landowners to: harness planted pine forest productivity to mitigate atmospheric CO₂; more efficiently use nitrogen and other fertilizers; and adapt forest management approaches to increase resilience in the face of climate variability and change. In the third year of the project, we produced key products and results that will support these outcomes as described below.

- The silviculture and ecophysiology team is performing regionwide measurements of tree and stand growth, above and below ground carbon, changes in soil nutrient and water availability, whole-tree water use, leaf area development and canopy light capture, nitrogen fertilizer incorporation, and soil carbon dynamics.
- The modeling team validated the 3-PG (physiological principles of predicting growth) model for use in the loblolly pine region and improved growth and yield models to incorporate climate and carbon balance.
- The genetics team continued work on the development of a regional seed deployment tool and completed an assessment of current genotyping techniques to determine appropriate genome reduction methods.
- The economics and policy team initiated survey research to estimate willingness of non-industrial private landowners to accept carbon offset payments and preferences for carbon sequestration and continued efforts related to economic analyses on risk, regional market impacts, and policies and programs affecting carbon mitigation.
- The education team launched the second year of a regionwide undergraduate internship program; coordinated a distance graduate education course to prepare graduate students to address climate change mitigation and adaptation issues in southern pine forests; and completed the development of the draft module for high school students on southern pine forests and climate change.
- The extension team implemented a comprehensive audience assessment program, and is continuing development and dissemination of extension materials and programs, including fact sheets, webinars, and workshops.

Our focus on integration across disciplinary groups positions us to deliver the real-world outcomes embedded in our mission:

- Increased carbon sequestration from silvicultural and genetic enhancement of productivity and efficiency of fertilizer use, and resilience to climate variability and disturbance.
- Engaged and literate public with the capacity to make informed, practical decisions related to climate, forest ecosystems, and forest management.
- Public policy that supports sustainable management of planted pine under future climate scenarios.
- Enhanced capacity for regional, interdisciplinary collaboration among climate and forest scientists and Extension and education professionals.
- Enhanced connections between corporate and noncorporate forest landowners and forestry and climate researchers and education and outreach professionals.
- A more robust and resilient forest-based economy in the Southeast U.S.

Appendix A: Team Outputs

Products

Peer-reviewed publications

Aim 1 (Silviculture & Ecophysiology)

Albaugh, T.J., J.L. Stape, T.R. Fox, R.A. Rubilar, and H.L. Allen. 2012. Midrotation vegetation control and fertilization response in *Pinus taeda* and *Pinus elliottii* across the southeastern United States. *Southern Journal of Applied Forestry* 36(1):44-53. doi: <http://dx.doi.org/10.5849/sjaf.10-042>

Albaugh, T.J., T.R. Fox, C.A. Blinn, H.L. Allen, R.A. Rubilar, and J.L. Stape. Developing a new foliar-nutrient based method to predict response to competing vegetation control in *Pinus taeda*. *Southern Journal of Applied Forestry*, in press.

Campoe, O.C., J.L. Stape, T.J. Albaugh, H.L. Allen, T.R. Fox, R.A. Rubilar, and D. Binkley. 2013. Fertilization and irrigation effects on tree level aboveground net primary production, light interception and light use efficiency in a loblolly pine plantation. *Forest Ecology and Management* 288:43-48. doi: <http://dx.doi.org/10.1016/j.foreco.2012.05.026>

Carlson, C.A., T.R. Fox, H.L. Allen, T.A. Albaugh, J.L. Stape, and R.A. Rubilar. Growth responses of loblolly pine in the Southeast United States to midrotation applications of nitrogen, phosphorus, potassium and micronutrients. *Forest Science*, in press

Comerford, N.B., A.J. Franzluebbbers, M. Stromberger, L. Morris, D. Markewitz, and R. Moore. Ecosystem services derived from soil. *Soil Horizons*, in press.

Comerford, N.B., A. Franzluebbbers, M. Stromberger, L. Morris, D. Markewitz, and R. Moore. 2012. Ecosystem services derived from soil. *Soil Ecosystem Services – ASSSA Task Force Report*. Cincinnati, OH.

Johnsen, K. H., L.J. Samuelson, F.G. Sanchez, and R.J. Eaton. 2013. Soil carbon and nitrogen content and stabilization in mid-rotation, intensively managed sweetgum and loblolly pine stands. *Forest Ecology and Management* 302:144-153. doi: <http://dx.doi.org/10.1016/j.foreco.2013.03.016>

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Kiser, L.C. and T.R. Fox. 2012. Soil accumulation of nitrogen and phosphorus following annual fertilization of loblolly pine and sweetgum on sandy sites. *Soil Science Society of America Journal* 76:2278-2288. doi: <http://dx.doi.org/10.2136/sssaj2012.0118>

Kiser, L.C. and T.R. Fox. 2013. Foliage and litter chemistry, decomposition, and nutrient release in *Pinus taeda*. *Forests*, in press.

McDowell, N.G., R.A. Fisher, C. Xu, J.C. Domec, T. Hölttä, et al. 2013. Evaluating theories of drought-induced vegetation mortality using a multi-model-experiment framework. *Tansley Review New Phytologist*, in press.

Products

Peer-reviewed publications

- Noormets, A., S.G. McNulty, J.C. Domec, M.J. Gavazzi, G. Sun, and J. King. 2012. The role of harvest residue in rotation cycle carbon balance in loblolly pine plantations. Respiration partitioning approach. *Global Change Biology* 18:3186-3201.
doi: <http://dx.doi.org/10.1111/j.1365-2486.2012.02776.x>
- Rubilar, R.A., T.J. Albaugh, H.L. Allen, J.Alvarez, T.R. Fox, and J.L. Stape. 2013. Foliage development and leaf area duration in *Pinus radiata*. *Forest Ecology and Management* 304:455-463. doi: <http://dx.doi.org/10.1016/j.foreco.2013.05.044>
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Products

Peer-reviewed publications

Aim 2 (Modeling)

- Amateis, R.L. and H.E. Burkhart. 2013. Relating quantity, quality, and value to planting density for loblolly pine plantations. *Southern Journal of Applied Forestry* 37(2):97-101.
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- Sabatia, C.O. and H.E. Burkhart. 2013. Height and diameter relationships and distributions in loblolly pine stands of enhanced genetic material. *Forest Science* 59(3):278-289.
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Products

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Aim 3 (Genetics)

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Aim 4 (Economics & Policy)

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Products

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Products

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Aim 5 (Education)

- Monroe, M.C. 2012. Enhancing both Cooperative Extension and national environmental education resources. *Journal of Extension* 50(6): Article 6IAW6. <http://www.joe.org/joe/2012december/iw6.php>
- Monroe, M.C., A. Oxarart, and R.R. Plate. 2013. A role for environmental education in Climate Change for Secondary Science Educators. *Applied Environmental Education and Communication* 12:4-18. doi: <http://dx.doi.org/10.1080/1533015X.2013.795827>

Products

Peer-reviewed publications

Aim 6 (Extension)

Burnett, R.E., M.A. Megalos, A.J. Vuola, D.C. Adams, and M.C. Monroe. Educational needs assessment of North Carolina Cooperative Extension professionals' climate change perceptions, willingness, and perceived barriers to programming. *Journal of Extension*, in review.

Monroe, M.C. and D.C. Adams. 2012. Increasing response rates to web-based surveys. *Journal of Extension* 50(6): Article 6TOT7. <http://www.joe.org/joe/2012december/tt7.php>

Products

Other publications

Aim 2 (Modeling)

Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, and J. A. Moore Myers. 2012. *WaSSI Ecosystem Services Model, Version 2.0*. Web application.

Sun, G., P.V. Caldwell, A.P. Georgakakos, S. Arumugam, J. Cruise, R.T. McNider, A. Terando, P.A. Conrads, J. Feldt, V. Misra, L. Romolo, T.C. Rasmussen, S.G. McNulty, and D.A. Marion. 2012. Impacts of Climate Change and Variability on Water Resources in the Southeastern US, in: *Southeastern Regional Technical Report to the National Climate Change Assessment, Water Resources*. http://downloads.usgcrp.gov/NCA/Activities/NCA_SE_Technical_Report_FINAL_7-23-12.pdf

Aim 4 (Economics & Policy)

James, N.A. 2013. *Projecting Sustainability: Growth to Removals Dynamics*. M.S. Thesis, Raleigh, North Carolina: North Carolina State University. 74 p.

Joshi, O., D.L. Grebner, I.A. Munn, S.C. Grado, J.E. Henderson, and R.K. Grala. 2013. *A preliminary assessment of issues related to mill residue utilization in Mississippi*. In: conference proceeding of Southern Forest Economists' Workshop (SOFEW), 2012. Retrieved from /sofew.cfr.msstate.edu/.

Kreye, M., F.J. Escobedo, D.C. Adams, T. Stein, and T. Borisova. 2013. *Valuing the Ecosystem Services of Florida's Forest Conservation Programs: The Economic Benefits of Protecting Water Quality*. University of Florida- IFAS, EDIS, FOR 309 <https://edis.ifas.ufl.edu/fr377>

Aim 5 (Education)

Hall, S. and M. Monroe. 2013. *Addressing Climate Change through Biology Concepts*. PINEMAP Research Summary.

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Monroe, M., A. Oxarart, and A. Stenstrup. 2013. Southeastern forests and climate change: A Project Learning Tree secondary environmental education module, final draft. Gainesville: University of Florida. http://sfrc.ufl.edu/extension/ee/climate/wp-content/uploads/Module_Final.pdf

Products

Other publications

Aim 6 (Extension)

Fact sheets: published

Title	Author(s)
<i>Healthy Forests: Managing for Resilience</i>	Hilary Cole, Heather Dinon, Mark Megalos, and Christina Temple
<i>Healthy Forests: Invasive Plants and Your Forests</i>	Hilary Cole, Mark Megalos, and Christina Temple
<i>Protecting Your Forest Asset: Managing Risks in Changing Times</i>	Lisa Jennings, Leslie Boby, Mark Megalos, William Hubbard, and Emrys Treasure

Fact sheets: in development

Title	Author(s)
<i>Assessing Forest Vulnerability</i>	Mark Megalos and Heather Dinon
<i>Climate Change and Forestry</i>	Leslie Boby and Heather Dinon
<i>Climate Change in the Southeastern United States: Opportunities for Adaptation and Mitigation</i>	Anslei Foster and Joshua Idassi
<i>Climate Oscillations: Impacts to Forestry</i>	Heather Dinon and Ryan Boyles
<i>Drought and Southern Forests: The Importance of Forest Health and Resilience</i>	Rachel Burnett, Heather Dinon, Ryan Boyles, Mark Megalos, Eric Taylor, and Sean Burns
<i>Fire Risk and a Changing Climate</i>	Rachel Burnett
<i>Frequently Asked Questions about Climate Projections</i>	Heather Dinon & Ryan Boyles
<i>Glossary of Climate Terms</i>	Mark Megalos and Heather Dinon
<i>Herbicide Use Considerations</i>	Eric Taylor and Sean Burns
<i>Interpreting Uncertainty of Climate Model Projections</i>	Heather Dinon and Ryan Boyles
<i>Introduction to Weather and Climate</i>	Heather Dinon and Ryan Boyles
<i>Minimizing Forest Insect / Disease Risk: A Practical Landowner Guide</i>	Mark Megalos
<i>Misconceptions about Global Warming and Climate Change</i>	Heather Dinon and Ryan Boyles
<i>Obstacles to Delivering Climate Variability Programming to Traditional Audiences</i>	Martha Monroe and Mark Megalos
<i>Drought and Southern Forests: Management Practices</i>	Eric Taylor and Mark Megalos
<i>To Plant or Not To Plant: New Timber Stand Drought Risk Assessment</i>	Eric Taylor & Matt Bonham
<i>Water Cycle in Forested Lands with Emphasis on Silvopasture Systems</i>	Shareika Williams and Gwendolyn Boyd
<i>What's Under the Umbrella that is Climate?</i>	Heather Dinon and Ryan Boyles

Products

Audio/video products

Aim 1 (Silviculture & Ecophysiology)

Oklahoma State University PINEMAP video, OSU SunUp TV, October 13, 2012

<http://sunup.okstate.edu/category/seg/2012seg/101312-pinemap>

Aim 5 (Education)

Krantz, S. (Producer). 2013. Module introduction. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=Ifz7tvSsfII&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=3>

Krantz, S. (Producer). 2013. Global climate models. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=q13i0RHiuZg&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=10>

Krantz, S. (Producer). 2013. Systems thinking. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=kSeKzWxiuUg&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=8>

Krantz, S. (Producer). 2013. Forest profile: Private family landowner. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=zrk6BSeKkgY&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=9>

Krantz, S. (Producer). 2013. Loblolly pine genetics. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=fnQP-Vw9ArY&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=4>

Krantz, S. (Producer). 2013. Exploring the carbon cycle. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=PV1ac6gFyRY&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=7>

Krantz, S. (Producer). 2013. Measuring carbon sequestration. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=ozaBUI75c8M&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=1>

Krantz, S. (Producer). 2013. Using a clinometer. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=9zY3JcfaTkc&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=6>

Products

Audio/video products

Krantz, S. (Producer). 2013. Positive and negative externalities. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

http://www.youtube.com/watch?v=5_wOVSBigws&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=5

Krantz, S. (Producer). 2013. Using the life cycle inventory database. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

http://www.youtube.com/watch?v=FwE93ernvC4&feature=player_embedded

Krantz, S. (Producer). 2013. Life cycle analysis. Video from Southeastern Forests and Climate Change: A Project Learning Tree Secondary Environmental Education Module.

