



SCIPP

A NOAA RISA TEAM

*Increasing resiliency and preparedness for weather
and climate extremes now and in the future across
the South-Central United States*

Southern Climate Impacts Planning Program
A NOAA RISA Team

Annual Report
June 1, 2014 - May 31, 2015

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The Southern Climate Impacts Planning Program (SCIPP) Phase II was funded on award NA13OAR4310183. For the last six years, our annual performance report has been submitted under the title "Southern Climate Impacts Planning Program (SCIPP)" and has been accepted. Please accept the annual report entitled "Southern Climate Impacts Planning Program (SCIPP) Phase II for the period 6/1/2014-5/31/2015.

1. SCIPP Team Members

The Southern Climate Impacts Planning Program team consists of the following investigators, core office staff, research & support staff, summer interns, and graduate students from the University of Oklahoma (OU), Louisiana State University (LSU), Texas A&M University (TAMU), and the National Drought Mitigation Center (NDMC). SCIPP's Stakeholder Services Committee (Advisory Committee) is also detailed below. Team personnel are current as of May 31, 2015.

Principal Investigators: Mark Shafer (OU), Barry Keim (LSU)

Co-Principal Investigators: Harold Brooks (OU), Renee Edwards (LSU), Mike Hayes (NDMC), Yang Hong (OU), Renee McPherson (OU), Randy Pepler (OU), Steven Quiring (TAMU), Kevin Robbins (LSU)

Core Office: Margret Boone - Program Manager (OU), Hal Needham - Program Manager (LSU), Rachel Riley - Associate Program Manager (OU), Alek Krautmann - Research Associate (OU), Katy Christian - Research Associate (OU), Amanda Lewis - Research Associate (LSU), Christine Kuhn - Student Assistant (OU), Gina Fujan ** - Student Assistant (OU)

Research and Support Staff: Jared Bostic (OU), Kyle Brehe (LSU), Luigi Romolo (LSU), David Sathiaraj (LSU), Ada Shih (OU), and Nick Richardson (OU)

SCIPP Affiliates: Jeff Basara (OU), Jerry Brotzge (OU), Sean Crowell (OU), Scott Greene (OU), Cody Knutson (NDMC), Patrick Marsh (NWS SPC), Heather McCarthy (OU), Mike Richman (OU), Kodi Monroe (OU), John Nielsen-Gammon (TAMU), Cindy Rosenthal (OU), Chie Sakakibara (OU), Theodore Trafalis (OU), and Kai Zhang (UTHealth)

Graduate Students: Amanda Lewis (LSU), Preston Hartman (OU), Darrien Noyes (OU) and Carrie Pavlowsky* (OU)

Advisory Committee: David Brown (NOAA), Jeffrey Gaffney (University of Arkansas), Gregg Garfin (University of Arizona), Marilu Hastings (Cynthia and George Mitchell Foundation), Bill Hooke (American Meteorological Society), Rebecca Jennings (Federal Emergency Management Agency), Bill Kiene (NOAA), Victor Murphy (NOAA), Sascha Petersen (Adaptation International), Putnam Reiter (Oklahoma Department of Emergency Management), Bob Rose (Lower Colorado River Authority), David Schlotzhauer (NWS Lower Mississippi River Forecast Center), Melissa Stults (University of Michigan), and Tom Wilbanks (Oak Ridge National Laboratory)

* Partnered funding through SC-CSC

** Partnered funding through NOAA SARP grant

2. New Areas of Focus and Partnerships

Planning for extreme weather and climate events are central to the work of the Southern Climate Impacts Planning Program, though are not our only focus. The following represent the various new areas of focus and partnerships of SCIPP with a brief description of the questions and issues the SCIPP team is working to address. New partnerships are in **bold**.

Since May 2014, SCIPP has experienced several changes within its core office. Within the OU Core Office, Alek Krautmann resigned from his position as Research Associate to pursue an opportunity with the National Weather Service Office in Slidell, LA. Dr. Irene Lodangco will work at OU as a postdoctoral researcher for three months to assist tribes with climate data analysis. Two former SCIPP Student Assistants, Katy Christian and Christine Kuhn, have remained with SCIPP as Research Associates and will continue through the summer months. SCIPP has hired a new Student Assistant, Gina Fujan, who will be located at the OU Core Office.

The **Rockefeller Foundation** launched a **100 Resilient Cities** initiative in 2013. The goal of the 100 Resilient Cities Initiative is to provide seed funding for a Chief Resilience Officer and projects. The Initiative has an International scope, but includes 4 cities in the SCIPP region so far: New Orleans, LA, El Paso, TX, Dallas, TX, and Tulsa, OK. The Chief Resilience Officer will help the cities focus on leadership and strategy, health and well-being, infrastructure and environment and economy and society. Dr. Mark Shafer, SCIPP PI, participated in a Resilient Cities workshop as a subject matter expert. SCIPP is considering additional opportunities for further involvement.

Likewise, the Department of **Housing and Urban Development** re-directed around \$1 billion in funds from Hurricane Sandy for various resilience initiatives. Communities and states are eligible to apply for these HUD grant funds if they were impacted by a federally-declared disaster between 2011 to 2013. In the SCIPP region, eligible cities include Moore, OK, New Orleans, LA, Jefferson and St. Tammany Parishes (LA) and Shelby County (TN).

SCIPP, along with others at the University of Oklahoma, worked with the **City of Moore** on their HUD proposal. The City of Moore's chief concern is security of their long-term water supply, as they are currently almost completely dependent on the City of Oklahoma City for their drinking water. In order to be eligible for HUD funding, the City of Moore was able to connect their long-term water issues to direct impacts and situations that arose from the May 20, 2013 tornado.

Our undergraduate student internship program was launched during the summer of 2014. The goal of the internships is to provide undergraduate students with the opportunity to conduct research and work alongside researchers in geography, meteorology, climatology and/or resiliency outside of the University setting, while providing the host organization with a student whose background and interests fill a possible expertise gap at their organization.

During the Summer of 2014, SCIPP worked with the **Gulf Coast Joint Venture** and the **National Wetlands Research Center**, both in Lafayette, LA, to host two students. Not only does SCIPP provide the means for these students to participate in these internships, but we encourage them to pursue opportunities during the upcoming school year to showcase their research results at national meetings and conference. Both students attended the 95th Annual American Meteorological Society meeting in January of 2015 and presented their research findings.

In early May 2015, SCIPP started its second summer internship program. The **Gulf Coast Joint Venture** was pleased with the results from their previous SCIPP internship, and asked to be a host again for the Summer 2015. Likewise, and partially with the current selection of cities in the 100 Resilient Cities initiative, two summer interns are being hosted by **Tulsa Partners, Inc.**, a non-profit organization which works with many organizations across the City of Tulsa, OK to promote disaster resistance, sustainability, and community resiliency.

