



SOUTH CENTRAL

CLIMATE ADAPTATION SCIENCE CENTER



2019-2020 Annual Report

August 1, 2019 - July 31, 2020

The South Central Climate Adaptation Science Center (CASC) is one of eight regional Climate Adaptation Science Centers that are managed by the U.S. Geological Survey (USGS). The USGS Climate Science Adaptation Centers are working across regions of the United States to develop and bring critical science results to managers and stakeholders concerning impacts of climate variability, trends, and extremes with the goal of developing strategies to minimize economic, sociological, and ecological consequences. Priority science activities include measurement, modeling, and decision support that are related to the impacts of climate on natural and cultural resources.



Administrative

Award Recipient:

University of Oklahoma
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Project Title:

Hosting the Department of the Interior's South Central Climate Adaptation Science Center

Award Agreement Number:

G19AC00086

Report Date:

July 1, 2020

Reporting Period:

August 1, 2019 – July 31, 2020

Purpose and Objectives

The South Central Climate Adaptation Science Center (CASC) is a research collaboration between the USGS, University of Oklahoma (host institution), Texas Tech University, Chickasaw Nation, Choctaw Nation of Oklahoma, Louisiana State University, Oklahoma State University, and the University of New Mexico. Our team conducts science that helps fish, wildlife, ecosystems, and the communities they support adapt to climate change. The South Central CASC collaborates with a wide range of researchers and decision-makers in tribes, state and Federal agencies, universities, and non-governmental organizations. Our Center has existed since March 2012, but in this report we refer to Year 1 since it is the first year in our current Host Agreement.

This report provides a summary of the South Central CASC Consortium activities for Year 1 (August 1, 2019 – July 31, 2020). The Consortium accomplished the agreed-upon deliverables for Year 1 outlined in our Key Elements document, and these are discussed throughout this report. In Year 1, the South Central CASC:

- Established a Climate Adaptation Minor in the Department of Geography and Environmental Sustainability at the University of Oklahoma;
- Hosted four online short courses for resource managers world-wide in Fall 2019;
- Conducted stakeholder-driven science related to our six science priorities;
- Engaged with stakeholders and built capacity through listening sessions, trainings, and workshops (e.g., climate 101s, soil health, tribal health, tribal resiliency, etc.);
- Finalized high-resolution climate projections for the south central U.S. and began developing guidance documents to assist managers in using the products;
- Promoted cross-departmental and inter-collegial engagement at each institution and across the Consortium through climate-related discussion groups and our Communities of Practice;
- Began the process to establish Tribal Engagement evaluation metrics;
- Maintained our online presence through our website, social media, and webinars; and,
- Submitted the required communications products to the National CASC.



Organization and Approach

We strive to maintain at least 50% females and 40% non-Caucasians in our workforce.

Personnel Financially Supported on the Host Agreement

The table below highlights CASC employees at our consortium institutions supported on our host agreement.

Personnel	Affiliation	Role	FTE on Host Agreement
Renee McPherson	University of Oklahoma	Consortium PI & University Director	0.75 FTE for 3 months
Emma Kuster	University of Oklahoma	Consortium Co-PI & University Assistant Director	1 FTE for 12 months
Derek Rosendahl	University of Oklahoma	Research Scientist	1 FTE for 1 month
Christiaan Patterson	University of Oklahoma	Science Translator	1 FTE for 2 months
Ellen Robertson	Oklahoma State University	Postdoctoral Associate	1 FTE for 6 months
Tirhas Hailu	Texas Tech University	Postdoctoral Associate	1 FTE for 12 months
Kristine DeLong	Louisiana State University	Consortium Co-PI	1 FTE for 1 month
Victor Rivera-Monroy	Louisiana State University	Consortium Co-PI	1 FTE for 1 month
Xioachen Zhao	Louisiana State University	Graduate Student	0.5 FTE for 12 months
Jessica Tolen	Louisiana State University	Graduate Student	0.5 FTE for 9 months
Kendall Brome	Louisiana State University	Undergraduate Student	~460 hours in Year 8
Dave Gutzler	University of New Mexico	Consortium Co-PI	0.01 FTE for 9 months
Renia Ehrenfeucht	University of New Mexico	Consortium Co-PI	0.01 FTE for 9 months
John Fleck	University of New Mexico	Consortium Co-PI	0.01 FTE for 9 months
Tylee Griego	University of New Mexico	Graduate Student	0.5 FTE for 5.5 months & 0.25 FTE for 6.5 months
Talisa Barncik	University of New Mexico	Graduate Student	0.5 FTE for 2 months & 0.25 FTE for 7.5 months
Kirena Clah	University of New Mexico	Graduate Student	0.5 FTE for 12 months
Kassidy Steckbeck	University of New Mexico	Undergraduate Student	~180 hours in Year 8
April Taylor	Chickasaw Nation	Consortium Co-PI & Tribal Liaison	1 FTE for 12 months
Jacob Nichols	Chickasaw Nation	Undergraduate Student	~260 hours in Year 8

Personnel Who Contribute Time/Service to the Host Agreement

The table below highlights the CASC employees at our consortium institutions that are supported by other means but contribute time/service to the host agreement mission.