<http://www.youtube.com/watch?v=MwakzG79t0M&list=PLgM-uU3vOAbIVCkFxqkwGNQPkRL0Rs7gl&index=2>

Aim 6 (Extension)

Boby, L. and B. Hubbard. Forest Management in a Changing World (in draft). This is a 6 minute video which includes an interview with 2009 tree farmers of the year Wanda and Earl Barrs as they talk about what they've experienced on their forest and the changes they have witnessed.

Krantz, S. et al. Forest Management techniques from a Landowners' Perspective. 2013. Shelby developed this video, in conjunction with the video listed below, to test theories of information presentation and what landowners would be most receptive to.

Krantz, S. et al. 2013. Pine Management in a changing world: PINEMAP.

Events/Activities

Presentations

Aim 1 (Silviculture & Ecophysiology)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Akers, M.	PINEMAP Overview Presentation	Presentation (Meeting)	July 17-18, 2013	Plantation Management Research Cooperative Annual Advisory Committee Meeting, Athens, GA
Albaugh, T.J., T.R. Fox, J.L. Stape, C. Alvares, and M. Yanez	Silviculture of varietal <i>Pinus taeda</i> – Spacing and silviculture effects on varieties with different crown ideotypes	Presentation (Meeting)	May 26-30, 2013	Contact Meeting of the Forest Productivity Cooperative, Rio Negrinho, BR
Albaugh, T.J., T.R. Fox, J.L. Stape, C. Alvares, and M. Yanez	Silviculture of varietal <i>Pinus taeda</i> – Spacing and silviculture effects on varieties with different crown ideotypes	Presentation (Meeting)	June 3-7, 2013	Contact Meeting of the Forest Productivity Cooperative, Reynolds Homestead, VA
Albaugh, T.J., T.R. Fox, J.L. Stape, R.A. Rubilar, J. Alvarez, J.M. Vose	RAFES: Remote Assessment of Ecosystem Stress	Presentation (Meeting)	June 3-7, 2013	Contact Meeting of the Forest Productivity Cooperative, Reynolds Homestead, VA
Albaugh, T.J., T.R. Fox, J.L. Stape, R.A. Rubilar, H.L. Allen	Effects of imazapyr rate and application method in mid-rotation <i>Pinus taeda</i> stands	Presentation (Meeting)	March 5-7, 2013	17 th Biennial Southern Silvicultural Conference, Shreveport, LA
Albaugh, T.J., H.L. Allen, T.R. Fox, and C.A. Carlson	Identifying optimal rates and frequencies of nutrient application to achieve and maintain high rates of production in forest plantations	Presentation (Meeting)	October 15-18, 2012	Advisory Council meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Albaugh, T.J., T.R. Fox, J.L. Stape, R.A. Rubilar, and H.L. Allen	Effects of imazapyr rate and application method in mid-rotation <i>Pinus taeda</i> stands	Poster Presentation	March 5-7, 2013	17th Biennial Southern Silvicultural Conference, Shreveport, LA
Albaugh, T.J., T.R. Fox, and J.L. Stape	Silviculture of varietal <i>Pinus taeda</i> spacing and silvicultural effects on varieties with different crown ideotypes	Presentation (Meeting)	October 15-18, 2012	Advisory Council meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Alvarez, J., C. Alvarez, J. Stape, T.R. Fox, R. Rubilar, and T. Albaugh	Potential productivity modeling in South America and U.S.	Presentation (Meeting)	October 15-18, 2012	Advisory Council Meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Bartkowiak, S.M., IV and L.J. Samuelson	Effects of a 30% reduction in precipitation on transpiration and hydraulic properties of 7-year-old loblolly pine	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Bartkowiak, S.M., IV and L.J. Samuelson	Potential impacts of climate change on transpiration and hydraulic properties of 7-year-old loblolly pine	Poster Presentation	August 5-9, 2013	98 th Ecological Society of America Meeting, Minneapolis, MN
Caudill, B., M. Wightman, G. Lokuta, T.A. Martin, and E.J. Jokela	Characterization of top 20cm of soil profile for PINEMAP Tier III site in Taylor Co., FL	Presentation (Conference)	March 5-7, 2013	17th Biennial Southern Silvicultural Conference, Shreveport, LA
Clark, J.E., S.M. Bartkowiak, IV, and L.J. Samuelson	Impact of rainfall manipulation and fertilization on light and water use efficiency in 6-year-old loblolly pine	Presentation (Conference)	August 5-10, 2012	97th Ecological Society of America Annual Meeting, Portland, OR

Events/Activities

Presentations

Aim 1 (Silviculture & Ecophysiology)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Clark, J.E. and L.J. Samuelson	Ecophysiological Responses of Loblolly Pine to Rainfall Manipulation and Fertilization at the Georgia Tier III site	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Clark, J.E. and L.J. Samuelson	Ecophysiological Responses of Loblolly Pine to Rainfall Manipulation and Fertilization at the Georgia Tier III site	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Clark, J.E. and L.J. Samuelson	Early Impacts of Rainfall Manipulation and Fertilization on the Ecophysiology of Loblolly Pine at the Georgia PINEMAP Tier III Experiment	Poster Presentation	March 5-7, 2013	17th Biennial Southern Silvicultural Conference, Shreveport, LA
Clark, Z., M. Kane, D. Markewitz, D. Zhao, and M. Akers	Effects of Site and Silvicultural Practices on Non-Planted Vegetation Composition, Abundance and Development in Loblolly Pine (<i>Pinus taeda</i>) Plantations	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Domec, J.C., J.S. King, J. Ogee, A. Noormets, J. Warren, F.C. Meinzer, G. Sun, Jordan-Meille, E. Martineau, R.J. Brooks, J.P. Laclau, P.B. Laclau, and S.G. McNulty	Convergence of the effect of root hydraulic functioning and root hydraulic redistribution on ecosystem water and carbon balance across divergent forest ecosystems	Presentation (Meeting)	December 3-7, 2012	45th AGU Fall Meeting, San Francisco, CA
Fox, T.R.	PINEMAP Pine Integrated Network: Education, Mitigation and Adaptation Project: Mapping the future of pine management in a changing world	Presentation (Meeting)	October 15-18, 2012	Advisory Council Meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Fox, T.R., J. Raymond, and A. Werner	Use of ¹⁵ N to Trace Applied Fertilizer Nitrogen in Douglas-Fir, Loblolly Pine and Walnut Forest Plantations to Evaluate Fertilizer Uptake Efficiency and Ecosystem Fate	Presentation (Meeting)	October 15-18, 2012	Advisory Council Meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Fox, T.R., T.A. Martin, and G.F. Peter	Leveraging 50 years of university-corporate-government forestry research cooperation	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Gavazzi, M.J., S.G. McNulty, A. Noormets, and E. Treasure	Management effects on soil respiration in North Carolina coastal plain loblolly pine plantations	Presentation (Meeting)	December 3-7, 2012	45th AGU Fall Meeting, San Francisco, CA
Heim, B.C., J.R. Seiler, and B.D. Strahm	Response of heterotrophic and autotrophic soil respiration to simulated drought in managed southern pine forests	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Heim, B.C., J.R. Seiler, and B.D. Strahm	Loblolly pine heterotrophic and autotrophic soil respiration as influenced by fertilization and reduced throughfall	Presentation (Conference)	March 4-7, 2013	17th Biennial Southern Silvicultural Research Conference, Shreveport, LA

Events/Activities

Presentations

Aim 1 (Silviculture & Ecophysiology)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Kiser, L.C. and T.R. Fox	Site and silvicultural effects on root growth and nutrient content of 4 loblolly pine (<i>Pinus taeda</i> L.) clones	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Laviner, A. and T.R. Fox	Soil Water Supply in the Virginia Throughfall Exclusion by Fertilization Experiment	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Laviner, A. and T.R. Fox	Water Relations in a Throughfall Exclusion Experiment in a Loblolly Pine Plantation	Poster Presentation	June 16-20, 2013	North American Forest Soils Conference, Whitefish, MT
Lin, W., A. Noormets, J.-C. Domec, J. King, G. Sun, and S. McNulty	A conifer-friendly high-throughput α -cellulose extraction method to analyze $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ isotope ratios	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Lin, W., A. Noormets, J.-C. Domec, J. King, G. Sun, and S. McNulty	A conifer-friendly high-throughput α -cellulose extraction method to analyze $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ isotope ratio analysis	Presentation (Meeting)	December 3-7, 2012	45th AGU Fall Meeting, San Francisco, CA
Lin, W., A. Noormets, J.-C. Domec, J. King, G. Sun, and S. McNulty	A conifer-friendly high-throughput α -cellulose extraction method to analyze $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ isotope ratios	Poster Presentation	March 9, 2013	Graduate Student Research Symposium of North Carolina State University, Raleigh, NC
Lokuta, G., A. Milligan, B. Gottlob, T. Martin, and E. Jokela	PINEMAP Florida Tier III Site Overview	Poster Presentation	February 13, 2013	REACCH Second Annual Meeting, Portland, OR
Luedtke, C.L., D.P. Aubrey, M.A. McGuire, and R.O. Teskey	Dissolved $[\text{CO}_2]$ in xylem sap of C3 annuals, shrubs, vines, and bamboo	Poster Presentation	August 9, 2012	97 th Ecological Society of America Annual Meeting, Portland, OR
Qi, Ji (Jill) and D. Markewitz	Effect of Drier Summers on Deep Soil Carbon	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Maggard, A.O, C. Meek, R. Will, D. Wilson, T. Hennessey, J. Pike, C. Ausmus, and J. Vogel	Preliminary leaf gas exchange and soil CO_2 efflux results for loblolly pine (<i>Pinus taeda</i> L.) plantations experiencing partial rainfall exclusion and fertilization in Oklahoma	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Maggard, A., C. Meek, R. Will, D. Wilson, T. Hennessey, J. Pike, C. Ausmus, J. Vogel, and J. West	Preliminary leaf gas exchange and soil CO_2 efflux results for loblolly pine (<i>Pinus taeda</i> L.) plantations experiencing partial rainfall exclusion and fertilization in Oklahoma	Presentation (Conference)	March 4-7, 2013	17th Biennial Southern Silvicultural Research Conference, Shreveport, LA
Maier, C. D. McInnis, and K. Johnsen	Partitioning root and heterotrophic respiration from soil CO_2 efflux in clonal loblolly pine plantations that differ in growth efficiency and carbon allocation	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA

Events/Activities

Presentations

Aim 1 (Silviculture & Ecophysiology)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Maier, C. D. McInnis, and K. Johnsen	Partitioning root and heterotrophic respiration from soil CO ₂ efflux in clonal loblolly pine plantations that differ in growth efficiency and carbon allocation	Poster Presentation	August 4-9, 2013	98 th Ecological Society of America, Minneapolis, MN
Maier, C.A., K. Johnsen, and P. Dougherty	Effect of Harvest Residue Management on Nutrient Cycling and Tree Growth in a Young Loblolly Pine Plantation	Presentation Symposium	November 27-28, 2012	IUFRO Symposium “Nutrient Dynamics of Planted Forests” Vancouver, WA
Maier, C.A.	Effects of harvest residue management on tree productivity and carbon pools in clonal loblolly pine stands	Presentation Meeting	October 15-17, 2012	Annual Meeting of the Forest Nutrition Cooperative, Chapel Hill, NC
Markewitz, D., M. Kane, M. Akers, J. Qi, and J. Lord	N ₂ O Fluxes under managed pine in response to throughfall and fertilization: Study Initiation	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Markewitz, D. and L. Boby	PINEMAP: Assessing the role of pine plantations in climate change adaptation and mitigation	Presentation (Meeting)	August 2012	Warnell Seminar Series The University of Georgia, Athens, GA.
Markewitz, D. and L. Boby	PINEMAP: Southern Pines, Carbon, and Climate Change	Webinar	January 9, 2013	Georgia Initiative for Climate and Society, The University of Georgia
Markewitz, D. and L. Boby	PINEMAP: Assessing the role of pine plantations in climate change adaptation and Mitigation	Presentation (Seminar)	August 23, 2012	UGA Warnell School of Forestry and Natural Resources Seminar Series, Athens, GA
Meeks, A., J.L. Stape, and T. Albaugh	Incorporating mid-rotation competing vegetation into the 3-PG model for Loblolly pine plantations in the Southeastern United States	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Minick, K. T.R. Fox, B.L. Strahm, E. Sucre and Z. Leggett	Soil Organic Matter Fractions in Loblolly Pine Forests Intercropped with Switchgrass in Coastal North Carolina	Presentation (Meeting)	October 15-18, 2012	Advisory Council Meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Minick, K.J., B.L. Strahm, T.R. Fox, E. Sucre, and Z. Leggett	Switchgrass growth in southern loblolly pine forests alters soil organic carbon and N fractions under bedded rows of pine trees	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Nichols, L., T.R. Fox, B. L. Strahm, J. Seiler, E. Sucre, and Z. Leggett	The impact of low molecular weight organic acids and dissolved organic carbon on microbial biomass in a loblolly pine and switchgrass intercropped system	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Noormets A., G. Miao, J.C. Domec, S.G. McNulty, G. Sun, and J.S. King	CO ₂ and CH ₄ exchange in an undisturbed coastal forested wetland in North Carolina	Presentation (Meeting)	December 3-7, 2012	45th AGU Fall Meeting. San Francisco, CA
Raymond, J. and T.R. Fox	Uptake of ¹⁵ N labeled fertilizer in loblolly pine plantations	Presentation (Meeting)	October 15-18, 2012	Advisory Council Meeting of the Forest Productivity Cooperative, Chapel Hill, NC

