PINEMAP Year 5 Progress Report 2
December 2015
Aim 6 (Extension)

This is the second Aim progress report for year 5 (covering activity from July 1, 2015-November 30, 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.

Extension agents' perceptions of climate change mirror those of the general public. Varying perspectives and depths of knowledge about climate change influence whether an agent is interested and able to incorporate climate-related topics in their programs. Interviews were conducted with extension agents across southeastern states (n=14) in forestry, agriculture, livestock and coastal sectors to better understand their climate-related needs and perceptions. Ongoing analyses of these interviews reveal agents across the perspective and knowledge spectrum are interested in learning more about climate change. While interest in learning more on climate change is universal, specific topics for continued learning vary by perspective and sector.

The purpose of this report is to gather information on progress since the previous progress report in July 2015.

To streamline this process, information reported in July 2015is 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 December 1st.

PROGRESS SUMMARY:

Please provide 1-3 paragraph summary of key areas of progress since June 30, 2015. You might consider writing this section after completing the remaining sections.

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 have developed partnerships among state climatologists and Extension foresters and established a PINEMAP Extension network in the Southeast. These

partnerships and networks are 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. An additional 80 foresters were educated on climate change and forest management in Tifton, GA in April 2015.
- 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 workshops with minority landowners and forestry extension.

OUTPUTS

Outputs are activities, events, services, and products that reach people.

Members of the Aim 6 Extension team have leveraged our efforts with the PINEMAP project to work with two other eXtension projects, and the USDA Southeast Climate Hub (SERCH) that have the same goals, and are also avenues for sharing PINEMAP products. Specifically, Mark Megalos, Leslie Boby and Bill Hubbard have worked towards development and reconfigurations of the Climate Learning Network, and the Climate, Forest and Woodlands eXtension Community of Practice. As PINEMAP products continue to be developed- these sites can house the information past the life of the PINEMAP project and Aim 6 members' work on these learning networks and community of practice are informed by insights learned through PINEMAP outreach. Thus, better web-based avenues for Extension are being created directly as a result of PINEMAP funding. And secondly, these projects will help to ensure that developments and insights from the PINEMAP project continue to be available to other audiences. Specific joint outputs include a webinar providing PINEMAP information on the Climate Learning Network, as well as collaboration on a joint factsheet with SERCH on methods for communicating about risks from climate change (Climate Change Communication to Land Managers: Lessons from the Field). Further Collaborations and products are currently being planned.

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 products reported in the July 2015Progress Report (March 1, 2015-June 30, 2015)
Please update as necessary (including in press publications that are now published) and highlight in yellow any new products added to the list for the December 2015 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. Journal of Extension.

Cole, H.L.C., Boby, L.A., Megalos, M.A. and Hubbard, W.G. *Accepted with minor revisions.* Climate Change Attitudes of Southern Forestry Professionals: Outreach Implications." Journal of Forestry

Monroe, M.C., Plate, R.R., Adams D.C. and Wojcik, D.J. 2015. Harnessing homophily to improve climate change education. Environmental Education Review, 21(2): 221-238.

Krantz, S. A. and M. C. Monroe. 2015. Message framing matters: Communicating climate change with forest landowners. Journal of Forestry, 113 (x): xxx-xxx. (this is available online, but hasn't come out in print yet. it may happen in Nov)

Theses/Dissertations

None reported in July 2015 report.

Other publications

Forest Thinning Scheduler

The Forest Thinning Scheduler, funded in part by PINEMAP and hosted at texasforestinfo.com under the Timber Decision Simulator button (http://tfsfrd.tamu.edu/ThinningScheduler/index.aspx) , is an online application that assists landowners and managers with determining the optimum thinning schedules and requirements for a forest stand based upon user inputs. It determines the optimum timing and timber yield for up to three thinnings and a final harvest. In addition, this Thinning DSS allows the results for up to three scenarios to be compared.