SCIPP continues its relationship with the **Lake Pontchartrain Basin Foundation**, which works on a wide range of projects, including flood protection projects for the Greater New Orleans Metro Area. In the past, they have hosted round-table discussions for all of the major flood-protection players to get together and discuss the state of the flood protection system and future goals.

Dr. Mark Shafer continues to serve on the **Texas Sea Grant Advisory Committee** and the **Gulf Coast Prairie Landscape Conservation Cooperative** (GCP LCC) Science Advisory Team. He attended the GCP LCC Science Team meetings in San Marcos, TX (Fall 2014) and Ardmore, OK (Spring 2015). The GCP LCC has been instrumental in assisting with the SCIPP internships in Lafayette, LA at the Gulf Coast Joint Venture and National Wetlands Research Center. He also collaborated with several others from the GCP LCC to initiate a study of fire conditions for the Southern Plains (funded by the DoI South Central Climate Science Center, beginning Fall 2015). Texas Sea Grant is undergoing some reorganization, but in the coming year Shafer will have opportunities to participate in review and revision of their strategic plan.

Dr. Hal Needham was appointed to the **Pontchartrain Maurepas Surge Consortium** Steering Committee in January, 2015, and has participated in their monthly planning calls and community meetings. Likewise, Dr. Needham also participates in the **Gulf Coast Prairie Landscape Conservation Cooperative** Steering Committee since being appointed in April, 2015. He has joined in their monthly planning calls.

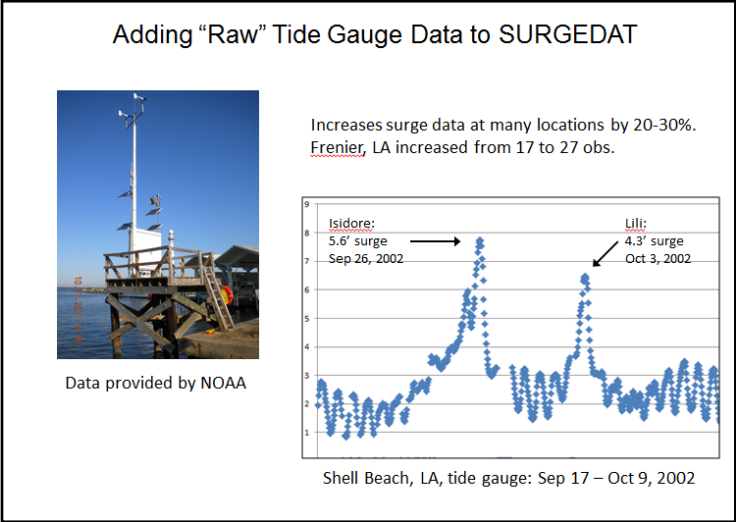
Dr. Hal Needham and Dr. Barry Keim have engaged fellow RISA Teams in regards to expanding SCIPP's SURGEDAT database. They have met in-person, and via conference call, with members of the **Southeast Climate Consortium (SECC)**, the **Carolinas Integrated Sciences and Assessments (CISA)** and the **Consortium for Climate Risk in the Urban Northeast (CCRUN)**. Such collaboration will improve SURGEDAT along both the U.S. Gulf and Atlantic Coasts, and create opportunities to analyze coastal flooding risk for many new communities. This effort is undertaken in response to numerous requests SCIPP has received for location-based storm surge data and risk analysis. These cross-RISA collaborations not only improve SURGEDAT, but they also provide connections with RISA partners in regions that are threatened by coastal flooding.

3. Key Research Findings

No Long-Term Trends in Hurricane Winds or Storm Surge Flooding Events along the U.S. Gulf Coast

Investigators: Barry Keim, Hal Needham

SCIPP researchers Dr. Hal Needham and Dr. Barry Keim analyzed raw tide gauge data for more than 20 gauges along the U.S. Gulf Coast. Most of these data were provided by the National Oceanic and Atmospheric Administration's National Ocean Service. They discovered that including raw tide gauge data increased the number of storm surge observations by 20-30 percent for most locations. They have now analyzed these records



and included these data in the SURGEDAT storm surge database. The SURGEDAT record now includes a combination of raw tide gauge data, high water marks, and measurements from various scientific sources, such as government reports that provide observations for specific hurricanes.

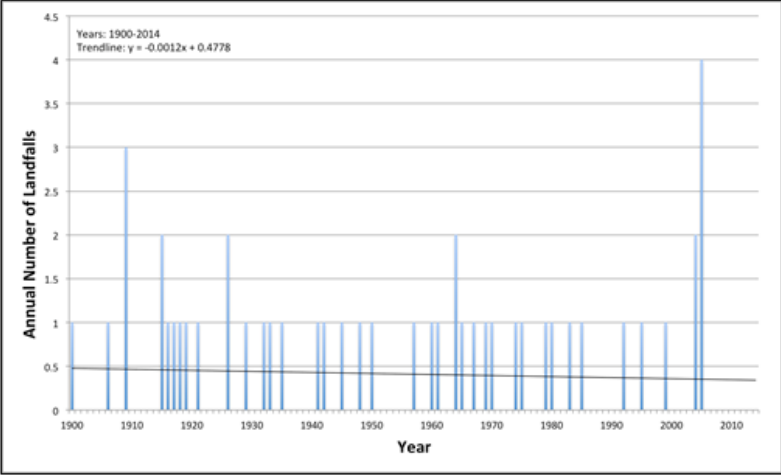


Figure 1: Trend in annual major hurricane landfall counts along the U.S. Gulf Coast.

Dr. Barry Keim and Dr. Hal Needham also analyzed long-term hurricane wind and storm surge flooding trends along the U.S. Gulf Coast. They found no long-term trends in either of these hazards. These findings were documented in a research paper that provides an overview of their data sources and methodology, and also suggests that hurricane/storm surge impacts will become more

severe in this region due to population increase, land subsidence and relative sea-level rise. This paper was submitted to the International Journal of Climatology.

Graduate Student and Summer Internship Research

Temperature Threshold for Mangrove Mortality Reached Several Times Over Past 130 years along the US Gulf Coast

Investigator(s): Marisa Brumfield, Michael Osland, Richard Day, Mark Shafer

As climate change occurs, the frequency of freeze events will affect the presence and abundance of mangrove trees in Louisiana and neighboring states along the northern Gulf of Mexico coast. Black mangroves (*Avicennia germinans*) provide Louisiana with numerous ecosystem services, including habitat for wildlife, sediment stabilization, and carbon sequestration. However, these trees are highly sensitive to cold weather events. Fewer freeze events would allow for expansion of the black mangrove at the expense of salt marsh vegetation, while more frequent freeze events would result in the contraction or death of mangrove forests.