Events/Activities

Presentations

Aim 1 (Silviculture & Ecophysiology)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Raymond, J. and T.R. Fox	Use of Stable Isotopes to Trace the Fate of Applied Nitrogen in Forest Plantations to Evaluate Fertilizer Efficiency and Ecosystem Impacts (CAFS 10.33 Southeast Region)	Presentation (Meeting)	June 26-28, 2012	NSF Center For Advanced Forestry 2012 Meeting
Samuelson, L.J. and J. Clark	Early impacts of rainfall manipulation and fertilization of the ecophysiology of loblolly pine at the Georgia PINEMAP Tier 3 experiment	Presentation (Meeting)	December 3-7, 2012	45th AGU Fall Meeting. San Francisco, CA
Sun G., Y. Fang, P. Caldwell, A. Noormets, J.C. Domec, S.G. McNulty, J.S. King, S. McLaughlin, J. Uddling, and J. Chen	Environmental Controls of Ecosystem Evapotranspiration (ET): Why generalized ET models do not work for forests?	Presentation (Meeting)	December 3-7, 2012	45th AGU Fall Meeting. San Francisco, CA
Vogel, J., R.E. Will, D.S. Wilson, M. Wigley, J.B. West, and L. Zhai	Implementation of the PINEMAP carbon sampling protocol for six Tier II plots in the Western Gulf Region	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Wang, Y. and R. Teskey	Sensitivity analysis of 3-PG model for <i>Pinus taeda</i> (loblolly pine)	Poster Presentation	August 5-10, 2012	Ecological Society of America 97th Annual Meeting, Portland, OR
Ward, E.J., J.C. Domec, G. Sun, S. McNulty, J. King, and A. Noormets	Transpiration and Canopy Conductance at the Virginia Tier 3 Site	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Ward, E.J., J.C. Domec, G. Sun, S. McNulty, J. King, and A. Noormets	Transpiration and Canopy Conductance of Loblolly Pine with Fertilization and Throughfall Exclusion	Poster Presentation	June 5, 2013	North Carolina State University Post-Doctoral Research Symposium, Raleigh, NC
Ward, E.J., J.C. Domec, G. Sun, S. McNulty, J. King, and A. Noormets	Transpiration and Canopy Conductance of Loblolly Pine with Fertilization and Throughfall Exclusion	Poster Presentation	August 9, 2013	Ecological Society of America Annual Meeting, Minneapolis, MN
Werner, A. and T.R. Fox	Uptake efficiencies of ¹⁵ N enriched enhanced efficiency fertilizers in a <i>Pinus taeda</i> L.	Presentation (Conference)	October 21-24, 2012	Soil Science Society of America Annual Meeting, Cincinnati, OH
Wightman, M.	Loblolly pine water relations in response to fertilization and throughfall exclusion	Presentation (Meeting)	September 26-27, 2012	Forest Biology Research Cooperative Annual Advisory Council Meeting, Gainesville, FL
Wightman, M., T. Martin, E. Jokela, C. Gonzalez, and W. Cropper	The Impact of Fertilization and Throughfall Exclusion on Loblolly Pine Growth and Water Use	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Wightman, M., T. Martin, E. Jokela, C. Gonzalez-Benecke, and W. Cropper	The impact of fertilization and throughfall exclusion on loblolly pine growth and water use	Presentation (Conference)	March 4-7, 2013	17th Biennial Southern Silvicultural Research Conference, Shreveport, LA

Events/Activities

Presentations

Aim 1 (Silviculture & Ecophysiology)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Wightman, M., T. Martin, E. Jokela, C. Gonzalez-Benecke, and W. Cropper	The impact of fertilization and throughfall exclusion on loblolly pine growth and water use	Poster Presentation	April 2-3, 2013	Sustaining Economies and Natural Resources in a Changing World: Key Role of Land Grant Universities Symposium
Wang, Y. and Teskey, R.O.	Using 3-PG lob model to predict southeastern region <i>Pinus taeda</i> (loblolly pine) productivity	Presentation (Conference)	March 5-7, 2013	17th Biennial Southern Silvicultural Research Conference, Shreveport, LA
Will, R.	Preliminary results from Tier III studies	Presentation (Meeting)	April 24, 2013	PINEMAP 2013 Annual Meeting, Athens, GA
Will, R.	Advancing silviculture in an era of climate change: An overview of PINEMAP	Presentation (Meeting)	May 15, 2013	Western Gulf Forest Tree Improvement Program, Contact Meeting, Idabel, OK
Will, R., C. Meeks, R. Heinemann, R. Holeman	Tier III PINEMAP field tour	Presentation (Field Tour)	May 15, 2013	Western Gulf Forest Tree Improvement Program, Contact Meeting, Idabel, OK
Wilson, E., J. West, and J. Vogel	The effects of water stress on variability in mesophyll conductance of loblolly pine (<i>Pinus taeda</i> L.) leaves	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Yanez, M., T.R. Fox, and J. R. Seiler	Assessing leaf-level physiology on loblolly pine varieties under different silvicultural treatments	Presentation (Meeting)	October 15-18, 2012	Advisory Council Meeting of the Forest Productivity Cooperative, Chapel Hill, NC
Yang, J., C.M. Luedtke, M.K. Akers, and R.O. Teskey	Throughfall exclusion and fertilization effects on soil CO ₂ efflux at a loblolly pine plantation in Georgia	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Zhang, Y.	Effects of climate change and forest management on belowground carbon cycling	Presentation (Meeting)	2013	Department of Ecosystem Science and Management Seminar Series, College Station, TX
Zhang, Y., J. West, and J. Vogel	Effect of climate change, forest management and genetic differences on soil carbon sequestration in southeastern US loblolly pine forests	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
	PINEMAP Presentation	Presentation (Meeting)	October 16, 2012	Concepcion Forest Productivity Cooperative Annual Advisory Committee Meeting, Chapel Hill, NC
	PINEMAP Presentation	Presentation (Meeting)	September 27, 2012	Forest Biology Research Cooperative Annual Advisory Council Meeting, Gainesville, FL

Events/Activities

Presentations

Aim 2 (Modeling)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Burkhart, H.E.	Initial tree spacing and thinning impacts on pine wood quality	Presentation (Meeting)	June 6, 2012	North Carolina Society of American Foresters meeting, Rocky Mount, NC
Burkhart, H.E.	Planning initial spacing and thinning to optimize value	Presentation (Meeting)	March 13, 2012	Lexington County Forestry Association meeting, Batesburg-Leesville, SC
Burkhart, H.E.	Modeling genetic improvement effects on growth and value of forest plantations	Presentation (Conference)	June 6, 2013	Southern Forest Tree Improvement Conference, Clemson, SC
Burkhart, H.E. and R.L. Amateis	Plot installations for modeling growth and yield of loblolly pine plantations	Presentation (Conference)	September 20-21, 2012	International Workshop at Beijing Forestry University, Beijing, China
Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, and J. A. Moore Myers	Modeling the individual and cumulative impacts of anthropogenic activities and climate change on water resources in data-rich and data-poor regions	Presentation (Conference)	September 24-27, 2012	HydroPredict 2012 International Interdisciplinary Conference on Predictions for Hydrology, Ecology, and Water Resource Management, Vienna, Austria
Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, and J. A. Moore Myers	Potential Impacts of Water Withdrawals, Impervious Cover, and Climate Change on River Flows Across the Conterminous United States	Presentation (Conference)	September 30-October 5, 2012	EcoSummit 2012 - Ecological Sustainability: Restoring the Planet's Ecosystem Services, Columbus, OH
Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, and J. A. Moore Myers	Water Supply Stress Index (WaSSI) Model, Forest Threat Factsheet no. 6, July 2012	White Paper/Fact Sheet	July 2012	
Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, and J. A. Moore Myers	WaSSI Ecosystem Services Model, Version 2.0	User Guide	October 2012	
Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, J. A. Moore Myers, and R. Bhattarai	Predicting the impact of global change on water supply stress in the conterminous U.S.	Presentation (Conference)	July 29-August 1, 2012	2012 ASABE Annual International Meeting, Dallas, TX
Fang, Y., J.L. Stape, T. Fox, T. Albaugh, and C. Maier	Simulating loblolly pine soil carbon dynamics for two contrasting Piedmont soils under different climate change scenarios	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Ford, C.R., S.H. Laseter, P. Caldwell, G. Sun, and J.M. Vose	Drought, exurban expansion, and water yield in southern forest ecosystems (Published abstract, http://eco.confex.com/eco/2012/webprogram/Paper33288.html)	Presentation (Conference)	August 5-10, 2012	Ecological Society of America Annual Meeting in Portland, OR
Gopalakrishnan, R., R. Wynne, and V. Thomas	Efficacy of using heterogeneous LIDAR datasets in predicting tree heights over a large region	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Gopalakrishnan, R., V. Thomas, J. Coulston, and R. Wynne	Efficacy of using heterogeneous lidar in predicting canopy heights over a large region	Presentation (Conference)	October 9-11, 2013	SilviLaser 2013, Beijing, China

Events/Activities

Presentations

Aim 2 (Modeling)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Gyawali, N. and H.E. Burkhart	General response functions for silvicultural treatments and genetic improvement	Presentation (Meeting)	October 1-2, 2012	Northeast Mensurationists Organization meeting, State College, PA
McNulty, S.	Regional carbon sequestration and climate change: It's all about water	Presentation (Meeting)	April 24, 2013	PINEMAP 2013 Annual Meeting
Patarasuk, R., S. Grunwald, C.W. Ross, X Xiong, B. Cao, and B. Hoover	A Spatially-Explicit Landscape Modeling Approach to Assess the Growth of Loblolly Pine Forests	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Ross, C.W., S. Grunwald, S. Gerger, L. Kobziar, and T. Schurr	Assessing the Effects of Drought and Fire Disturbance in Southern Pine	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Sabatia, C.O. and H.E. Burkhart	Tree-size based competition indices for modeling individual tree basal area growth in genetically enhanced loblolly pine	Presentation (Meeting)	October 8-9, 2012	Southern Mensurationists meeting, Jacksonville, FL
Sabatia, C.O. and H.E. Burkhart	A comparison of a non-parametric and a parametric approach for predicting loblolly pine site index from biophysical variables	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Timilsina, N., F. Escobedo, A. Abd-Elrahman, W.P. Cropper, Jr., S. Delphin, and S. Lambert	A framework for mapping carbon storage hotspots and determining optimal forest structure and management regime characteristics	Poster Presentation	August 7-12, 2011	96th ESA Annual Meeting, Austin, TX
Wang, Y. and R.O. Teskey	Using 3-PG lob model to predict southeastern region <i>Pinus taeda</i> (loblolly pine) productivity	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Ward, E.J., A. Noormets, J.-C. Domec, J. King, G. Sun, S. McNulty	Data-model integration in the PINEMAP project	Poster Presentation	October 10, 2012	RCN FORECAST Conference, Woods Hole, MA

Aim 3 (Genetics)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Byram, T.	Strengths and weaknesses of universal response function approaches for support of deployment decisions	Presentation (Meeting)	April 24, 2013	PINEMAP 2013 Annual Meeting, Athens, GA
Byram, T.	WGFTIP Seed Source Study and Seed Movement	Presentation (Meeting)	May 16, 2013	WGFTIP Contact Representatives Meeting
Byram, T., T. Koralewski	A climate change response function for loblolly pine (<i>Pinus taeda</i> L.) from the Western Gulf region of the United States	Presentation (Conference)	September 11, 2013	Southern Forest Tree Improvement Conference, Clemson, SC