Affiliation	Personnel (Role at CASC)
University of Oklahoma	Elinor Martin (Consortium Co-PI); Mark Shafer (Consortium Co-PI); Berrien Moore (Consortium Co-PI); Tyler Pearson (IT Staff - left Nov 2019); Michael Malahy (IT Staff - left Nov 2019); Maurice Cruz (NM Tribal Liaison); Noetta Harjo (Financial Administrator); Terri Sarsycki (Financial Administrator - retired in Dec. 2020); Adrienne Wooten (Postdoctoral Associate); Caitlin Rottler (Postdoctoral Associate); Melissa Perkins (Graduate Research Assistant); Paulina Cwik (Graduate Research Assistant); Taylor Dewinter (Graduate Research Assistant); Sean Wineland (Graduate Research Assistant); Olivia VanBurskirk (Graduate Research Assistant); Tiana Nguyen (Student Office Assistant); Codie Winn (USGS Student Assistant); Peyton Cavnar (Undergraduate Research Assistant); Adam Siebel (Website Coordinator); Jovon Jojola (BIA Pathways Intern)
Oklahoma State University	Jim Ansley (Consortium Co-PI); Scott Loss (Postdoc Supervisor); Gail Wilson (Faculty); Omkar Joshi (Faculty)
Texas Tech University	John Zak (Consortium Co-PI); Katharine Hayhoe (Consortium Co-PI); Venki Uddameri (Consortium Co-PI); Natasja van Gestel (Consortium Co-PI); Ian Scott-Fleming (Research Associate); Anne Stoner (Research Faculty); Nick Smith (Faculty) Rosalynn Vasquez (Outreach Coordinator); Erin Stukenholtz (Graduate Research Assistant)
Louisiana State University	Chris D'Elia (Consortium Co-PI); Barry Keim (Research Professor)
University of New Mexico	N/A
Chickasaw Nation	Kara Berst (Consortium Co-PI); Wayne Kellogg (Researcher); Matthew Armor (School to Work Intern); Heath Steward (BIA Pathways Intern)
Choctaw Nation	Ethan Schuth (Consortium Co-PI); Tye Baker (Consortium Co-PI)

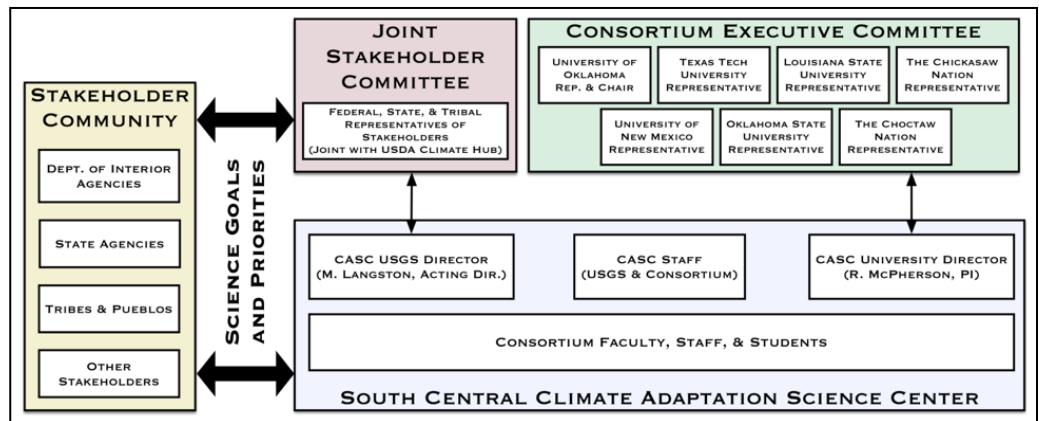
In addition, the CASC has over 90 Research Affiliates across the consortium and at partner institutions. Affiliates of the CASC are individuals whose professional activity, including research or education, contributes to our mission of collaboratively developing science and tools that address the impacts of climate change.



Organization and Approach

Organizational Structure & Communication

The University Director and University Assistant Director oversee the Consortium budget and provide guidance on science and planning activities conducted through the host agreement. The diagram shown overviews the relationship between USGS and Consortium leadership teams and stakeholders as of August 2019.



The Consortium Executive

Committee (EC) meets annually (typically in March or April) to discuss progress-to-date in a given year and begin planning for the following year. In Year 8, the EC met virtually on April 14th to discuss challenges related to COVID-19 and future research, capacity building, and communication efforts conducted through the host agreement.

To facilitate regular communication across the Consortium, we have scheduled bi-monthly conference calls to discuss general updates, critical issues, and the science being conducted by students and postdocs.

