Annual Report to NOAA Regional Integrated Sciences and Assessments Program
assembled by SECC Coordinator Shelby Krantz, UF

1. **SECC-RISA: Science and partnerships for adaptation and resilience to climate change and climate variability**

2. **Performance Period – June 1, 2014 through May 30, 2015**

3. **SECC Team Members**

University of Florida: S. Asseng, C. Fraisse, D. Dourte, W. Bartels, S. Krantz, C. Martinez, D. Cammarano, B. Kassie, M. Ramirez Rodrigues, J. Jones, D. Ti, W. Graham, I. Hernandez-Ochoa, R. Raymundo, J. Guarin
Florida State University: V. Misra, M. Griffin, D. Zierden, L. Stefanova, J. O'Brien
University of Miami: D. Letson, J. Bolson, B. Kirtman
Auburn University: P. Srivastava, B. Ortiz, S. Mitra, S. Singh, D. Damianidis, N. Islam, P. Woli
University of Alabama-Huntsville: J. Christy, R. McNider, C. Handyside
University of Georgia: G. Vellidis, C. Furman, P. Knox, B. Liakos, C. Lowrance, X. Liang

4. New areas of focus or partnerships that have begun this past year? Please provide some context for why you are expanding into this area or partnership.

- At University of Miami, SECC members have been working closely with a number of local and regional area partners, including the Miami Beach Sea Level Rise Initiative, Miami Dade Water and Sewer Department, and the Southeast Florida Regional Climate Compact, to build an understanding of climate information needs and to develop ongoing research partnerships with stakeholders concerned about potential climate change impacts. There has been a great deal of action in response to climate change impacts in south Florida, with a particular focus on sea level rise impacts and response. In efforts to enhance our involvement in this area so that our research products contribute to the development of usable science tools for the stakeholder community, we have been interacting regularly with local and county-scale decision makers, water managers, and members of the business and environmental communities. Activities have been centered on attending area meetings, participating in research development teams and developing proposals for additional funding to pursue collaboratively developed research ideas.

- Auburn University researchers have expanded into three new focus areas: 1) Evaluating the Impact of Climate Change on Rainfall Erosivity, 2) Future Climate Changes and Drought, and 3) Climate variability impacts on nitrogen use efficiency in corn production.
  1) **Evaluating the Impact of Climate Change on Rainfall Erosivity in the Southeast.** Climate change is expected to change the intensity of precipitation events in the Southeast. This change in intensity would change the energy in the

storm events and would result in increased rainfall erosivity. The best management practices designed to control erosion from urban and agricultural areas would not be sufficient in future. To adapt to climate change, natural resource managers should use new rainfall erosivity values that are derived from climate projections.

2) **Future Climate Changes and Drought: What do Existing Indices Say about Future Droughts in the Southeastern U.S.?** To support NIDIS efforts in the Southeast and to assist with the NOAA Climate and Societal Interactions (CSI) programs, it is important to study the likely impacts of anthropogenic future climate changes on droughts in the Southeast. Together with existing drought monitoring, forecasting, and stakeholder engagement, the new information generated by this project regarding future droughts will help to develop more effective drought triggers and response policies.
3) **Climate variability impacts on nitrogen use efficiency in corn production.** Increasing environmental stewardship aided by adapting new management practices for nitrogen management, based on climate information is explored to understand important environmental and economic implications of climate change.

- SECC scientists at the University of Alabama-Huntsville have been partnering with scientists at UC Davis to quantify how the value of water in the West might change as production of certain crops, particularly low value and high water-use crops in California, responds to different scenarios of crop migration to other regions in the US. Aspects of production, economics and policy are included in the suite of models utilized. With pressures increasing on Western water resources, we are considering how the nation might best retain its agricultural production in an environmentally and economically sustainable way.

- Several SECC members have expanded into the realm of the AgMIP project (Agricultural Model Intercomparison and Improvement Project), both to participate in stakeholder engagement and to support model improvement and application efforts. The aim of the project is improving simulation of climate change risk and adaptation strategies for the agricultural sector in developed and developing countries across the world with major implications for agriculture and trade in the US, including the SE US.

