PINEMAP Year 4 Progress Report 2
April 2015
Aim 6 (Extension)

This is the final Aim progress report for year 4 (March 1, 2014-February 28, 2015). The information provided in these reports is used to track Aim-level outputs and outcomes over the course of the project and to fulfill NIFA reporting requirements via the annual continuation proposals and REEport progress report.

Please note that this is not a cumulative report. Rather, the purpose of this report is to gather information on progress since the previous progress report completed in September 2014.

To streamline this process, information reported in September 2014 is provided below, so you will simply need to review and update each section as necessary.

Please return the completed report to Grace no later than April 10

OUTCOMES/IMPACTS

Outcomes and ***Impacts*** are tangible results for stakeholders and society that the project has produced to advance on the societal challenge (e.g., ***changes in knowledge, actions, or conditions*** that result from project activities). Outcomes and impacts are similar, but impacts are typically longer-term; outcomes are used as a nearer-term proxy for impacts.

Describe how Aim-level activities, results, findings, techniques, or products contribute to project-level outcomes and impacts (e.g., changes in knowledge, actions, or conditions resulting from activities).

A narrative has been drafted below. Please modify or update as necessary.

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. We 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; engagement with the USDA Climate Hubs (specifically the Southern Region one), joint work with the Climate Science Learning Network; and promotion of other mitigation and adaptation programs through the Southern Region Extension Climate Academy (SRECA) graduates.

- To date, PINEMAP information has reached 72 Siviculturists through the Western Gulf Silvicultural and Technology Meeting representing 9 million acres- 5 of those million in

pine. Based on what they learned from this effort, changes will be made to management plans covering at least 250,000 acres.

- Texas Forestry Agency Training- 16 foresters have participated in the initial run, representing around 200,000 northeast Texas landowners. They have incorporated PINEMAP strategies into their forest management plans and landowner outreach efforts. This group represents roughly 4 million acres across the Western Gulf region.
- About 150 southeastern extension agents (ranging from foresters to agriculture and natural resource agents) have been trained on climate science, change and mitigation efforts through three different workshops (Huntsville, AL May 2013; Wilmington, NC January 2014; and Athens, GA September 2014).
- Western Gulf workshop and Woodlands Owner workshop August- 150 attendees (Diboll, TX). Wilmington, Workshop, Agency foresters-15.
- Upcoming workshops include: Spring 2015 herbicide training on adaptive silviculture (northeast TX region) and multi-state SAF meeting (250)- "Reflections on Water" adaptive silviculture, and the Growing Pines in Changing Times workshop for foresters in Tifton, GA.

OUTPUTS

Products

Products include published or in press peer-reviewed publications; other written materials such as white papers, research summaries, fact sheets, or popular press articles; audio or video products; etc.

The lists below summarize year 4 (March 1, 2014-February 28, 2015) products reported in the September 2014 Progress Report.
Please update as necessary and highlight in yellow any products added to the list for the April 2014 Progress Report.

Peer-reviewed publications

Boby, L.A., Hubbard, W.G., Megalos, M.A. and Morris, H.L.C. In submission. Climate Change Observations, Perceptions and Concerns of Southern United States Forestry Professionals. Forest Science.

Burnett, R. E., Vuola, A. J., Megalos, M. A., Adams, D. C., & Monroe, M. C. (2014). North Carolina Cooperative Extension professionals' climate change perceptions, willingness, and perceived barriers to programming: An educational needs assessment. *Journal of Extension* [On-line], 52(1) Article 1RIB1. http://www.joe.org/joe/2014february/rb1.php

Monroe, M.C., Plate, R.R., Adams, D.C., and Wojcik, D.J. 2014. Harnessing Homophily to improve Climate Change Education. Environmental Education Research. http://dx.doi.org/10.1080/13504622.2014.910497

Morris, H.L.C. Megalos, M.A., Vuola, A.J., Adams, D.C., Monroe, M.C. (2014). Cooperative Extension and Climate change: Successful Program Delivery. *Journal of Extension* 52 (2). http://www.joe.org/joe/2014april/comm3.php

Morris, H.L.C. Megalos, M.A., Boby, L.A. and Hubbard, W.G. In Revision. Climate Change Attitudes of Southern Forestry Professionals: Outreach Implications. Journal of Forestry.

Theses/Dissertations

Burnett, R. E. 2014. Climate Predictors of Wildfire Size in North Carolina, 1979-2006: A Quantile Regression Approach. Master of Science Thesis, NC State University, http://ww.live.ncsu.edu/resolver/1840.16/9399

Morris, Hilary Lynn Cole. 2013 Climate Change Attitudes of Southeast Forestry Professionals: Implications for Outreach. Master of Science Thesis, NC State University, http://www.lib.ncsu.edu/resolver/1840.16/9225

Other publications

Forest Ecosystem Values Tool

The Forest Ecosystem Values Tool, funded in part by PINEMAP and hosted at texasforestinfo.com, is an online application that provides estimated economic values for certain ecosystem services and benefits provided by forests for forest practitioners and landowners. To date, there have been 166 unique users to use the tool.