This project used historical temperature data to identify the frequency, duration, and intensity of cold-air outbreaks in and near the Louisiana coastline. Criteria for defining extreme events were based upon the expected mortality and presence thresholds of black mangrove trees, in particular minimum air temperatures in a range of -9 degrees C to -7 degrees C. This range represents a climate window where mangrove tree survival is at stake. Below the lower threshold, mangrove mortality is likely. Optimal mangrove growth and dominance is likely above the higher threshold.

This study also examined cold air outbreaks from the present dating back into the late 1800s, using data from the NOAA National Climatic Data Center, which includes the U.S. Historical Climatology Network and the 19th Century Forts and Voluntary Observers Database. Temperatures below -9 degrees C were rare along the Louisiana coastline, but all stations indicated multiple days reaching this threshold in the past 130 years. Stations along or near the Gulf of Mexico experienced minimum temperatures on average 3 degrees C warmer compared to those just 50 km inland. Collectively, these results help explain the current distribution of mangrove forests in Louisiana and can be used to evaluate the potential for future mangrove forest range expansion in response to climate change.

Drought Indices May be Effective in Explaining Variability in Waterfowl Habitat

Investigator(s): Tara Rodgers, Steve DeMaso, Nicholas Enwright, Mark Shafer

In order to help monitor wintering waterfowl habitat the Gulf Coast Joint Venture (GCJV) sought to determine if one or more weather parameters might explain the abundance of

ephemeral shallow wetland habitats. Three different time periods were used to assess the habitat. The early period was from August 16 - October 31. The middle period was November 1 - January 15; and, the late period was from January 16 - March 31. Additionally, certain weather parameters were assessed to see if they correlated with the flooded acreage. The Drought Atlas was used as a criteria for determining the five weather stations in the different initiative areas provided by the GCJV. The Drought Atlas also provided calculations for weather variables used such as the Standard Precipitation Index (SPI) and the Palmer Drought Severity Index (PDSI), and Standard Precipitation Evapotranspiration Index (SPEI). Using those calculations, some correlations were made to determine the relationship between the weather variable and the flooded acres. Although, it is still early to determine if there is a direct correlation. Research found that during the early and late periods that SPEI 1 month showed a strong correlation. However, when all the periods were pooled together the SPI 4 month showed a correlation. The middle period did not show much of a correlation with any of the indices. Precipitation and average daily temperature also showed some correlations in different periods. These weather indices may prove to be effective in helping explain the variability in the waterfowl habitat. Adding more habitat acreage and weather data each year allows for the database to grow larger, and become more accurate.

Water Utilities in Oklahoma Possessing Dynamic Capabilities Better Suited for Innovation

Investigators: Dr. Travis Gliedt, Jeffrey Widener, and Preston Hartman

This research examines how water utilities in Oklahoma use dynamic capabilities to create sustainable value (Hart and Milstein, 2003) through technological, institutional, or social innovations, which may include supply capacity upgrades (e.g., pipelines), increasing the flexibility of water management (e.g., storm water management), integrating users into governance processes (e.g., adaptation planning and communication strategies), or decreasing demand through user management (e.g., conservation programs).

This study compiled and analyzed quantitative and qualitative data, including semi-structured interviews with 38 key decision makers of water systems across Oklahoma, in order to answer two questions: (1) what characterizes municipal water systems that are highly innovative, and (2) what explains the actual process of innovation in water utilities.

The results of question one suggest that population size, median household income, and education and training of water decision makers are positively correlated with increased innovation rates. Within the state, municipal water systems largely engaged in incremental innovation (80%) as opposed to radical innovation (20%). Innovation aimed at current infrastructure assets accounted for 82% of total innovations, while 18% targeted institutional innovations, such as rate increases, public education programs, and

conservation plans.

The most frequent innovations occurred in water treatment systems, wastewater systems, distribution systems, and the pump and lift stations. The most innovative cities in Oklahoma had the highest levels of water system vulnerability, the largest populations, the greatest precipitation levels, the most advanced educational backgrounds of water decision makers, and are most likely to reside in Central or Northeast Oklahoma. On the other hand, financial barriers, the quality of water system infrastructure assets, and fear of climate change did not show a relationship to levels of innovation. Although water utilities are changing their water systems in response to system vulnerabilities, these innovations are not driven by the risk of climate change and its projected impacts on water systems in Oklahoma.

The results of question two show a strong and positive relationship between the level of dynamic capabilities and the level of innovation within Oklahoma's water systems. This is important because dynamic capabilities assist organizations in achieving long-term competitive performance that can lead to superior innovation and alternative trajectories (Teece, 2007; Helfat and Peteraf, 2011). Oklahoma's most highly innovative water utilities possessed the most dynamic capabilities. Higher population size, median income, education, and geographic location in Central and Northeastern Oklahoma were also found to be influential factors in the creation and use of dynamic capabilities. In addition, dynamic capabilities have been shown to positively influence the adoption of radical innovations, which are crucial to increasing adaptive capacity and resiliency of water systems (Kiparsky et al., 2013; Gaziulusoy, 2015). Our results coincide with these findings, as water systems characterized by higher rates of dynamic capabilities were more likely to deploy radical innovations than municipalities that lack these capabilities. Municipal water utilities that possess higher rates of dynamic capabilities are better suited to engage in innovation that can increase the resiliency of their respective water systems.

The conclusion of this study is that while the factors that influence water system change vary across Oklahoma (e.g., the level of risk and vulnerability), the consistent driving force of higher levels and rates of innovation is dynamic capabilities. The implication is that water managers wishing to prepare their utilities for uncertainties including the future impacts from climate change should focus on developing dynamic capabilities regardless of the current level of risk or water system vulnerability.

4. Key Outreach Activities

Lake Pontchartrain-Maurepas Storm Surge Consortium

Investigators: Dr. Hal Needham

Dr. Hal Needham regularly participates in a new outreach venue called the Lake Pontchartrain-Maurepas Storm Surge Consortium. This organization seeks to raise awareness of storm surge and coastal flooding issues around Lakes Pontchartrain and Maurepas, including metropolitan New Orleans and suburban communities of the New Orleans metro area. Needham joined the steering committee for this consortium and participates in planning and outreach events every 4-6 weeks. Needham also gave a formal presentation of our SCIPP research to this consortium, and actively participated in regular meetings.