- The Florida Climate Center at Florida State University (FSU)/COAPS (Center for Ocean-Atmospheric Prediction Studies) has entered into a partnership with the Florida Department of Health (FLDOH) to contribute to the Building Resilience Against Climate Effects (BRACE) project sponsored by the Centers for Disease Control. The climate center has advised and provided a myriad of climate data, products, and forecasts to the DOH to assist in the development of the vulnerability assessment and the climate and health profile for the state of Florida. The Florida Climate Center will continue to partner in this project in the coming year, serving on the project's technical advisory committee (along with the SECC Coordinator) and assisting in outreach and education efforts.

- Florida State University is also becoming more active in the area of coastal resilience. David Zierden attended the University of Florida IFAS Extension/Florida Sea Grant's Climate Action Group in-service training workshop this year and presented information on climate change in the State and demonstrated various climate tools used for community planning. FSU is also becoming more involved with the Gulf of Mexico Community of Practice, attending the annual meeting and presenting on climate variability during the science panel.

- SECC researchers have started to explore collaborations with a wheat breeder at UF and breeders from CIMMYT (International Maize and Wheat Improvement Center), based on stakeholder demand for future expansion of wheat as a winter crop to better adapt to climate variability by expanding to more crop options. Based on the large potential to expand wheat cropping in the SE, we founded an Expert Working Group for Wheat Plant and Crop Modeling in the international Wheat Initiative to benefit the Southeast from global collaboration on wheat research.

- We have started to build linkages with a group at the University of Bonn, leading experiments on scaling from field to regional scales, a critical issue for extending our research on climate change impact and adaptation in the SECC from fields to the entire SE region.

- SECC members have become members of the Miami Beach Sea Level Rise Initiative, Scenarios sub-group. They regularly meet with this group and with the broader team to discuss related climate impact concerns and scientific research/tools that are available to the stakeholder community.

- In 2015, SECC will participate in a Strategic Planning Workshop focused on risk management. With leadership of the Federation of Southern Cooperatives Land Assistance Fund, the workshop will identify opportunities for integrating climate information within risk management and for developing a common framework for future collaborative work. Cornelius Blanding, a personal contact of SECC researchers, was nominated Director of the Federation in March 2015, strengthening the SECC alliance with this group significantly.

- The SECC Strategic Planning Team added coastal expertise to our team by inviting Mark Risse, Georgia Sea Grant Director, to join the SECC and take a leadership role. Mark's direction has enabled us to understand coastal issues in relation to our SECC work and to carve out a role for more coastal research to be integrated into the SECC's portfolio. Mark also introduced Chuck Hopkinson, a marine scientist to the SECC. Chuck is helping to define directions in coastal science and climate change research for the SECC.

- The SECC has taken new directions in our online presence. The SECC website was updated this year (www.seclimate.org), and the SECC joined Twitter and Facebook. Our social media presence has connected us with many other regional, national, and international organizations that now follow our work and get a taste of what is

happening in the SECC. We have grown to have 200+ followers on Twitter and 250+ on Facebook. We also use these platforms to regularly interact with other regional climate groups (https://twitter.com/SECC_RISA; https://www.facebook.com/southeastclimateconsortium).

5. **Please provide a list of up to 5 research findings – Please try to include examples that span disciplinary and interdisciplinary work. Examples might be: a) dust-on-snow reduces Colorado River runoff by 5%, or b) analysis revealing the presence or absence of adaptive capacity in legal and policy frameworks for managing resources.**