Fact sheets: published

Climate Communication Series V3: *Risk Perceptions and Needs: Defining Extension's Climate Change Adaptation Role*	Mark Megalos, Martha C. Monroe and Claire Layman Bode
Climate Communication Series V2: *Strategies for Communicating Climate Change to Extension Audiences*	Claire Layman Bode, Martha Monroe and Mark Megalos
Climate Communication Series V1: Challenges in Communicating Climate Change to Extension Audiences	Martha C. Monroe, Claire Layman Bode, Mark Megalos
Southern Pine Plantations and the Carbon they store: Important Information for the Forest Landowner	Adam Maggard and Leslie Boby
The Role of Woodlands in Climate Regulation	Eric Taylor and Sean Burns
The Role of Woodlands in the Bio-based Industry: Woody Biomass for Power and Products	Eric Taylor and Sean Burns
Climate Change Attitudes of Southeastern Foresters	Leslie Boby, William Hubbard and Shafkat Khan
Drought and Southern Forests: The Importance of Forest Health and Resiliency NOVEMBER 2013	HEATHER DINON, RACHEL BURNETT, ERIC TAYLOR, RYAN BOYLES, WILLIAM HUBBARD, MARK MEGALOS, SEAN BURNS, LESLIE BOBY

Fact sheets: in development

Assessing Forest Vulnerability	Mark Megalos and Heather Dinon
Climate Oscillations: Impacts to Forestry	Heather Dinon and Ryan Boyles
Ecophysiological Effects of Temperature	Evelyn Denzin, Tim Martin, Leslie Boby,

and Moisture Stress on Trees in the Southern U.S.	Jeremy Stovall and Eric Taylor
Fertilizer Application Guidelines for Southern Forests	Evelyn Denzin, Tim Martin, Leslie Boby, Jeremy Stovall and Eric Taylor
Frequently Asked Questions about Climate Projections	Heather Dinon & Ryan Boyles
Glossary of Climate Terms	Mark Megalos, Heather Dinon and John Hastings
Interpreting Uncertainty of Climate Model Projections	Heather Dinon and Ryan Boyles
Introduction to Weather and Climate	Heather Dinon and Ryan Boyles
Managing for Temperature and Moisture Stress in Forests in the Southern U.S.	Evelyn Denzin, Tim Martin, Leslie Boby, Jeremy Stovall and Eric Taylor
Minimizing Forest Insect / Disease Risk: A Practical Landowner Guide	Mark Megalos
Misconceptions about Global Warming and Climate Change	Heather Dinon and Ryan Boyles
Thinning Recommendation Key	Eric Taylor
Nutrient Cycling in Forests under Variable Environmental Conditions	Evelyn Denzin, Tim Martin, Leslie Boby, Jeremy Stovall and Eric Taylor
Water Cycle in Forested Lands with Emphasis on Silvopasture Systems	Shareika Williams and Gwendolyn Boyd
What's Under the Umbrella that is Climate?	Heather Dinon and Ryan Boyles
Seedling Selection Tool Factsheet	Eric Taylor

Audio/video products

Forest Landowners Discuss Changes they've Witnessed- May 2014, Leslie Boby, Bill Hubbard and Shelby Krantz. https://www.youtube.com/watch?v=5E8xuC9KPTI&list=PLHu4PGejzrIw-WSdG8Jlb7h8R-mCRjXrm&index=1

Managing for Resilient Forests, February 2014, Shelby Krantz. https://www.youtube.com/watch?v=bV7jlAGuhaA&list=PLHu4PGejzrIw-WSdG8Jlb7h8R-mCRjXrm&index=2

1. Density Management: How to make decisions about planting density and thinning given uncertain future markets Presented by Jeremy Stovall at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA. Stovall is Assistant Professor of Silviculture, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University https://youtu.be/i43cOKuj6U8

2. Bringing it Together: How to think about the timing and application Presented by Jason Vogel at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in

Shreveport, LA.Vogel is Assistant Professor of Ecosystem Science, Department of Ecosystem Science and Management, Texas A&M University

3. Unmanned Aerial Vehicles (UAVs) for Forest Applications Presented by Wesley Palmer at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA. Palmer is Spatial Data Lab Supervisor, GIS/GPS Instructor, GIS Program Coordinator, School of Forestry, Louisiana Tech University https://youtu.be/LKcZ6xOZwqA

4. On the Horizon: the South East Research Climate Hub Presented by Steven McNulty at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA. McNulty is Director, USDA South East Regional Climate Hub (SERCH), Raleigh, NC. https://youtu.be/f-gbbqh6Jx8
5. Stand Establishment Strategies Dr. Michael Blazier - Associate Professor and Forestry Research Project Leader at Louisiana State University https://youtu.be/kPAUWhqwTo0

6. Tree Physiological Responses to Extreme Stress Presented by Dr. Michael Tyree - Assistant Professor and Homer T. Rogers professorship of Eco-physiology at Louisiana Tech University.https://youtu.be/1Kf4qAfY_0g

7. Nutrient Cycling and Nutrient Deficiencies in Production Forests Presented by Dr. Jeremy Stovall - Assistant Professor of Silviculture at Stephen F. Austin State University https://youtu.be/baOi3i5ZUNk

8. Climate Resources Hal Needham - Department of Geography and Anthropology at Louisiana State University discusses various web-based climate tools and resources helpful to natural resource managers. https://youtu.be/Y6BQ1sRicfo

9. Hurricanes in a Changing Climate Presented by Dr. Barry Keim - Louisiana State Climatologist and LSU Professor of Geography and Anthropology. https://youtu.be/y0HfkQJEDnY

10. Climate Prediction Made Difficult Presented by Dr. John Nielsen-Gammon - Texas State Climatologist & Regents Professor of Atmospheric Sciences at Texas A&M University https://youtu.be/l43d4zrNB1w

Events/Activities

Events/activities include presentations (oral and poster) given at meetings or conferences; workshops/trainings/courses conducted; and experiments/surveys/data collection conducted.

The table(s) below summarizes year 4 (March 1, 2014-February 28, 2015) events/activities reported in the September 2014 Progress Report.
Please update as necessary and highlight in yellow items added to the list for the April 2015 Progress Report.