Personnel Achievements

Dr. Katharine Hayhoe was named the 2019 Champion of the Earth by the United Nations Environmental Program, which recognizes outstanding individuals whose actions have had a transformative positive impact on the environment. Dr. Hayhoe is recognized for her expertise and passion for communicating climate change. She was also awarded an honorary doctorate from Victoria University at the University of Toronto last year.

Dr. Elinor Martin was awarded a \$1 million dollar National Science Foundation CAREER grant in February 2020. The Faculty Early Career Development (CAREER) Program supports early career researchers who most effectively integrate research and education within the context of their organization's mission. She plans to use the support to further our understanding and ability to predict precipitation variability.

Host Agreement Challenges

We were faced with a few challenges in Year 1 (primarily related to COVID-19 or hiring delays), but we have been able to overcome all of these and adjust accordingly. **Hiring Challenges:** OSU had a delay in hiring a postdoctoral associate, but were able to make an offer in February 2020. Excess salary funds will be used to support summer salaries of faculty working on projects to map and predict changes in species and ecosystems across the south central U.S. OU had a delay in hiring a part-time Science Translator, but were able to make an offer for a full-time position starting in June 2020.

Cross-Departmental Interaction Challenges: OU postdocs and students were scheduled to lead discussion groups or working groups to foster cross-departmental interactions. However, with a lack of attendance during Fall 2019, we made the decision to re-evaluate and initiate something new. Since the situation with COVID-19 started, we have not been able to re-establish such interactions. Similarly, we were to establish a postdoc exchange program between our institutions, but with travel restrictions from COVID-19, this has been put on hold. Restrictions with COVID-19 have also inhibited in-person interactions at UNM to establish a strong CASC-centered team as was planned for their first year as part of the Consortium. **Capacity Building Challenges:** Our CASC had several workshops and listening sessions planned for Spring and Summer 2020, most of which have been cancelled or postponed to later this year. This has impacted our ability to effectively engage with our stakeholders and tribal partners. However, we are transitioning as much as we can to a virtual setting. For example, we had a Climate 101 for Natural Resource Managers scheduled for April 29-30, 2020 that is being transitioned to an online workshop in late July.



Results

Partnerships

Our goal is to respond to high priority natural and cultural resource management challenges and foster substantive, sustained engagement between scientists and managers. In Year 1, the South Central CASC focused on developing new cross-departmental and inter-collegial relationships across the Consortium, as well as continuing to build upon existing stakeholder relationships throughout the region.

The South Central CASC hosted a Science Workshop in Fall 2019 that brought together scientists from across our region to discuss research opportunities related to climate adaptation. With over 45 attendees from Consortium institutions and state agencies, we discussed how we can achieve our vision and work with decision makers in adapting to a changing climate. During the workshop, we established five Communities of Practice (CoPs), each focused on a specific theme based on science needs from our stakeholder community. The science being conducted by each group is further discussed in the *Science* section.

Additionally, we promoted cross-departmental and inter-collegial engagement at OU through a climate-related discussion group in Fall 2019. We will re-evaluate the design of this group moving forward to foster more interactions and look for ways to build multi-institutional connections. At LSU, we continued to build on similar collaborations between the College of the Coast & Environment and Department of Geography & Anthropology by developing new coastal meteorology and climatology course offerings.

In Year 1, we continued to engage with our stakeholder community through listening sessions with the USGS Deputy Director and started to establish new relationships with the National Wildlife Refuge network and National Park Service. At TTU, we continued to build our relationship with the Citizen Science Cotton Producer Network. This is a group of currently 20 producers from across the Southern High Plains that are looking to better understand how climate variability influences crop management, soil health and economic sustainability.

In March 2020, we established monthly meetings to develop an evaluation plan for our Tribal Engagement efforts. By the end of Year 1, we will establish a committee to start working toward the development of an evaluation plan document. The evaluation plan document (first draft to be completed by December 2020) will identify evaluation questions and approaches. The plan will be implemented in Year 2.

Capacity Building

Our goal is to build a community of researchers and managers and foster their leadership in science-based resource management. In Year 1, we focused our attention on developing materials and programs that would benefit our stakeholder community, tribes and pueblos across our region, and the next generation of scientists.

In addition to new course offerings at LSU, we worked at OU to establish a Climate Adaptation Minor in the Department of Geography and Environmental Sustainability. This is the first step in achieving our ultimate goal of developing a Climate Adaptation Graduate Certificate program. Additionally, OSU added two additional faculty members to help bring climate adaptation material into the curriculum.

The South Central CASC hosted four online short courses for resource managers world-wide in Fall 2020, which had the highest completion rates (16% – 45%) and each course averaging over 200 registrants.

In Year 1, we hosted four workshops for tribal professionals, including our first on tribal health and climate change and our first Climate 101 for the Navajo Nation. On average, over 20 individuals attended these workshops designed for tribal professionals. Additionally, we hosted a workshop on no-till for over 500 producers and local government officials in the Texas Panhandle.