1. Carbon neutral farming in the SE USA: Agriculture is an important source of greenhouse gases (GHG), especially from crop production practices and enteric fermentation by ruminant livestock. Improved production practices in agriculture and increase in terrestrial carbon sinks are alternatives for mitigating GHG emissions in agriculture. The objective of this study was to estimate GHG emissions from hypothetical farm enterprise combinations in the southeastern United States with a mix of cropland and livestock production and estimate the area of forest plantation necessary to offset these emissions. Four different farm enterprise combinations (Cotton; Maize; Peanut; Wheat + Livestock + Forest) with different production practices were considered in the study resulting in different emission scenarios. We assumed typical production practices of farm operations in the region with 100 ha of cropland area and a herd of 50 cows. GHG emissions were calculated for production, storage and transportation of agrochemicals (pre-farm) and farm activities such as fertilization, machinery operation and irrigation (on-farm). Simulated total farm GHG emissions for the different farm enterprise combinations and production practices ranged from 348.8 t CO_2e per year to 765.6 t CO_2e per year. The estimated forest area required to neutralize these emissions ranged from 19 to 40 ha. In general, enterprise combinations with more intense production practices that include the use of irrigation resulted in higher total emissions, but lower emissions per unit of commodity produced.
2. Hydrologic design of water management infrastructures is based on storm characteristics derived from historic rainfall events available in the form of intensity-duration-frequency (IDF) curves. Comparison of stochastic methods and Artificial Neural Networks (ANN) indicated that ANN provides superior performance in estimating maximum rainfall depths (i.e. soil depth penetration of rainfall), while a stochastic method tends to under-predict maximum rainfall depths. Developed IDF curves for future climate scenarios indicated that short-term-rainfall events (< 2 hours) are expected to decrease by 33% to 74% in Alabama, while large uncertainty exists in the projected rainfall intensities of longer duration events.
3. Simulations based on the SimCLIM and the CSM-CERES-Maize models showed that by 2050 corn should be planted earlier to reduce heat stress during flowering. Also, irrigation could be used for cooling a crop to offset negative effects of higher temperatures on crop growth, but this would increase the future irrigation demand.

4. A new downscaled global atmospheric reanalysis database, FLAReS1.0 (http://elnino.coaps.fsu.edu/thredds/catalog.html) can now serve as a viable alternative to reconstruct 20th century SE US seasonal winter climate that captures the interannual variations of ENSO and associated decadal variations forced by AMO (Atlantic Multidecadal Oscillation).This is critical to better understand long-term climate trends and their impacts on the various sectors in the SE US.
5. The WASSI hydrologic model was executed under historic weather conditions in the SE US to determine climate stresses per basin. Results indicated that for most of the Alabama and Mississippi basins, surface water remains unstressed even in the driest years, and thus available for potential irrigation use. Several basins in Georgia, however, do experience climate stress in many seasons (defined as a reduction in flow below 40% of the environmental flow) and expansion of irritated agriculture from surface water resources is not recommended in this state.

6. **Please provide a list of up to 5 outreach activities that you have undertaken in the past year. OPTIONAL: If applicable, please share the outcomes of these activities.**

A. Southern Region Extension Climate Academy – SRECA: More than 100 Extension professionals gathered in Athens, GA from 14 different southern states for an innovative Climate Extension training opportunity from September 3-5, 2014. Participants learned about management options and communication strategies for more resilient crop, forest, livestock, and coastal systems.

Figure 1. Participants at SRECA during group discussions

SRECA was developed in conjunction with the SECC under the leadership of three USDA-NIFA funded projects: Southeast Climate Extension, PINEMAP, and Animal Agriculture in a Changing Climate. The planning team from these projects designed and facilitated a three-day program that aimed to:

- Support Extension professionals in the application of climate science and stakeholder engagement methods for developing place-based adaptation and mitigation options that support more resilient crop, forest, livestock, and coastal systems in the Southeastern US.
- Build an alumni network of innovative leaders in Extension who are knowledgeable on key climate science basics, skilled in stakeholder engagement

strategies, capable of being state or local resources, and can share ideas with others regionally through exchanging innovative program ideas and outreach materials.

Participants developed ideas for Extension resources and communication strategies in their breakout groups (Coasts, Livestock, Forests and Crops). Numerous possibilities for training resources and communication strategies related to climate-resilience and resource efficiency emerged and a summary of these ideas is available on the SRECA blog (http://srecablog.wordpress.com/). This list of ideas will guide potential future research programs, including projects within the SECC.