Presentations

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Boby, L., W. Hubbard, and H. C. Morris	Southern Foresters' Perceptions on Climate Change and Implications for Extension	Poster Presentation	May 14-16, 2014	PINEMAP Annual Meeting, Athens, GA
Boyles, R.	PINEMAP's Decision Support System	Presentation	May 14, 2014	PINEMAP Annual Meeting, Athens, GA
Boyles, R.	PINEMAP Climate Scenarios and Projection Datasets	Presentation	May 14, 2014	PINEMAP Annual Meeting, Athens, GA
Boyles, R., Dinon Aldridge, H., Davis, C.	DSS and seed deployment tool	Presentation / Web Demo	May 15, 2014	PINEMAP Annual Meeting, Athens, GA
Boyles, R.	Climate Models, Downscaling, and Usage	Presentation	August 15, 2014	USDA Southern Region IPM and SE Regional Climate Hub
Boyles, R.	Climate Risks for Forests	Presentation	September 4, 2014	Piedmont SAF
Boyles, R.	Climate outreach and extension	Webinar	November 20, 2014	National Park Service Climate Ready Parks
Boyles, R.	Climate change in NC	Presentation	December 2, 2014	NC Ag/Forest Adaptation Workgroup
Davis, C.	Fire Weather Monitoring and Predictability in the Southeast	Presentation	March 13, 2014	Piedmont Chapter of the Society of American Foresters
Davis, C.	Teaching the Basic Weather Processes unit of the S-290 (Intermediate Wildland Fire Behavior) training course	Presentation	September 15, 2014	S-290 Training for NC Forest Service
Davis, C.	Fire Weather Portal	Presentation	October 9, 2014	Triangle Climate and Landscaper Researchers Brown Bag
Davis, C., Dinon Aldridge, H.	Climate-Based Decision Support for Foresters	Virtual Presentation	January 28. 2015	Multi-state SAF meeting
Davis, C., Dinon Aldridge, H.	MACA updates	Webinar	January 23, 2015	PINEMAP ATP meeting
Dinon Aldridge, H., Boyles, R., Davis, C.	DSS Progress Updates	Webinar	April 21, 2014	PINEMAP DSS subcommittee meeting
Dinon Aldridge, H., Boyles, R., Davis, C.	DSS Tool Demo	Presentation	April 28-29, 2014	Carolinas Climate Resilience Conference

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Dinon Aldridge, H., Boby, L., Li, J., Megalos, M., Monroe, M.	Assessing Misconceptions about Global Warming and Climate Change in the Southeast US	Poster Presentation	May 19, 2014	ANREP Conference 2014
Dinon Aldridge, H., Boyles, R., Davis, C., Peter, G.	PINEMAP's Decision Support System	Presentation	September 4, 2014	SRECA meeting
Dinon Aldridge, H., Peter, G., Boyles, R., Davis, C.,	PINEMAP DSS Seed Deployment Tool Demo	Presentation / Web Demo	September 4, 2014	SRECA meeting
Dinon Aldridge, H., Davis, C., Boyles, R.	PINEMAP DSS & MACA updates	Webinar	December 5, 2014	PINEMAP ATP meeting
Hubbard, W.G.	Southern Regional Extension Forestry Updates	Presentation	March 25, 2014	Clemson Society of American Foresters Meeting, Clemson SC
Idassi, J., G. Boyd, L. Boby, M. Megalos, H. Dinon Aldridge, M. Monroe, and W. Hubbard	1890 Land Grant Institutions and PINEMAP Climate Change Workshops	Poster Presentation	May 14-16, 2014	PINEMAP Annual Meeting, Athens, GA
Knox, P.	Environmental Change Agents	Presentation (Meeting)	August 21, 2014	9th Annual Georgia Environmental Conference
Krantz, S.	Engaging audiences through Video: Communicating science effectively	Workshop	March 22, 2014	League of Environmental Educators in Florida 2014 Conference Ocala, FL
Krantz, S.	Engaging audiences through Video: Communicating with forest Landowners Effectively	Presentation	May, 2014	Association of Natural Resource Extension Professionals 2014 Conference
Krantz, S. and M. Monroe	Message Framing Matters: Communicating Climate Change with Forest Landowners	Poster Presentation	May 14-16, 2014	PINEMAP Annual Meeting, Athens, GA
Martin, T.A.	PINEMAP Stakeholder Needs Assessment: Research Priorities	Presentation	May 14, 2014	PINEMAP Annual Meeting, Athens, GA
Martin, T.A. and W. Hubbard	PINEMAP Stakeholder Needs Assessment: Research Delivery Mechanisms and PINEMAP Outreach Plans	Presentation	May 14, 2014	PINEMAP Annual Meeting, Athens, GA

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Megalos, M.A.	Climate Tools For Forestry	Presentation	9/5/2014	Inaugural SREC Academy
Megalos, M.A.	PINEMAP PLT Train the Trainer workshop	Presentation	9/19/2014	Regional Teacher Training for PINEMAP PLT MODULE
Megalos, M.A.	Considering Climate as an Additional Management Risk	Presentation	11/20/2014	NCSUTIP PINEMAP Workshop - Savannah
Megalos, M.A.	Ag/For Adaptation	Presentation	12/2/2014	NCAdapatation Team (25x25 Grant)
Megalos, M.A.	. Foresters Survey: Observations (climate& weather)	Presentation	12/11/2014	SALCC Roundtable
Megalos, M.A.	S. Foresters Survey: Observations (climate& weather)	Presentation	Jan.22, 2015	APSAF Annual Meeting
Megalos, M.A.	. Foresters Survey: Observations (climate& weather)	Webinar	3/19/2015	National Forestry Webinar.net
Will, Rodney, Monroe, M.C. and others	Oklahoma Tier III Site field trip for the Four-State Society of American Foresters meeting	Field Trip	1/27/15	Oklahoma, Arkansas, Texas and Louisiana Society of American Foresters
Knox, P.	Recent Climate Trends in the Southeast and their Impact on Trees	Presentation	October 23, 2014	Georgia Urban Forest Council Annual Conference 2014
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	March 18, 2014	Multi-County Extension Program
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	March 25, 2014	Intra-Agency Natural Resource
Taylor, E.L.	Climate Change Made Difficult	Prerecorded lecture	March 31, 2014	Recorded at Western Gulf Silvcultural Technology Exchange and hosted at forestrywebinars/.net
Taylor, E.L.	Hurricanes in a Changing Climate	Prerecorded lecture	March 31, 2014	Recorded at Western Gulf Silvcultural Technology Exchange and hosted at forestrywebinars/.net