Unfortunately, due to ongoing challenges with COVID-19, we have postponed our workshops for water managers in Louisiana and natural resource managers in Oklahoma. However, we are moving forward with transitioning some workshops to an online format.



Results

Science

Our goal is to advance the understanding of the impacts of climate change and variability on fish, wildlife, water, land, and people to support sound resource management and adaptation. In Year 1, we established 5 Communities of Practice to help produce stakeholder-driven research.

- *Sustainable & Usable Water Resources:* Team members are working on a synthesis paper related to the challenges and opportunities of environment flows under climate change. Additionally, one of our funded students at UNM has been leading research related to documenting water resources within the San Juan Basin for the Navajo Nation using Traditional Navajo Ecological Knowledge. This project generated a valuable source of information that can be used to help build resilient ecological communities on Navajo land. Two other students at UNM have also been leading projects related to this theme. They compared adaptation strategies used by communities in the San Luis Valley to those in the Middle Rio Grande Valley and noticed there are very different responses between the areas.
- *Enhancing the Resilience of Indigenous, Rural, & Vulnerable Communities:* This CoP worked on a survey for water suppliers to elicit feedback about their needs and priorities related to water adaptation planning. In partnership with the Southern Plains Climate Hub, this team has been refining the survey and plan to engage a few water suppliers to review it before going live. The ultimate goal is to produce a set of water adaptation guidelines that managers could use in developing adaptation plans.
- *Mapping & Predicting Changes in Species and Ecosystems:* As one of our larger teams, they have worked on several projects, including a conceptual paper about climate change impacts on species distributions. One of our UNM students has also been working on assessing how climate change may impact wildlife species distributions in NM. Building on this work, a subset of this CoP focused on identifying habitats and species across the region that are vulnerable to climate variability. They are currently working on a survey to send to key stakeholders across the region. Our CASC-funded postdoc at OSU will build on this work by developing species distribution models for several bird species across the Great Plains to understand how changes in climate, landcover, and land use effect distribution shifts. Additionally, team members from this CoP are researching the formation and impact of urban ecosystems in Lubbock, Norman, and Las Cruces, which can be impacted by climate change differently than “natural” ecosystems. Another subgroup of the CoP has partnered with the Edwards Aquifer Authority to act as collaborators and provide expert review in their new rangeland restoration work plan.
- *Understanding Teleconnections that Influence Ecosystem Resilience:* Team members of this CoP are actively writing a review paper on the impacts of atmosphere-ocean teleconnections (e.g., how El Nino Southern Oscillation impacts drought conditions) in the south central US. They are also writing an interdisciplinary synthesis paper focused on reviewing teleconnections from a multidisciplinary perspective, a perspective that we feel is missing but critical to help drive future research efforts.
- *Cognitive Climate Corps:* Primary focus for this team was to further develop the Cognitive Climate Corp website and start adding new membership based on our PIs, Affiliate Program, and stakeholder community. The team is actively looking for opportunities to use this system to bridge science and management. Members of this CoP submitted a proposal to the NSF EPSCoR Research Infrastructure Improvement Program: Track 2 for \$6 million over four years to help build a larger network across multiple CASCs.
- *Other research efforts:* While there is not a CoP formally established for our theme on Resilient Coastal Ecosystems, our research team at LSU started working on the issue. They looked at how warming temperatures impact mangrove productivity along the northern most edge of their range, and how changes in hydrologic conditions effect the interactions between temperature and productivity. Similarly, there is not an official CoP established for Stakeholder Understanding of Product Sensitivities, but TTU has started some research in this area as well as on soil health. Using citizen science, they determined that microbial biomass and diversity of microbes are indicators of soil health, which helps producers build more resilient croplands.



Outreach Efforts

Our goal is to understand and respond to information needs and support the integration of climate adaptation in resource management through usable, useful products and tools. Below is a brief description of our outreach, products, and tools resulting from efforts directly funded by the host agreement.

Communications & Outreach

In Year 1, we submitted 15 communications products to the National CASC that were used as USGS Mission Area Highlights and Climate Adaptation Insights Newsletter pieces. These submissions included publications, presentations, success stories, and announcements. We also maintained our online presence through our website (<https://southcentralclimate.org/>), social media (Facebook [825 followers], Twitter [437 followers], and LinkedIn [134 followers]), monthly newsletters [620 subscribers], and semi-regular webinars. We established google analytics in December 2019 to monitor activity on our website. Since December 2019, we have had over 3,000 visitors, resulting in over 8,000 page-views.

