



SOUTH CENTRAL CLIMATE SCIENCE CENTER

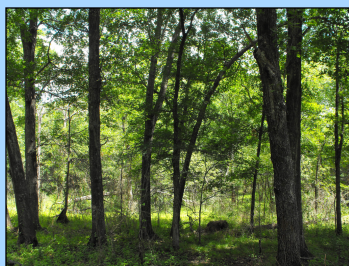


2014 Annual Report

March 1, 2014 - February 28, 2015

This year's highlights:

- Continued evaluation of global and downscaled climate projections for the region
- Expanded the capacity of climate-related research in the region, especially in areas of hydrology and ecology
- Hosted a research planning workshop, an early-career researcher training, and an undergraduate internship
- Conducted multiple trainings and workshops to engage with tribes and released a Tribal Engagement Plan



Helping to solve real problems in a variable and changing climate

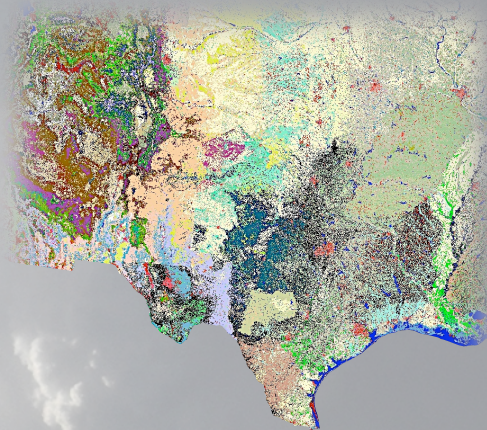
The South Central Climate Science Center is one of eight regional Climate Science Centers that are managed by the U.S. Geological Survey (USGS). Established in 2012, the South Central Climate Science Center is a research collaboration between the USGS, University of Oklahoma, Texas Tech University, Chickasaw Nation, Choctaw Nation of Oklahoma, Oklahoma State University, Louisiana State University, and the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration. The South Central Climate Science Center collaborates with a wide range of Landscape Conservation Cooperatives, tribes, state and Federal agencies, universities, and non-governmental organizations.

Our research

The USGS Climate Science 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.

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 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.

Hired South Central CSC Sustainability Scientist Assistant

The SC-CSC welcomed Kim Merryman through the Chickasaw Nation as our new Assistant Sustainability Scientist. Kim spent 9 years with the US Forest Service as a Forester and Interdisciplinary team member in the Ozark National Forest and the Holly Springs National Forest. She has also previously worked for her tribe, the Choctaw Nation of Oklahoma, as a GIS Specialist. In this role, she identified, mapped, and performed environmental assessments on trust lands for all of the Choctaw Nation. She then initiated an Ozone Monitoring Project as the Air Quality Specialist for her tribe.



Kim additionally has experience with the Eastern Shawnee Tribe of Oklahoma in Water Quality monitoring. In this capacity, she worked with the SC-CSC to plan a Climate Change Workshop for the Northeast Oklahoma tribes. In her new role, Kim will assist April Taylor, our Sustainability Scientist, to continue the SC-CSC's work with tribes in our region, with a particular focus on tribes in New Mexico.

Consortium Researchers and Students

To formalize the relationship with researchers conducting non USGS-funded yet CSC-relevant work in the region, the SC-CSC began an “Affiliate Program” in May 2014. Benefits of affiliate membership include notification of new requests for proposals, an invitation to the annual SC-CSC research workshop, and the ability to have new research or publications featured on the SC-CSC website and Facebook page.



Associated:	Faculty/PIs	Staff	Post-docs	Grad Students
University of Oklahoma	14	3	2	3
Texas Tech University	20	3	2	
Louisiana State University	12			4
Chickasaw Nation	1	2		
Choctaw Nation of Oklahoma	3			
Oklahoma State University	2		2	3
NOAA's GFDL	3			

An Integrated Approach to Providing Climate Data and Guidance

The SC-CSC is working on the robust and quantitative regional evaluation of the strengths and limitations of a variety of global climate models (GCMs) and downscaling methods. In addition to the generation and dissemination of high quality datasets for use within the greater climate science community, the SC-CSC is developing guidance on the suitability of each product for different classes of applications.