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Taylor, E.L.	Climate Resources	Prerecorded lecture	March 31, 2014	Recorded at Western Gulf Silvcultural Technology Exchange and hosted at forestrywebinars/.net
Taylor, E.L.	Nutrient Cycling and Nutrient Deficiencies in Production Forests	Prerecorded lecture	March 31, 2014	Recorded at Western Gulf Silvcultural Technology Exchange and hosted at forestrywebinars/.net
Taylor, E.L.	Tree Physiological Responses to Extreme Stress	Prerecorded lecture	March 31, 2014	Recorded at Western Gulf Silvcultural Technology Exchange and hosted at forestrywebinars/.net
Taylor, E.L.	Stand Establishment Strategies	Prerecorded lecture	March 31, 2014	Recorded at Western Gulf Silvcultural Technology Exchange and hosted at forestrywebinars/.net
Taylor, E.L.	PINEMAP Outcome Themes: Enhanced Capacity and Enhanced Connections	Presentation	May 14, 2014	PINEMAP Annual Meeting, Athens, GA
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	April 12, 2014	Community meeting
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	April 24, 2014	Multi-County Extension Program
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	April 26, 2014	Tree Farm Tour
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	May 6, 2014	WGFTIP Meeting
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	May 31, 2014	Intra-Agency Landowner Workshop
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	June 5, 2014	Texas SAF chapter meeting
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	August 14, 2014	Landowner Workshop

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	August 14, 2014	Landowner Workshop
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	August 27, 2014	Professional Conference
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	September 4, 2014	SRECA
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	September 20, 2014	Multi-County Extension Program
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	September 27, 2014	Multi-County Extension Program
Taylor E.L.	Incorporating Climate and Resilience Concepts into Forest Management Outreach Programs	Presentation	October 11, 2014	National SAF
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	November 20, 2014	Texas SAF chapter meeting
Taylor E.L.	Biological Optimum Thinning Schedules	Presentation	November 21, 2014	In-service training
Taylor E.L.	Stand Establishment Strategies	Presentation	November 21, 2014	In-service training
Taylor E.L.	Stand Establishment Strategies	Presentation	February 3, 2015	County Program
Taylor E.L.	Strategies for Forest Health and Resiliency	Presentation	February 13, 2015	Multi-County Program

Trainings, workshops, and courses

The Western Gulf Silvicultural Technology Exchange

The Western Gulf Silvicultural Technology Exchange (WGSTE) is a biennial workshop focused on disseminating new knowledge, tools, and strategies about pine-based silviculture to industrial and large-scale silviculturists working primarily in the Western Gulf region of the U.S. This event is crucial due to the unique climate conditions of the region and the concomitant impact to forest health and resilience. In other words, the effects of climate and climate variability on southern forests are particularly hard-hitting here. PINEMAP is sensitive to the greater urgency of adaptive silvicultural strategies in the Western Gulf region. PINEMAP has established a

permanent committee to guide this effort consisting of not only PINEMAP members, but also, non-PINEMAP funded universities and agencies in the Western Gulf including the Louisiana State University AgCenter, Stephen F. Austin College of Forestry, and Louisiana Tech School of Forestry. To date, PINEMAP information has reached 72 silviculturists through the WGSTE representing 9 million acres – 5 of those million in pine.

Professional Development Webinar Series

The Professional Development Webinar Series was a monthly series of webinars that debuted in November 2012 using the Forestry Webinars portal (www.forestrywebinars.net). This effort primarily targets large-scale forest managers and natural resource professionals such as forestry consultants and state forestry agency personnel. The series packages and delivers new knowledge and tools developed by PINEMAP in such a way that the audience can confidently incorporate these into their daily business and, as a result, improve the resilience, productivity, carbon sequestration, and nutrient management of their forest lands. Combined survey results show that participants feel satisfied with the amount of information covered in the webinars (Figure 18.1). There were 14 webinars with a total of 739 viewers.

Adaptive Silvicultural Training: State Forestry Agency Training (also in Article)

PINEMAP is driving efforts in adaptive silvicultural training for state agency foresters. The key goal is to inform foresters of the latest research and tools so they can transfer information to their clients (primarily small-scale family forest landowners) and positively impact forest health, resilience, and productivity. To date, the program has been tested with the Texas A&M Forest Service. Sixteen foresters participated in the initial training program and have already incorporated the new strategies into their forest management plans and used new decision-support tools to guide landowners. Plans are in place to conduct four trainings of this type across the region in 2014.