In collaboration with the USDA Southern Plains Climate Hub and the Southern Plains Climate Impacts Planning Program, we established a bi-monthly Southern Plains Climate Science Seminar series. At the current time, we average 20-30 viewers for each webinar. We have also been highlighting the work of our CASC-funded students and postdocs through an additional webinar series that is primarily aimed at our Research Affiliate community to promote cross-institution collaborations. Webinars that are recorded are made available for viewing on our website (<https://southcentralclimate.org/resources/webinars-talks/>).

TTU has also maintained their Science by the Glass forums on a monthly basis, averaging 40-60 attendees, to talk about various aspects of climate impacts on regional issues. LSU and OU successfully submitted session proposals for the 2021 American Meteorological Society Annual Conference. The LSU-led team focused on our teleconnections science theme to highlight some of our South Central CASC research, while the OU-led team will be focusing on co-production lessons learned from the CASC network. UNM and OU co-hosted a DisasterProof series for the general public in Albuquerque in Fall 2019 to promote local climate adaptation discussions.

Additionally, we continued to engage in outreach efforts with youth to build up the next generation of scientists: four events for native youth and one event for seventh graders in OK.

Tools & Products

Building off of a USGS funded project, we finalized the last set of high-resolution climate projections for the south central U.S. and started developing guidance documents to assist managers in using the products. We have shared the initial products at stakeholder-focused conferences (e.g., Oklahoma Natural Resources Conference, OSU Horticulture Symposium), listening sessions with stakeholders, and through invited webinars (e.g, US Fish and Wildlife Workshop in Houston) since August 1, 2020. We plan to start releasing the temperature projections to the public by the end of Year 1.

We continued to develop project summaries for all of our CASC-funded projects, which we plan to post on our website in Summer 2020. We find that having short project summaries available helps us to share more effectively the great work conducted by our research team. Additionally, we are in the process of updating our GIS Story Map that showcases all of the funded South Central CASC funded projects (<https://tinyurl.com/r2srsoe>).

In Year 1, we submitted over 30 publications and gave over 60 presentations at conferences and meetings across our region. A selected list of publications and presentations are included in the appendix. To see all of our current publications, visit our website (<https://southcentralclimate.org/science/publications/>).

We expect additional tools and products to be developed as our research efforts continue to progress over the next year. For example, some of our UNM students are working on developing graphics to showcase their results, and our OSU postdoc will be developing some species distributions maps based on her work.



Activities Planned for Year 2

In Year 2 of this host agreement, we plan to continue building on our work from our first host agreement (2012-2019) to develop new products and tools that will assist our stakeholders in adapting to a changing climate. Moving forward, we plan to:

- Continue to grow existing Communities of Practice and establish additional CoPs to synthesize and identify gaps in stakeholder-driven science priorities;
- Conduct research describing and projecting effects of climate on wildlife and habitat distributions in the south-central U.S. and beyond;
- Host four, online climate education short courses for natural resource managers and co-teach climate adaptation courses across our CASC institutions;
- Continue taking our new projections to DOI agencies to infuse climate planning information into existing adaptation planning processes;
- Engage stakeholders directly through listening sessions and workshops to provide scientific expertise, climate projections, and other information for climate adaptation planning;
- Educate and support Tribal engagement across the region, including hosting Tribal workshops and pursuing funding opportunities in collaboration with Tribal partners;
- Implement our Tribal Engagement evaluation plan and use the results to strengthen our efforts;
- Develop an evaluation plan to evaluate other CASC activities;
- Further enhance partnerships with Tribes and Tribal organizations, National Wildlife Refuge network, National Park Service, and other State and Federal agencies across our region; and,
- Strategically develop large-scale inter-institutional and inter-disciplinary regional proposals to establish a broader funding base.





South Central CASC Host Agreement Budget

Budget numbers shown below represent expenditures from August 1, 2019 through May 31, 2020. The relatively low spending rates are primarily because we have not yet spent our summer salaries. The low spending rate at TTU has resulted from the wrong account being charged for a postdoc's salary and fringe; this issue is currently being addressed.

Institution	Budget	Expended	Percent Expended
University of Oklahoma	\$292,398	\$177,232	61%
Texas Tech University	\$124,427	\$1,140	1%
Louisiana State University	\$113,283	\$79,832	70%
Chickasaw Nation	\$120,655	\$85,363	71%
Choctaw Nation of Oklahoma	—	—	—
Oklahoma State University	\$95,738	\$24,712	26%
University of New Mexico	\$124,143	\$74,527	60%

Unfortunately, due to the ongoing COVID-19 pandemic, many of our institutions have faced difficulty in spending from their travel lines. Since many workshops and conferences have been postponed or cancelled, we have submitted a reallocation request to move funds from travel lines to salary and fringe at OU, CN, and UNM. At TTU, we are requesting a reallocation of travel to materials and supplies that will support CASC research moving forward in their growing office. At OU, we also requested to send part of our travel line to LSU to help support graduate student salary. OSU and UNM plans to spend their remaining travel at rescheduled events in Fall 2020 and Spring 2021. Due to a delay in hiring a postdoc at OSU, they are requesting to shift some of that excess salary and fringe to partially cover summer salary for Dr. Jim Ansley and Dr. Scott Loss. An official reallocation request was submitted to OU's Office of Research Services on May 14, 2020.