Regional Evaluation of Global Climate Model Projections

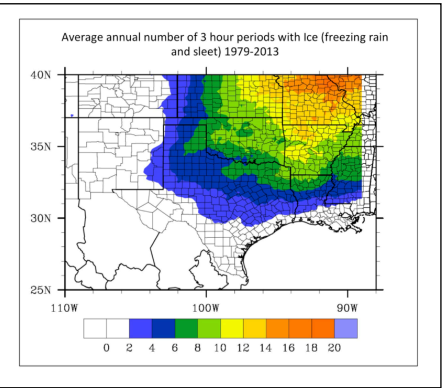
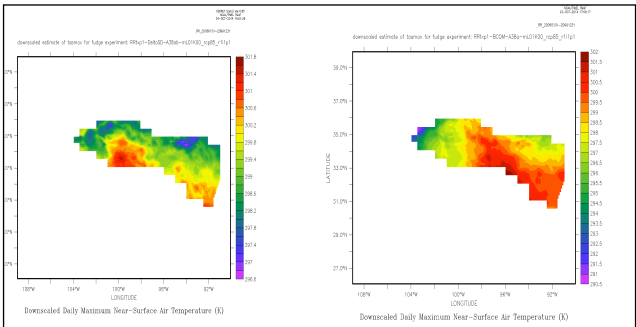
Model	Precip Bias (% of obs mean)						Temp Bias (% of obs mean)						Heavy Precip Days		Hot Days		Low-Level Jet		Score	
	DJF			JJA			DJF			JJA			Annual bias		Annual bias		Avg RMSE(3var)		(CNA)	
	NA	U.S.	CNA	NA	U.S.	CNA	NA	U.S.	CNA	NA	U.S.	CNA	S-C U.S.	S-C U.S.	S-C U.S.	S-C U.S.	Great Plains	Total	Total	
bcc-csm1-1	14.8	21.4	-16.4	-15.0	-20.7	-30.2	-1.0	-2.0	-1.3	-0.8	0.5	1.8						10.0	3.0	
CanESM2	-3.8	-5.5	-13.2	-25.7	-39.2	-49.7	2.1	2.0	4.1	3.1	4.1	5.8	-16.9	8.0		0.9		-19.0	-11.0	
CCSM4	17.1	10.2	-20.2	-7.0	3.5	-5.4	0.0	-0.5	-0.2	1.1	1.4	2.0	-9.6	-5.6		0.9		33.0	12.0	
CNRM-CM5	0.4	-1.6	-25.5	-0.1	-4.7	-29.3	-1.9	-2.0	-0.0	0.4	-0.1	1.2					0.8	32.0	8.0	
CSIRO-Mk3-6-0	2.8	5.4	-8.5	-3.5	-29.1	-38.9	-1.6	-2.1	-2.3	1.3	3.0	5.2						8.0	-4.0	
GFDL-CM3	18.9	27.4	-2.8	7.7	16.0	7.5	1.4	0.8	1.3	-2.0	-2.2	-2.3	-16.1	-49.4				14.0	8.0	
GFDL-ESM2M	10.1	14.7	-16.7	7.4	12.0	2.7	1.7	-0.8	0.8	-0.4	-0.6	-0.2	3.1	-26.4		0.9		36.0	13.0	
GISS-E2-R	23.7	25.2	-6.8	20.8	32.4	24.2	-0.3	-1.2	-0.5	-0.6	-2.1	-1.7	7.3	-41.3				7.0	10.0	
HadCM3	2.6	14.4	-4.6	-3.4	1.2	0.7	-2.9	-3.5	-3.5	-1.1	-0.7	0.1	-20.9	8.3				21.0	9.0	
HadGEM2-ES	1.4	4.3	-4.4	-1.4	-15.9	-32.6	-3.8	-3.0	-3.2	1.2	1.8	2.6	-5.3	-0.3		1.0		19.0	5.0	
Inmcm4	40.8	25.7	-7.4	4.0	-1.7	-19.7	1.7	0.3	1.5	-0.8	-2.1	-1.0						23.0	13.0	
IPSL-CM5A-LR	16.6	12.4	-14.1	-13.7	-1.6	-13.3	0.2	-1.1	-0.6	0.4	-1.2	0.0	-20.5	-35.5				23.0	5.0	
MIROC5	7.5	7.9	-13.7	3.3	0.7	-17.4	1.0	0.7	1.2	2.6	2.3	3.1	-13.1	13.8		0.9		27.0	9.0	
MIROC-ESM	16.8	8.7	-37.2	-4.4	4.4	-28.0	3.3	1.7	3.0	2.8	1.9	3.3						4.0	-4.0	
NPL-ESM-LR	11.9	14.3	-6.0	9.1	11.0	8.2	-0.1	0.3	1.3	-0.8	-0.7	-0.1	-8.9	-19.0		0.8		41.0	20.0	
MRI-CGCM3	25.0	34.4	-6.2	11.0	16.9	0.5	-0.4	-0.4	0.4	-0.4	-1.8	-1.0	-4.9	-46.1		1.1		24.0	11.0	
NorESM1-M	2.2	-6.9	-39.1	-10.0	11.5	12.3	-0.9	-1.6	-1.4	-1.0	-0.5	-0.6						30.0	6.0	