Southern Region Extension Climate Academy,
Athens, GA, September 3-5, 2014

The SRECA program was first initiated in August 2013, when the Extension leadership in the Southern region asked the coordinators from three USDA/NIFA-funded regional climate projects to coordinate a regional professional development program. SRECA was designed to help Extension professionals who bring a variety of perspectives on climate change become leaders and facilitators in their state for appropriate and relevant programming in climate variability and change. The Academy enabled individuals to work in small groups to develop resources or programs and report experiences to the entire group through web-based workshops over the next year. SRECA aims to improve Extension response and programming in four target areas: Crops, Livestock, Forestry, and Coastal areas. Through new relationships built with professionals in similar arenas across the region, participants have and will continue to exchange ideas and enhance their programs. Twenty five foresters attended the forestry sector meeting, out of 120 attendees.

Joint Texas Forest Service, Texas Forestry Association and Landowner Council Annual meeting and Workshop, August 14, 2014

This workshop included a wide audience of professional foresters and landowners and covered the bases of managing for forestry in a changing climate.

Texas Forest Service Natural Resource Conference, August 27, 2014.

This one day workshop was geared towards a range of natural resource professionals, including foresters and other land managers and included components which addressed climate change and land management.

Advanced Pine Silvicultural Concepts
November 21, 2014
This Workshop was for foresters in Texas, Louisiana and Oklahoma to learn more about the latest developments in silviculture.

4-State Society of American Foresters Meeting (Oklahoma, Louisiana, Texas and Arkansas)
January 27-2, 2015
The 4-state region of Society of American foresters hosted this three day workshop for SAF members to learn more about the latest forestry concepts. Many PINEMAP researchers spoke at this workshop in addition to Eric Taylor, Aim 6 member.

Annual Forest Pesticide Conference Workshop
February 13, 2015
Thisworkshop for professional foresters included components on increasing threats from diseases and insects from a changing climate.

PROGRESS NARRATIVE

Please provide a *brief* summary of progress on each deliverable/task/input/output listed below. In many cases, a one sentence summary may suffice. If there is no progress update on an item, leave blank. Please highlight additions in yellow.

- Do not include any figures or tables, but please do include quantifiable measurements, if available (i.e., # of plots measured, # of samples, # of runs, # of people reached, etc.)

Extension outreach

Task: Conceptualization of "one-stop" web presence (8/31/14)

The "one-stop" website is in the early design stages, currently, we have a draft framework. The initial iteration of website organization, as well as a selection of topics and features to be covered have been started. Discussions of next steps for PINEMAP materials and the Decision Support System have been ongoing in the Extension team and now, Aim 6 members are partnering with the Southeast Reagional Climate Hub (SERCH), the Climate, Forest and Woodlands Community of Practice (eXtension), and a newer project on a Climate Science Learning Network to discuss ways to combine efforts and create a comprehensive location for educational and Extension resources on climate and forestry. This collaborative effort will help leverage and share PINEMAP resources with wider audiences, and continue sharing the work, after the PINEMAP project has completed. Essentially, working together with these other groups will create a better product that will be advertised widely.

Task: Revive Regionwide (make Unit leaders meeting) representative of all southern states and US forest service Advisory Panels (8/31/14)-

Beta testing of DSS- find some folks to be beta-testers, coordinate some of those activities

Multiple advisors have been solicited for feedback on the DSS and outreach materials at two meetings (one foresters and one extension foresters). Additional meetings are scheduled for December 2014, January 2015 and February 2015. Southern Regional Extension Forestry (Bill Hubbard and Leslie Boby), annually host a meeting for Extension Foresters at the different southern land grant universities, called the Unit Leaders meeting, and have solicited feedback

and ideas from the group, as an ad-hoc regional advisory board. Since these leaders are engaged in extension forestry with similar work, their feedback has been valuable towards improving products and direction of work.

Task: Facilitate development of presentations; publicize, test, evaluate (ongoing)
Over the past few years, we have produced 14 webinars for professional foresters using PINEMAP researchers and other professionals to present. We worked closely with them to guarantee the quality and relevance of their presentations. 739 people viewed the webinars for an average attendance of 53 per webinar. Additionally, we have asked PINEMAP researchers to assist at nearly ten workshops to speak to foresters about their work and to focus on management actions.

Deliverable: Landowner fact sheets (ongoing)
More than 8 landowner factsheets have been completed since last year and more than 16 are in progress.

Deliverable: Professional Development webinars (past tense-delivered!!!)
14 PINEMAP webinars have were watched by 739 total viewers (professional foresters, targeted audience) and archived for further viewing.

Deliverable: Journal articles (ongoing)
Five peer-reviewed articles have been published or are in submission, and two masters theses have been completed.

Deliverable: Adaptive silvicultural training (8/31/15)
Aim 6 personnel developed two workshops specifically on silvicultural training that trained 300 foresters and landowners total. About 45 other extension foresters were trained in adaptive forest management at 3 other workshops. Nearly ten other workshops have been delivered that encompassed silvicultural training and are listed under workshops, training sessions, etc.

Deliverable: Videos (Ongoing)

11. Density Management: How to make decisions about planting density and thinning given uncertain future markets Presented by Jeremy Stovall at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA. Stovall is Assistant Professor of Silviculture, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University https://youtu.be/i43cOKuj6U8

12. Bringing it Together: How to think about the timing and application Presented by Jason Vogel at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA.Vogel is Assistant Professor of Ecosystem Science, Department of Ecosystem Science and Management, Texas A&M University

13. Unmanned Aerial Vehicles (UAVs) for Forest Applications Presented by Wesley Palmer at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA. Palmer is Spatial Data Lab Supervisor, GIS/GPS Instructor, GIS Program

Coordinator, School of Forestry, Louisiana Tech University
https://youtu.be/LKcZ6xOZwqA