Leveraged Funding

In 2014, there was an anonymous donation of \$330,000 provided to the South Central CASC, which has been set up as a Foundation Account at OU. Each year we use that funding to provide three study abroad scholarships and two academic scholarships. This year, we were only able to provide our two academic scholarships because of cancelled study abroad programs.

Our NM Tribal Liaison receives funding through a separate grant from the Bureau of Indian Affairs. We have been able to secure funding for this position through grants since June 2017.

Tribal Resilience Planning in New Mexico and Beyond

Renee McPherson (OU), PI – 5 years, BIA, Start Date: 6/5/2017 (New Funding: \$118,473)

In 2018, the South Central CASC became a consortium member of the Oklahoma NASA Space Grant Consortium. The funding provided by this grant has been used to support postdocs and students working on CASC-related projects.

National Space Grant College and Fellowship Program-Opportunities in NASA STEM FY 2020-2024

Renee McPherson (OU), PI – 1 year, NASA, Start Date: 7/1/2020 (Pending, New Funding: \$242,059)

South Central CASC Consortium researchers submitted 11 full proposals to the South Central CASC USGS Request for Proposals in Spring 2020. We should hear in early June which of these proposals were selected for funding in FY20.

The research team of the South Central CASC successfully submitted three additional grants to other federal agencies, totaling in an additional \$1,134,498 of leveraged funds for CASC-related projects since August 1, 2020. This funding, in addition to the two projects listed above, results in a return on investment for this year of 1.7 to 1. Many of these projects are awarded to our PIs because of the expertise built through the South Central CASC network.



Appendix: Success Stories

NASA Earth to Sky Academy

In October 2019, April Taylor and Emma Kuster participated in the NASA Earth to Sky Academy to become regional leaders for the Earth to Sky Program. As regional leaders, we are tasked to build a community of practice in our region focused on climate change informal education. We plan to host our first in-person workshop in Year 2 for tribal educators.

Climate 101 for the Navajo Nation

The South Central CASC hosted the first Climate 101 for the Navajo Nation in August 2019. Dr. Renee McPherson and Dr. Dave Dubois (NM State Climatologist) led the workshop and provided the 25 participants with an introduction to weather and climate, climate projections and available data, and projected regional impacts of climate change. The workshop took place at the Navajo Nation Museum in Window Rock, AZ. Participants represented a variety of different disciplinary backgrounds, and they were excited to learn more about climate change adaptation in their region. Climate 101s like this help participants become better prepared to adapt to a changing climate by providing them with a foundation of climate knowledge that they can further build upon. This workshop helped participants enhance communications and collaborations between the Navajo Nation Agency and BIA, and provided managers with a clear understanding of how their respective areas of expertise could be impacted by changes in the current climate system. We look forward to continuing to hold in-person and virtual Climate 101 workshops in Year 2 of this host agreement.

Building New Partnerships

In December 2019, we started to engage with National Wildlife Refuge managers across our region to learn about their needs and introduce them to the South Central CASC. Emma Kuster led the effort to reach out to refuge managers across our four-state region. She held introductory conversations with over 30 refuge managers and biologists, and that number is still growing. Since then, we developed a proposal focused on wildlife health, a topic of interest that was repeated on several of those calls, that was submitted to the most recent USGS RFP with 16 refuge managers and biologists listed as collaborators. Moving forward, we plan to continue building these relationships with refuge managers in our region, as well as engage with natural and cultural resource managers from other DOI agencies, state agencies, and tribes and pueblos.

Climate Monitoring Workshop

During the 10th Annual Tribal GIS Conference in Albuquerque, NM, our Tribal Liaisons, in collaboration with NASA, the Southwestern Indian Polytechnic Institute (SIPI), and the University of New Mexico Department of Geography and Environmental Studies, held a full-day workshop to provide Tribal GIS Professionals with a variety of specialized tools and applications to aid in vegetation monitoring and mapping. Over 20 individuals attended the workshop, representing 12 distinct tribes from across the south-central and southwest regions. April Taylor introduced the participants to the concept of Climate-Smart Monitoring and our newest high-resolution climate projections for the region. Additional topics presented at the workshop included an overview of the Vegetation Mapping component of the NASA GLOBE Observer App and how to incorporate such technology into community science and monitoring projects; an introduction to affordable, ground-based remote sensing systems for effective phenology monitoring; and a brief overview of remote sensing fundamentals using hands-on activities. All material presented during this workshop was designed to provide the participants with a foundation in GIS for climate adaptation planning. The curriculum for the hands-on supervised classification for vegetation mapping tutorial was developed at UNM and includes several other modules that are freely available to help support distance-learning and capacity building for GIS Professionals. We look forward to continuing to build upon the partnerships we developed in organizing this workshop, as well as offering this workshop to more participants in the future.

