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**South Central Climate Adaptation Science Center
Science Agenda**

2025-2030



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DRAFT IN REVISION – 9/6/2024

Table of Contents

[Introduction](#)

[Core Values of the South Central CASC](#)

[Science Agenda Overview](#)

[Glossary of Terms](#)

[Science Priorities: Key Management Challenges](#)

[Current and Prospective Research Focal Areas](#)

[Opportunity Areas](#)

[Geographic Focal Areas](#)

[Science Plan Implementation](#)

[Appendix A: Summary of Science Advisory Committee Interviews](#)

[Appendix B: Links to Reports from Recent State Visits and Listening Sessions](#)

Introduction

The mission of the United States Geological Survey (USGS) Climate Adaptation Science Centers (CASCs) is to deliver science to help fish, wildlife, water, land, and people adapt to a changing climate. Created in 2010, the CASC program continues to cultivate and support regional partnerships with colleges, universities, state and federal organizations, and Tribal nations, to share expertise, produce high-quality science, increase accessibility of information, and prepare the next generation of scientists. The national and regional CASCs work with natural and cultural resource managers to generate data, decision-support tools, and other practical and relevant products for their climate change modeling, monitoring, and adaptation work.

Established in 2012, the South Central CASC remains focused on transforming how climate adaptation science is conducted and applied in Oklahoma, Texas, New Mexico, and Louisiana. Each regional CASC is a federal-consortium partnership between the USGS and a consortium of universities, research entities, tribal organizations and/or non-governmental organizations. Currently, the University of Oklahoma is the host institution for the South Central CASC. The main office is located on the University of Oklahoma research campus in Norman, Oklahoma. Consortium members currently include the Chickasaw Nation, Choctaw Nation of Oklahoma, Texas Tech University, Louisiana State University, Oklahoma State University, and the University of New Mexico.

The mission of the South Central CASC is to work with DOI, Federal, Native Nations, and State agencies including natural and cultural resource decision-makers to create, translate, and deliver science that benefits fish, wildlife, water, land, and people adapting to a changing climate.

To achieve this mission, the South Central CASC prioritizes the climate information needs of federal, state, and Tribal natural and cultural resource managers across our four-state region. This includes working with organizations responsible for priority-setting, resource allocation, and decision-making regarding the restoration, protection, conservation, and management of fish, wildlife, plants, lands, waters, and cultural resources in the South Central U.S.

Beyond the CASC consortium members, many other entities contribute to and benefit from the work of the Center. Implementation of the objectives and strategies outlined in this Science Agenda will require collaboration among Tribal Nations, government agencies, communities, and other users who work with us to identify and develop cutting-edge scientific data sets, applications, and training to help resource managers anticipate and adapt to climate change. Throughout this document, we use the term "partners" to refer to all governmental and non-governmental organizations with an interest in the development and application of climate science within our region.

DRAFT IN REVISION – 9/6/2024

These partners may include:

- Tribal Nations (also see South Central CASC Tribal Engagement Plan)
- U.S. Department of the Interior (DoI) bureaus, including U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), USGS, and the Bureau of Indian Affairs (BIA)
- State partners of the DoI including state fish, wildlife, land, and water agencies
- Non-profit organizations working with Tribes and Pueblos, states, and others in natural and cultural resource management (e.g., Ducks Unlimited, Theodore Roosevelt Conservation Partnership, National Wildlife Federation, the Nature Conservancy); and
- Other boundary-spanning organizations (e.g., U.S. Department of Agriculture (USDA) Climate Hubs, National Oceanic and Atmospheric Administration (NOAA) Climate Adaptation Partnerships), agricultural interests, and community organizations.

Among partners of the South Central CASC, Tribal Nations hold prominence for several reasons. First, the federal government has a trust responsibility to recognize the sovereignty of Tribal Nations. Indigenous Peoples have developed their knowledge systems over millennia and continue to do so based on evidence acquired through direct contact with the environment, long-term experiences, and extensive observations. The historical and cultural ecology embedded in Indigenous languages, practices, values, place names, songs, and stories hold knowledge that informs a deep understanding of patterns and processes of change in the natural world. This knowledge is critical to enhancing our understanding of climate change and environmental sustainability that is necessary for developing comprehensive climate adaptation and natural resource management strategies (as recognized by the [White House Office of Science & Technology Policy and Council on Environmental Quality Federal Guidance on Indigenous Traditional Ecological Knowledge](#)).