Another component of Needham's involvement was participating in a multidisciplinary, hazard reduction project that focused on building a smartphone app for commercial fishermen. The app provides information on docking and commercial facilities that are useful to the fishing industry, as well as natural hazard information, such as storm surge modeling and historical hurricane/ storm surge information. Needham provided SCIPP's storm surge and hurricane climatology data for this app. These data will enable fishermen to access historical climate information related to hurricanes and coastal flooding, which will improve decision making in both fair weather and when threatened by hurricanes. A test version of the app will launch during summer 2015.

Field Photos Weekend

Investigators: Dr. Mark Shafer, Katy Christian, Christine Kuhn, Gina Fujan

For the past 3 years, SCIPP, CoCoRaHS, and the Earth Observation and Modeling Facility have conducted a “Field Photos Weekend” project to create a national picture of our landscape. SCIPP asked CoCoRaHS observers and other citizen scientists to take pictures of the land around them - water bodies, fields, forests, or any other facet of our environment - at roughly the same time. These events began with Labor Day Weekend in 2012 and have continued over Presidents Day and Memorial Day ever since.

The project started out as a way to compare visual impacts of drought to the kinds of things we measure. But even if the weather seems normal, these photos give a point of reference for what will maybe be different next year or in another season or maybe has recovered from a previous year.

To participate, an individual needs to take a picture or two with their camera or smartphone and upload it via the EOMF iPhone app or Android app, the EOMF Field Photos Archive, or email it to us at fieldphotos@southernclimate.org. Participants are asked to include hashtags (e.g. #CoCoRaHSMay15) as keywords when uploading. For photos that are not geo-referenced, the participant can provide a description of where and when the photo was taken.

To date, no formal research has been conducted using the photos obtained from these Field Photo Weekends. However, SCIPP researchers are actively seeking funds to do so.



Climate Training for Native American Tribes

Investigators: Rachel Riley, Dr. Mark Shafer, April Taylor

Four 2-day climate training workshops were conducted last August and September across Oklahoma. There were 35 tribal attendees at the trainings and they represented 18 tribes. Since the workshops, the training materials were finalized and posted on the SCIPP website as a news story and on the SCIPP Documents page. Those activities completed the bulk of the grant, which will end in August 2015. However, remaining funds are being used to provide 1-on-1 assistance to some of the participants by analyzing climate data for them or helping them interpret climate data. Dr. Irena Lodangco, a postdoctoral researcher who started working with SCIPP on May 18th, was hired to provide this service for about three months. Additionally, Rachel Riley hosted an informational webinar on May 21st for individuals and organizations who are interested in expanding the training to other regions.

Presentations: See Appendix A for complete list of presentations.

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast., December 2014, Presentation given to City of Freeport, Brazoria County, and National Weather Service, at Freeport, Texas (H. Needham)

Assessing Natural Hazard Risk: A Focus on Hurricanes. Presentation to Latin-American group with USAID. Louisiana State University, August 2014, Baton Rouge, Louisiana (H. Needham)

Building Non-Traditional Collaborations to Innovatively Address Climate-Related Scientific and Management Needs. 2014 Fall Meeting of the American Geophysical Union, San Francisco, CA, December 15-19, 2014 (R. McPherson)

Building Stakeholder Partnerships: Putting Science into Practice, 27th Conference on Climate Variability and Change, American Meteorological Society, January 6, 2015, Phoenix, AZ (R. Riley)

Citizen Science: Forms of Engagement, 10th Symposium on Societal Applications: Policy, Research and Practice, American Meteorological Society, January 5, 2015, Phoenix, AZ (M. Shafer)

Climate Science Grant Writing Workshop for Tribes, Presented at the National Adaptation Forum, St. Louis, MO, May 12-14, 2015 (R. McPherson)

Climate Sector Introduction. Presented to the NWS-Integrated Warning Team: Gulf Coast Kick-Off Meeting, New Orleans, LA, April 21, 2015 (B. Keim)

Climate Training Workshops for Native American Tribes, Presented at the 27th Conference on Climate Variability and Change, 95th Annual American Meteorological Society Meeting, Phoenix, AZ, J7.2, (R. Riley, A. Krautmann, M. Shafer)

Southern Climate Impacts Planning Program (SCIPP) Phase II Annual Report June 2014 - May 2015

Climate Change and Architecture, presentation made to Introduction to Landscape Architecture class (L A 4970, Thomas Woodfin, instructor), November 11, 2014, The University of Oklahoma, Norman, OK (M. Shafer)

Climate Hazards, Science of Climate Change and Variability Workshop, Lake Texoma, September 27, 2014 (A. Krautmann)

Climate Patterns and Outlook: The Impact on Sustainability, North Texas Cattleman's Conference, Aubrey, TX , October 24, 2014 (M. Shafer)

Climate change Impacts on Invasive Species, Presented at the Oklahoma Invasive Plant Council Annual Meeting, Norman, OK, March 13, 2015 (R. McPherson)

Climate Change and Climate Impacts in the South-Central U.S., Presented at the Oklahoma Skeptics Society, Oklahoma City, OK, March 9, 2015 (R. McPherson)

Climate Training Workshops for Native American Tribes, RISA monthly conference call, 5 March 2015 (R. Riley)

Connecting Climate Science to Stakeholders: Strategies & Experiences of the South Central Climate Science Center. Technical Presentation to NOAA's Geophysical Fluid Dynamics Laboratory, Princeton, NJ, July 24, 2014 (R. McPherson)

Dangers of Heat Stress and Lightning to Athletes. Presented to the Louisiana High School Officials Association Annual Meeting, Thibodeaux, LA, August 15, 2014. (B. Keim and A. Lewis)

Drought Impacts in the Southern Great Plains, Managing Drought in the Energy Sector, Western Governors' Association, September 18, 2014, Norman, OK (M. Shafer)

Drought Planning, Drought Outlook and Assessment Forum, June 24, 2014, Wichita Falls, TX (M. Shafer)

Drought, Climate Variability and Climate Change, presentation made to Hydrometeorology (METR 4633, Jeff Basara, instructor), April 28, 2015, The University of Oklahoma, Norman, OK (M. Shafer)

Exploring Land Cover Change in the Oklahoma Cross Timbers, Presented at the Annual Meeting of the Association of American Geographers, Chicago, IL, April 21-25, 2015 (R. McPherson)

High-Impact Weather Events and their Climatologies, Presented at the Annual Meeting of the Association of American Geographers, Chicago, IL, April 21-25, 2015 (R. McPherson)

Hurricanes in a Changing Climate. Presented to the Louisiana Ag Leadership Conference, LSU, Baton Rouge, LA, January 6, 2015 (B. Keim and A. Lewis)

Hurricane History of the Gulf and East Coast of the United States. Presented to the Southeast Climate Consortium Fall Planning Meeting 2014, Auburn University, Auburn, AL, November 19, 2014 (B. Keim)