14. On the Horizon: the South East Research Climate Hub Presented by Steven McNulty at the 2014 Western Gulf Silvicultural Technology Exchange (http://wgste.org) in Shreveport, LA. McNulty is Director, USDA South East Regional Climate Hub (SERCH), Raleigh, NC. https://youtu.be/f-gbbqh6Jx8
15. Stand Establishment Strategies Dr. Michael Blazier - Associate Professor and Forestry Research Project Leader at Louisiana State University https://youtu.be/kPAUWhqwTo0

16. Tree Physiological Responses to Extreme Stress Presented by Dr. Michael Tyree - Assistant Professor and Homer T. Rogers professorship of Eco-physiology at Louisiana Tech University.https://youtu.be/1Kf4qAfY_0g

17. Nutrient Cycling and Nutrient Deficiencies in Production Forests Presented by Dr. Jeremy Stovall - Assistant Professor of Silviculture at Stephen F. Austin State University https://youtu.be/baOi3i5ZUNk

18. Climate Resources Hal Needham - Department of Geography and Anthropology at Louisiana State University discusses various web-based climate tools and resources helpful to natural resource managers. https://youtu.be/Y6BQ1sRicfo

19. Hurricanes in a Changing Climate Presented by Dr. Barry Keim - Louisiana State Climatologist and LSU Professor of Geography and Anthropology. https://youtu.be/y0HfkQJEDnY

20. Climate Prediction Made Difficult Presented by Dr. John Nielsen-Gammon - Texas State Climatologist & Regents Professor of Atmospheric Sciences at Texas A&M University https://youtu.be/l43d4zrNB1w

Task: Facilitate development of presentations; publicize, test, evaluate (11/30/14)

AIM 6 members facilitated development of presentations for the webinar series over the past year by guiding speakers and providing feedback on content and flow. Additionally, AIM 6 members have facilitated development of presentations for workshops, put together workshops and developed guidelines for what should be presented.

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Decision Support System

The Multivariate Adaptive Constructed Analogs (MACA) dataset has been averaged over HUC12 regions for variables required by 3PG, Growth & Yield, and WaSSI. MACA was created using a statistical downscaling method with 20 global climate models from IPCC's 5th Assessment Report and two different emission scenarios across a model baseline period (1950-2005) and future period (2006-2099).

The way we were previously creating spatial averages for HUC12 scales could possibly cause problems for some modelers, so we had to re-tool our analysis software (again). We used this opportunity to create some additional efficiencies, and we were able to reprocess all the MACA projections at HUC12 in a few weeks with output now available for:

- 9 PINEMAP modeling variables: growing season days, total annual precipitation, summer dryness index, monthly min and max temp, monthly total precipitation, mean incoming radiation, frost days, and monthly mean temp
- all 20 global climate models
- all climate model scenarios (baseline, RCP45, RCP85)
- all HUC12s within the PINEMAP region (exception: WaSSI data is CONUS)

This has created ~ 6TB worth of new output for folks to use both at HUC12 and as gridded data. Here is an example of frost days in Jan 2035 for the MIROC5 model under RCP45. The scale ranges from 0 (blue) to 31 (red).

Using the gridded data, we have now a lot of new processed data to serve as the basis for climate change maps for the DSS.

3PG and G&Y data for all PINEMAP states are ~30GB and ~1.5GB, respectively; WaSSI for continental US is ~250GB. After downloading this data, the modelers will run it through their models and create output for the DSS.

Daily extractions have also been completed for the six standard outputs from MACA (min/max temperature, precipitation, wind speed, specific humidity, and solar radiation) at a daily time step. These extractions have been completed for the following sites: Tier 1 (~749 sites), Tier 2 (~100 sites), Tier 3 (4 sites), and 36 3PG validation sites. Processing for the 749 Tier 1 locations generates 67 million rows per file (daily data for 56 baseline years plus 2 RCPs with 94 years each times 749 sites) or ~4.5GB per file. Tiers 2, 3, and 3PG validation sites amount to about 150GB of data.

Input: Regional modeling output (8/31/15)

A web interface has been developed to download the Multivariate Adaptive Constructed Analogs (MACA) dataset averaged over HUC12 regions. MACA was created using a statistical downscaling method with 20 global climate models from IPCC's 5th Assessment Report and two different emission scenarios across a baseline period (1950-2005) and future period (2006-2100).

Modelers can download CSV files for each requested time period (baseline, future), region (huc, state, PINEMAP), model, parameter, time step (daily, monthly, annual), and emission scenario (RCP 4.5, RCP 8.5, or both). Once the data begin processing, the user will be emailed a link to check the status of their request, and a subsequent email will be sent with a link to download the data.

Available parameters include the six standard outputs from MACA (min/max temperature, precipitation, wind speed, specific humidity, and solar radiation) at a daily time step as well as aggregated to monthly and annual time steps. Other calculated parameters are also available, which include monthly average mean temperature, frost days per month, growing season days, and summer dryness index. After downloading this data, the modelers will run it through their models and create output for the DSS.

Biological Optimum Thinning Key – developing a web-based key that will guide land managers to better, proactive management and improved thinning regiments that promote pine forest health, resiliency, and resistance to climate driven environmental stressors. Based on what trees needs are!!

Herbicide Decision Key – developing a web-based key that will guide land managers in making herbicide prescriptions, encourage better management thus promoting pine forest health, resiliency, and resistance to climate driven environmental stressors File maker/web-based! Choose what your needs are and it will spit out your herbicide for those tasks! Takes guesswork out of it! The herbicide key is stand level vs. PINEMAP DSS, which is "sub-regional level.

Task: Assess tools/info. for market change inclusion: ecosystem services, timber yields, bioenergy (8/31/15)
Identified individuals to provide feedback and much of the work will be done small pieces at a time through webinar meetings. (no updates)

Task: Regional model integration—what is/will be available? (8/31/15
The DSS team has been working closely with Evan Brooks to identify meaningful modeling outputs. We will continue this conversation during Spring and Summer 2015.