Members of tribes and Pueblos throughout the region may be considered within the category of underserved populations who have historically been denied access or inclusion in federal programs, policies, and activities in which their health, well-being, and identity have been compromised ([Executive Order 13985: Advancing Racial Equity and Support for Underserved Communities Through the Federal Government](#)). The impacts of climate change disproportionately affect these populations, exacerbating existing social and economic inequities. It is incumbent on the South Central CASC to prioritize ways to both include and serve these populations in identifying climate-related information needs and co-developing research and support tools that advance adaptation efforts rooted in equity to address disparities in climate risks and create opportunities for all people within the region to thrive ([U.S. Department of the Interior Environmental Justice Strategic Plan](#)).

Because the work of the South Central CASC has a broad footprint across multiple disciplines, diverse

DRAFT IN REVISION – 9/6/2024

participants, and research questions, it can be a challenge to identify specific boundaries where it begins and ends. This Science Agenda recognizes that:

- Both the consortium and the USGS engage in work that extends well beyond the scope of this Science Agenda, which is encouraged—especially when it creates synergy with the efforts outlined in this agenda.
- The South Central CASC is one of nine regional centers, functioning as a localized satellite operation of the National CASC that has its own specific mission and objectives.
- The South Central CASC works with a consortium of universities and Tribal Nations along with other partners, and this collaborative work may extend outside the current scope of this Science Agenda.
- Areas where we work with partners must include a clear nexus between climate change and natural and cultural resources.

Core Values of the South Central CASC

These shared values co-developed by CASC staff form the fundamental and core beliefs that we collectively hold and which, in turn, unite us. This approach guides us in achieving our mission.

- Science produced by the CASC is what we are here for—our collective undertaking. We emphasize research that can **‘move knowledge into action’** and we emphasize **‘actionable science.’**
- **Respectful and open communication** among co-workers, students, managers, and partners reflects our shared desire to grow and genuinely ‘show-up’ at work ready to help others succeed. We all play a role in fostering a **greater sense of belonging** within and among our work teams. Great internal communication can translate to better outcomes for the broad base of people supported by our work and more effective engagement with external partners.
- **Diversity, Equity, Inclusion, and Accessibility** form the foundation upon which we build everything else we do at the Center. Internally, our DEIA efforts mean a culture/work environment that embraces our differences, celebrates everyone’s contributions, and is a more productive place to work because we believe that:
 - Diverse teams are more effective.
 - Our resources, research, and results should be made accessible to all.
 - Everyone contributes a unique experience and voice to our chorus. We are committed to incorporating and elevating the voices and lived experiences of all our members.
 - Diversity can refer to any variety in racial or ethnic background, sexual orientation or gender identification, country of origin or citizenship, disability, etc.
- Our work has meaning. Together we **make a difference in the world and in people's lives**. We show up every day ready to help each other continue to **make the world impacted by climate change a safer and better place**.
- We’re **mindful** of how we **show up at work** and the impact that has on our **relationships**.

Science Agenda Overview

This Science Agenda is the product of several years of work led by the USGS arm of the CASC (see Figure 1). The document is structured around three primary components: 1.) Key Management Challenges, 2.) Current and Prospective Research Focal Areas, and 3.) Implementation Approach.

1. Key Management Challenges

Five management challenges have been identified that guide the CASC's Science Agenda. These management challenges are intentionally broad and overarching. They encompass long-term challenges and knowledge gaps that are critical to advancing the mission of the South Central CASC.

2. Current and Prospective Research Focal Areas

This component highlights areas where the CASC has invested substantial resources in the past, as well as additional areas that will need heightened attention in the coming years. Focal areas draw on the broader management challenges and are narrower in scope, highlighting specific aspects of the management challenges that will be the focus of competitive Project Solicitation cycles in subsequent years.

3. Implementation Approach

This section outlines how the CASC will approach actionable science, project selection, engagement with partners, and CASC operations (see also the South Central CASC 2025-2030 Strategic Plan).

The South Central CASC's federal science investments will be guided by this Science Agenda, which outlines key priorities and goals for our region. Developed through extensive dialogue, outreach, and synthesis efforts, this agenda reflects current management challenges and near-term climate science needs of our partners to guide future work. This document serves as a framework for collaboration between the USGS arm of the CASC and the future University host of the Center from 2025-2030, ensuring accountability for both the federal and university arms in fulfilling our shared mission. This agenda is intended to be a living document, updated as partner management priorities change, Consortium membership changes, and climate adaptation science practices advance over the next 5 years.