This workshop also helped to change the attitude of stakeholders towards climate change issues. The following statement by one SRECA participant summarized the experience felt by many at the SRECA workshop. *"I was not excited about the subject matter prior to the workshop…it was better than I expected. I am now more open to discussing climate change."*

B. Southeast Climate Extension/AgroClimate

B1. Video: Climate Risks and Management Solutions: We have begun a series of educational videos about climate science and the management solutions that can improve climate resilience. These short videos provide an excellent learning opportunity for Extension, producers, and stakeholders interested in agriculture in a changing environment. Videos have been used in SECC and AgroClimate presentations and meetings with the research community, stakeholders, and Extension agents.

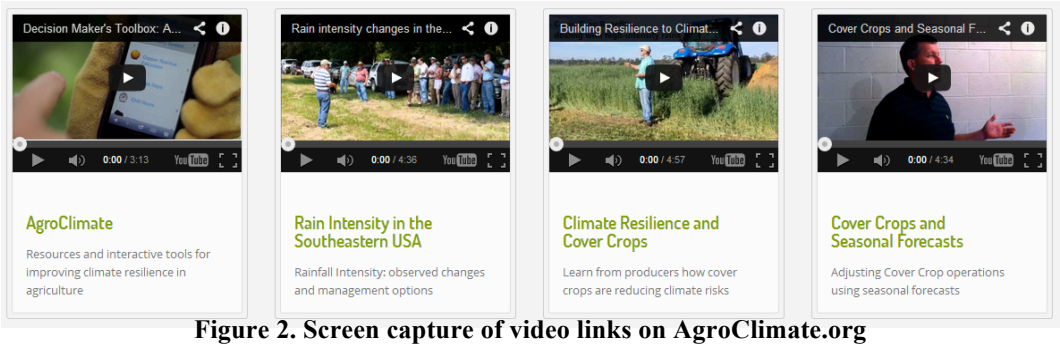

Figure 2. Screen capture of video links on AgroClimate.org

B2. Learning outcomes from Adaptation Exchanges: The Adaptation Exchange is an annual workshop featuring climate outlooks and management strategies for increased climate-resilience and improved efficiency in production systems. Southeast Climate Extension has now organized three Adaptation Exchanges: Quincy, FL in 2012, Tifton, GA in 2013, and Blackville, SC in 2014. The next Adaptation Exchange is scheduled for August 2015 in southwestern Alabama. About 160 participants, including producers, Extension, researchers, and others, have come to the Adaptation Exchanges, and our project has carefully evaluated the learning that happens in these workshops.

C. Tri-state climate network workshops

C1. "WHAT IF" scenarios for row crops in the SE USA, Tallahassee, FL, Feb 9th 2015 – Participants discussed future scenarios for row crop production in the SE US based on past trends, potential changes in climate, competing land uses, and water availability; Identified possible strategies for different stakeholder groups to anticipate and prepare for climate changes.

C2. Open Sesame: A Possible Crop to Mitigate Climate Risk? Live Oak, FL, August 7th

C3. Videos: The Tri-state Climate Network has created videos to summarize the work conducted as part of the Tri-state climate network from the perspectives of the participants (farmers, extension, and scientists). Other topics include benefits of cover crops and climate change.

C4. Web-based climate learning platform -- SIFT - Southeast Innovative Farming Team www.siftag.org. W. Bartels and D. Dourte (UF) developed a new online knowledge exchange portal to share information and experiences. This website is a dynamic space to support continuous interactions among participants who are part of existing agricultural networks, such as the Tri-state row crop climate learning community and the Florida soil health and cover crop network.

D. 4-H Weather and Climate Toolkit. M. Griffin from FSU developed a 4-H Weather and Climate Toolkit in conjunction with the SECC and an USDA NIFA Climate Extension project. She has used this toolkit to train 4-H students and instructors in a series of summer workshops in Florida and more recently Georgia.

E. Presentations and Meetings. Below is a select list of presentations given by SECC members at varying local, regional, national, and international meetings, as well as meetings organized and facilitated by SECC members.