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 (cumulative)

Effects of Temperature and Moisture Stress on Tree Physiology in the Southern U.S	Edited By: Evelyn Denzin, Eric Taylor, Michael Tyree, Timothy Martin, Leslie Boby, And William Hubbard Based Upon: Presentations Given By Michael Tyree And Timothy Martin At The 2014 Pinemap Ecophysiology Shortcourse I,

	Februa February 19-20, 2014
Managing for Temperature and Moisture Stress in Pine Forests in the Southern U.S.	Edited By: Evelyn Denzin, Eric Taylor, Michael Tyree, Timothy Martin, Leslie Boby, And William Hubbard Based Upon: Presentations Given By Michael Tyree And Timothy Martin At The 2014 Pinemap Ecophysiology Shortcourse I, February 19-20, 2014
Nutrient Cycling in Forests under Variable Environmental Conditions	Edited By: Evelyn Denzin, Eric Taylor, Jeremy Stovall, Leslie Boby, And William Hubbard By Jeremy Stovall At The 2014 Pinemap Ecophysiology Shortcourse III, March 20 And April 11, 2014
Fertilizer Application Guidelines for Southern Forests	Edited By: Evelyn Denzin, Jeremy Stovall, Eric Taylor, Leslie Boby, And William Hubbard By Jeremy Stovall At The 2014 Pinemap Ecophysiology shortcourse III, March 20 And April 11, 2014
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

Productivity Timing and Application of Pine Management Technologies	Edited by: Eric Taylor, Klara Fielder, Evelyn Denzin, Leslie Boby Based upon: presentation given by Jason Stoval at the 2014 Western Gulf Silvicultural Technology Exchange,
Climate Change and Variability: Impacts	**Edited by:** Evelyn Denzin, James Vose,

and Adaptation Responses	Mark Megalos, Leslie Boby, Eric Taylor, and William Hubbard **Based upon:** a presentation by James Vose at the Southern Region Extension Climate Academy (SRECA) Conference in Athens, GA September 3-5, 2014
Southern Forest Soils	Edited by: Evelyn Denzin, Eric Taylor, Leslie Boby, Dan Markewitz, Eric Jokela, Ed O'Brien, and William Hubbard Based on presentations by: Dan Markewitz, Ed O'Brien, and Eric Jokela at the PINEMAP Forest Soils Short Course webinars October 16-18, 2014
Communicating Climate change to Land Managers: Lessons from the Field	Steve McNulty, Leslie Boby, William Hubbard and Mark Megalos
Assessing Forest Vulnerability	Mark Megalos and Heather Dinon
Climate Oscillations: Impacts to Forestry	Heather Dinon and Ryan Boyles
Ecophysiological Effects of Temperature and Moisture Stress on Trees in the Southern U.S.	Evelyn Denzin, Tim Martin, Leslie Boby, 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
Pine Seed Sources: what you need to know to select the best seeds for your site	Katherine Sanders, Leslie Boby and Brhan Eskinder
Thinning Recommendation Key	Eric Taylor
Nutrient Cycling in Forests under Variable Environmental Conditions	Evelyn Denzin, Tim Martin, Leslie Boby, Jeremy Stovall and Eric Taylor
Schmidling's Rule- A guide to the 5 degree rule	Brhan Eskinder, Leslie Boby, Katherine Sanders
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

No new reported July 2015.

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 summarize products reported in July 2015Progress Report (March 1, 2015-June 30, 2015)
Please update as necessary and highlight in yellow any new products added to the list for the December 2015 Progress Report.

Presentations

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Aldridge, H.	How to communicate about climate change and agriculture, and DSS visualization demo	Presentation	November 5, 2015	USDA Borlag Fellow visit to NCSU
Boby, L., Taylor, E., Hubbard, W. and Megalos, M.	Outreach Efforts: Educating Foresters and Influencing Change on the Ground	Poster Presentation	June 3, 2015	PINEMAP Annual Meeting 2015 Athens, GA
Boby, L.	Survey Results: Southern Foresters and Climate change	Presentation	May 28, 2015	Climate Learning Network Advisory Board meeting Tampa, FL
Boby, L.	Climate Challenges and Strategies for Southern Forests	Presentation	September 28, 2015	Forest Stewardship Meeting, Jones Center, Georgia
Boby, L., Boyles, R., Davis, C., Hubbard, W., and Aldridge, H.	PINEMAP Extension Delivery and DSS tools	Poster	October 19-20, 2015	SECC Fall Meeting
Boyles, R., Aldridge, H.	PINEMAP DSS: an example of how to visualize MACA data	Presentation	October 28, 2015	Climate Hubs Data Forum
Boyles, R., Davis, C. and Dinon Aldridge, H.	Decision Support System	Presentation	June 3, 2015	PINEMAP Annual meeting 2015
Boyles, R., Davis, C. and Dinon Aldridge, H.	Decision Support System	Presentation	September 3, 2015	GSMNP visit to NCSU
Boyles, R., Davis, C. and Dinon Aldridge, H.	Logistics of getting regional modeling inputs into DSS	Presentation	November 30, 2015	PINEMAP modeling summit
Clifford, M., Monroe, M.	Understanding the Needs and Perceptions of Extension Agents for Climate-related Professional Development	Poster	June 3-4, 2015	PINEMAP Annual Meeting, Athens, GA