Events/Activities

Presentations

Aim 3 (Genetics)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Farjat, A., F. Isik, R. Whetten, and S. McKeand	Modeling the Growth of Loblolly Pine in the Southeastern United States	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Holliday, J.A. and L. Zhou	Toward genome-wide association mapping in a model tree	Presentation (Meeting)	October 31, 2012	Texas Tech University Department of Biology Seminar, Lubbock, TX
Holliday, J.A. and L. Zhou	Toward genome-wide association mapping in a model tree	Presentation (Meeting)	October 15, 2012	University of Maryland Department of Plant Science Seminar, College Park, MD
Isik, F.	Universal Response Function development from the Plantation Seed Selection Source Study field trial data	Presentation (Meeting)	October 25, 2012	North Carolina State Cooperative Tree Improvement Program Contact Meeting, Asheville, NC
Koralewski, T.E, T.D. Byram, E.M. Raley	A climate change response function for loblolly pine (<i>Pinus taeda</i> L.) from the Western Gulf region of the United States	Presentation (Conference)	February 4-7, 2013	Breeding for Value in a Changing World, Jacksonville, FL
Koralewski, T.E, T.D. Byram, E.M. Raley	A climate change response function for loblolly pine (<i>Pinus taeda</i> L.) from the Western Gulf region of the United States	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Krutovsky, K.V.	Forest genomics for mitigating climate change and breeding resilient trees, keynote presentation	Presentation (Conference)	October 3-5, 2012	AdapCAR and IUFRO (WP 2.02.00) meeting, Genetic Aspects of Adaptation and Mitigation: Forest Health, Wood Quality, and Biomass Production, Riga, Latvia
Krutovsky, K.V.	Forest ecogenomics and genomic selection for mitigating climate change and breeding resilient trees	Presentation (Conference)	October 16-17, 2012	Final Conference and Workshops of Noveltree Project, Tree Breeding and Evolutionary Biology: New Synergies to Tackle the Impact of Climate Change in the 21st Century, Helsinki, Finland
Lu, M., C. Loopstra, and K. Krutovsky	Preliminary SNP Discovery in Loblolly Pine (<i>Pinus taeda</i> L.) Exome	Presentation (Conference)	January 12-16, 2013	P0459. Plant and Animal Genome XXI
Lu, M., C. Loopstra, and K. Krutovsky	Genome Target Sequencing in Loblolly Pine (<i>Pinus taeda</i> L.) using Different Multiplexing Strategies	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Martin, T.A., G.F. Peter, T. Byram, and R. Whetten	Genetics research and outreach in support of enhanced climate adaptation and mitigation in southern pine	Presentation (Meeting)	October 22-24, 2012	NIFA Project Directors' meeting, Cincinnati, OH
Townsend, L. and R. Whetten	Identifying Genetic Variation in Site Adaptability in Loblolly Pine	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA

Events/Activities

Presentations

Aim 3 (Genetics)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Whetten, R.	Genetic Approaches to Understanding and Increasing the Resilience of Pine Plantations to Climate Change	Webinar	November 16, 2012	PINEMAP Internal Webinar Series
Whetten, R.	Rust resistance screening and new molecular marker methods for pine	Presentation (Meeting)	October 24, 2012	North Carolina State Cooperative Tree Improvement Program Contact Meeting, Asheville, NC
Whetten, R.	The Pine Reference Genome Sequence and Applied Tree Breeding Programs	Presentation (Conference)	January 12, 2013	Pine Reference Genome Workshop at the 21st International Plant and Animal Genome Conference, San Diego CA USA
Zhang, J., S. Gezan, and G.F. Peter	Integrating Climate and Genetic Effects of Loblolly Pine by Universal Response Functions	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Zhao, L. and J.A. Holliday	Targeted enrichment of the black cottonwood (<i>Populus trichocarpa</i>) gene space using sequence capture	Presentation (Conference)	January 12-16, 2013	Plant and Animal Genome Conference. San Diego, CA

Aim 4 (Economics & Policy)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Abt, R.C.	Bioenergy demand and the southern forest resource	Presentation (Meeting)	October 2012	Soil and Mulch Producers Council, Atlanta, GA
Abt, R.C. and C.S. Galik	Southeastern U.S. Forest Bio-Economic Dynamics: The Impact of Spatial and Temporal Scale on Carbon Accounting	Presentation (Meeting)	September 21, 2012	Nicholas Institute for Environmental Policy Solutions & UPEP Environmental Institutions Seminar Series
Abt, R.C. and C.S. Galik	Southeastern U.S. Forest Bio-Economic Dynamics: The Impact of Spatial and Temporal Scale on Carbon Accounting	Webinar	November 15, 2012	ERPI Research Meeting Webinar
Abt, R.C. and K.L. Abt	The carbon impact of increased loblolly pine growth: Potential market and land use feedback	Webinar	December 12, 2012	PINEMAP Aim 4 Webinar
Abt, R. and P. Dwivedi	Carbon consequences of changes in wood supply and product demand from pine plantations: Preliminary results from market and life cycle analysis	Presentation (Meeting)	April 24, 2013	PINEMAP 2013 Annual Meeting
Adams, D.C., J. Soto, and F. Escobedo	Estimating the Supply Of Forest Carbon Offsets: A Comparison Of Best-Worst And Discrete Choice Valuation Methods	Presentation (Conference)	December 10-14, 2012	ACES and Ecosystem Markets Conference, Ft. Lauderdale, FL

Events/Activities

Presentations

Aim 4 (Economics & Policy)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Cademus, R., F.J. Escobedo, A. Abd-Elrahman, and M.J. Cohen	Evaluating and Mapping Interactions Among Multiple Ecosystem Services	Poster Presentation	April 2-3, 2013	Sustaining Economies and Natural Resources in a Changing World: Key Role of Land Grant Universities, Gainesville, FL
Dwivedi, P.	Does Wood-based Electricity Generation Reduce GHG Emissions? An Exploration Considering Forestland Holdings, Harvest Age, and Power Plant Capacities	Webinar	October 19, 2012	PINEMAP Internal Webinar Series
Escobedo, F.	Reducing vulnerabilities to climate change and increasing biodiversity	Presentation (Workshop)	July 23-24, 2013	USDA Forest Service International Programs Workshop, San Salvador, El Salvador
Grala, R.K., D.L. Grebner, I.A. Munn, and A. Hussain	Capacity of southern mills to utilize woody residues for bioenergy production	Presentation (Conference)	March 10-12, 2013	Southern Forest Economics Workers Annual Meeting in Auburn, Alabama
Grala, R.K., E. Mutandwa, I.A. Munn, D.L. Grebner, S.C. Grado, A. Hussain, and D.R. Petrolia	Willingness to Mississippi's forest landowners to manage their forests for ecosystems services.	Presentation (Conference)	March 10-12, 2013	Southern Forest Economics Workers Annual Meeting in Auburn, Alabama
Joshi, O., D.L. Grebner, I.A. Munn, A. Hussain, and S.R. Gruchy	Analyzing landowners' preferred harvesting methods for supplying feedstock to potential wood-based bioenergy industries: A choice experiment approach	Presentation (Conference)	October 24-28, 2012	Society of American Foresters National Convention, Spokane, WA
Joshi, O., D.L. Grebner, J.E. Henderson, S.C. Grado, and I.A. Munn	Input-output modeling of wood-based bioenergy industries in Mississippi.	Presentation (Conference)	March 10-12, 2013	Southern Forest Economics Workers Annual Meeting in Auburn, Alabama
Joshi, O., D.L. Grebner, I.A. Munn, S.C. Grado, R.K. Grala, and J.E. Henderson	An econometric analysis of utilizing unused woody biomass from wood processing facilities in Mississippi	Presentation (Conference)	September 9-12, 2012	Fourth International Faustmann Symposium, Saariselkä, Lapland, Finland
Khanal, P., D.L. Grebner, I.A. Munn, S.C. Grado, J.E. Henderson, O. Joshi., and R.K. Grala	Determining Optimum Carbon Sequestration Strategies for Pine Plantations in Nonindustrial Private Forestlands of Mississippi	Poster Presentation	October 24-28, 2012	Society of American Foresters National Convention, Spokane, WA
Khanal, P., D.L. Grebner, I.A. Munn, S.C. Grado, J.E. Henderson, O. Joshi., R.K. Grala, and J.E. Henderson	Assessing Non-Industrial Private Forest Landowners' Attitude and Willingness to Carbon Sequestration in the Southern Region	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Kreye, M.M., D.C. Adams, F. Escobedo, and J. Soto	Using best-worst scaling choice experiments to measure preferences for forest conservation programs that protect water quality	Presentation (Conference)	December 10-14, 2012	ACES and Ecosystem Markets Conference, Ft. Lauderdale, FL

Events/Activities

Presentations

Aim 4 (Economics & Policy)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Soto, J.R. and D.C. Adams	Estimating the Supply of Forest Carbon Offsets: A Comparison of Best-Worst and Discrete Choice Valuation Methods	Presentation (Meeting)	August 12-14, 2012	Agricultural and Applied Economics Association Meeting, Seattle, WA
Soto, J.R. and D.C. Adams	Estimating the Supply of Forest Carbon Offsets: A Comparison of Best-Worst and Discrete Choice Valuation Methods	Poster Presentation	December 10-12, 2012	ACES and Ecosystem Markets Meeting, Ft. Lauderdale, FL
Steen, J.D., S.C. Grado, I.A. Munn, M.K. Measells, A. Hussain, J.E. Henderson, R.K. Grala, D.L. Grebner, and R.J. Rousseau	Factors influencing nonindustrial private forest landowner willingness to grow short-rotation woody crops for bioenergy in Mississippi.	Presentation (Conference)	March 10-12, 2013	Southern Forest Economics Workers Annual Meeting in Auburn, Alabama
Susaeta, A., D. Carter, and D. Adams	Economics of climate change in even-aged forest management	Poster Presentation	June 12-15, 2013	Third IUFRO Latin American Congress: Forest, Competiveness and Sustainable Landscapes, San Jose, Costa Rica
Susaeta, A.I., D.R. Carter, and S.J. Change	A generalized economic model for carbon sequestration: Implications for sustainability of forestlands in the U.S. South	Presentation (Conference)	October 13-16, 2012	The 2nd Forest Science Forum: Forest Management Adapting to Climate Change. Beijing, China
Susaeta, A.I., D.R. Carter, S.J. Change, and D.C. Adams	The impact of hurricane risk on optimal forest management in southern U.S. pine plantations: Application of a generalized Reed model	Presentation (Conference)	September 9-12, 2012	The Fourth International Faustmann Symposium: Forest Economics under Multiple Challenges. Tunturihotelli, Saariselkä, Lapland, Finland
Susaeta, A.I., D.R. Carter, S.J. Change, and D.C. Adams	The generalized Reed model and its application to determine the impact of hurricane risk on even-aged plantation management in southern United States	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Susaeta, S.J. Chang, D. Carter, and P. Lal	Economics of carbon sequestration under fluctuating economic environment, forest management and technological changes: an application to forest stands in the southern United States	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Susaeta, A., D. Carter, and D. Adams	Impacts of climate change on economics of forestry and mitigation strategies in the United States South	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA

Events/Activities

Presentations

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Monroe, M. C., A. Oxarart, J. Li, T. Ritchie, K. Kunkle, K. Glover, A. Stenstrup	Climate Change and Southeastern Forests: A New PLT Secondary Module	Workshop	October 10, 2013	North American Association for Environmental Education (NAAEE conference), Baltimore MD
Monroe, M. C.	Engaging Adult Learners in Extension Programs	Webinar	September 9, 2013	Minnesota Extension Professional Development
Monroe, M. C.	Why Deny? How climate deniers justify their beliefs	Poster	October, 2013	North American Association for Environmental Education (NAAEE) Research Symposium, Baltimore MD
Ryan, C., M. C. Monroe, C. Ginger, K. Nelson	Disciplinary integration in education and research: from rhetoric to reality	Panel Discussion	June 6, 2013	International Symposium on Social Science and Resource Management, Estes Park CO
Monroe, M. C.	Why so many perceptions about climate?	Presentation	May 24, 2013	Climate Change Symposium for Teachers, University of Florida, Gainesville FL
Hall, S. and M.C. Monroe	Climate change education for secondary students	Poster Presentation	October 9, 2012	North American Association for Environmental Education (NAAEE) Research Symposium, Oakland, CA
Hall, S. and M.C. Monroe	Incorporating Climate Change into the Biology Classroom	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Hall, S. and M.C. Monroe	Student learning with two different ways of teaching about climate and carbon	Presentation (Meeting)	April 24, 2013	PINEMAP 2013 Annual Meeting, Athens, GA
Kidd, J.B., J.R. Seiler, M.C. Monroe, and S. Sriharan	The PINEMAP Intern Program: Integrating undergraduates into forest resource and climate change research and education	Poster Presentation	August 5-10, 2012	Ecological Society of America Annual Meeting, August 5-10, Portland, OR
Li, C. and M.C. Monroe	Exploring Factors Affecting Students' Learning and Characteristics for Educative Curriculum to Build Teachers' Self-Efficacy in Climate Change Education	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Monroe, M.C., A. Stenstrup, S. Hall, J. Li, and A. Oxarart	Project Learning Tree Secondary Module: Southern Forests and Climate Change	Presentation (Conference)	October 11, 2012	North American Association for Environmental Education (NAAEE) Conference, Oakland, CA
Oxarart, A., M. Monroe, S. Hall, and C. Li	Climate Change and Southeastern Forests: A Project Learning Tree Secondary Module	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA
Seiler, J., J. Kidd, M. Monroe, A. Oxarart, and S. Hall	Internship Successes and Education Research--PINEMAP's Integrating Education Projects	Webinar	September 21, 2012	PINEMAP Internal Webinar Series