Dr. Derek Rosendahl, a SC-CSC post-doctoral research associate, has commenced a full performance evaluation of GCMs across the historical past for the South-Central U.S region in order to better constrain future projections. Derek’s initial evaluation examined biases in modeled precipitation and temperature as well as the presence of the low-level jet. Major differences in model performance for these metrics are already apparent (left) illustrating how complicated choosing the “optimal” model for a particular application can be. This evaluation framework will be expanded to

include other surface metrics such as seasonal means and variability, extreme events, and spatial gradients, as well as metrics for physical processes such as El Nino, the North American Oscillation, and the Pacific Decadal Oscillation.

Evaluation of Statistical Downscaling Techniques

GCM results typically lack fine-scale detail and may contain biases that make it inappropriate to use the raw GCM output in studies of projected regional or local-scale climate impacts. Informed by observational data sets, statistical downscaling (SD) techniques are often applied to refine GCM output in an attempt to account for shortcomings in a GCM's simulation of local climate. A variety of SD methods exist and can provide dramatically different results from the same source data (right). It typically is assumed that the skill exhibited by a SD method during the historical period will be retained in the future even as the climate is changing - an untested assumption with potentially large implications for the quality of SD output used as input to climate impacts analyses. Dr. Carlos Gaitán, a SC-CSC research scientist, is working with collaborators at NOAA’s GFDL to test this assumption. Carlos is working on a novel experimental design, known as a “Perfect Model” design, to compare the downscaled methods’ performance for both historical and future periods through the use of synthetic data.



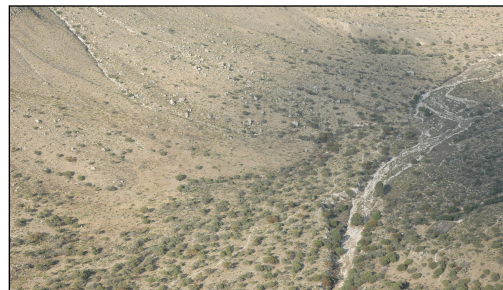
Development of Value-Added Products

In a project co-funded by the U.S. Department of Transportation’s Southern Plains Transportation Center, Dr. Esther Mullens, a SC-CSC post-doctoral research associate, is deriving value-added winter weather temperature and precipitation products for use by researchers and managers within the transportation sector. Esther is currently deriving historic products from the North American Regional Reanalysis data, such as a climatology of 3-hour freezing rain and sleet events (left) and other additional statistical information for the south-central U.S. In the future, Esther will derive these products from climate projection data. These results can be used not only to examine the impacts of winter weather on transportation infrastructure, but also on vegetation, ecosystems and wildlife.

South Central Climate Science Center Research Projects

Predicting Sky Island Forest Vulnerability to Climate Change (Schwilk, TTU)

Dr. Dylan Schwilk, Associate Professor at Texas Tech University, and his research team are working to produce a generalizable framework for predicting tree species susceptibility to drought, climate change, and fire in the unique montane forests and woodlands of west Texas (right). The Sky Island forests of the southwestern United States comprise one of the most diverse temperate forest ecosystems in the world. These mountain ranges are key animal habitats and important stepping-stones for migration. Drought has led to significant tree death throughout the southwest and climate predictions are that this region will face a hotter, more arid climate in the future.



Although simple models of plant response to warming climates predict vegetation moving to cooler and wetter locations (in mountainous locations, “marching” upslope); the mechanisms explaining species-specific responses to changes in temperature and water availability are most likely much more complex. Dylan’s work aims both to identify susceptible species and to inform mitigation strategies, especially in fire management. Thus far, Dylan’s team has learned that fire response strategies are linked to desiccation tolerance in Sky Island oaks, that trees re-sprouting after fire can alter their water conducting tissue appropriately to the new supply and demand constraints, and that striking patterns of cold-air drainage may complicate predictions of upslope movement under climate warming.