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Clifford, M. Monroe, M.	Concern, Confusion, and a Climate-learning Sweet Spot	Poster	October 27,2015	Graduate Student Research Day, Gainesville, FL
Davis, C.	Basic Weather Processes unit of the S-290 (Intermediate Wildland Fire Behavior)	Presentation	September 28, 2015	S-290 Training for NC Forest Service
Dinon Aldridge, H., Boyles, R., Davis, C.	Decision Support System/MACA updates	Presentation	June 3, 2015	PINEMAP Annual meeting 2015
Dinon Aldridge, H., Boyles, R., Davis, C.	DSS "poster"/live demo	Poster Presentation	June 3, 2015	PINEMAP Annual meeting 2015
Dinon Aldridge, H.	PINEMAP DSS Updates	SCO Summer Seminar	May 28, 2015	NCSU
Greene, R.E. and Megalos, M.A.	Southern foresters' Observations of Climate Change: What, Where, and Implications for Continuing Education	Poster presentation	June 3, 2015	PINEMAP Annual Meeting, Athens, GA
Hastings, J., Megalos, M., Jetton, R., Potter, K. and Koch, F.	Using Climate and Genetic Diversity Data to Prioritize Conservation Seed Banking	Poster Presentation	June 3, 2015	PINEMAP Annual Meeting, Athens, GA
Hubbard, W., Bartels, W., Boby, L., Clifford, M., Dourte, D., Fraisse, C., Gambill, J. Knox, P., Monroe, M., Ortiz, B., Risse, M. and Megalos, M. and	Southern Region Extension Climate Academy	Presentation	April 14, 2015	Public Issues Leadership Development Forum
Hubbard, W., Boby, L., Megalos, M. and Moore, S.	Land Grant Activities in Climate Science Education/Extension Arena	Presentation	May 28, 2015	Climate Learning Network Advisory Board meeting Tampa, FL
Knox, P.	Climate Impacts: Changing Tree and Forest Lives	Presentation	October 27, 2015	Warnell Continuing Education Program called "Issues in Tree and Forest Health Care: Assessment and Treatment", Athens, GA
Megalos, M., Boyles, R., Davis, C., Aldridge, H.	PINEMAP update including DSS	Presentation	August 11, 2015	25x25 Summit
Megalos, M.	PINEMAP Progres	Presentation	August 28, 2015	CCSC Talley

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Megalos, M.	What we've learned from PINEMAP	Presentation	September 2, 2015	Sandhills Forestry Club/SAF group discussion
Megalos, M., Boyles, R., Davis, C., Aldridge, H.	PINEMAP update including DSS	Presentation	September 7, 2015	Piedmont/Sandhills land managers and owners meeting
Megalos, M.	Leveraging Climate work in the SE	Presentation	October 2, 2015	IUFRO meeting, Ireland
Megalos, M.	Climate and Forestry Extension	Presentation/Discussions	November 1-3, 2015	National Forestry Extension Meeting, Cocodrie, LA
Megalos, M.	NC Forest Sector Adaptation Group (co-lead)	Working group discussion on sector adaptation solutions, research needs and draft report for stakeholders, policymakers, etc.	November 18, 2015	North Carolina
Megalos, M	Bracing for a changing forest: adapting for resilience	Webinar	Nov 19	Climate Learning Network
Megalos, M.	Pine Management for Success	Landowner/Agency Presentation	December 4, 2015	North Carolina
Taylor, E.L.	Resilient Pine Management	Webinar	Nov 19	Climate Learning Network
Taylor, E.L.	Resilient Pine Management	Presentation	Nov. 23	Tri-county forest landowner meeting, Linden TX
Taylor, E.L.	Resilient Forest Management	Presentation	October 12, 2015	County landowners association, Overton, TX
Taylor, E.L.	Forest diversity and management. Healthy resilient forests: importance of forest management	Presentation	October 5, 2-15	Native plant society meeting, Tyler TX
Taylor, E.L.	Forest adaptation strategies	Training	Oct 1, 2015	Agency training, Overton, TX
Taylor, E.L.	Forest Management field day	Training	Sept 14, 2015	Agency training - Carthage, TX