2015

- Asseng, S. Key note address at Agriculture and Climate Change Conference, Amsterdam, The Netherlands 15-17 February 2015, www.agricultureandclimatechange.com.
- Knox, P. and Furman, C. Weird and wacky weather- How do we cope? In Organic Educational Session II Southeast Regional Fruit and Vegetable Conference Savannah Georgia January 8-11, 2015. Program given on January 9th.
- Krantz, S. The Southeast Climate Consortium: Modeling climate risks for a sustainable future, Florida Section of the American Society of Agricultural and Biological Engineers meeting. Ponte Vedra Beach, Fl.
- Krantz, S. Identifying Decision-Focused Climate Adaptation Activities and Aligning Priorities Across Multiple Sectors and Scales in the Southeastern United States. National Adaptation Forum. Saint Louis, MO.
- Krantz, S. Breaking the Ice: Engaging the Public in a Climate Change Conversation. Florida Chapter of the Wildlife Society Meeting. Jacksonville, FL.
- Furman, Carrie, and P. Knox (2015) Weird and wacky weather- How do we cope? In Organic Educational Session II Southeast Regional Fruit and Vegetable Conference Savannah Georgia January 8-11, 2015. Program given on January 9th.

- Tristate working group Climate change- "what if" scenarios. Farmers, scientists and extension associated with row crop production got together to talk about the future of climate and farming in the SE. February 9, 2015. FSU Tallahassee FL
- Knox, P. Presentation on GaClimate.org to the Georgia Cotton Conference, January 28, 2015. The conference is attended annually by over 200 cotton growers and other members of the cotton industry.
- Vellidis, G. Two training events for Georgia County Agents on using the smartphone app for scheduling irrigation on cotton, January 21 and 22, 2015 in Reidsville (19 agents) and Tifton (45 agents), respectively.
- Vellidis, G. Produced a 1-minute radio spot on the SmartIrrigation Cotton App which was broadcast several times a day during the week of March 30th by 92.5 FM, a Tifton, Georgia based farm-oriented radio station.

2014

- Bartels, W. 2014. Invited for opening panel address to share NIFA project experiences of working with famers around climate change and decision support. Bill and Melinda Gates Foundation Next Generation Farming System Models. Seattle, WA.
- Bauer, M., Bartels, W., Dourte, D., Treadwell, D., Dillard, J., Love, J., Toro, E. Catalyzing collaborative cover-crop conversations: Peer-to-peer learning to reduce the gap between research and practice. Presentation at the 2014 Water Education Summit scheduled for September 8-10 in Asheville, NC
- Bartels, W. Webinar presentation Learning Communities and other Conversations with Extension Clientele - Invited with William Birdsong to share lessons from the Tri-state climate network with Nebraskan Extension agents engaged in a meeting entitled: Starting a Conversation with Nebraskans on Climate Change. Organized by Rick Koelsch and Rick Stowell, University of Nebraska-Lincoln, Aug 26th 2014.
- Bartels, W. Session presented at the 99th Annual Meeting and Professional Improvement Conference National Association of County Agricultural Agents (NACAA). Co-organized a Climate Communication session with Crystal Powers, University of Nebraska-Lincoln, and Chris Jones, University of Arizona. Mobile, Alabama July 20-24.
- Krantz, S. AgroWeather and AgroClimate Tools for Food and Water Security. Session coordinated by SECC. International Symposium on Weather and Climate Extremes. George Mason University.
- Krantz, S. Coastal Climate Resilience session at RISA Annual Meeting. Charleston, SC.
- Toro, E. M., Wright, D., Balkcom, K., Birdsong, W., Beasley, J., Kemerait, B., Ortiz, B., Johnson, L., Dillard, B., Zierden, D, Bartels, W., Bauer, M., Dillard, J., Duarte, D., Engaging Farmers, researchers and extension to integrate climate information to row crop productive systems in the Southeast. Presented at NACAA, Mobile, Alabama July 20-24.
- Ortiz, B. 2014. How to use the Climate risk Tool in Agroclimate, 2014 National Agricultural County Agricultural Agents meeting. Mobile, Alabama. 24-26 July, 2014.