Events/Activities

Presentations

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Decker, P.	Counting the Carbon	Presentation (Education)	November 15, 2012	Shawsville Middle School, Shawsville, VA (Course: Physical Science, 8th; Teacher: Angela Borealo)
Decker, P.	Counting the Carbon	Presentation (Education)	November 15, 2012	Shawsville Middle School, Shawsville, VA (Course: Physical Science, 8th; Teacher: Angela Borealo)
Decker, P.	Counting the Carbon	Presentation (Education)	November 15, 2012	Shawsville Middle School, Shawsville, VA (Course: Physical Science, 8th; Teacher: Angela Borealo)
Decker, P.	Counting the Carbon	Presentation (Education)	November 15, 2012	Shawsville Middle School, Shawsville, VA (Course: Physical Science, 8th; Teacher: Angela Borealo)
Decker, P.	Counting the Carbon	Presentation (Education)	November 15, 2012	Shawsville Middle School, Shawsville, VA (Course: Physical Science, 8th; Teacher: Angela Borealo)
Decker, P.	Counting the Carbon	Presentation (Education)	November 16, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Decker, P.	Counting the Carbon	Presentation (Education)	November 16, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Decker, P.	Counting the Carbon	Presentation (Education)	November 16, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Decker, P.	Counting the Carbon	Presentation (Education)	November 16, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Decker, P.	Counting the Carbon	Presentation (Education)	November 16, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Decker, P.	Counting the Carbon	Presentation (Education)	November 26, 2012	George Wythe High School, Wytheville, VA (Course: Horticulture; Teacher: Kristin Walsh)

Events/Activities

Presentations

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Decker, P.	Counting the Carbon	Presentation (Education)	November 26, 2012	George Wythe High School, Wytheville, VA (Course: Horticulture; Teacher: Kristin Walsh)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 2, 2012	Peabody Middle School, Petersburg, VA (Course: Biology, 8th; Teacher: Cindy Forehand)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 6, 2012	Colonial Heights High School, Colonial Heights, VA (Course: Ecology, 10th; Teacher: Christine Hutto)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 12, 2012	Sussex High School, Sussex, VA (Course: Biology, 11th; Teacher: Frianeza Rowena)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 12, 2012	Sussex High School, Sussex, VA (Course: Biology, 12th; Teacher: Lakesha Sherrita)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 12, 2012	Sussex High School, Sussex, VA (Course: Earth Science, 11th; Teacher: Isaac Linton)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 12, 2012	Sussex High School, Sussex, VA (Course: Chemistry, 11th; Teacher: Felicitas Corpuz)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 12, 2012	Sussex High School, Sussex, VA (Course: Mathematics, 12th; Teacher: Jerry Parham)
Faison, A.	PINEMAP Experience at Virginia Tech	Presentation (Education)	November 27, 2012	Petersburg High School, Petersburg, VA; Course: Biology, 11th; Teacher: Gilbert Capate)
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Bluewell Boyscout Troop
Gregory, B.	Where's the Water?	Presentation (Education)	November 14, 2012	Chatham High School, Chatham, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Rocky Gap High School, Rocky Gap, VA (Course: Agriculture; Teacher: Faith Copenhagen)
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Rocky Gap High School, Rocky Gap, VA (Course: Agriculture; Teacher: Faith Copenhagen)

Events/Activities

Presentations

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Bland High School, Bland, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Bland High School, Bland, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Bland High School, Bland, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Rural Retreat High School, Rural Retreat, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Rural Retreat High School, Rural Retreat, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Rural Retreat High School, Rural Retreat, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 2012	Wilson Memorial High School, Fishersville, VA
Gregory, B.	Where's the Water?	Presentation (Education)	November 30, 2012	Twin Springs High School, Nickelsville, VA (Course: Environmental Research; Teacher: April Addington)
Gregory, B.	Where's the Water?	Presentation (Education)	November 30, 2012	Twin Springs High School, Nickelsville, VA (Course: Earth Science; Teacher: April Addington)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 4, 2012	Auburn High School, Riner VA (Course: Ecology, 11th-12th; Teacher: Terri Shepard)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 4, 2012	Auburn High School, Riner VA (Course: Ecology, 11th-12th; Teacher: Terri Shepard)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 4, 2012	Auburn High School, Riner VA (Course: Ecology, 11th-12th; Teacher: Terri Shepard)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 6, 2012	Pulaski County High School, Dublin, VA (Course: Dual Enrollment Biology; Teacher: Eileen Petzold and Michael Hoffman)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 6, 2012	Pulaski County High School, Dublin, VA (Course: Dual Enrollment Biology; Teacher: Eileen Petzold and Michael Hoffman)

Events/Activities

Presentations

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 6, 2012	Pulaski County High School, Dublin, VA (Course: Dual Enrollment Biology; Teacher: Eileen Petzold and Michael Hoffman)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 6, 2012	Pulaski County High School, Dublin, VA (Course: Dual Enrollment Biology; Teacher: Eileen Petzold and Michael Hoffman)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 13, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Earth Science, 6th-7th; Teacher: Michaelle Wilkins)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 13, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Earth Science, 6th-7th; Teacher: Michaelle Wilkins)
Jarvis, R.	Our Changing Climate	Presentation (Education)	December 13, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Earth Science, 6th-7th; Teacher: Michaelle Wilkins)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 26, 2012	Twin Springs High School, Nickelsville, VA (Course: Environmental Research; Teacher: April Addington)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 28, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 28, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 28, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 28, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)

Events/Activities

Presentations

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 28, 2012	Blacksburg Middle School, Blacksburg, VA (Course: Life Science, 7th; Teacher: Jim Shockley)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 30, 2012	Carroll County High School, Hillsville, VA (Course: Natural Resources, 10-11th; Teacher: Scott)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 30, 2012	Carroll County High School, Hillsville, VA (Course: Biology, 10th; Teacher: Scott)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 30, 2012	Carroll County High School, Hillsville, VA (Course: Biology, 10th; Teacher: Scott)
Kennerley, W.	Photosynthesis, Respiration, and Combustion: Carbon Cycling in Action	Presentation (Education)	November 30, 2012	Carroll County High School, Hillsville, VA (Course: Honors Biology, 10th; Teacher: Scott)

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location	# of Attendees
Adams, D.C. and M.C. Monroe	Climate Change Perceptions Among Southeast Extension Professionals	Presentation (Conference)	November 5, 2012	AgSystems Seminar, Department of Agriculture and Biological Engineering, University of Florida, Gainesville, FL	25
Boby, L.A.	Presentation on PINEMAP	Presentation (Meeting)	October 4, 2012	Southern Group of State Foresters SUM Task Force Meeting, Williamsburg, VA	30
Boby, L.A.	PINEMAP: An Overview of PINEMAP Extension	Presentation (Meeting)	November 13, 2012	Southeast Climate Consortium Annual Meeting, Tifton, GA	75
Boby, L.A.	Update on PINEMAP	Presentation (Meeting)	February 20, 2013	Southern Regional Extension Forestry Unit Leaders Meeting	25
Boby, L.A. and D. Markewitz	PINEMAP: Pine Integrated Network: Education, Mitigation, and Adaptation Project	Presentation (Meeting)	August 23, 2012	Warnell School of Forestry, University of Georgia Forestry Seminar	40

Events/Activities

Presentations

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location	# of Attendees
Boby, L.A. and D. Markewitz	Southern Pines, Carbon and Climate Change	Presentation (Meeting)	January 9, 2013	Presentation given through the Georgia Initiative for Climate and Society, Athens, GA	50
Boby, L.A., W.G. Hubbard, and H. Cole	Climate change perceptions of southern foresters: Preliminary survey results, William Hubbard	Presentation (Meeting)	April 24, 2013	PINEMAP 2013 Annual Meeting, Athens, GA	
Boby, L.A. and M.C. Monroe	PINEMAP PLT Activity	Workshop Activity	May 15, 2013	Huntsville, AL	26
Boby, L.A.	PINEMAP Extension Program	Presentation (Meeting)	July 17, 2013	Plantation Management Resource Cooperative Annual Meeting, Athens, GA	
Boby, L.A.	PINEMAP Information	Presentation (Meeting)	June 4, 2013	Southern Group of State Foresters Annual Meeting Savannah, GA	
Boby, L.A., W.G. Hubbard, and J.O. Idassi	PINEMAP and Foresters Survey Summary Information	Presentation (Meeting)	August 26, 2013	Climate Change Education Roundtable/Washington, D.C.	
Boyd, G.D.	Climate Change and the Forest Environment	Presentation (Meeting)	October 17-20, 2012	Mississippi Forestry Association Annual Meeting, Tupelo, MS	12
Boyles, R.	Weather hazards and forests in NC	Presentation (Meeting)	October 4, 2012	NC Forestry Association Meeting, Asheville, NC	500
Boyles, R. and S. McKeand	Climate hazards and forests in NC	Webinar	October 10, 2012	Forestry Forum Teleconference, Raleigh, NC	15
Burnett, R. and M. Megalos	PINEMAP: Pine Integrated Network: Education, Mitigation, and Adaptation Project	Poster Presentation	August 21-22, 2012	NC Prescribed Fire Council Annual Meeting, Chapel Hill, NC	115
Burnett, R. and M. Megalos	Climate drivers of wildfire size in North Carolina: scale thresholds and cross-scale interactions for 1970-2012	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA	
Burnett, R.E.	Prescribed Fire and Climate Change: Keeping Pace with a Changing Climate	Poster	August 27, 2013	NC Prescribed Fire Council and NC Longleaf Coalition Joint Meeting, Wilmington, NC	120
Cole, H., M. Megalos, W. Hubbard, and L. Boby	2013 Climate Change Attitudes of Southeast Forestry Professionals	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA	

Events/Activities

Presentations

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location	# of Attendees
Cushing, T. and J. Stringer	Forest Management on Your Land	Webinar	October 25, 2012	Natural Resource Opportunities for Landowners webinar series	75
Dinon, H.A.	What is PINEMAP and how could it help you?	Webinar	November 15, 2012	Webinar given to South Atlantic LCC Third Thursday Web Forum	20
Dinon Aldridge, H.	What is PINEMAP and how could it help you?	Webinar	December 7, 2012	Webinar given as part of the Forest Service First Friday All Climate Change Talks	27
Dinon Aldridge, H.	Climate 101: Southeast U.S.	Webinar	January 15, 2013	Webinar given as part of the PINEMAP Distance Graduate Course	21
Dinon Aldridge, H.	What are PINEMAP and the DSS?	Presentation (Meeting)	February 12, 2013	State Climate Office of NC Lab Meeting	10
Dinon Aldridge, H.	PINEMAP you can use: Development of a decision support system for forestry applications	Webinar	April 4, 2013	Webinar given on the ANREP CSI conference call	20
Dinon Aldridge, H. and R. Boyles	Decision Support System: Connecting your research to decisions	Presentation (Meeting)	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA	
Dinon Aldridge, H.	What are people saying about global warming and climate change?	Presentation (Meeting)	May 16-17, 2013	PINEMAP 1890 Land Grant Climate Change Workshop	25
Dinon Aldridge, H.	PINEMAP's Decision Support System! What is it, what can it do for you?	Presentation (Meeting)	May 16-17, 2013	PINEMAP 1890 Land Grant Climate Change Workshop	25
Dinon Aldridge, H.	PINEMAP's Decision Support System: The Good, The Bad, & The Ugly	Presentation (Meeting)	June 13, 2013	State Climate Office of NC Summer Seminar Series	25
Dinon, H., Boyles, R.	PINEMAP Decision Support System (DSS)	Presentation (Meeting)	May 15-16, 2012	PINEMAP Annual Meeting, Atlanta, GA	
Dinon Aldridge, H., E. Taylor, L.A. Boby, M. Bonham, V. Simon-Brown, L. Jennings, and others	It's Getting Hot Out Here: An interactive workshop focused on communicating climate change for natural resource professionals	Presentation (Conference)	May 20-23, 2012	ANREP Biennial Conference, Hendersonville, NC	
Dinon Aldridge, H., L. Boby, M. Bonham, G. Boyd, R. Boyles, B. Hubbard, J. Idassi, T. Martin, M. Megalos, M. Monroe, and E. Taylor	PINEMAP: Progress and future plans	Poster Presentation	July 9-12, 2012	37th Annual Meeting of the American Association of State Climatologists, Destin, FL	

Events/Activities

Presentations

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location	# of Attendees
Hall, K. and M. Haggerty	Natural Resource Appreciative Values on Your Land	Webinar	November 1, 2012	Natural Resource Opportunities for Landowners webinar series	75
Hubbard, W.G.	Effective climate change Extension programming	Webinar	April 3, 2012	Webinar given for Spring 2012 PINEMAP Distance Graduate Course	15
Hubbard, W.G. and M.A. Megalos	Forestry under a variable climate: tools and resources	Presentation	May 18, 2013	PINEMAP 1890 Land Grant Climate Change Workshop	25
Jones, D.	Natural Resource Enterprise Considerations for Your Land	Webinar	November 8, 2012	Natural Resource Opportunities for Landowners webinar series	75
Knox, P.	Impacts of a changing climate on forestry	Presentation (Meeting)	May 16-17, 2013	PINEMAP 1890 Land Grant Climate Change Workshop	25
Krantz, S. and M.C. Monroe	Video as a communication tool: Forest landowners and climate change	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA	80
Krantz, S.	Video as a Communication Tool: Forest Landowners and Climate Change	Roundtable Presentation	October 9, 2013	National Association for Environmental Educators Baltimore, MD	
Krantz, S.	Engaging Audiences Through Video: Communicating Science Effectively and Interestingly	Roundtable Presentation	October 11, 2013	National Association for Environmental Educators Baltimore, MD	
McMillan, P.	Introduction to Natural Resource Conservation	Webinar	October 11, 2012	Natural Resource Opportunities for Landowners webinar series	75
Megalos, M.A.	PINEMAP and Your Forest	Presentation (Meeting)	November 9, 2012	Duke Forestry Symposium, Durham, NC	175
Megalos, M.A.	Tree solutions to today's vexing environmental problems: Remediation, sequestration, and ecosystem services	Presentation (Meeting)	October 5, 2012	NC Urban Forestry Council, Greensboro, NC	23
Megalos, M.A., A.J. Vuola, M.C. Monroe, D. Wojcik, R. Plate, and D.C. Adams	Bridging the climate communication divide between agents and small forest landowners in North Carolina	Poster Presentation	September 24-27, 2012	IUFRO 3.08, Amherst, MA	89
Monroe, M.C.	What will help us communicate complex, value-laden information?: Climate Change	Presentation (Meeting)	November 1, 2012	County Extension Director's Training, University of Florida, Gainesville, FL	45
Monroe, M. C., D. C. Adams, R. Plate, and D. Wojcik	The Six Americas of Climate Change: Perceptions of Southeast Extension Professionals	Poster Presentation	August 6-9, 2012	CSCAP 2012 Annual Meeting, Wooster, OH	