Hurricanes of the Gulf of Mexico. Presented to the Poydras House Retirement Community, New

Orleans, LA, November 18, 2014 (B. Keim)

Improving our Understanding Land-Atmosphere Interactions with the North American Soil Moisture Database (NASMD). Contributed poster presented at the Annual Meeting of the American Association of Geographers, Chicago, IL, April 2015 (S. Quiring)

Local Tornado Knowledge, Beliefs, and Risk Perception - Building upon the Central Oklahoma Tornado Town Hall Meetings of Fall 2012, Presented at the 2015 Association of American Geographers Annual Meeting, Chicago, IL, April 21-25, Paper Session 4266: Weather and Society Integrated Studies (WAS*IS), (R. Pepler)

May 20 Newcastle/Oklahoma City/Moore Tornado: Post-Disaster Assessment of Preparedness, Planning and Recovery, Annual Meeting of the Oklahoma Chapter of the American Planning Association, Norman, OK, October 2, 2014 (R. Riley)

Planning for Ice Storms using the Sperry-Piltz Ice Accumulation Index, Annual Meeting of the Oklahoma Chapter American Planning Association, Norman, OK October 2, 2014 (R. McPherson)

Planning for Our Future Climate: Projections from the 2014 National Climate Assessment (Invited Presentation). 19th Annual Inter-tribal Environmental Council Conference, Tulsa, OK, July 29-30, 2014 (R. McPherson)

Predictors and Outcomes of Interpretations and Implications. Paper presented at the annual meeting of the National Communication Association, November 2014, Chicago (R. Edwards)

Predicting Electricity Outages. Presentation at the State Energy Risk Assessment Workshop, Denver, CO, April 2015 (S. Quiring)

SCIPP and the National Climate Assessment, Regional Climate Conference, National Weather Service, August 26, 2014, Shreveport, LA (M. Shafer)

Speaking Truth to Power and Power to Truth: Building a Two-Way Street in Climate Change Assessments, Presented at the National Adaptation Forum, St. Louis, MO, May 12-14, 2015 (R. McPherson)

The Societal Applications Symposium: Ten years of growth, and predictions for the next ten years (Core Science Lecture), Presented at the 10th Symposium on Societal Applications: Policy, Research and Practice, 95th American Meteorological Society Annual Meeting, Phoenix, AZ, January 4-8, Paper 1.2, (R. Pepler)

Using Simple Graphs to Communicate Storm Surge Risk. NOAA RISA Annual Meeting, January 2015, Charleston, South Carolina (H. Needham)

Water and Society – On the Edge Session II: Panel Discussion on Addressing the Risk Tolerance and Tipping Points of Communities Faced with Extreme Lack/Surplus of Precipitation, 29th Conference on Hydrology, American Meteorological Society, January 6, 2015, Phoenix, AZ (M. Shafer panelist)

Weather and Climate Impacts on Transportation for SPTC Region 6. Southern Plains Transportation Center Research Day, Oklahoma City, OK, October 21, 2014 (R. McPherson)

5. Key Publications

See Appendix B for complete list of publications.

1. **Needham, H. F., B. D. Keim, and D. Sathiaraj**, 2015: A Review of Tropical Cyclone-Generated Storm Surges: Global Data Sources, Observations and Impacts. *Reviews of Geophysics*, in press.
2. **Lewis, A. B., and B. D. Keim**, 2015: A Hybrid Procedure for Classifying Synoptic Weather Types for Louisiana. *International Journal of Climatology*, in press.
3. **Powell, E. J., and B. D. Keim**, 2015: Trends in Daily Temperature and Precipitation Extremes for the Southeastern United States: 1948-2012. *Journal of Climate* 28:1592-1612. DOI: <http://dx.doi.org/10.1175/JCLI-D-14-00410.1>
4. Otkin, J. A., **M. Shafer**, M. Svoboda, B. Wardlow, M. C. Anderson, C. Hain and J. Basara, 2015: Facilitating the use of drought early warning information through interactions with agricultural stakeholders. *Bulletin of the American Meteorological Society*, doi:10.1175/BAMS-D-14-00219.1, in press
5. Ford, T. W., Rapp, A. D., **Quiring, S. M.**, and Blake, J., 2015: Soil moisture–precipitation coupling: observations from the Oklahoma Mesonet and underlying physical mechanisms. *Hydrology and Earth System Sciences Discussions*, 12: 3205-3243, doi:10.5194/hessd-12-3205-2015 .

6. Narrative Examples

Water Reservoir Data and Visualization Tool

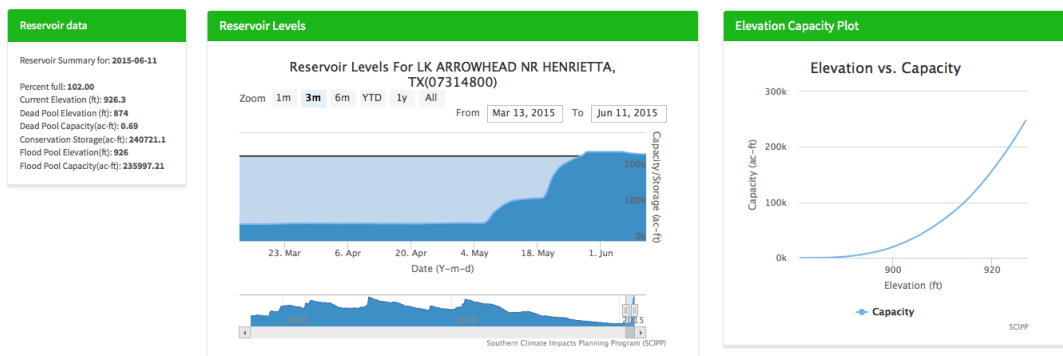
Investigators: Mark Shafer and Margret Boone (OU), Kevin Robbins, Hal Needham, and David Sathiaraj (LSU)

During the Southern Plains drought of 2011, SCIPP identified that water resources information was sparse, distributed and inconsistent. Based upon this finding, SCIPP has pursued a two-pronged approach to addressing this problem. The Southern Regional Climate Center (SRCC) has sought and obtained funding to develop an integrated reservoir database, built upon the Applied Climate Information System (ACIS) framework. The second component is engagement of stakeholders in the region to assess requirements for design of the database and visualization tools.

SCIPP is in the final testing stage of the Water Data and Visualization Tool, or Reservoir Tool. Much of the reservoir data for Texas is incorporated into the tool, and available for viewing. The data for Oklahoma reservoir's is being added, and should be available soon. SCIPP aims to have the Reservoir Tool publicly available on the SCIPP website by the end of the summer.