- Ortiz, B. 2014. Exploring management options for more resilient and efficient systems. 2014 Southern Region Extension Climate Academy (SRECA). Athens, GA. 3-5 September, 2014.
- Woli, P. 2014. El Niño-Southern Oscillation (ENSO) Effects on Hessian Fly Infestation in Wheat in the Southeastern USA. American Society of Agronomy Meeting. Long Beach, California. 2-5 November, 2014. (Oral presentation)
- Singh, S., Srivastava, P., and S. Mitra. 2014. Climate Variability Impacts on Surface and Ground Water Interactions in the Lower Apalachicola-Chattahoochee-Flint River Basin. Paper No. 14-1914613. ASABE Annual International Conference, Montreal, Canada, July 13-16, 2014.
- Srivastava, P. 2014. Critical Water Issues and Approaches in the Southeast. Presented at the LEAD21-H2O Symposium, Kansas City, MO, October 5-6, 2014.
- Climate Risk Roundtable Epes, Alabama, July 15-16, 2014 with Federation of Southern Cooperatives Land Assessment Fund.
- Knox, P. and Furman, C. Advanced Farming Technologies for Reducing Climate Risks workshop, August 12, 2014, Edisto Research & Education Center, Blackville, SC Farmers and Extension (about 75 agricultural producers and extension agents participated).
- Roncoli, C. Furman, C. Involving minority farmers in climate services: a case study from the southern US, Building indigenous knowledge into climate change assessments: a roundtable discussion. UNESCO New York, NY, September 24, 2014.

7. Please provide a list of <u>key publications</u> from the past year - We are seeking ~ 5 publications, give or take a few, to be highlighted on the CPO webpage. These can be either non-peer reviewed or peer-reviewed. For peer-reviewed publications, please list either published or in press, but *not* "in review". For non peer-reviewed publications, please provide a hyperlink or webpage wherever possible. (You may include a more comprehensive list of publications as an appendix.)

Asseng S, Ewert F, Martre P, et al. 2015. Rising temperatures reduce global wheat production. Nature Climate Change 5: 143-147. doi: 10.1038/nclimate2470.

Diehl, D.C., Sloan, N.L., Galindo-Gonzalez, S. Bartels, W., Dourte, D.R., Furman, C.A. and C.W. Fraisse. 2014. Toward Engagement in Climate Training: Findings from Interviews with Agricultural Extension Professionals. Journal of Rural Social Sciences, 29(3), 2014, pp. 25–47.

Dourte, D.R., Bartels, W. and C.W. Fraisse 2015. Exploring changes in rainfall intensity and seasonal variability in the Southeastern U.S.: Stakeholder engagement, observations, and adaptation. Climate Risk Management, 7, 2015, pp. 11–19

Furman, C., C. Roncoli, W. Bartels, H. Crockett, Gray, M. Boudreau, G. Hoogenboom. 2014. Drought in the Deep South: Climate Services for African American Farmers.

Climate Risk Management, 2, 2014, pp. 11–25. doi: http://dx.doi.org/10.1016/j.crm.2014.02.002.

Tian D, Asseng S, Martinez CJ, Misra V, Cammarano D, Ortiz BV. 2015. Does decadal climate variation influence wheat and maize production in the southeast USA? Agriculture Forest Meteorology 205, pp. 1-9.

8. Please provide up to 3 narrative examples from the past year of plans, policies, strategies, tools, agreements, etc. that were proposed, adopted, and/or implemented as a result of prior RISA work.