The table below summarizes the major input sources that informed the development of this Science Agenda (Figure 1 and Table 1).

DRAFT IN REVISION – 9/6/2024



Figure 1. The South Central CASC Science Agenda is the result of several years of work led by the USGS arm of the CASC. This agenda was developed through extensive and iterative interactions between South Central CASC staff, regional management partners, and science end-users. The figure above illustrates the main sources of information that informed the development of this Science Agenda. Additional details can be found in Table 1.

Science Advisory Committee (SAC) Interviews and Discussions	<p>The South Central CASC Science Advisory Committee (SAC) includes natural and cultural resource managers throughout the South Central region. The SAC meets regularly to help identify priority science needs to ensure that CASC-funded research is ultimately useful, relevant, and of value to regional management of cultural and natural resources. The committee played a key role in developing this Science Agenda.</p> <p>DJ Case and Associates was contracted to conduct a series of interviews with South Central CASC SAC members, collaborators, and end-users of South Central CASC climate science. These interviews were intended to solicit recommendations for key science research needs over the next 5 years, collect feedback on the Project Solicitation application and scoring process, and identify opportunities to strengthen partnerships. A summary of interview results can be found in Appendix A. Additionally, SAC members were surveyed by CASC federal staff to solicit needs for future Research Focal Areas.</p>
State Visits with Management Partners, Researchers, and End Users	<p>CASC staff regularly visit each state in the region to better understand key climate science needs by engaging directly with natural resource managers, researchers, and partners, where they live and work. During these visits, staff often host discussions to identify specific regional climate challenges and gather feedback on priority adaptation research needs. This feedback guides development of the annual Project Solicitation research priorities to ensure that calls for funding are closely aligned with the real-world requirements of those managing natural resources, fostering collaboration and the development of actionable solutions tailored to local conditions. A high-level summary of</p>

DRAFT IN REVISION – 9/6/2024

	research needs identified from state visits in the last two years can be found in Appendix B.
Funded Project Portfolio Analysis	A quantitative portfolio analysis of USGS-funded research projects was conducted to answer key questions about how USGS funds have been distributed since the CASC was established in 2012. The primary objective of the analysis is to enable improved understanding of how the South Central CASC research portfolio has evolved over time in order to identify strengths, gaps, opportunities, and inform future directions for strategic research investment.
Partner Agency Meetings	CASC staff routinely meet with partner agencies throughout the region to gain an understanding of the climate adaptation challenges they face, explore opportunities for collaboration, and to exchange information on climate adaptation activities. Additionally, the CASC has a number of staff embedded on the landscape that are working with partners on a regular basis. Information gained from these engagements is important to ensure that CASC research priorities, activities, and outputs align with and are shared with partners throughout the region.
Document Analysis (Agency Science Plans, Scientific Literature, CASC Reviews)	This Science Agenda is derived from a document analysis of partner agency science and strategic plans that identify climate adaptation research needs and resource management priorities. Additionally, peer reviewed scientific literature and technical reports (such as the National Climate Assessment) were referenced to inform and guide the structure of this plan. Finally, the Tribal Engagement Evaluation, the Consortium External Review Report, and the South Central CASC 2025-2030 Strategic Plan were referenced to inform the development of this agenda.
Direct-Funded Projects	Direct-funded projects are vital to the success and sustainability of the CASC. These projects are selected by USGS leadership and are intended to support CASC operational needs, enable rigorous program evaluation and monitoring, and support USGS strategic goals. The CASC has funded a number of direct-funded projects to identify resource management needs of partners and improve operations. Results and lessons learned from these projects will continue to inform and shape the CASC’s approach to science.

Table 1: Descriptions of key sources of information that informed and guided the development of the Science Agenda.

Glossary of Terms

Stakeholder, Rightsholder, and Partner Engagement: The effects of climate change are not bound by federal, state, or Tribal domains. To develop science that is useful and useable across the region, CASC research is characterized by an emphasis on partnership engagement. CASCs support scientists in working iteratively with project stakeholders, rightsholders, and projected end- users of information to ensure final products address salient management needs. This partnership engagement falls along a continuum depending on user needs and resources. Partners are fully engaged in the scientific process from start to finish, from simply providing partners with results (“inform”) to complete “co-production of knowledge.” The CASC value projects supporting high levels of partner involvement, as these collaborations often generate the most actionable science. See Bamzai-Dodson et al., 2021 for additional information.