There are three key pieces of information that are needed to include a reservoir in the tool. Two of these data are static, metadata, and the third is dynamic. The static information needed for each reservoir are: 1. Flood-pool, dead-pool and conservation-pool elevation levels, 2. Elevation-area-capacity (EAC) tables for that reservoir. The third dynamic piece needed is current elevation - does the reservoir report this on a daily basis (most often reservoirs report this via USGS web-services - so SCIPP needs a USGS-id for the gauge closest or most representative of the reservoir). This information is crucial for visualizing the reservoir data.

The focus initially has been on the creation of the Water Reservoir Data and Visualization Tool by building and populating the database. Future work focuses on studying how water managers and other stakeholders use the tool.



This is an example from the Reservoir Tool that shows Lake Arrowhead near Wichita Falls, TX.

7. Measuring Overall Impact

How does SCIPP measure success?

Measuring success in any working relationship can be difficult, whether there is an attempt to quantify the success, or prove an action was successful. One way SCIPP measures success is through our relationships with our stakeholders. Defined below are a few ways in which we measure success. Some points are quantitative (how many people attended a webinar or forum), and some are more qualitative (presenting information). SCIPP has not formally assessed our success, but rather we use the following as an informal method to measure success, thereby guiding our research and community outreach.

Success depends on our relationship with the decision maker.

- Approaching us with additional questions after some initial correspondence
- Participation in a webinar, workshop, or forum that we host
- Willing to give a testimony on how information was used
- Use of a product (e.g., Climate Trends Tool) in their work
- Responding to an email (in some cases, e.g., with tribes)
- Inclusion of information or a graphic that we provided in a report or presentation
- Invitation to present at one of their meetings
- SCIPP-provided information influenced a decision or outcome
- SCIPP-provided information influenced a policy change

Decision Maker Relationship Level



8. NIDIS-Coping With Drought

SCIPP has worked with NIDIS, the National Drought Mitigation Center, and the NOAA Southern Region Climate Services Director in the context of Managing Drought in the Southern Plains since the onset of the exceptional drought conditions in 2011. Primary engagement activities have included in-person drought forums, a webinar series, periodic 5-minute recorded updates on current conditions and outlooks (posted to YouTube) and several research and support activities with specific partners.

Key findings from these activities include:

1. Stakeholders desired discussion and interpretation of products; not just improved access
2. Stakeholders already have access to products via trusted intermediaries; they were more interested in the scientific basis of the causes, physical inter-relationships, and processes driving the climate
3. Provision of information (products or services) may not match jurisdictional boundaries of professional and social networks (e.g., state associations)
4. More guidance is needed on how to interpret graphics, the reasoning behind outlooks and assessments, and examples of how the information, products or services are being used by others
5. More needs to be learned about how critical decisions in planning relate to production and skill of seasonal climate forecasts
6. Active engagement can attenuate stakeholders' desire for certainty, increasing receptivity of products with limited skill
7. Additional research is needed on physical processes: ecological impacts of drought, wildfire climatology and changes; quantifying evaporative losses from reservoirs and vegetation, and integrated data archives that places current observations in historical context

Specific activities undertaken in the last year include distribution of a regional survey; developing a brochure for promoting awareness of the Drought Monitor and resources; developing a prototype drought app; additional research on stakeholders' use of drought indices and ecological impacts of drought; and continued production of webinars, briefings, and forums.

The regional survey was targeted toward county and parish offices (extension, NRCS, FSA, emergency management, and water districts) to examine how well they were connected to the Drought Monitor process and what information sources they used. The survey had 330 respondents across the six-state region, with approximately two-thirds of those coming from the extremely drought-impacted states of Texas and Oklahoma. Analysis of the responses is ongoing with an expected summary prepared by early Fall 2015. SCIPP plans

to follow-up with these county offices with printing and delivery of a “Diagnosing Drought” brochure that includes descriptions of the Drought Monitor and its production process, emphasizes the importance of monitoring and planning, summarizes commonly-used indicators, and encourages participation in the Drought Impacts Reporter and interaction with their state climatologists.

The drought app is being developed by Weather Decisions Technologies (WDT), a private company based in Norman, Oklahoma, with expertise in developing weather-related apps for media. The app is being developed for the iPhone initially with planned expansion to Android. SCIPP is assisting in soliciting stakeholder feedback throughout the process and in developing a database for reporting drought conditions that will be tied to the app.

In the coming year, SCIPP and its partners plan to continue work on drought, even through record flooding has eliminated nearly all vestiges of drought in the region. Activities are planned on all aspects of drought management: planning, monitoring, communication, forecasting, and research.

Drought Planning: Integrate drought and climate change into state FEMA Hazard Mitigation plans; revise the Oklahoma Drought Management Plan and use it as a prototype to extend to other SCIPP states; promote Drought Ready Communities, the Drought Risk Atlas, and other resources via the Managing Drought in the Southern Plains webinar series; assist in planning the Drought/Flood tournament in Austin, TX (Fall 2015, led by the U.S. Army Corps of Engineers) and the NIDIS/NDMC Early Preparedness Communities (EPC) meeting, tentatively also scheduled for Fall in Austin.

Drought Monitoring: Continue working with WDT to complete development of the drought app for both iPhone and Android; integrate drought condition reports from the app with other drought monitoring databases, including the Drought Impacts Reporter; continue the Field Photos project and analyze previous photos for Drought Monitor depictions (new funding provided by NOAA SARP); compare performance of drought indicators (project led by Steven Quiring, Texas A&M, with funding from the DoI South Central Climate Science Center).

Drought Communication: Continue the webinar and briefing series; host at least one regional forum, potentially focused on recovery from extreme, extended drought; create video and social media content to explain drought-related processes (in response to identified stakeholder interest in physical explanations); distribute the Diagnosing Drought brochure to local and regional offices.

Drought Forecasting and Research: Explore development of seasonal temperature forecasts based on soil moisture anomalies (Steven Quiring, lead); prepare a synthesis document discussing long-term ocean patterns and their relationship to drought in the Southern Plains; develop return-period analysis for various drought and heavy rainfall thresholds (regional maps); conduct a targeted community-level post-drought assessment to examine the economic impacts from the 2010-2015 drought.