- UGA developed and released www.GaClimate.org to provide county agents and growers in Georgia with localized climate and weather information. The website recorded over 600 hits in its first month of operation. The website features the daily blog "Climate and Agriculture in the Southeast", which is written by Pam Knox from UGA in conjunction with the SECC to feature impacts of climate on agriculture in the Southeast and beyond.
- The questions encountered and discussed in a recent workshop with farmers (February 9th, 2015 Row Crop Climate Learning Network Meeting, Tallahassee, FL: '"WHAT IF" Scenarios for Row Crops in the Southeastern U.S.') from the Tri-state climate network, indicated a new opportunity to discuss long-term climate change, a topic previously addressed with significant caution/hesitance.
    - "If arctic ice melts, where does the water go?" - Farmer
    - "Do you have evidence about changes in the spatial distribution of rainfall?" - Farmer
    - "What can we do to reduce evapotranspiration?" - Farmer
    - "Do farmers have the technological capacity for this type of farming?" – Extension Agent
    - "How do we prepare for future crops as crop handlers" – Peanut Distribution Company
    - "What politics drive the changes we see at local scales?" – Extension Agent
- From a series of papers (Misra et al. 2013; Li and Misra 2013; Bastola et al. 2014) that demonstrated the efficacy of using seasonal climate forecasts for streamflow estimation over watersheds in peninsular Florida, the Peace River Manasota Regional Water Supply Authority developed its Aquifer Storage and Recovery Wells (ASR) Recovery Initiation Index in the summer of 2013, which is also based on four climate forecast products from NOAA CPC (including 3-month precipitation probability outlook, 1-month precipitation probability outlook, 3-month temperature probability outlook, 1-month temperature probability outlook). The Peace River Authority's primary supply source (as their name implies) is the Peace River, which has highly seasonal flow characteristics and flows freely without any in-stream dams or salinity barriers. The river is generally unavailable as a supply source for up to 6 months each year. To compensate for this flow variability, the agency harvests water from the river in the wet season when flows are high to sustain the utility during low flow periods. Raw water is stored in off-stream reservoirs and also water is stored deep underground in Aquifer Storage and Recovery (ASR) wells. The agency's 21 ASR

wells make it the largest potable water ASR system in the United States east of the Mississippi River. For further details please see:

- Misra, V., H. Li, Z. Wu and S. DiNapoli, 2013: Global seasonal climate predictability in a two tiered forecast system: part I: boreal summer and fall seasons *Clim. Dyn*., 42(5-6), 1425-1448, doi:10.1007/s00382-013-1812-y.
- Li, H. and V. Misra, 2013: Global seasonal climate predictability in a two tiered forecast system. Part II: boreal winter and spring seasons *Clim. Dyn*., 42(5-6), 1449-1468, doi:10.1007/s00382-013-1813-x.
- Bastola, S., V. Misra, and H. Li, 2013: Seasonal hydrological forecasts for watersheds over the Southeastern United States for the boreal summer and fall seasons Earth Interactions, 17(25), 1-22, doi:10.1175/2013EI000519.1.

9. How are you measuring the overall impact of your RISA team on decision-making in your region? For instance, how do you know what your program-level impact is?

<u>The overall impact of the RISA team is regularly assessed in the following ways:</u>

- Surveys and related tools are completed by participants at each workshop, field day, and other event. For example: the Florida Water Climate Alliance, which meets every 3-4 months, evaluation efforts include development and distribution of pre and post-workshop assessment surveys and their analyses.
- The SECC-RISA social science research team works on publications addressing their impact across the stakeholder groups they work with.
- Feedback from stakeholders, particularly county agents, who request information on climate, adaptation strategies, and related topics.
- Addressing stakeholder requests for information.
- Sustaining partnerships with established networks in our region.
- Collaboratively developing ideas for new projects with stakeholder groups.
- Achieving outcomes associated with specific projects.
- Building continuity in our research efforts by maintaining SECC scientist teams and incorporating outcomes & ideas generated in previous projects.

Outcomes and Impacts

- **Scaling up local successes:** 122 participants from 15 states attended the SRECA training, where we discussed methods for communicating about climate change and adaptation options that were incubated within smaller networks, such as the tri-state group.
- **Ownership of process:** Extension agents continue to lead the Tri-state group and are spearheading presentations in Extension venues about their experience within this group. This indicates that the Tri-state group activities are no longer driven by researchers, but owned by partners in Extension. Farmers are beginning to use our new virtual learning platform, SIFT to share experiences in adaptation within their peer group and with farmers.
- **New conversations:** Beginning to discuss climate change in farmers meetings with tri-state participants.