Events/Activities

Presentations

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location	# of Attendees
Monroe, M. C., D. C. Adams, R. Plate, and D. Wojcik	The Six Americas of Climate Change: Perceptions of Southeast Extension Professionals	Poster Presentation	February 13, 2013	REACCH Second Annual Meeting, Portland, OR	
Monroe, M.C., D. Wojcik, R. Plate, and D.C. Adams	Understanding educators' perceptions on climate change	Presentation (Conference)	October 9, 2012	NAAEE Research Symposium formal presentation, Oakland, CA	30
Monroe, M. and R. Plate	Climate Change Perceptions Among Southeast Extension Professionals	Presentation (Meeting)	August 21, 2012	Southeast Extension Administrators Annual Meeting, Orlando, FL	25
Monroe, M. and R. Plate	Climate Change Perceptions Among Southeast Extension Professionals	Presentation (Meeting)	August 22, 2013	Southeast Extension Administrators Annual Meeting, Orlando, FL	20
Monroe, M.C., A.W. Bowers, D.C. Adams, and R.R. Plate	Listening to Climate Perceptions: What the Comment Box Can Tell Us	Poster Presentation	April 24-26, 2013	PINEMAP Annual Meeting, Athens, GA	
Reed, D. and G. Yarrow	Wildlife Conservation on Your Land	Webinar	October 18, 2012	Natural Resource Opportunities for Landowners webinar series	75

Events/Activities

Trainings, workshops, and courses

Aim 3 (Genetics)

Author(s)/Presenter(s)	Title	Date	Venue/Location	Description
Krutovsky, K.	Population genetic and genomic approaches to mitigate global climate change impacts on forest genetic resources and to breed more resilient trees	September 24-28, 2012	Büsgen Institute, Department of Forest Genetics and Forest Tree Breeding, University of Göttingen Göttingen, Germany	This workshop was organized by Büsgen Institute, Department of Forest Genetics and Forest Tree Breeding, University of Göttingen and funded by EvolTree (Evolution of Trees as Drivers of Terrestrial Biodiversity, EU-funded Network of Excellence), September 24-28, 2012, Göttingen, Germany. The workshop taught how the application of population genetics and genomics can help to tackle challenges posed by global climate change, and guide forest protection and conservation programs aimed to mitigate its undesirable effects. It also demonstrated how modern genomic selection can be used for breeding more resilient trees that will be productive in harsh and variable environments. The workshop also covered population genetics and genomics tools and methods that can be used to better characterize available forest tree genetic resources. (http://www.evoltree.eu/index.php/component/jevents/icalrepeat.detail/2012/09/24/2012/-/- , http://www.uni-goettingen.de/en/evoltree-summer-school-in-goettingen/361359.html)
Byram, T. and R. Will	Advancing silviculture in the era of climate change: An overview from PINEMAP WGFTIP Seed Source Study and Seed Movement	May 15-16, 2013	2013 Western Gulf Forest Tree Improvement Contact Representatives meeting, Idabel, OK	Tree improvement practitioners heard talks from Rod Will, ‘Advancing silviculture in the era of climate change: An overview of PINEMAP’, and Tom Byram, ‘WGFTIP Seed Source Study and seed movement’. In addition they visited the Oklahoma Tier III site and were introduced to the breadth of the research data being collected.

Events/Activities

Trainings, workshops, and courses

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Date	Venue/Location	Description
Kidd, J. and J. Seiler	PINEMAP Undergraduate Fellowship Program (2012)	May-August 2012 and May-August 2013	A PINEMAP Collaborating University (locations vary)	The PINEMAP Undergraduate Fellowship Program has a unique twist on the traditional research experience for undergraduates (REU) in that each of the undergraduates accepted into the program is paired with a PINEMAP graduate student mentor and participates in a distance course following completion of the 12-week, full-time summer internship. Undergraduates from across the southeastern United States are hired as wage employees of Virginia Tech, earning up to \$7,000, and are paired with graduate student researchers at one of PINEMAP's collaborating universities. This distributed fellowship affords most undergraduate fellows the opportunity to experience working in a setting outside their home universities. Additionally, the program vertically integrates undergraduates, graduate students, and faculty with the potential for each participant to be exposed to a variety of research interests, skillsets, and learning experiences. In 2012, 6 undergraduate fellows participated in the program; in 2013, 12 undergraduate fellows are participating.
Kidd, J. and J. Seiler	PINEMAP Undergraduate Fellowship Program Effective Communication Skills Course (2012)	August-December 2012		Effective Communication Skills is a three-credit, letter-graded, distance education course co-taught by Virginia Tech faculty. Students receive credit by registering for independent study hours through their universities' academic advisors. The course is conducted synchronously over the Internet using web conferencing software and meets formally for one hour each week during the fall. Students also complete assignments outside of class as their schedules allow. Students learn various interpersonal written, oral, and nonverbal communication skills through multimedia, readings, and self-reflection, and then put these skills to use when writing an abstract and creating scientific poster and PowerPoint® presentations based on their summer research. Additionally, students develop and give presentations to secondary public school audiences. In 2012, fellows delivered presentations to 1,060 public school students from 16 different schools.

Events/Activities

Trainings, workshops, and courses

Aim 5 (Education)

Author(s)/Presenter(s)	Title	Date	Venue/Location	Description
Monroe, M.C., J. Ireland, and other PINEMAP PIs and staff	Spring 2013 Distance Graduate Course	January-April 2013	Online course	<p>As part of the education outcomes of PINEMAP, the second offering of the online graduate course was conducted during the spring 2013 semester. The course goals were to:</p> <ul style="list-style-type: none"> engage graduate students in exploring climate change mitigation and adaptation issues in southern pine forests and build capacity for integration among research disciplines and between research and education/Extension <p>19 students from 8 universities participated in the spring 2013 course.</p>
Monroe, M.C., A. Oxarart, and many others	Climate Change Symposium for Teachers	May 2013	University of Florida, Gainesville, FL	<p>This one-day professional development opportunity for middle and high school science teachers was held on May 24, 2013 at University of Florida in Gainesville, Florida. This symposium included faculty research presentations and discussions related to the impact of climate change on marine, coastal, forest, and agricultural systems and engaged educators in novel hands-on activities they can use to teach climate change related topics in the classroom. Florida-specific projections and implications of climate change were used to consider potential risks to coastal development, ecosystems, and forest health. Of the 12 concurrent sessions, 6 were conducted by PINEMAP faculty and students and featured module activities. The symposium brought together five partners: PINEMAP, Florida Climate Institute, UF Center for Precollegiate Education and Training, UF School of Forest Resources and Conservation, and League of Environmental Educators in Florida.</p>

Events/Activities

Trainings, workshops, and courses

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Date	Venue/Location	Description
Forestry Extension Faculty from University of Georgia and Clemson University	Natural Resource Opportunities for Landowners	October-November 2012	Online	This five series course ran from mid-October to early November 2012. Topics included: 1. Introduction to Natural Resource Conservation, 2. Natural Resource Enterprise Considerations, 3. Wildlife Conservation (Introduction to Master Wildlifer), 4. Forest Management on Your Land (Introduction to Master Tree Farmer), and 5. Natural Resources Appreciative Values and Uses. Within the general course content, instructors also discussed impacts to natural resources from a changing and variable climate. Approximately 75 people attended each session, for a total count of 375 people reached, however, there were also 'viewing sites', where multiple attendees watched the webinars and we do not have final numbers from them yet.
Multiple PINEMAP researchers	1890 Agroforestry Consortium Climate Change Workshop	May 2013	Huntsville, Alabama	A workshop was implemented in Huntsville, Alabama in May 2013. Attendees included Extension specialists from 1890's Universities in the Southeast. The focus of the workshop was climate science, climate change, forestry and climate tools, and PINEMAP developments.
Taylor, E.L.	Adaptive Forest Management Option	November 16, 2012	Brookhaven, TX	Day training for Brookhaven community leaders; 12 attendees
Taylor, E.L.	Forest Decline and Environmental Pressures	January 8, 2013	NE Texas	Workshop for natural resource professionals--Northeast Texas; 43 attendees
Taylor, E.L.	Forest Health and Resiliency Management Options, Part 2	January 12, 2013	Brookhaven, TX	Day training for Brookhaven community leaders; 23 attendees
Taylor, E.L.	Forest Pest Agency Training	January 25, 2013		5 attendees
Taylor, E.L.	Adaptive Strategies for Regeneration Pests	January 31, 2013	NE Texas	Workshop for natural resource professionals--Northeast Texas; 87 attendees
Taylor, E.L.	Adaptive Strategies for Regeneration Pests	February 1, 2013		Workshop for natural resource professionals--County meeting; 21 attendees
Taylor, E.L.	Forest Pesticide Seminar--Adaptive Management	February 8, 2013	Central East Texas	Workshop for natural resource professionals--Central East Texas; 85 attendees
Taylor, E.L.	Forest Pesticide Seminar--Adaptive Management	March 1, 2013	SE Texas; 73 attendees	Workshop for natural resource professionals--Southeast Texas

Events/Activities

Trainings, workshops, and courses

Aim 6 (Extension)

Author(s)/Presenter(s)	Title	Date	Venue/Location	Description
Taylor, E.L.	Forest Resiliency	November 10, 2012	Central East Texas; 34 attendees	Workshop provided to natural resource professionals - Central East Texas
Taylor, E.L.	Adaptive Forest Afforestation	November 13, 2012	NE Texas; 26 attendees	Workshop provided to natural resource professionals - Northeast Texas

Events/Activities

Experiments, surveys, and data collection

Aim 1 (Silviculture & Ecophysiology)

Title	Time frame	Description
Tier I Legacy Experiments	Ongoing	The Tier I legacy network consists of hundreds of existing silviculture experiments and growth-and-yield plots that blanket the region and provide extensive, spatially explicit information on regional variability and productivity. Industry/university cooperative research installations to include in the Tier I legacy experiments have been identified and archived data from these sites has been uploaded into the TerraC database.
Tier II Active Experiments	Ongoing	The Tier II active experiments network consists of 127 sites distributed throughout the Southeast. These sites were selected to represent the range of climate, geology, and soil conditions in the Southeast and span a range of plantation ages (5 to more than 25 years) covering a progression of stand development. Principle treatments represented in the network include planting density, thinning, fertilization, and competition control. Sampling on all or a subset of locations in this network include biomass and carbon inventory; soil sampling; tree canopy light interception measurements; wood core sampling for $^{13}\text{C}/^{18}\text{O}$ analysis to determine water use efficiency; and assessments of soil carbon emissions, nitrous oxide emissions, and nitrogen uptake efficiency. Data collection from Tier II sites is ongoing.
Tier III Throughfall Exclusion x Fertilization Experiments	Ongoing	<p>The Tier III throughfall exclusion x fertilization network is made up of four research sites situated at the edges of the native range of loblolly pine. The four sites, located in McCurtain County, Oklahoma; Taylor County, Florida; Taliaferro County, Georgia; and Buckingham County, Virginia, capture the current range-wide variability of climate, precipitation, and productivity (Figure 3). The research sites range in planting date from 2003 to 2008, are unthinned, and were planted with a mix of genetic sources appropriate for each region. Treatments at the four Tier III sites consist of a factorial experiment:</p> <ul style="list-style-type: none"> • Control (no treatment) • Fertilizer: fertilizer additions to achieve “optimum” nutrition • Throughfall exclusion: panels installed in understory to divert 30% of throughfall off the plot • Fertilizer + throughfall exclusion: combined fertilizer and throughfall exclusion treatment <p>Researchers at each Tier III site are measuring tree and stand growth, above and below ground carbon, changes in soil nutrient and water availability, whole-tree water use, leaf area development and canopy light capture, and soil carbon dioxide (CO_2) efflux (partitioned into autotrophic and heterotrophic respiration).</p>

Aim 2 (Modeling)

Title	Time frame	Description
LIDAR data	Ongoing	Aim 2 team members acquired a large collection (more than 30 separate mapping projects) of LIDAR data (from NOAA and USGS), covering a substantial amount of the PINEMAP region of interest. This enabled us to get LIDAR profiles for over 1600 FIA plots, distributed over several southern states (collaborating with USFS SRS, Knoxville). Preliminary results are quite promising: over all lidar projects, we observe a correlation of ~78% between the 85th percentile of lidar heights and field-measured height, with an RMSE of ~3.9 meters (n=1655). Using a subset of plots (n=281) with increased point density significantly reduces the RMSE to 2.7 meters.