APPENDIX A: Presentations

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast. Oral Presentation at the Southeast Louisiana Flood Protection Authority – East, July 2014, New Orleans, Louisiana (H. Needham)

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast, LSU Consortium SC CSC, LCC and USGS Workshop. National Wetlands Research Center, August 2014. Lafayette, Louisiana (H. Needham)

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast. Regional Climate Conference, sponsored by the National Weather Service, November 2014, Shreveport, Louisiana (H. Needham)

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast. Poydras Home, November 2014, New Orleans, Louisiana (H. Needham)

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast. The Nature Conservancy, November 2014, Baton Rouge, Louisiana (H. Needham)

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast. Gulf Coast Prairie LCC Webinar, November 2014, Video available on the Web at: <http://www.youtube.com/watch?v=jsoYL7f4bNE&feature=youtu.be> (H. Needham)

A Data-Driven Storm Surge Analysis for the U.S. Gulf Coast. Southeast Climate Consortium SECC Fall Planning Meeting. November 18-20, 2014, Auburn University (H. Needham)

A Data-Driven Storm Surge Analysis for Lake Pontchartrain, Presented to the Lake Pontchartrain Storm Surge Consortium, Madisonville, Louisiana, February, 2015 (H. Needham)

Building a Lasting Legacy: Lessons from the Oklahoma Mesonet, Presentation to the Climate, People, and the Environment Program, University of Wisconsin, Madison, WI, March 20, 2015 (R. McPherson)

Developing a High-Resolution Freezing Precipitation Dataset for Climatological Research, Presented at the 2015 University of Oklahoma-Nanjing University (OU-NJU) Symposium on Weather and Climate Research, Norman, OK, May 11, 2015 (R. McPherson)

Hurricanes in a Changing Climate. Presented to the Friday Speakers Forum, Department of Geography at Texas A&M, February 20, 2015 (B. Keim)

Hurricanes and Climate Change. Presented to the St. Bernard Parish Rotary Club, February 19, 2015 (B. Keim)

Impacts of Climate Change on Flows in the Red River Basin, Presented at the 2015 University of Oklahoma-Nanjing University (OU-NJU) Symposium on Weather and Climate Research, Norman, OK, May 11, 2015 (R. McPherson)

Introduction to Climate Science and Impacts Research. South Central Climate Science Center Undergraduate Minority Summer Intern Program, Norman, OK, July 21, 2014 (R. McPherson)

Land-Atmosphere Interactions and Drought in the U.S. Great Plains. Presentation at the

Southern Climate Impacts Planning Program (SCIPP) Phase II Annual Report June 2014 - May 2015

Department of Earth and Atmospheric Sciences Stout Lecture, University of Nebraska-Lincoln, March 2015 (S. Quiring)

Life Beyond Graduate School, Presented at the 2nd Annual Conference of the Association of Geography Graduate Students, Texas A&M University, College Station, TX, March 6, 2015 (R. McPherson)

May 20 Newcastle/Oklahoma City/Moore Tornado: Post-Disaster Assessment of Preparedness, Planning and Recovery, 39th Annual National Weather Association Meeting, Salt Lake City, UT, October 22, 2014 (A. Krautmann)

Maximizing Wind Farm Power Output by Modified Genetic Algorithm, Presented at the 13th Conference on Artificial Intelligence, Phoenix, AZ, January 4-8, 2015 (R. McPherson)

Overview of the South Central Climate Science Center for ACCCNRS, Presented at the Advisory Committee on Climate Change and Natural Resource Science (ACCCNRS) Quarterly Meeting, Norman, OK, April 28-29, 2015 (R. McPherson)

Quantifying the Value of Quantile Mapping Methods Using a Perfect-Model Approach, Presented at the Special Symposium on Model Postprocessing and Downscaling, Phoenix, AZ, January 4-8, 2015 (R. McPherson)

Research Activities at the South Central Climate Center. Presented at the 2015 University of Oklahoma-Nanjing University (OU-NJU) Symposium on Weather and Climate Research, Norman, OK, May 11, 2015 (R. McPherson)

South Central Climate Science Center. Transportation-Climate Summit, Southern Plains Transportation Center, Norman, OK, September 30, 2014 (R. McPherson)

Statistical Downscaling: Evaluation and Opportunities. 39th Annual Meeting of the American Association of State Climatologists, Stevenson, WA, July 8-11, 2014 (R. McPherson)

Statistically Downscaled North American Precipitation Using Support Vector Regression and the Big Brother Approach. 11th International Conference on Hydroinformatics, New York, NY, August 17 - 21, 2014 (R. McPherson)

The SURGEDAT Storm Surge Database, Presented to U.S. Coast Guard at Morgan City, Louisiana, February, 2015 (H. Needham)

The SURGEDAT Web Tool, Presented at the Gulf of Mexico Alliance Tools Café, St. Petersburg, Florida, May 19, 2015 (H. Needham)

The SURGEDAT Web Tool, Presented at the Climate Education Workshop for Formal and Informal Educators, St. Petersburg, Florida, May 17, 2015 (H. Needham)

Wind Speed Trends over Brazil from 1980-2014. Poster Presented at the Association of American Geographers Conference, Chicago, IL, April 2015 (B. Keim)

Yearly and Seasonal Precipitation Day Patterns in Michigan. Poster Presented at the Association of American Geographers Conference, Chicago, IL, April 2015 (B. Keim)

APPENDIX B: Publications

Allard, J. M., C. R. Thompson, and **B. D. Keim**, 2015: How robust is the pre-1931 National Climatic Data Center - Climate Divisional Dataset? Examples from Georgia and Louisiana. *Theoretical and Applied Climatology* 120(1-2):323-330. DOI 10.1007/s007.

Ford, T. W., Rapp, A. D., and **S. M. Quiring**, 2015: Does afternoon precipitation occur preferentially over dry or wet soils in Oklahoma? *Journal of Hydrometeorology*, 16: 874-888. <http://dx.doi.org/10.1175/JHM-D-14-0005.1>

Ford, T. W. and **S. M. Quiring**, 2014: In-situ soil moisture coupled with extreme temperatures: A study based on the Oklahoma Mesonet. *Geophysical Research Letters*, 41, doi: 10.1002/2014GL060949

Guikema, S. D., Nateghi, R., **Quiring, S. M.**, Staid, A., Reilly, A. C. and M. Gao, 2014: Predicting hurricane power outages to support storm response planning. *IEEE Access*, 2: 1364-1373. doi: 10.1109/ACCESS.2014.2365716

Hu, J., O. T. Ogunsola, L. Song, **R. McPherson**, M. Zhu, Y. Hong, and S. Chen, 2014: Restoration of missing dry-bulb temperature data with long-term gaps (up to 60 days) for use in building performance monitoring and analysis - Part II, *HVAC&R Research*, 20, 594-605.