New CASC Employees

In Year 1, the South Central CASC added Ms. Noetta Harjo as our Financial Administrator & Office Manager. She replaced Ms. Terri Sarsycki in December 2019. Additionally, we hired Ms. Christiaan Patterson to fill our vacant Science Translator position. Moving forward, we hope to continue to grow our team by adding new postdoc positions.



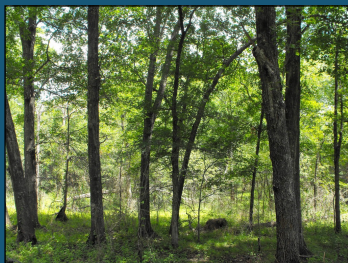
Appendix: Selected Publications

- Bertrand, D., **R.A. McPherson**, 2019: Development of downscaled climate projections: A case study of the Red River Basin, South-Central U.S. *Advances in Meteorology*, 2019. [<https://www.hindawi.com/journals/amete/2019/4702139/>]
- Dee, S., M. Torres, R. Martindale, A. Weiss, **K. DeLong**, 2019: The future of reef ecosystems in the Gulf of Mexico: insights from coupled climate model simulations and ancient hot-house reefs. *Frontiers in Marine Science*, 6(691), doi:10.3389/fmars.2019.00691, part of a special issue titled, “Gulf of Mexico Reefs: Past, Present and Future.”
- Hargreaves J., **K. DeLong**, T. Felis, N. Abram, K. Cobb H. Sayani, 2020: Tropical ocean hydroclimate and temperature from coral archives. *Past Global Changes Magazine*, 28. [<https://doi.org/10.22498/pages.28.1>]
- Harron, P., **O. Joshi**, C.B. Edgar, S. Paudel, A. Adhikari, 2020: Predicting Kudzu (*Pueraria montana*) spread and its economic impacts in timber industry: A case study from Oklahoma. *PLoS ONE*, 15, [<https://doi.org/10.1371/journal.pone.0229835>]
- Joshi, O.**, N.C. Poudyal, J.R. Weir, S.D. Fuhlendorf, T.O. Ochuodho, 2019: Determinants of perceived risk and liability concerns associate with prescribed burning in the United States. *Journal of Environmental Management*, 230, 379-385. [10.1016/j.jenvman.2018.09.089]
- Licht, J., **N.G. Smith**, 2020: Pyrogenic Carbon Increases Pitch Pine Seedling Growth, Soil Moisture Retention and Photosynthetic Intrinsic Water Use Efficiency in the Field. *Frontiers in Forests and Global Change*, 3, 31. [10.3389/ffgc.2020.00031]
- Rastetter, E. B., M. D. Ohman, K. J. Elliott, J. S. Rehage, **V.H. Rivera-Monroy**, R. E. Boucek, E. Castañeda-Moya, T. M. Danielson, L. M. P. Gough, C. R. Jackson, C. R., Miniati, G. R. Shaver, n.d.: Future trajectories for ecosystems of the U.S. Long Term Ecological Research Network: The importance of time lags. Submitted to *Ecosphere*.
- Revillini, D., **G.W.T. Wilson**, R.M. Miller, R. Lancione, and N.C. Johnson, 2019: Plant diversity and fertilizer management shape the belowground microbiome of native grass bioenergy feedstocks. *Frontiers Plant Science*, 10, 1-18. [10.3389/fpls.2019.01018]
- Simard, M., L. Fatoyinbo, S. Charlotte, **V. Rivera-Monroy**, E. Castaneda-Moya, N. Thomas, T. Van der Stocken, 2019: Mangrove canopy height globally related to precipitation, temperature and cyclone frequency. *Nature-Geoscience*, 12, 40-45. [<https://doi.org/10.1038/s41561-018-0279-1>]
- Stukenholtz, E., **T. Hailu**, S. Childers, C. Leatherwood, L. Evans, D. Roulain, D. Townsley, M. Treider, R. Neal Platt II, D. A. Ray, **J. C. Zak**, R. D. Stevens, 2019: Ecology of Feral Pigeons: population monitoring, resource selection, and management practices. *Wildlife Population Monitoring*. [10.5772/intechopen.84612]
- Wootten A.M.**, K.W. Dixon, D. Adams-Smith, and R.A. McPherson, n.d.: Downscaled Precipitation Sensitivity to Gridded Observation Data and Downscaling Technique. Submitted to *International Journal of Climatology*.
- Zhao, X.**, **V.H. Rivera-Monroy**, Z. Xue, C. Tsai, C. Wilson, E. Castañeda-Moya, R. Twilley, n.d.: Modeling Water and Salt Budgets in Mangrove Forests (Everglades, Florida, USA) Impacted by Hydrological Restoration and a Warming Climate. Submitted to *Ecological Modeling*