Actionable Science: The South Central CASC prioritizes scientific outputs and findings that are useful, usable, and used to support management decisions, actions, or plans. Actionable science is described as providing data, analyses, projections, tools, and technical services that can support decisions regarding the management of the risks and impacts of climate change (as defined by the Advisory Committee on Climate Change and Natural Resource Science in Report to the Secretary of the Interior, 2015, Retrieved from: <https://www.sciencebase.gov/catalog/item/5c1d05d3e4b0708288c9bc2a>).

Co-Production: A specific type of partnership engagement that involves iterative, two-way exchanges with partners that grounds scientific objectives within the management context. The choice of engagement approach is dependent on the context of the research. It is important to note that there is no best approach to engagement and co-production approaches do not work in all research situations. The selection of the engagement approach is highly context dependent and might be dictated by a number of factors such as resource constraints or other barriers and require that the team balances the transaction costs of greater partner interaction against expected gains in the quality and quantity of outputs and outcomes. See Bamzai-Dodson et al., 2021 for additional information.

Natural & Cultural Resource Managers: Professionals charged with managing natural and/or cultural resources, from planning to implementation.

Science Priorities: Key Management Challenges

1. Amplification and seasonality of hydrometeorological extremes:

- Changes in the seasonality, duration, frequency, and intensity of precipitation and temperature extremes alter the condition, structure, services, and management of natural and cultural resources.

2. Wildfire and forest resilience:

- Increased temperatures and prolonged droughts heighten wildfire risks, threaten forest health, and require adaptive forest management practices to maintain resilience.

3. Altered hydrological regimes:

- Changes in precipitation, water and air temperature, flows, and connectivity alter water quality and quantity available to freshwater and riparian ecosystems within aquifers and permanent and ephemeral ponds, lakes, rivers, streams, and drainage ways.

4. Changes in water quality, quantity, and sediment delivery in the coastal marine zone:

- The compounding effects of sea level rise, increased storm intensity, changes in tidal cycles, and timing of freshwater flows from rivers and streams affect habitats, biodiversity, cultural resources, and coastal communities.

5. Barriers, opportunities, and unintended consequences of adaptation:

- Climate change alters the feasibility of management goals and suitability of management tools.

Management Challenge 1: Amplification and seasonality of hydrometeorological extremes

As climate conditions change, Texas, New Mexico, Oklahoma, and Louisiana are experiencing significant challenges due to heavy rainfall and increasingly frequent and extreme droughts. These shifts in precipitation patterns pose substantial risks to natural and cultural resources in the region, affecting water availability, agriculture, ecosystems, and overall environmental health.

In these states, heavy rainfall events are projected to become more intense and frequent. More intense and frequent rainfall can cause severe flooding, which threatens infrastructure, disrupts communities, and causes erosion. In Texas and Louisiana, heavy rainfall has historically led to devastating floods, and these events are expected to become more common with climate change (NOAA, 2021). Flooding increases soil erosion, which can degrade land quality and contribute to sedimentation in waterways. This

DRAFT IN REVISION – 9/6/2024

sedimentation, along with runoff of pollutants from urban and agricultural areas, adversely affects water quality.

Floods can disrupt ecosystems, displace wildlife, and alter habitats. Aquatic systems are particularly vulnerable to increased precipitation as rapid changes in water levels and flow rates can impact fish populations and other aquatic organisms. Heavy rains can exacerbate runoff, carrying pollutants from agricultural and urban areas into rivers and lakes. This runoff can lead to algal blooms and degrade water quality, affecting drinking water supplies and aquatic ecosystems (EPA, 2022). In New Mexico and Oklahoma, where water resources are already under stress, this additional contamination can compound existing water quality issues.

Coastal cities have exacerbated flooding risks from sea level rise. By 2100, with a projected sea level rise of 3.3 feet along the Texas Gulf Coast, a Category 2 hurricane is estimated to cause 3 to 10 times more damage to buildings and incur an additional cost of \$10.4 billion (in 2022 dollars), compared to a similar storm event today (Texas GLO, 2019). Conversely, this region is also expected to experience more frequent and severe droughts, leading to several critical issues such as water scarcity and ecosystem stress. Prolonged droughts reduce the availability of surface and groundwater resources. These droughts can strain water supplies for agricultural, industrial, and municipal uses. Decreased water availability impacts irrigation practices, forest health, wildlife, and increases competition for limited water resources. In Oklahoma, the combination of heat and drought can exacerbate soil degradation and lead to the decline of native plant species. In Louisiana, where wetlands play a crucial role in flood mitigation and habitat support, reduced water levels can threaten these ecosystems.