Author(s)/Presenter(s)	Title	Type	Date	Venue/Location
Taylor, E.L.	Resilient forest and wildlife	Presentations	September 12, 2015	Tree Farm tour – Franklin TX
Taylor, E.L.	Healthy Forests	Presentation	August 7, 2015	Landowner workshop, Lufkin TX
Taylor, E.L.	A Briefing on Forest Stand Establishment and Management	Presentations	July 21, 2015	Marion Co. meeting – Jefferson, TX

Trainings, workshops, and courses

Growing Pines in Changing Times Workshop
This workshop was co-organized by Aim 6 personnel with other relevant partners (such as the Georgia Forestry Commission, other extension foresters) and many PINEMAP researchers were brought into speak. Nearly 100 people attended this one-day workshop in Tifton, GA and evaluations were very favorable with 25-70% knowledge gain depending on the topic. Additionally, 93% of evaluation respondents indicated that they would make management changes based on what they had learned at the workshop. Respondents indicated that they owned or managed over 2,000,000 acres of planted pine.

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.

Experiments, surveys, and data collection

Interviews were conducted with Extension agents in summer 2015. Understanding Extension agent perceptions of climate change will help PINEMAP better shape training workshops and materials to meet needs. We know that Extension agent perceptions mirror those of the general public (Monroe, et al. 2015). Interviews were conducted with Extension agent participants in SRECA (n=14) in forestry, agriculture, livestock and coastal sectors to better understand their climate-related needs and perceptions. Ongoing analyses of these interviews reveal that varying perspectives and depths of knowledge about climate change influence whether an agent is interested in and able to incorporate climate-related topics in their programs. Despite this variation, agents from all perspective are interested in learning more about climate change. While interest in learning more on climate change is universal, specific topics for continued learning vary by perspective and sector.

PROGRESS NARRATIVE

Provide a brief summary of progress on each deliverable/task/input/output listed below. 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 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.)

Text below summarizes products reported in the July 2015Progress Report (March 1, 2015-June 30, 2015). Older entries are grey

Please update as necessary and highlight in yellow any new products added to the list for the July 2015 Progress Report, with approximate month of estimated completion.

Corporate outreach

Task: Develop presentations, trainings, plan and begin work on special issue of journal, plan wrap-up symposium (8/31/15)

Task: Plan and deliver 2015 virtual meeting (11/30/15)

Deliverable: In person wrap up symposium (2/29/16)

Extension outreach

Deliverable: Landowner workshops (ongoing)
New deliverable added during June 2015 meeting

Deliverable: Landowner fact sheets (ongoing)
More than 8 landowner factsheets have been completed in year 4 and more than 18 are in progress.

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

Deliverable: Videos (Ongoing)
See videos output section above.

Deliverable: Professional Development webinars, PINEMAP 14 PINEMAP webinars have been watched by 739 total viewers (professional foresters, targeted audience) and archived for further viewing. As the DSS near completion and is ready to be shared, we will develop a webinar series/e-learning modules/videos to demonstrate how to use the tool.

Deliverable: Forester fact sheets (11/30/14)
New deliverable added during June 2015 meeting
Two more factsheets, which are companion pieces for the Decision Support System are in review now.

Deliverable: Regional advisory Panel Meeting: Reach out to the forestry community for advising (11/30/14)
New deliverable added during June 2015 meeting. The Decision Support System has been beta-tested with multiple foresters and will be debuted at the Southeastern Society of American Foresters in late January 2016. This debut and the prior beta-testing have informed development of the DSS.

Deliverable: "One-stop" online presence (8/31/15)
New deliverable added during June 2015 meeting.
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. Work is ongoing towards this end.