Events/Activities

Experiments, surveys, and data collection

Aim 3 (Genetics)

Title	Time frame	Description
Genome complexity reduction methods for genotyping by sequencing	Ongoing	Ongoing research is being conducted in 4 regions to determine the most operationally efficient and cost-effective methodologies for genotyping in support of allele discovery efforts. The work is coordinated by researchers at the University of Florida, North Carolina State University, Texas A&M University, and Virginia Tech
Genetic deployment tool	Ongoing	Ongoing research is being conducted in 4 regions to integrate existing loblolly pine progeny trial data with climate data to understand the response of thousands of loblolly pine genotypes to climate. The models developed in this effort will support the development of a regionwide genetic deployment tool that will aid land managers in selecting and deploying appropriate germplasm under future climate scenarios. The work is coordinated by researchers at the University of Florida, North Carolina State University, Texas A&M University, and Virginia Tech

Aim 4 (Economics & Policy)

Title	Time frame	Description
Willingness to pay for forest-based water quality improvement (survey)	2012-2013	D.C. Adams (co-PI), M.M. Kreye (PhD student), and Justin Soto (undergraduate PINEMAP intern) conducted pilot tests and M.M. Kreye implemented the full survey on willingness to pay for forest-based water quality improvement, which will inform the bioeconomic modeling non-market ecosystem services.
Non-industrial private forest landowners' willingness to accept carbon offset payments (surveys)	2011-2013	D.C. Adams (co-PI) and Jose Soto (PhD student) have finished the second and final wave of surveys to estimate non-industrial private forest landowners' willingness to accept carbon offset payments. The results of this survey will inform landowner adoption of mitigation and adaptation strategies, and our assessment of policies and programs that affect C mitigation in planted pine forests.
Forest landowner survey	Ongoing	D.L. Grebner and Puskar Khanal (PhD student) completed the design and development of survey instrument for forest landowners. A landowner list of forest landowners across the southern United States was purchased from List Grant. Printing of all materials has been accomplished. First mailing of the survey instrument was conducted on August 26, 2013. The first mailing will be followed up with a postcard mailing one week afterwards, and another survey mailing three weeks after the initial mailing.
Supplementing FIA data	Ongoing	N. Timilsina (Postdoc), W. Cropper (Co-PI) and F. Escobedo (Co-PI) have supplemented the FIA database with US Census data and plot-level understory species richness data from Timilsina et al.'s (2013) species richness predictive model. This diversity data was supplied to the PINEMAP group working on developing a decision support system (DSS) and has been integrated into the TerraC database. Additionally, FIA tree and plot-level remeasurement data for several periods has been matched to obtain gross C sequestration estimates. The data is being used to develop a genetic algorithm that can analyze plot-level trade-offs among carbon, timber, understory diversity.

Events/Activities

Experiments, surveys, and data collection

Aim 4 (Economics & Policy)

Title	Time frame	Description
Developing carbon, timber, and biodiversity models	Ongoing	N. Timilsina (Postdoc), F. Escobedo (Co-PI), and W. Cropper (Co-PI) are working with S. Gezan (Statistician from UF) in developing models that predict carbon, timber and biodiversity in order to develop scenarios (different management regime). These predictive models are using several FIA explanatory variables that contain several interactions among the variables or polynomials. Models are being developed using a Bayesian approach based on posterior probabilities and the Bayes factor as a model selection criteria. Collinearity issues are being addressed and models will be developed for specific FIA units.
Integrating FIA plot data with hydrologic unit watersheds and subwatersheds in Florida	Ongoing	F. Escobedo (Co-PI), D. Adams (Co-PI), M. Traboulsi (PhD student), and W. Cropper (Co-PI) are working on integrating FIA plot data with hydrologic unit watersheds and subwatersheds in Florida. Watershed-level WASSI water yield outputs will then be integrated with FIA C, Timber and diversity data to identify watersheds with optimal provision levels and use/non-use values for water yield, C, timber and understory diversity.

Aim 5 (Education)

Title	Time frame	Description
Research on Climate Change Education Strategies	2011-2013	Using activities drafted for the Project Learning Tree secondary module, the following research questions were being investigated: <ol style="list-style-type: none"> 1. To what extent are student attitudes about climate change influenced by their perception of their parents' opinions of climate change? 2. How does integrating carbon lessons with climate change affect student interest and knowledge about carbon? 3. Is a role play or discussion more effective for encouraging students to respectfully discuss a variety of opinions about climate change? Data were collected at two summer science programs organized by the University of Florida Center for Precollegiate Education and Training, Science Quest (SQ) and Student Science Training Program (SSTP).
Undergraduate Fellowship Program: Effective Communication Skills Course Evaluation Survey	December 2012; ongoing	Fellows were asked to complete a course evaluation survey at the end of the fall 2012 semester. Four of the five participants completed the survey. The survey contained 19 closed-ended, Likert-type items and 3 open-ended short answer questions.
Undergraduate Fellowship Program: Effective Communication Skills Course Public Speaking Apprehension Survey	May-December 2012; ongoing	Undergraduate fellows participating in the PINEMAP internship program's distance education course, Effective Communication Skills, were asked to complete a pre- and post-course quantitative survey using 5 point Likert-type items on their public speaking apprehension. Pre- and post-test responses will be collected each year the course is operated to identify changes in individuals' anxiety about public speaking.

Events/Activities

Experiments, surveys, and data collection

Aim 5 (Education)

Title	Time frame	Description
Undergraduate Fellowship Program Attitudes Survey	May-December 2012; ongoing	Undergraduate interns were surveyed to determine attitudes toward research before and after a 12 week internship in PINEMAP-related research. Interns were asked to complete a pre-internship survey on their attitudes toward research. Pre-internship results will be compared with those from a post-internship survey as an attempt to detect changes in attitudes. This study will be conducted over the length of the Undergraduate Internship Program, and has a potential maximum sample size of 50 interns. To date, 16 of 18 pre-internship surveys and 13 of 18 post-internship surveys have been voluntarily completed, either pre- or post-internship surveys, and three students completed both surveys.
Evaluation of Climate Change Symposium for Teachers	May-July 2013	Fifty-three teachers attended the symposium, and more than ¾ of the participants (n=43) completed the pre and post surveys which were used to evaluate the symposium. A “how-to” report that provides guidance, tips, and lessons learned from our experience is forthcoming. We hope this report will be useful for PINEMAP collaborators who are interested in developing a similar teaching training at their institution.

Aim 6 (Extension)

Title	Time frame	Description
Climate Change Perceptions of Southern Foresters (survey)	January 2013-present	Survey of forest professionals' perceptions of climate, climate change, and forestry education programs related to forestry and climate: More than 6,000 foresters from the entire southeastern region were contacted via Survey Monkey and more than 1,700 responded, yielding a response rate of about 27%. The main purpose of this survey was to determine what foresters believe about climate change (from no change in climate, to natural cycles to human-induced climate change, etc.), what changes they may have actually observed in their lifetimes, as well as what their interest would be in forestry programs about forest resiliency and climate science. Results from this survey will assist our effort to design educational programs (workshops, webinars, factsheets, etc.) that will be of interest to foresters. Data analysis is ongoing, and a manuscript is being prepared.

Appendix B: Training

These tables provide a comprehensive list of undergraduate and graduate students, postdocs, and technical/research personnel trained under this project, as well as their role in the project.

Project Administration/Management

Last name	First name	Position	University	Role
Bartels	Wendy-Lin	Assistant Research Scientist	UF	Conducting social network analysis, team science, and integration research; assisting with meeting planning and strategic project management.
Ireland	Jessica	Project Coordinator	UF	Coordinates project-wide activities; maintains the project web site and intranet site; organizes and coordinates project meetings; manages and oversees interim and annual reporting; and coordinates project communications.

Aim 1 (Silviculture & Ecophysiology)

Last name	First name	Position	University	Role
Akers	Madison	Research Staff	UGA	Coordinating baseline measurements on Tier II sites and overseeing installation and data collection on the Georgia Tier III site.
Albaugh	Tim	Research Staff	NCSU	Evaluating impacts of weed control and fertilization on loblolly pine using the 3-PG model.
Alvarez	Jose	Postdoc	NCSU	Evaluating changes in loblolly pine leaf area due to silvicultural treatments as a component of the 3-PG model.
Ausmus	Casey	M.S. Student	OSU	Research focus: determine the effects of fertilizer and water availability on tree physiological processes.
Baggett	Brittany	Undergraduate Intern	Univ. of W. FL	2013 Undergraduate Fellow; working with Adam Maggard at OSU.
Bartkowiak	Stan	M.S. Student	Auburn	Research focus: measuring water fluxes at Tier III sites; developing improved methods to evaluate stomatal response to update 3-PG.
Clark	Joe	M.S. Student	Auburn	Research focus: assessing relationships among intercepted radiation, LAI, photosynthetic capacity, phenology, and productivity in loblolly pine.
Clark	Zach	M.S. Student	UGA	Research focus: assessing developmental pattern of understory vegetation on Tier II installations.
Cucinella	Josh	Research Technician	UF	Assisting with Tier II and III data collection and analysis in Florida.
Diamond	Amanda	Undergraduate Intern	VT	2013 Undergraduate Fellow; working with Madison Akers at UGA.
Faison	Andrew	Undergraduate Intern	VSU	2012 Undergraduate Fellow; assisted Jay Raymond at Virginia Tech with investigating the mechanisms nitrogen dynamics and uptake efficiencies of N containing fertilizers in loblolly pine plantations using stable isotope (¹⁵ N) techniques.
Few	John	Undergraduate Intern	VSU	2013 Undergraduate Fellow; working with Asko Noormets at NCSU.
Fields	Anthony	Undergraduate Intern	VSU	2013 Undergraduate Fellow; working with Maxwell Wightman at UF.
Frye	Sam	Research Staff	VT	Assisting with soil CO ₂ efflux and N ₂ O measurements and installation and data collection on Tier II and III sites.
Gonzalez	Carlos	Research Associate	UF	Ecophysiology and Carbon Balance Modeling; support of tree transpiration measurements for Tier III; use of 3-PG model to assess the effect of climate change in productivity of loblolly pine plantations in SE U.S.

Aim 1 (Silviculture & Ecophysiology)

Last name	First name	Position	University	Role
Gregory	Bethany	Undergraduate Intern	VT	2012 Undergraduate Fellow; helped Andy Laviner at Virginia Tech with a study on environmental manipulation of fertilization, drought, and thinning in loblolly pine plantations.
Hancock	Amanda	Undergraduate Research Assistant	TAMU	Carbon monitoring protocol implementation for Tier II sites.
Heim	Brett	M.S. Student	VT	Research focus: separating heterotrophic and autotrophic respiration components of soil CO ₂ efflux.
Heinemann	Bob	Research Coordinator	OSU	Assists with site maintenance and data collection on Oklahoma Tier III site.
Holeman	Randy	Research Specialist	OSU	Assists with site maintenance and data collection on Oklahoma Tier III site.
Ingwers	Miles	Ph.D. Student	UGA	
Jackson	Colin	Undergraduate Intern	OSU	2013 Undergraduate Fellow; working with Jay Raymond at VT.
Jarvis	Rebecca	Undergraduate Intern	VT	2012 Undergraduate Fellow; assisted Wen Lin at North Carolina State University with quantifying the growth rate of loblolly pine, and analyze its sensitivity to temperature and precipitation dynamics.
Kinnerly	Will	Undergraduate Intern	VT	2012 Undergraduate Fellow; helped Brett Heim at Virginia Tech with experimental manipulations of belowground metabolic activity in order to separate microbial respiration from plant respiration.
Laviner	Andy	Ph.D. Student	VT	Coordinating baseline measurements on Tier II sites and overseeing installation and data collection on VA Tier III site; research focus is water use efficiency in loblolly pine.
Lin	Wen	Ph.D. Student	NCSU	Research focus: water use efficiency in loblolly pine using ¹² C/ ¹³ C ratios in wood.
Lokuta	Geoffrey	Research Staff	UF	Coordinating baseline measurements on Tier II sites and overseeing installation and data collection on the Florida Tier III site.
Luedtke	Cody	Ph.D. Student	UGA	Research focus: Soil CO ₂ efflux.
Maggard	Adam	Ph.D. Student	OSU	Research focus: ecophysiology on Tier II and III sites.
McElligott	Kristin	Ph.D. Student	VT	Research focus: mechanisms controlling total soil CO ₂ efflux and heterotrophic and autotrophic soil respiration.
Medsker	Teresa	M.S. Student	OSU	Research focus: belowground processes affected by fertilization and water availability
McConaghy	Scott	Undergraduate Intern	Kansas State	2013 Undergraduate Fellow; working with Yang Zhang at TAMU.
Meek	Casey	Research Staff	OSU	Assisting with ecophysiological and process measurements at Tier II and III sites.
Meeks	April	M.S. Student	NCSU	Incorporating competing vegetation in 3-PG model.
Nagel	Greg	Undergraduate Research Assistant	TAMU	Carbon monitoring protocol implementation at Tier II sites.
Parisher	Josh	Undergraduate Research Assistant	TAMU	Carbon monitoring protocol implementation at Tier II sites.
Pike	Jason	Research Staff	OSU	Assisting with installation, maintenance, and data collection on Tier III sites.
Qi	Jill	Ph.D. Student	UGA	Research focus: soil water and deep soil carbon responses under rain throughfall treatment at Tier III sites.
Raymond	Jay	Ph.D. Student	VT	Research focus is N uptake efficiency of enhanced efficiency N fertilizers using ¹⁵ N stable isotopes.
Rutemiller	Paul	Undergraduate Intern	VT	2013 Undergraduate Intern; working with Chris Maier at the USFS.