Hu, J., O. T. Ogunsola, L. Song, **R. McPherson**, M. Zhu, Y. Hong, and S. Chen, 2014: Restoration of 1-24 hour dry-bulb temperature gaps for use in building performance monitoring and analysis - Part I. *HVAC&R Research*, 20, 606-615

Hunt, E., M. Svoboda, B. Wardlow, K. Hubbard, **M. Hayes**, and T. Arkebauer, 2014: Monitoring the effects of rapid onset of drought on non-irrigated maize with agronomic data and climate-based drought indices. *Agricultural and Forest Meteorology*, 191: 1-11, [10.1016/j.agrformet.2014.02.001].

Khong, A., Wang, J. K., **Quiring, S. M.** and T. W. Ford, 2014: Soil moisture variability in Iowa. *International Journal of Climatology*. doi: 10.1002/joc.4176

Klockow, K. E., **R. Pepler**, and **R. A. McPherson**, 2014: Tornado folk science in Alabama and Mississippi in the 27 April 2011 tornado outbreak. *GeoJournal*, January 2014.

Labosier, C. F., Frauenfeld, O., **Quiring, S. M.** and C. W. Lafon, 2014: Air mass classification of wildfire ignitions in the central Gulf Coast, USA. *International Journal of Climatology*. doi: 10.1002/joc.4160

Lewis, A. B., and **B. D. Keim**, 2015: History and Applications of Manual Synoptic Classification. *Earth Systems and Environmental Sciences*, in press.

Nateghi, R., Guikema, S. D. and **S. M. Quiring**, 2014: Forecasting hurricane-induced power outage durations. *Natural Hazards*, 74: 1795–1811, doi: 10.1007/s11069-014-1270-9

Peppler, R. A., K. E., Kehoe, J. W. Monroe, A. K. Theisen, and S. T. Moore, 2015: "Data Quality Program." Chapter 12 in, The Atmospheric Radiation Measurement Program. Meteorological Monographs, American Meteorological Society, in press.

PytlíkZillig, L., S. Wang, L-K. Soh, A. J. Tomkins, A. Samal, T. K. Bernadt, and **M. Hayes**, 2014.:Exploring Reactions to Hacktivism Among STEM College Students: A Preliminary Model of Hacktivism Support and Resistance. Social Science Computer Review. DOI: 10.1177/0894439314546815.

Qiao, L., **Y. Hong, R. McPherson, M. Shafer**, S. Chen, D. Williams, D. Gade, and D. Lilly, 2014: Climate change and hydrological response in the trans-state Oologah Lake watershed – Evaluating dynamically downscaled NARCCAP and statistically downscaled CMIP3 simulations with VIC model. Water Resour. Manage., 28, 3291-3305.

Quiring, S. M., Ford, T. W. and S. Yuan, 2015: Chapter 2: Climate of the Critical Zone. In: Principles and Dynamics of the Critical Zone, C. Houser and R. Giardino (Eds.). Elsevier.

Quiring, S. M., 2015: Drought. In: Gerald R. North (editor-in-chief), John Pyle and Fuqing Zhang (editors). Encyclopedia of Atmospheric Sciences, 2nd edition, Vol 3, pp. 193–200.

Rapp, A. D., Peterson, A., Frauenfeld, O. W., **Quiring, S. M.**, and E. B. Roark, 2014: Climatology of storm characteristics in Costa Rica using the TRMM precipitation radar. Journal of Hydrometeorology. <http://dx.doi.org/10.1175/JHM-D-13-0174.1>

Sisterson, D. L., **R. A. Peppler**, P. J. Lamb, and D. D. Turner, 2015: "The ARM Southern Great Plains Site." Chapter 6 in, The Atmospheric Radiation Measurement Program. Meteorological Monographs, American Meteorological Society, in press.

Staid, A., Guikema, S. D., Nateghi, R., **Quiring, S. M.** and M. Z. Gao, 2014: Simulation of tropical cyclone impacts to the U.S. power system under climate change scenarios. Climatic Change, 127: 535-546. doi: 10.1007/s10584-014-1272-3

Tadesse, T., B. D. Wardlow, J. Brown, M. Svoboda, **M. Hayes**, B. Fuchs, and D. Gutzmer, 2015: Assessing the Vegetation Condition Impacts of the 2011 Drought Across the U.S. Southern Great Plains Using the Vegetation Drought Response Index (VegDRI). Journal of Applied Meteorology and Climatology, 54(1), 153-169.

Teale, N. G., Mahan, H. R., Bleakney, S., Berger, A., Shibley, N., Frauenfeld, O. W., **Quiring, S. M.**, Rapp, A. D., Roark, E. B., and R. W. Washington-Allen, 2014: Impacts of vegetation and precipitation on throughfall heterogeneity in a tropical pre-montane transitional cloud forest. Biotropica, 46(6), 667–676, doi:10.1111/btp.12166

Trnka, M., R. Brázdil, J. Balek, D. Semerádová, P. Hlavinka, M. Mozny, P. Stepanek, P. Dobrovolný, P. Zahradnicek, M. Dubrovsky, J. Eitzinger, B. Fuchs, M. Svoboda, **M. Hayes**, Z. Zalud, 2014: Drivers of soil drying in the Czech Republic between 1961 and 2012. International Journal of Climatology. DOI: 10.1002/joc.4167.

Xia, Y., Ford, T. W., Wu, Y., **Quiring, S. M.**, and M. B. Ek, 2015: Automated quality control of in situ soil moisture from the North American Soil Moisture Database using NLDAS-2 products. *Journal of Applied Meteorology and Climatology*. doi: <http://dx.doi.org/10.1175/JAMC-D-14-0275.1>, in press.

Yu, M., Q. Li, **M. Hayes**, M. Svoboda, and R. Heim, 2014: Are droughts becoming more frequent or severe in China based on the Standardized Precipitation Evapotranspiration Index (SPEI): 1951-2010? *International Journal of Climatology*, 34(3), 545-558, [10.1002/joc.3701].

Yuan, S. and **S. M. Quiring**, 2014: Drought in the U.S. Great Plains (1980-2012): A sensitivity study using three different methods for estimating potential evapotranspiration in the Palmer Drought Severity Index. *Journal of Geophysical Research-Atmospheres*: 19, 10,996–11,010, doi: [10.1002/2014JD021970](https://doi.org/10.1002/2014JD021970).

Zeng, L., B. Wardlow, T. Tadesse, J. Shan, **M. Hayes**, D. Li, and D. Xiang, 2015: Estimation of daily air temperature based on MODIS land surface temperature products over the Corn Belt in the U.S. *Remote Sensing*, 7, 951-970.

Zhu, L., **Quiring, S. M.**, Guneralp, I, and W. Peacock, 2015: Variations in tropical cyclone-related discharge in watersheds near Houston, Texas. *Climate Risk Management*, 7: 1-10. doi:10.1016/j.crm.2015.01.002