Input: Draft list of DSS factsheet needs (8/31/15)
New deliverable added during June 2015 meeting. Two factsheets for the DSS have been developed and are in review.

Deliverable: Adaptive silviculture workshops (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: DSS companion factsheets (11/30/15)
Two more factsheets, which are companion pieces for the Decision Support System are in review now.

Deliverable: Good series of DSS webinars (12/1/15)
New deliverable added during June 2015 meeting

Deliverable: Guidebook to managing for forest resilience (2/29/16)

New deliverable added during June 2015 meeting. The initial format for the Guidebook has been developed and work is ongoing. Other PINEMAP researchers will be approached for their insights and suggestions during early 2016.

Inputs (ongoing) Outreach inputs from other integration platforms
added during June 2015 meeting. Aim 6 personnel are drafting a peer-reviewed paper on the Extension process throughout the PINEMAP project.

Decision Support System

Task/ Deliverable: Finalized design, look/feel, language (3 map layout), min and max change for maps, risk/uncertainty visuals, time steps for backend model runs to generate data **(11/30/14)** and **Input: AIM 6 language/design feedback (8/31/15)**
Initial website has been designed, and a third 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. DSS developers are working with an SREF graphic designer to enhance graphics on the DSS introduction page, which is estimated to be completed and implemented into the DSS by January 2016. Aim 6 has also provided guidance on units commonly used by professional foresters as well as whether including a "zoom to county" feature would be useful to our target audience.

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 have the ability to show a 5 degree range in temperature isotherms which mimics the recommended "safe zone" by Schmidtling 2001. Feedback on all of this has been 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) are displayed as climate tools on the DSS using the 3-panel display described above. Three climate risk and opportunity tools have been developed and have undergone fairly rigorous internal alpha testing as well as beta testing with PINEMAP and non-PINEMAP folks (~2 month process): 1) extreme minimum temperature risk, which displays avg number of days < 32F, <28F, <25F, <20F, and <15F and how that is expected to change in the future, 2) average summer precipitation and how that is expected to change in the future, and 3) average summer temperature and how that is expected to change in the future. Alpha testing consisted of testing by State Climate Office colleagues while beta testing consisted of PINEMAP and non-PINEMAP folks (including industry representatives). Beta testing for climate risk and opportunity tools followed a similar process as before with a two-week independent study period including a survey instrument. After survey results were analyzed, small group follow-up

calls were completed to discuss details about suggestions/edits (see below for more details on the beta testing process). Finally, DSS developers ranked and implemented beta testing feedback. The DSS will officially be rolled out for public release at the December 4th All Team PINEMAP meeting.

Output: V1: Seedling deployment tools (2/28/15)

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 extreme January minimum temperature isotherms, and allowing users to select a temperature range around the historical isotherm based on a 5 degree "safe zone" (as recommended by Schmidtling) that still may be a potential recruitment zone for each planting location. Users of the seedling deployment tools can visualize different risk levels by displaying temperature ranges around any isotherm.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. (see below for details on the beta testing process). Many changes to the tools have been implemented based on our beta tester feedback. The two seedling deployment tools are now in a finalized state.

Input: beta testing of V1 climate risk/opportunity (8/31/15) and beta testing of V1 seedling deployment tools (2/28/15)

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, were 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.

As of November 2015, beta testing has been completed on both the seedling deployment tools and climate risk and opportunity tools.

Deliverable: Final climate risk and opportunity and seedling deployment tools (8/31/15)
The DSS (with finalized seedling deployment and climate risk and opportunity tools) will officially be rolled out for public release at the December 4th, 2015 All Team PINEMAP meeting.

Output: East coast HUC-12 averages to Evan (8/31/15)
Recently added
HUC12 averages for the rest of the East Coast states (defined as -98.5 longitude and eastward; amounts to 25 additional states) has also been processed for all parameters required by 3PG and G&Y.
A new MACA FAQ website has been developed and published for PINEMAP folks:
http://climate.ncsu.edu/hadinon/pinemap/MACA_FAQs.php
One question addresses how to run an ecological model with MACA data and gives guidance for analyzing output. Another MACA FAQ is being developed specifically targeted for users of the DSS.