Appendix: Selected Conference Presentations

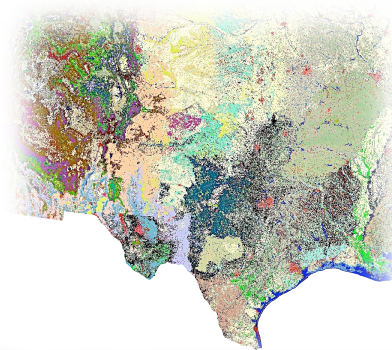
- Cruz, M.**, October 2019: “Climate Change Impacts & Water Resources in the Southwest” – BIA Southwest WATER Resources Regional Summit, Farmington NM
- DeLong K.**, G. Ouellette, X.Wang, T.Yu, C. Shen, December 2019: “Storm Deposit Corals from Little Cayman Reveal Shifts in Sea Surface Temperature and Upwelling in the Central Caribbean During the Holocene” – American Geophysical Union Fall Meeting, San Francisco, CA
- Eschliman C.M.**, J.T. Ripberger, **E. Kuster**, **A.M. Wootten**, January 2020: “Preparing to Adapt: Are People’s Expectations in Line with Climate Projections?” – 33rd Conference on Climate Variability and Change, 2020 American Meteorological Society Annual Meeting, Boston, MA
- Joshi, O.**, R.E. Masters, C.B. Zou, A. Adhikari, B. Mishra, R. E. Will, August 2019: “How resilience of forests to drought and climate change might affect management outcomes for different objectives?” – 104th Annual Ecological Society of America Conference, Louisville, KY
- Kuster, E.**, February 2020: “Setting the Stage: Future Climate in the South Central US” – Oklahoma Natural Resource Conference, Norman, OK
- Martin, E.**, **K. DeLong**, November 2019: “Around the World in 130k (ish) Years: Climate Variability from the Last Interglacial to the Next Century” – School of Geosciences Colloquium, University of Oklahoma, Norman, OK
- McPherson, R. A.**, October 2019: “What Might Oklahoma’s Climate Look Like in the Future?” – OSU Horticulture Symposium, Stillwater, OK
- Rosendahl, D. H.**, **A. M. Wootten**, **R. A. McPherson**, **E. Kuster**, E. Mullens, A. Bryan, January 2020: “Encouraging Planners and Decision-Makers to Embrace Uncertainty in Climate Model Projections for Adaptation Planning” – AMS 33rd Conference on Climate Variability and Change, Boston, MA
- Taylor, A.**, November 2019: “Introduction to Climate Smart Monitoring” – Climate Smart Monitoring and Tools for Remote Sensing training, Albuquerque, NM
- Taylor, A.**, February 2020: “Vulnerability Assessments and Adaptation Planning” – NW OK Tribal Resiliency Workshop, Joplin, MO
- Wooten, A.**, **E. Kuster**, March 2020: “Setting the Stage: Future Climate in the South Central US” – Webinar for U.S. Fish & Wildlife Workshop in Houston, Webinar
- Wootten A.M.**, K.W. Dixon, D. Adams-Smith, **R.A. McPherson**, January 2020: “Downscaling Extremes of Rainfall: Sensitivity to Gridded Observations and Downscaling Technique” – 34th Conference on Hydrology, Boston, MA
- Zak, J.**, February 2020: “Seeing with New Eyes: Understanding how Ecosystems Function” – Annual No-Till Texas Conference, Lubbock, TX
- Zhao X.**, **V. H. Rivera-Monroy**, L.Farfan, E. Castañeda-Moya, R. Travieso, E. Gaiser, November 2019: “Accounting for Carbon Fluxes Caused by Pulsing Disturbances in Mangrove Wetlands Carbon Budgets (Everglades, USA)” – Coastal and Estuarine Research Federation – 25th Biannual Conference, Mobile, Alabama



Helping to solve real problems in a variable and changing climate

Our region

Water, energy, agriculture, native peoples, and rapidly growing metropolitan areas intersect with a highly variable and changing climate to frame many of the risks, challenges, and opportunities for natural and cultural resources in the south-central United States. National parks, scenic waterways, tribal and trust lands, and other protected areas are prevalent across the region. Spatial and temporal changes in the south-central's climate are linked to changes in biodiversity; key wildlife habitats; wetlands quality and extent; stream sedimentation and flow; range and density of heritage and invasive species; cultural and natural landscapes; water quality; pathogen outbreaks; and health of ecosystem services. Changes in the region also result from other stressors; hence, responses to climate change must be examined in combination with land cover/use change, habitat fragmentation, increasing population, pollution, invasive species, increasing demand for natural resources, and other stressors.



The south-central U.S. encompasses 20 ecoregions, resulting from a significant gradient in annual average precipitation, from 60 inches in coastal areas to 6 inches in the deserts.

Visit our website at southcentralclimate.org

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