Competitive Interactions of Two Pelagic Broadcast Spawning Cyprinids of the Great Plains (Brewer, OSU)

Daniel Logue (right), a SC-CSC-funded masters student at Oklahoma State University, is studying if the non-native Red River Shiner *Notropis bairdi* has the potential to spread throughout the Arkansas River drainage basin. Its presence could adversely impact the federally threatened, native fish, the Arkansas River Shiner *Notropis girardi*. Daniel seined ten Cimarron River and ten South Canadian River reaches and collected microhabitat information. Using occupancy models, he is examining associations between species presence/absence and environmental characteristics typical of prairie streams including fluctuation of temperature, salinity, and discharge. Daniel works with Dr. Shannon Brewer, a research fisheries biologist and assistant unit leader of the Oklahoma Cooperative Fish and Wildlife Research Unit and an Associate Professor in the Department of Natural Resources Ecology and Management at Oklahoma State University.



Reconstructing Regional Climate from American Forts’ Documents (DeLong, LSU)



Jacob Warner (left) is a doctoral student at Louisiana State University, whose SC-CSC-funded research involves digitizing and organizing historic documents from American forts in the Caribbean Sea and Gulf of Mexico. These documents, in conjunction with proxy records, will be used in preparing a regional chronology of climate patterns and weather events. Jacob’s dissertation research examines El Niño patterns in bivalve proxies from Peru, as well as modern instances of El Niño and its impacts on human systems. Jacob is co-advised by Drs. Kristine DeLong and David Chicoine in the Department of Geography and Anthropology at Louisiana State University.

Tribal Engagement Plan

The SC-CSC's Tribal Engagement Plan was released on September 22, 2014, as USGS Circular 1396 and describes how we will engage and facilitate partnerships with the 68 federally recognized Tribes within our region. The Tribal Engagement Plan emphasizes the collaborative nature of science and outlines concrete steps that the SC-CSC intends to take, such as including Tribal leaders in an advisory capacity, offering trainings for Tribal staff, and engaging with Tribal educators. In addition, the Tribal Engagement Plan details a strategy for ensuring that researchers engage with Tribes in culturally appropriate ways. The SC-CSC's Tribal Engagement Plan is the first of its kind and provides a template upon which other CSCs and LCCs can build.



Tribal Youth Programs

An essential part of the SC-CSC's Tribal Engagement Plan is conducting tribal youth programs which are an important step in developing relationships, diversifying the climate-related fields, and building capacity in the next generation of tribal staff. In 2014, the SC-CSC began strategy meetings for youth programs to begin determining our priorities and our



approach for developing youth programs. The SC-CSC conducted seven tribal youth programs, conducted one program for Indian teachers,

attended one conference for Indian science teacher networking, hosted one Cherokee intern, and attended three student conferences to mentor tribal youth. Across the seven tribal youth programs, the SC-CSC had 234 tribal youth attendees and over 500 contact hours with participants.

Tribal Capacity Building

Another essential part of the Tribal Engagement Plan is facilitating the building of tribal stakeholder capacity in climate related areas while also building climate researcher stakeholder capacity in ethical research and how to develop these tribal relationships. In 2014, the SC-CSC partnered on nine trainings for tribal staff and hosted one webinar and one "Working in Indian Country" training for researchers.



The SC-CSC partnered with the Southern Climate Impacts Planning Program and the Chickasaw Nation to host four two-day "Climate 101" trainings for tribal environmental staff in OK and TX. The training introduced the basics of climate and weather, weather hazards and hazard climatology, past climate reconstruction and climate proxies, current climate variability and change, climate tools and data, and a basic introduction to vulnerability assessments. There were 35 tribal attendees from 18 different tribes, with a total of 470 contact hours with participants.

To address a need identified to the SC-CSC by tribal environmental professionals, the SC-CSC partnered with the University of Oklahoma's Center for Research Program Development and Enrichment, the Inter-Tribal Environmental Council, and the Environmental Protection Agency to host the first of a series of Climate Science Grant Writing training for tribal environmental staff and tribal grant writers. There were 43 tribal attendees from 24 different tribes, with a total of 200 contact hours.