The combined effects of heavy rainfall and extreme droughts are likely to pose serious threats to natural resources in Texas, New Mexico, Oklahoma, and Louisiana. These challenges necessitate proactive water management strategies, ecosystem conservation efforts, and climate adaptation measures to build resilience in the region.

Management Challenge #1	Science Priority
Amplification and seasonality of hydrometeorological extremes Changes in the seasonality, duration, frequency, and intensity of precipitation and temperature extremes alter the condition, structure, services, and	Identify strategic partnerships to streamline the incorporation of climate data within drought forecasting frameworks to improve the accuracy of predictions and increase lead times for events.
	Assess the efficacy of management strategies to mitigate the effects of sedimentation and contaminants on at-risk species, habitats, culturally sensitive plants, and endangered cultural resources as a result of temperature and precipitation extremes.
	Assess the use of nature-based solutions to manage stormwater and reduce urban flooding.

DRAFT IN REVISION – 9/6/2024

management of natural resources.	Co-produce management interventions with partners to maintain ecological integrity and ecosystem services for future drought and extreme precipitation events.
	Facilitate and sustain discussions with end users, stakeholders, and rightsholders, regarding trade-offs in Global Climate Modeling (GCM) downscaling methodologies to appropriately integrate GCM output into ecological and socio-economic models to address their informational needs.
	Support and forward partnerships focused on the advancement, management, and integration of quantitative and qualitative datasets to yield predictive models and inform management strategies for at-risk species, habitats, culturally sensitive plants, and endangered cultural resources.

Management Challenge 2: Wildfire and forest resilience

Wildfires in the south central United States have become increasingly frequent and intense. Rising temperatures, prolonged droughts, and shifting precipitation patterns are contributing to the heightened risk and severity of wildfires in this region. Climate change is exacerbating the conditions that lead to more frequent and severe wildfire events by increasing the likelihood of prolonged dry periods and higher temperatures, which in turn elevate the flammability of vegetation.

In New Mexico in particular, the combination of higher temperatures and decreased precipitation has led to a significant increase in wildfire activity. The National Interagency Fire Center (2022) reports that the state has experienced a rise in the frequency and size of wildfires in the last decade, with notable events like the 2022 Hermits Peak-Calf Canyon Fire demonstrating the severe impacts of these changing conditions. The increased frequency of wildfires in New Mexico is impacting both ecosystems and communities, leading to habitat loss and posing substantial risks to human safety. Texas has similarly seen an uptick in wildfire activity in recent years, driven by a combination of heatwaves and drought conditions. The Texas A&M Forest Service (2023) notes that the state has faced several severe wildfire seasons, with large fires such as the 2021 Big Bend Fire highlighting the growing challenge of managing wildfires under climate stress. Increased temperatures and variable rainfall patterns are creating an environment where wildfires can spread more rapidly and with greater intensity.

Oklahoma, while traditionally not as wildfire prone as its southwestern neighbors, is experiencing an increase in wildfire incidents as well. The Oklahoma Department of Agriculture, Food, and Forestry (2022) attributes this rise to warming temperatures and shifting weather patterns, which are contributing to more frequent and severe fires that are impacting agricultural lands and natural ecosystems. In Louisiana,

DRAFT IN REVISION – 9/6/2024

the threat of wildfires is also increasing, though the state is often more associated with hurricane risks. The Louisiana Department of Agriculture and Forestry (2023) cites climate change as a contributor to longer dry periods and higher temperatures, which are enhancing the risk of wildfires. The impact on the state's diverse ecosystems, including wetlands and forests, underscores the need for integrated fire management strategies that consider the effects of climate change.