Task: Assess feasibility of hurricane, fire risk as tools (8/31/15)
No progress reported in September 2014 report To assess future fire risk, we have discussed calculating the Keetch-Byram Drought Index and Energy Release Component -- two commonly used indices for fire weather monitoring -- with the MACA projections. Those could gauge the future changes in the frequency of periods with elevated fire risk. No updates about the hurricane risk tool. We need to follow up on our discussion with Damian Adams from last year's annual meeting.

Input: V1: beta testing (11/30/15)
Identified testers during Summer/Fall 2014 and connected Ryan Boyles with those potential testers. We plan active interactions with our beta tester team in April 2015. This team includes a few industry folks, a consultant, a TIMO/REIT rep, and several PINEMAP folks. Here is our plan for the beta testing:

- First step: Independent Exploration
  - Email each tester with some basic information about the tool they'll be testing and give them a scenario or two to work through using the tool
  - They'll work through these independently on their own time, since that best simulates the environment actual DSS users will be in
  - Schedule follow-up phone calls with small groups of testers to discuss questions like "What did you expect *this* to do?" and "How did you interpret *this*?" and "Was it clear that you could do *this*?"
- Second step: Small Group Collaboration
  - Compile responses from Step 1 and find any common concerns or misconceptions
  - Arrange conference calls with small groups of 3-5 testers to discuss these concerns, layout and color options, general comments about the tool, and any questions this tool doesn't answer or that they'd like to see added.

In the meantime, Mark Megalos and his graduate student, John Hastings, have been our Aim 6 pre-beta testers. They have identified several bugs within the existing tools. These bugs were submitted via a DSS issue tracker that was set up on GitHub.

Task: Finalize: overall design; time steps for backend model runs to generate data; risk/uncertainty visuals; determine min. and max. change for maps; shopping cart for "data export" (11/30/15)

The DSS team is still refining a 3-panel display for the climate data tools. We are also analyzing the MACA downscaled climate dataset (see above for more details on MACA data analysis related to the regional modeling efforts). For the DSS analysis, we are generating multi-model mean changes as well as multi-model mean changes +/-2 standard deviation changes for all variables across 20-year future time periods (2020-2039, 2040-2059, 2060-2079, 2080-2099). These change maps have already been generated for the seedling deployment tools (see below for more details), and the change maps for the climate risk/opportunities tools are being developed during Spring 2015. The seedling deployment tools incorporate three levels of risk: low, medium, and high, which are based on cold tolerance. Feedback on all of this will be obtained from the beta testers and DSS subcommittee. We have not had any further discussion about the shopping cart for data export, but if it's desired, it could probably be implemented fairly easily using a lot of the OPeNDAP calls we'll be using for the DSS timeseries code.

Deliverable: V1 climate risk and opportunity tools (11/30/14)

The multi-model outputs (mean changes as well as mean changes +/-2 standard deviation changes) will be displayed as climate tools on the DSS using the 3-panel display described above. These change maps for the climate risk/opportunities tools are being developed during Spring 2015.

Deliverable: Website design, look/feel, language (11/30/14)

Initial website has been designed, and a second iteration of the website was completed. Aim 6 provided feedback on the look, feel and language of the website and also solicited feedback from other foresters. The DSS menu structure has been updated again so users can navigate to their desired tool in fewer steps. We have worked with an NCSU Technical Communication graduate student to refine some technical language with the climate risk and seedling deployment tools, and based on her feedback, we have begun adding tooltips to define unfamiliar terms and provide navigational assistance for DSS users. Additional refinements to the DSS design and language are expected once beta testing commences.

Deliverable: Final climate risk and opportunity tools (2/28/15)

No progress reported in September 2014 report See above for update on these tools.

Deliverable: V1 SPB and fire risk and density management (2/28/15)

No progress reported in September 2014 report For fire risk, see above; after our discussion with Eric, it seems that his Thinning Tool would work best as a standalone tool separate from the DSS since it is site-specific.

Deliverable: Final website look, design, feel (2/28/15)

No progress reported in September 2014 report See above for update on this.

Output: DSS training; climate tools; seed deployment (5/31/15
The DSS will be rolled out at three Society of American Foresters (SAF) meetings across the PINEMAP region (SC, GA, and TX) during January 2015.
We have been working closely with Gary Peter on the seedling deployment tools, which have gone through several alpha tester revisions over the past few months. The tools initially display a map of shaded 5°F isotherms – or lines of constant or equal temperature – corresponding to the historical average January minimum temperatures from 1986 to 2005, which closely mimic the USDA Plant Hardiness Zones and the current seed transfer guidelines of Schmidtling (2001). When a user clicks a location of interest on the map, the specific historical isotherm associated with that location (e.g., the 33.4°F isotherm for Athens, Georgia) is highlighted, along with several other isotherms based on future projections from a suite of climate models.

On the Seed Movement Tool, these isotherms show the projected migration of the historical location-specific isotherm for selected future periods (2020–2039, 2040–2059, 2060–2079, and 2080–2099). This tool is ideal for nurseries to see where their current seed may be most effective in the future. On the Seed Selection Tool, these isotherms show the historical locations of projected future temperatures for the chosen site. For example, Athens, GA, has a mean projected average minimum temperature of 35.3°F from 2020 to 2039, so the historical location of this 35.3°F isotherm is highlighted. This tool is primarily intended for local growers to see where they could pull seed from for their site in the future.