Early Career Researcher Professional Development Training

From June 15-20, 2014, 28 early career researchers conducting climate-related research associated within the south-central U.S. gathered in Norman, OK, for the SC-CSC's first early-career researcher professional development training. This training brought together graduate students, post-docs, and early-career researchers representing seven individual institutions and 17 different disciplines.



Participants at the training were introduced to the goals, structure, and unique research-related challenges of the South Central Climate Science Center (SC CSC) and its place within the U.S. Department of the Interior and the larger national CSC network. The week-long event also facilitated interdisciplinary interactions between participants in an effort to foster opportunities for collaboration.

Training activities included visits to the National Weather Center, the

Chickasaw National Recreational Area, and the Chickasaw Cultural Center, as well as a case-study on the use of "actionable science" in decision-making based on the Arbuckle-Simpson aquifer. The participants also heard from speakers on topics ranging from climate change impacts on forests and agriculture to global climate models to climate change related decision making.



A video about the training is available online: <https://www.youtube.com/watch?v=PNOFVnvHogg>

Undergraduate Summer Internship for Under-represented Minorities

The SC-CSC hosted a summer undergraduate internship opportunity from July 20 to August 9, 2014, for ten students of under-represented minorities interested in science, technology, engineering and mathematics fields (for example, anthropology, civil engineering, computer science, meteorology). Internship participants traveled across the south-central U.S. to visit university campuses and field locations. The students interacted with faculty conducting cutting edge research and with resource managers facing decision-making under uncertainty. Interns were involved in hands-on activities that allowed them to see the direct impacts of climate variability and change on forest ecosystems in Oklahoma, coastal areas in Louisiana, and the Texas Hill Country.

In addition, the interns learned basic videography skills and captured the still and video footage for a short teaser that encapsulated the internship experience. This video about the internship program is available online: <https://www.youtube.com/watch?v=ShN9yawAWAs>



Building Regional Collaborations and Partnerships

2014 SC-CSC Annual Research Workshop



The SC-CSC invited approximately 70 federal and university researchers and land management representatives to participate in a research workshop on November 20-21, 2014 in Grapevine, Texas. The workshop featured a keynote talk by Keith Dixon (left) of NOAA-GFDL on pitfalls to avoid when working with climate projections. The primary focus of the workshop was for researchers and resource management professionals to discuss inter-disciplinary and inter-institutional climate-related research topics and develop teams in preparation for future solicitations. The format of the workshop focused on working in intense randomized inter-disciplinary, inter-institutional

small groups to develop proposal topic outlines related to climate challenges within the south-central US. Groups were asked to network and encouraged to sketch out some basic research questions based on the intersection of their interests. By the end of the first day, the groups had generated over 30 potential project topics. By consensus, participants narrowed down the topics to the top 12 for continued discussion at the workshop. Several of these ideas are currently under development as proposals.

Regional Transportation-Climate Summit

The SC-CSC co-hosted the Region-6 Transportation-Climate Summit (right) at the National Weather Center in Norman, OK, on September 30, 2014, with the U.S. Department of Transportation Southern Plains Transportation Center. Transportation infrastructure and operations are facing increasing challenges due to extreme weather and climate variability such as rising seas, increasing storm severity, extreme temperature cycles, severe winter snows, and droughts. The purpose of the one-day summit was to bring together weather and climate and transportation specialists to educate one another, spur new ideas, and promote fruitful collaborations for research at and between regional universities, transportation agencies and research institutions. There were many discussions during the breaks and lunch about ways that researchers can work together with decision makers in the transportation sector to help develop solutions to weather and climate challenges. Summit talks were recorded and have been released for digital streaming: <http://www.sptc.org/summit/>



SC-CSC and LCC Meeting in Louisiana



SC-CSC affiliated researchers and students from Louisiana State University met with representatives of the Gulf Coast Prairie and the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperatives (LCCs) on August 21, 2014, at the USGS National Wetlands Research Center in Lafayette, LA (left). The purpose of the meeting was to define areas of current scientific expertise, discuss the development of shared science priorities to address resource management needs, and to determine new options for future collaborative efforts. Participants from the SC-CSC's Early Career Researcher Training took a leadership role by planning, implementing, and attending the meeting which helped foster stronger partnerships between the SC-CSC and the LCCs.