The impacts of climate variability are significantly influencing wildfire dynamics across the South Central CASC region with increased temperatures and altered precipitation patterns exacerbating fire risks. Ice storms, drought, and high temperatures, have put stress on forests, making them vulnerable to post-event trauma such as disease, pests, fire, and increased mortality (Bragg et al., 2023). Rising temperatures and prolonged drought conditions heighten the risk and frequency of wildfires, posing significant threats to forest health and resilience. Effective forest management practices, such as controlled burns, selective thinning, and reforestation with fire-resistant species, are essential to mitigate wildfire risks and maintain forest ecosystems. Addressing these challenges requires comprehensive adaptation strategies that incorporate climate projections into fire management practices to mitigate the impacts and enhance resilience in these areas.

Management Challenge #2	Science Priority
<p>Wildfire and forest resilience</p> <p>Increased temperatures and prolonged droughts heighten wildfire risks, threaten forest health, and require adaptive forest management practices to maintain resilience.</p>	Develop and refine models that predict fire spread under varying conditions, including different vegetation types, topographies, and weather scenarios inclusive of wind and evaporative demand.
	Evaluate the most effective practices for fire management, including controlled burns and forest thinning, to reduce wildfire risk exacerbated by drought.
	Assess post-fire recovery, including reforestation practices, soil stabilization, invasive species management, and retention techniques for runoff from burn scars to restore ecosystems and prevent future fires.
	Evaluate the impacts of fire and drought on the quality of habitats inclusive of fragmentation, vulnerability of threatened species and cultural resources, and connectivity between habitats and species distribution.
	Develop climate adaptation strategies for forest management that account for increasing fire and drought risks under future climate scenarios.
	Evaluate the effectiveness of fuel reduction techniques such as thinning, controlled burns, and mechanical removal in reducing fire risk and severity.
	Investigate the role of social capital and relationships between management agencies and communities in developing effective fuel reduction techniques

DRAFT IN REVISION – 9/6/2024

	such as thinning, controlled burns, and mechanical removal in reducing fire risk and severity.
	Support interdisciplinary, multi-institutional teams to co-produce appropriate downscaling and application of GCMs and/or production of variables at scales that support socio-environmental systems modeling for wildfire and forest resiliency.

Management Challenge 3: Altered hydrological regimes

Climate change is poised to alter hydrological regimes in Texas, New Mexico, Oklahoma, and Louisiana, with substantial implications for natural and cultural resource management in this region. Heavy rainfall and subsequent flooding have already submerged archaeological sites and altered culturally significant landscapes in Louisiana and Texas (Reeder-Myers and McCoy, 2019). Rising temperatures and shifting precipitation patterns are expected to increase the frequency and intensity of extreme weather events. Large-scale and repeated damage from sea level rise, hurricanes, and flooding have led to increased displacement of people from coastal communities (McPherson et al, 2023).

In Texas, increased variability in precipitation will lead to more intense flooding and extended dry periods, challenging both flood management and water supply systems (Texas Water Development Board, 2022). Similarly, in New Mexico, reduced snowpack and more frequent droughts will decrease streamflow and groundwater recharge, placing additional stress on water resources (National Park Service, 2021). Oklahoma is projected to experience greater extremes in both precipitation and temperature, leading to increased flood risks and more severe water shortages, affecting both urban and rural water management (Oklahoma Climatological Survey, 2023). In Louisiana, intensified heavy rainfall events will exacerbate flooding and coastal erosion, while rising sea levels will further threaten freshwater wetlands and natural ecosystems (Louisiana Department of Environmental Quality, 2023).

These hydrological changes necessitate comprehensive management approaches for natural resources that consider the impacts of climate change. Effective strategies may include updated water allocation frameworks, improved drought contingency plans, and ecosystem management that focuses on preserving aquatic and terrestrial habitats. Continuous monitoring and adaptive management practices will be essential to address the evolving impacts of climate change on water resources in the region.

Management Challenge #3	Science Priority
	Identify drought impacts on groundwater recharge, discharge, and storage.