10. For teams that receive NIDIS-Coping With Drought funds for work on the NIDIS Regional Drought Early Warning System: Please describe how the research contributed to drought early warning technique or capabilities in the region and/or methodologies that advance the early warning systems. Areas could include improvements in monitoring, forecasting, impact assessment, identification of vulnerability and risks, aligning capabilities with planning and preparedness (e.g. indicators, thresholds,) evaluation of early warning, and improving awareness and communication about drought and drought response.

- NIDIS funding was used to continue to support the Apalachicola-Chattahoochee-Flint (ACF) River Basin Drought Assessment Webinars. These webinars are conducted monthly.
- In addition, funding was also used to assess how decadal climate variability phenomena modulate the effect of ENSO in the ACF River Basin. The individual and combined effects of ENSO, PDO, AMO, and NAO on baseflows of the Flint River and crop yields were quantified. The results indicated that the phases of ENSO, AMO and NAO significantly affect baseflows in the Flint River and winter crops. Interaction tests showed that the PDO and AMO phases modulate ENSO phase baseflows and winter crop yields. The results illustrate the importance of coupled analyses of climate variability by providing a better understanding of the severity of droughts and their impact on baseflows and crop yields. The results obtained from this study can be used by water managers and farmers in the region as a guide for the issuance of drought severity-based water restrictions and crop management.
- Together with existing drought monitoring, forecasting, and stakeholder engagement, new information are generated regarding future droughts to develop more effective drought triggers and response policies.
- NIDIS funding was used to better understand the modulation of the Atlantic Tropical Cyclone (TC) activity and its bearing on droughts of the SE US. The current consensus from multi-model experiments suggests that a warm eastern tropical Pacific and cold Atlantic Ocean Sea Surface Temperature Anomaly (SSTA) will lead to the increased likelihood of wetter conditions over the continental US including the SE US. Similarly, cold eastern tropical Pacific and warm Atlantic Ocean SSTA will

lead to the increased likelihood of drier conditions over the SE US. In addition, land-falling tropical cyclones contribute significantly to the annual mean total rainfall in the SE US. But in El Niño years with cold tropical Atlantic SSTA, this leads to reduced Atlantic tropical cyclone activity while in La Niña years with warm tropical Atlantic SSTA lead to increased Atlantic tropical cyclone activity. Our study found that the contribution of the rainfall from land-falling tropical cyclones on the mitigation of monthly drought in the 28 SE US watersheds is insignificant. It is so insignificant that the hydrological model uncertainty in estimating the drought index over the 28 SE US watersheds is larger than the sensitivity exhibited by the drought index to the inclusion of rainfall from land-falling tropical cyclone. This is further supported by the fact that the timing of the land-falling tropical cyclone in relation to overall soil moisture conditions of the watershed does not coincide with any drought like situation in the 1948-2006 time period analyzed in this study.

Appendix A
Publications 2014-2015

Asseng S, Ewert F, Martre P, et al. (2015) Rising temperatures reduce global wheat production. *Nature Climate Change* 5: 143-147. doi: 10.1038/nclimate2470.

Athayde, S. F., Bartels, W., Buschbacher, R., and R. D. R. Seluchinesk. 2014. Collaborative Learning, Transdisciplinarity and Socio-environmental Management in the Amazon: Approaches to Knowledge Production between Academy and Society. Revista Brasileira de Pós-Graduação (RBPG), special issue on "The Contribution of Graduate Education for Sustainable Development in Brazil"

Bao, Y. 2015. Coupling the SimCLIM system with crop simulation models for determining adaptation strategies under a changing climate: An application for maize production in the southeastern USA. *Ph.D. Dissertation*, University of Georgia, May, 2015.

Bao, Y., G. Hoogenboom, R.W. McClendon, and J.O. Paz. 2015. Potential adaptation strategies for rainfed soybean production in the south-eastern USA under climate change based on the CSM-CROPGRO-Soybean model. *Journal of Agricultural Science* 153(5):798-824, doi:10.1017/S0021859614001129.

Bao, Y., G. Hoogenboom, R.W. McClendon, and P. Urich. 2015. Soybean production in 2025 and 2050 in the southeastern USA based on the SimCLIM and the CSM-CROPGRO-Soybean models. *Climate Research* 63:73-89, doi: 10.3354/cr01281.

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