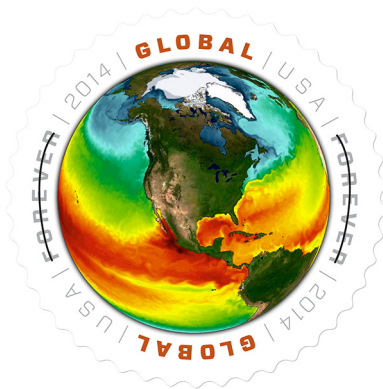
Texas Tech co-PI featured on Showtime's Years of Living Dangerously series

Dr. Katharine Hayhoe (right), Associate Professor at Texas Tech University and an SC-CSC co-PI, appeared in the premiere episode of Showtime's "Years of Living Dangerously" and served as a Science Advisor on the series. Each episode featured an all-star cast of correspondents who traveled across the U.S. to listen to and share stories of climate impacts on real communities. The nine-episode series premiered on April 13, 2014 and won an Emmy Award for Outstanding Documentary or Nonfiction Series. Don Cheadle kicked off the series with Katharine in West Texas and examined how changing climate and enhanced drought is impacting the lives of people within the region. Katharine's episode can be seen for free online: <https://youtu.be/brvhCnYvxQQ>



As a result of her participation in the show, Katharine was successfully nominated by Don as one of TIME Magazine's 100 Most Influential People of 2014: <http://time.com/70881/katharine-hayhoe-2014-time-100/>

Katharine was also named the winner of the 2014 American Geophysical Union Climate Communication Prize.



Geophysical Fluid Dynamics Laboratory co-PI's research featured on U.S. Postal Service Stamp

The U.S. Postal Service (USPS) and the National Oceanic and Atmospheric Administration (NOAA) officially issued the new "Global: Sea Surface Temperatures" forever international rate stamp (left) on Earth Day, April 22, 2014. The stamp depicts the globe, centered over North America, and features global sea surface temperatures on a typical July day in the 1990s derived from NOAA's Geophysical Fluid Dynamics Laboratory's (GFDL) global climate model output. In press surrounding the release of the stamp, Keith Dixon, research meteorologist at NOAA-GFDL, said "The reason we need to do this is

we can't perform real experiments. We don't have a twin planet Earth." Dixon serves as the SC-CSC co-PI at NOAA-GFDL and was instrumental in the creation of the model output and the design of the stamp.

A short video about the partnership titled "Putting NOAA Science on a USPS Stamp" is available online: <https://youtu.be/fOaS1VxpuaM>

Undergraduate Student's Research Project Wins Awards

The SC-CSC hosted Grant Williams (right), a Cherokee student from Oklahoma State University participating in a Research Experiences for Undergraduates summer program. He is working on his bachelor's degree in physics with a minor in mathematics. Grant modeled wind turbine wake interactions in Matlab using a modified genetic algorithm in order to optimize the production of wind energy on tribal lands. He successfully wrote his first journal article and developed a conference presentation on his project. Since completing the program, Grant has excelled by winning poster competitions at the annual meetings for the Society for Advancement of Hispanics/Chicanos and Native Americans in Science and the American Meteorological Society.



Selected publications

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Challenges During 2014

The ability for the SC-CSC's consortium to carry out our overall research objectives as outlined in the hosting agreement continues to be hampered by delays in the transfer of base and grant funding to consortium institution NOAA's GFDL. These delays greatly limit the ability of the consortium to work on topics related to evaluation of climate projections and continue to threaten the inclusion of GFDL in the consortium as a full partner.

Activities Planned for 2015

- Conduct a synthesis and evaluation of ecosystem modeling efforts in the region;
- Advance research on drought impacts and eco-hydrology in the Red River and Rio Grande Basins through holistic model integration and the use of coupled human-natural systems methods;
- Continue to strategically develop large-scale inter-institutional and inter-disciplinary regional proposals to establish a broader funding base;
- Evaluate global climate model projections across the region, evaluate statistical downscaling methods, and develop best practices for impacts researchers and resource managers on how to apply the output from these data sources in partnership with other regional and national efforts;
- Educate and train management partners and support tribal engagement across the region, including hosting grant writing workshops and tribal student conferences and pursuing funding opportunities in collaboration with tribal partners;
- Link students across the region by leading an undergraduate summer internship for under-represented minorities and creating an online open course on managing for climate impacts; and
- Establish data management best practices and begin to develop a central data portal.

Visit our website at <http://southcentralclimate.org/>

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