During summer 2015, DSS developers mentored an NCSU graduate student who researched mean bias of MACA’s average number of freezing days across the PINEMAP domain by comparing MACA climate model baseline data with the UofIdaho MetData observations. In most cases within the native loblolly range, the mean bias was between -10 to 10 days. The mean bias data gives us confidence for how well the MACA projections simulate number of freezing days in the future. The student also created probability density functions (PDFs) of this variable for different subregions within the PINEMAP domain. The PDFs show how well the MACA climate model baseline outputs matche with the UofIdaho MetData historical observations. Most of the global climate models show results similar to that of the UofIdaho MetData with the exception of MIROC5.

Task: Assess tools 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.

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 feasibility of hurricane, fire risk as tools (8/31/15)
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. 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.

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. At the November 30th modeling summit, DSS developers met with the modeling group to discuss how the regional modeling output will be displayed in the DSS, including which climate model baseline and future periods will be used especially with the complexity of running a model with a rotation period. Modelers were asked to start thinking about color ramps appropriate for each output (to be used on change maps). We will continue this conversation during winter 2016.

Input: list of resources needed for tools (aim 6) (11/30/15)
Recently added
We are comprising a list of resources needed for DSS tools as well as tooltips/jargon that needs to be reworded with help from Aim 6. We need these terms to be meaningful to our target audience. Aim 6 provided the tooltip/jargon list to DSS developers and the updates have been implemented.

Input: regional modeling output (11/30/15)

Deliverable: SPB and fire risk and density management tools (11/30/15)
Unclear if this is a V1 or a final version.

Input: SRTS output (12/31/15)
Recently added

Input: Tier II AGB, FF C, nutrient availability (12/31/15)
Recently added

Output: DSS training (ongoing)

The DSS will be rolled out at regional Society of American Foresters (SAF) meetings across the PINEMAP region during January 2016.

Deliverable: Final disturbance/resilience change in productivity, carbon based regional G&Y set of models (2/29/16)
recently added

Deliverable: Final modeling tools: G7Y, Daycent, 3-PG, WaSSI, change in productivity and historical (2/29/16)
recently added

Task: DSS series/ summit on tool development (12/31/15)
recently added

Input: NEP output (post PINEMAP/ NCE)
recently added

Deliverable: Fully functional tested DSS to support climate-based decisions (post-PINEMAP/NCE)
No progress reported yet.

Deliverable: DSS paper (Post-PINEMAP/NCE)
Two DSS paper outlines have been developed. One paper (co-written with Wendy-Lin Bartels) will highlight the tool development process as iterative not modular and explain successes as well as lessons learned when developing a decision support system with an interdisciplinary team. The other paper will focus on how to effectively communicate climate projections in a web environment.

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.

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.

DSS developers have partnered with a Geoscience Ed professor at NCSU. She has a graduate student that is working on a project with eye tracking software and we are planning to use this software with the DSS tools (pending IRB approval). Since the eye tracking software is on a mobile platform, we are going to have attendees participate at the AP SAF meeting in January 2016. The DSS eye tracking will help us answer several questions about the way users interact with the tools, including:

- How do users engage with the PINEMAP DSS when completing directed tasks and free exploration activities?
- How long does it take users to locate information targets (e.g., radio buttons, drop-down menus, three graph panels, time-series graphs) and complete tasks when using the PINEMAP DSS? What order do they navigate the elements of a page and the individual pages?
- What is distracting and what is most salient about the provided figures?
- What are the users' understandings of the presented climate data? Do they understand minimums and maximums? Are they interpreting the data correctly? Do they understand spread?

TRAINING

A CUMULATIVE list of all Aim 1 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 made in the July 2015 progress report are highlighted in blue. Please update as necessary and highlight in yellow any updates made for this 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	Applied Climatologist. 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.
Eskinder	Brhan	PINEMAP Intern	Spellman College	PINEMAP intern for the summer of 2015, and is working on a Decision Support System companion piece.
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.
Sanders	Katherine	Undergraduate Research Assistant	UGA	Working on Decision Support System Companion pieces for summer 2015

Last name	First name	Position	University	Role
Starr	Morgan	Undergraduate Research Assistant	TAMU	Assisted in planning forestry training events and researching and writing factsheets, as well as database entry.
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.