Aim 1 (Silviculture & Ecophysiology)

Last name	First name	Position	University	Role
Ryland	Rachel	Undergraduate Research Assistant	UGA	Received training in field sampling of trace gases at the Georgia Tier III installation and has been trained in laboratory techniques for soil gas analysis on the gas chromatograph.
Sherrod	Charles Allen	Undergraduate Research Assistant	UGA	Received training in field sampling of soil at the Georgia Tier III installation and has been trained in laboratory techniques for soil sample preparation and analysis.
Shrestha	Raj	Postdoc	VT	Soil greenhouse gas (CO ₂ , N ₂ O, CH ₄) flux across soil moisture and management gradients.
Souza	Bruce Barros	M.S. Student	UGA	Research focus: ecophysiology.
Stebler	Elaine	Research Staff	OSU	Coordinating baseline measurements on Tier II sites and overseeing installation and data collection on the Oklahoma Tier III site.
Stokes	Tom	Research Staff	Auburn	Assisting with data collection on Tier II and III sites.
Subedi	Santosh	Ph.D. Student	VT	Research focus: identifying an improved method to determine fertility rating for 3-PG.
Wightman	Maxwell	M.S. Student	UF	Research focus: Ecophysiology of drought response on FL Tier III site.
Wigley	Madison	Undergraduate Research Assistant	TAMU	Carbon monitoring protocol implementation for Tier II sites.
Wilson	Elizabeth	M.S. Student	TAMU	Research focus: understanding the effects of mesophyll conductance on isotopic signatures in leaves.
Yang	Jinyan	Ph.D. Student	UGA	Research focus: Heterotrophic and autotrophic components of soil respiration.
Zhai	Lu	M.S. Student	TAMU	Research focus: Family and culture effects on ecosystem C and N dynamics.
Zhang	Yang	Ph.D. Student	TAMU	Research focus: Carbon and nitrogen cycling response to drought at the OK Tier III site.

Aim 2 (Modeling)

Last name	First name	Position	University	Role
Brooks	Evan	Postdoc	VT	Extrapolating stand-scale measurements to the region via multitemporal satellite image analysis, focus on Tier III sites and environs.
Cook	Madison	Undergraduate Intern	VSU	2013 Undergraduate Fellow; working with Jose Alvarez at NCSU.
Fang	Yuan	Ph.D. Student	NCSU	Using G'DAY model to address nitrogen use efficiency in pine plantations.
Gopalakrishnan	Ranjith	Ph.D. Student	VT	Research focus: Downloading and reformatting the NARCCAP scenarios for key climate variables from six models (GCM/RCM combinations).
Gyawali	Nabin	Ph.D. Student	VT	Research focus: Utilizing Tier I data to develop a growth and yield model flexible enough to allow modification in diameter, height, and mortality at tree- and stand-level for diverse genotypes and silvicultural practices under varying conditions.
Ross	Wade	Ph.D. Student	UF	Research focus: Investigating soil carbon dynamics along hydrology and fire regimes in southern pine ecosystems, as well as the effects of fire disturbance on the structure and function of soil carbon dynamics in pine and wetland ecosystems and developing a mechanistic model to upscale site specific findings to the regional scale.
Sabatia	Charles	Postdoc	VT	Investigated growth and yield response to climate and soils variables using Tier I data.
Wang	Maggie	Ph.D. Student	UGA	Research focus: Working on a research proposal to predict C pool dynamics for alternative land use, management, and climate scenarios at the stand level. The proposal is to link 3-PG and Century to examine forest ecosystem carbon sequestration.
Ward	Eric	Postdoc	NCSU	Measuring and modeling forest water and carbon cycles, including quantifying uncertainty in key processes; working with both Aim 1 and 2 to integrate data and models such as 3PG and WaSSI-C across scales; assisting with data collection and analysis of water fluxes at the Virginia Tier III site.

Aim 3 (Genetics)

Last name	First name	Position	University	Role
Bawa	Rajesh	Ph.D. Student	VT	Research focus: Conducting Phenotyping of adaptive traits (i.e., cold hardiness and bud phenology) in the loblolly pine progeny trials and working with universities across region to conduct genome-wide association mapping between these traits and the re-sequencing data.
Farjat	Alfredo	Ph.D. Student	NCSU	Research focus: Carrying out joint analysis of progeny test data and climate data for the Cooperative Tree Improvement Program.
Koralewski	Tomasz	Postdoc	TAMU	Building a location database for the progeny tests and the parents represented in those progeny tests that can be linked to climatic data, and performing URF analysis to optimize seedling deployment.
Lu	Mengmeng	Ph.D. Student	TAMU	Research focus: Evaluating efficiency of the Agilent SureSelect target gene enrichment system for Illumina GAI and HiSeq high-throughput sequencing instruments, based on capture probes designed using the Agilent eArray tool and the most recent and comprehensive unigene set consisting of 35,550 sequences representing individual genes expressed in loblolly pine.
Kohlway	Will	Undergraduate Research Assistant	NCSU	Working on pilot scale experiments to test genotyping-by-sequencing as a cost-effective means of genotyping the experimental populations.
Rusche	Ben	Undergraduate Research Assistant	NCSU	Working on pilot scale experiments to test genotyping-by-sequencing as a cost-effective means of genotyping the experimental populations.
Townsend	Laura	M.S. Student	NCSU	Research focus: Genetic variation in loblolly pine for adaptability to climate variables.
Zhang	Jianxing	Ph.D. Student	UF	Research focus: conducting analyses linking progeny test performance with climatic data and developing a database for the URF analysis to optimize seedling deployment.

Aim 4 (Economics & Policy)

Last name	First name	Position	University	Role
Dwivedi	Puneet	Postdoc	University of Illinois-UC	Working with Dr. Gan to assess impacts of climate change on southern pine beetle infestation and exploring life cycle impacts of different wood products produced using southern pines.
Khanal	Puskar	Ph.D. Student	MSU	Research focus: Evaluating forest management practices that enhance carbon sequestration in stands and developing a survey instrument to determine small forest landowner's willingness to implement these practices and identify potential incentives that increase carbon sequestration at the stand level.
Kreye	Melissa	Ph.D. Student	UF	Completed a literature review on the economic value of forest-based changes in water quality; conducted a meta-analysis of forest-based water quality values; and specified an econometric model that predicts willingness to pay for forest-based water quality. Using a benefit transfer method, she has applied the model to two representative sites.
Soto	Jose	Ph.D. Student	UF	Research focus: Assessing and summarizing competing programs and policies that incentivize carbon sequestration at the local, state, national, and international level. He has also developed, pre-tested, and implemented a survey of non-industrial private forest landowners to determine their willingness to accept payments for carbon offsets based on offset program characteristics. Results of this work will be used to predict participation rates in programs that incentivize changes in land use that increase carbon sequestration and will be integrated in a bioeconomic model of non-market ecosystem services produced under competing approaches for climate change adaptation and mitigation.
Soto	Justin	Undergraduate Intern	UF	2012 Undergraduate Fellow; assisted Melissa Kreye at University of Florida with assessment of the economic value of forest-based ecosystem services under alternative management and policy regimes.
Susaeta	Andres	Postdoc	UF	Primarily involved in developing a forest stand-level model to assess expected economic rents for forest landowners under hurricane risks associated with future climate change conditions. He has also played a key role in developing an economic model to analyze carbon sequestration in loblolly pine plantations under various carbon subsidies and tax rates in the context of climate change. He will also be exploring different aspect climate change and their effect on ecosystems services provided by forestlands in the U.S. South.
Timilsina	Nilesh	Postdoc	UF	Working on assessing the interactions between different ecosystem services in pine flatwoods and optimizing modeling to maximize a particular ecosystem service and asses the tradeoff of the others.
Traboulsi	Mohamad	Ph.D. Student	UF	Working on integrating FIA plot data with hydrologic unit watersheds and subwatersheds in Florida. Watershed-level WASSI water yield outputs will then be integrated with FIA C, Timber and diversity data to identify watersheds with optimal provision levels and use/non-use values for water yield, C, timber and understory diversity.
Tucker	Joanna	Postdoc	UF	Assisting with analysis and manuscript preparation for a project involving the use of available USDA Forest Service FIA forest inventory data to estimate understory species richness (i.e. biodiversity).

Aim 5 (Education)

Last name	First name	Position	University	Role
Decker	Paul	Undergraduate Intern	VT	2012 Undergraduate Fellow; worked with Stephanie Hall at University of Florida to investigate how to teach high school students about controversial topics such as climate change.
Glover	Kristen	Undergraduate Intern	UF	2013 Undergraduate Fellow; working with Christine Li at UF.
Hall	Stephanie	M.S. Student	UF	Research focus: conducting research on how to best introduce potentially divisive and contested concepts in secondary school curricula; also helping to develop and pilot test activities for the PLT/PINEMAP Secondary Module.
Kidd	John	Research Staff/ Ph.D. Student	VT	Undergraduate Intern Program Coordinator. Developing the selection criteria, matching students, awarding proposals, developing the fall course, and working with local teachers to set up school presentations for the Undergraduate Internship Program.
Kunkle	Kristen	M.S. Student	UF	Research focus: conducting evaluation of module website and tools that convey pedagogical content knowledge about climate change to educators.
Li	Ji (Christine)	Ph.D. Student	UF	Research focus: Assessing interest in climate change based on and hopefulness and relevance of solutions; teacher self-efficacy for teaching about climate; student self-efficacy for participating in climate change solutions.
Oxarart	Annie	Research Staff	UF	Environmental Education Program Coordinator. Working on the development of the PLT/PINEMAP Secondary Module, including assisting with the needs assessment, development and pilot testing of activities, and oversight of the Education Advisory Committee.
Plate	Richard	Postdoc	UF	Assisting with the development and evaluation of activities for the PLT/PINEMAP Secondary Module and analyzing needs assessment data; assisting with data analysis for the Extension climate perceptions survey.
Ritchie	Tracey	Ph.D. Student	UF	Research focus: Conducting summative evaluation of PLT Secondary Module.

Aim 6 (Extension)

Last name	First name	Position	University	Role
Boby	Leslie	Extension Staff	UGA/SREF	Assisting with formation of regional Extension teams; participating in and presenting at research cooperative meetings; and facilitating internal and external PINEMAP research dissemination. Planned work includes developing and evaluating written and web-based (i.e., eXtension, webinars, etc.) educational materials and disseminating resources and materials to forestry stakeholders.
Burnett	Rachel	M.S. Student	NCSU	Assisting with reviewing factsheets and other PINEMAP-related publications; research focus: annual and decadal climate forcing of historical and current trends in fire regime in Southeast forests.
Burns	Sean	Extension Assistant	TAMU	Assisting with Extension program/product development.
Cole	Hilary	M.S. Student	NCSU	Serving as a copy editor for factsheets and other PINEMAP-related publications. She is also providing guidance with contextual examples for the climate education materials in collaboration with the State Climate Office of NC. Hilary is assisting the SREF office with a region-wide Forest managers survey on Climate education needs that she will analyze as part of her Master's thesis.
Dinon Aldridge	Heather	Research Staff	NCSU	Applied Climatologist. Facilitating interaction between PINEMAP team members and state climatologists across the region through activities such as presentations in the internal webinar series and research cooperative meetings and weather/climate conferences. Other involvement includes development of the DSS, creation of fact sheets, and guidance on the best climate datasets for PINEMAP.
Foster	Anslei	M.S. Student	NCAT	Working on fact sheets and publications for PINEMAP.
Hall	Megan	Research Assistant	NCSU	She is implementing contextual examples into the climate education materials for forestry in collaboration with PINEMAP colleagues.
Holmes	Tiara	Undergraduate Intern	VSU	2013 Undergraduate Fellow; working with Shelby Krantz at UF.
Krantz	Shelby	M.S. Student	UF	Conducted focus groups, helped design the forest landowner Extension workshop, developed a pre/post survey and analyzed data to better understand perceptions on climate, willingness to change management strategies, and opportunities to make a meaningful difference; produced videos for PLT Secondary Module web site.
Martin	Andrew	Undergraduate Research Assistant	NCSU	Developing a tool for forestry professionals across the southern U.S. that displays historical temperature, precipitation, and drought indices.
O'Connell	Charlie	Undergraduate Research Assistant	NCSU	Reviewing the climate education materials for forestry as well as developing a tool for forestry professionals across the southern U.S. that displays historical temperature, precipitation, and drought indices.
Temple	Christina	M.S. Student	NCSU	Drafted two fact sheets on adaptation related to forest pests and invasive species.
Vuola	Aaron	M.S. Student	NCSU	Graduated in May 2012. Thesis focused on Six Americas Extension research in North Carolina.
Wojcik	Deborah	Postdoc	UF	Assisted with data analysis for the Extension climate perceptions survey. Dr. Wojcik helped develop the Six Americas survey for SE Extension Professionals and is writing one article.