The PINEMAP seedling deployment tools build on the research of Schmidtling by mapping projected future average January minimum temperature isotherms, and allowing users to select a temperature range around the historical isotherm based on individual freezing risk tolerance. Users of the seedling deployment tools can visualize different risk levels by displaying temperature ranges around any isotherm. These ranges -- from a low-risk scenario of +/-1°F to a higher risk scenario of -1 to +5°F -- expand the isotherms to show locations projected to have slightly warmer or cooler temperatures in the future, but that still may be potential recruitment zones for each planting location. Thus, these two tools enable foresters and forest landowners to better match seed sources with future climates to increase and optimize productivity.

Beta testers will be refining these tools during April 2015.

The DSS will be rolled out at regional Society of American Foresters (SAF) meetings across the PINEMAP region during Fall 2015.

Input: Regional maps of carbon (above & below-ground) & potential change climate (8/31/15)
No progress reported in September 2014 report

Deliverable: Final SPB and fire risk and density management (8/31/15)
No progress reported in September 2014 report

Deliverable: Fully functional tested DSS to support climate-based decisions (11/30/15)
No progress reported in September 2014 report

Deliverable: Final disturbance resilience change in productivity/carbon-based regional G&Y set of models (2/28/15)
No progress reported in September 2014 report

BROAD IMPACTS

Provide a short narrative describing broad impacts (i.e., far-reaching and possibly unanticipated outcomes resulting from Aim work). Specifically, please highlight leveraged funds and/or partnerships with other projects/external collaborations.

Climate science learning network, Climate F, and W- coP, with USDA hubs- hub integration working closely to deliver programs
One important broad impact of AIM 6's work for PINEMAP has been collaborations with other similar projects, which focus on different natural resource sectors. PINEMAP's Aim 6 partnered with an animal livestock and climate change project (Animal Agriculture and Climate Change Project) as well as an agriculture and climate change project (Southeast Climate Extension), in order to collectively train about 100 extension agents on climate science/change and tools for their resource areas. This successful collaboration, called Southern Region Extension Climate Academy was first started after Martha Monroe presented results from her PINEMAP funded survey on Southeastern Extension Agents' perceptions on climate change to extension directors from the southeast. After that, one extension director approached Martha as well as Bill Hubbard to discuss how best to train agents on these topics. From there, other partners were brought in to assist. One important focus of the academy has been to create a cohort of trained agents who can share ideas within their sectors and with their statewide colleagues. Within the forestry sector group, about 22 foresters have agreed to continue to share ideas and work together jointly on some projects as well- goals that are compatible with PINEMAP's larger goals.

Another unforeseen broad impact is engagement with multiple partners all focused on education related to climate change and natural resource management. The AIM 6 Extension team are working closely with the new leading team of the Climate, Forests and Woodlands Community of Practice (Aim 6 member Mark Megalos is part of this team), the staff and leadership of the Southeast Regional Climate Hub (SERCH)- which includes PINEMAP researcher Steve McNulty, and the new Climate Science Learning Network (an eXtension initiative being lead by AIM 6 staff Bill Hubbard and Leslie Boby, along with others). Timing, as everyone knows, is critical, and timing has been excellent, as far as these collaborations go, since one of the key discussions within the project and within the Aim 6 group is how to ensure that results, materials and resources from the PINEMAP effort continue to be utilized and continue to have a "home," as the project finishes. As the AIM 6 team began these discussions, these three other initiatives were getting started. And, since AIM 6 and other PINEMAP staff are involved with these other projects, talk about collaborating and leveraging PINEMAP resources for these efforts have come about. These three additional projects will help provide continuity for PINEMAP Extension resources and the DSS, and collective planning will help avoid replication of efforts and more relevant, robust, and streamlined resources.

An additional effort that the PINEMAP extension team has been involved with is Extension efforts with the International Union of Forest Research Organizations and the National

Adaptation Forum. Aim 6 members have been active within both groups to promote PINEMAP efforts and share lessons, learned and other resources.

TRAINING

A CUMULATIVE list of all Aim 6 undergraduate and graduate students, postdocs, and technical/research personnel trained under this project and descriptions of their research focus and/or role in the project is provided below. Additions/ changes from the Sept 2014 progress report are highlighted in blue.
Please update as necessary and highlight in yellow any updates made for the April 2014 Progress Report.

Last name	First name	Position	University	Role
Boby	Leslie	Extension Staff	UGA/SREF	Assisting with formation of regional Extension teams, and a PINEMAP Extension Advisory Board; 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. Graduation 5/14
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. Graduation 5/14
Davis	Corey	Research Staff	NCSU	Environmental Meteorologist. Working with Heather Dinon Aldridge on DSS development.
Denzin	Evelyn	Research Staff	UGA/SREF	MS Level Forester, Factsheet development and technical writing
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.
Martin	Andrew	Undergraduate Research Assistant	NCSU	Developing a tool for forestry professionals across the southern US, which 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 US which displays historical temperature, precipitation, and drought indices.
Starr	Morgan	Undergraduate Research Assistant	Texas A&M U.	Assisted in planning forestry training events and researching and writing factsheets, as well as database entry.

Last name	First name	Position	University	Role
Temple	Christina	M.S. Student	NCSU	Drafted two fact sheets on adaptation related to forest pests and invasive species. Drafts were finalized by Hilary Cole and are undergoing developing a comprehensive list of climate education materials across the southern US.
Vuola	Aaron	M.S. candidate	NCSU	Successfully defended his thesis on 3/30, graduated in May 2012. . Aaron has coauthored a peer-reviewed paper and commentary from his theses with current graduates Hilary Cole and Rachel Burnett as research notes and ultimately as refereed publications. Aaron's thesis research was featured in poster during an IUFRO Small-Scale Forestry Conference in Amherst, MA fall, 2012.
Wojcik	Deborah	Postdoc	UF	Assisting with survey development and 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.