DRAFT IN REVISION – 9/6/2024

<p>Altered hydrological regimes</p> <p>Changes in precipitation, water and air temperature, flows, and connectivity alter water quality and quantity available to freshwater and riparian ecosystems within aquifers and permanent and ephemeral ponds, lakes, rivers, streams, and drainage ways.</p>	Investigate the vulnerability of surface and groundwater systems to climate change in order to develop effective restoration and adaptation strategies for stream habitats, riparian communities, alluvium, fish and wildlife resources, and culturally significant plants and places.
	Improve the accuracy and lead time of drought prediction models to enable proactive management of water resources.
	Investigate integrated watershed management approaches that optimize the use and conservation of water resources across different sectors, including agriculture, urban, and ecological systems.
	Evaluate the specific responses of fish populations and at-risk aquatic organisms to changes in water temperature, chemistry, turbidity, and flow.
	Increase participation of social scientists to investigate the appropriate use of socio-environmental systems modeling to examine the adaptive capacity of fisheries, recreational activities, and cultural practices related to water resources.
	Assess and predict changes in future abundance and distribution of high-value fish species and at-risk aquatic organisms.
	Support partnerships to identify data and knowledge gaps in observing and computing systems to improve ecological and socio-environmental modeling frameworks for aquifers and permanent and ephemeral ponds, lakes, rivers, streams, and drainage ways.
Support teams with epistemological diversity to investigate best practices to inform decision makers about uncertainty (e.g. structural uncertainty vs. uncertainty in data and model parameters) for water resource and aquatic ecosystem management planning activities.	

Management Challenge 4: Changes in water quality, quantity, and sediment delivery in the coastal marine zone

Climate change has profound impacts on the coastal regions of Texas and Louisiana, which are particularly vulnerable due to their low-lying topography and economic reliance on coastal resources. These changes threaten coastal ecosystems, leading to land loss, increased flooding, and saltwater intrusion into freshwater systems. Restoring wetlands, barrier islands, and other coastal habitats is crucial for protecting biodiversity and mitigating the impacts of climate change on coastal communities.

DRAFT IN REVISION – 9/6/2024

In Texas, rising sea levels are leading to increased erosion and inundation of barrier islands and wetlands, critical habitats for wildlife (FitzGerald et al., 2008; Nicholls & Cazenave, 2010). These changes threaten the structural integrity of coastal ecosystems and reduce their ability to act as natural buffers against extreme weather events. In Louisiana, the situation is compounded by subsidence, which exacerbates the effects of sea-level rise. This land loss has devastating effects on both natural habitats and human communities. Wetlands that once provided crucial services such as water filtration, carbon sequestration, and storm protection are rapidly disappearing, leaving communities more exposed to the impacts of hurricanes and other extreme weather events (Craft et al., 2009).

Moreover, the increased frequency and intensity of hurricanes pose significant threats to both Texas and Louisiana. Hurricanes bring heavy rainfall, storm surges, and strong winds, which can cause widespread flooding, damage infrastructure, and disrupt local economies (Bender et al., 2010). Between 2000 and 2021, Texas experienced its five wettest months on record and 19 named tropical storms, 8 of which were hurricanes, including Harvey (2017), Ike (2008), and Rita (2005). The 2020 Atlantic hurricane season was particularly destructive, with multiple storms causing extensive damage along the Gulf Coast (National Oceanic and Atmospheric Administration, 2021). During this same period, Oklahoma and Texas experienced 69 and 82 months, respectively, of severe to exceptional drought conditions (McPherson et al., 2023).

Climate change also affects water quality and availability in these regions. In Texas, prolonged droughts interspersed with heavy rainfall events can lead to significant fluctuations in water supply, affecting both agricultural and urban water use (Seager et al., 2009). In Louisiana, saltwater intrusion due to rising sea levels and storm surges threatens freshwater resources, impacting agriculture, drinking water supplies, and ecosystems (Herbert et al., 2015). Addressing these challenges requires integrated management strategies that consider the complex interactions between climate change and coastal ecosystems. Effective adaptation measures will include restoring wetlands, improving coastal defenses, and implementing sustainable land-use practices to enhance the resilience of both natural and human systems (Glick et al., 2011).

Management Challenge #4	Science Priority
Changes in water quality, quantity, and sediment delivery in the coastal marine zone	Investigate the impacts of climate change variables on sea level, water temperature and chemistry, tidal cycles, and coastal storm intensity to identify trends that threaten the biodiversity of high priority coastal wetlands (salt marshes, freshwater marshes, seagrass meadows, mangrove swamps, and forested swamps).

DRAFT IN REVISION – 9/6/2024

<p>The compounding effects of sea level rise, increased storm intensity, changes in tidal cycles, and timing of freshwater flows from rivers and streams affect habitats, biodiversity, and coastal communities.</p>	<p>Test and evaluate the effectiveness of hardscape and softscape restoration strategies such as beach nourishment, dune restoration, and protective barriers, to mitigate the effects of climate-induced factors contributing to coastal erosion.</p>
	<p>Evaluate and increase our understanding of the impacts of changing freshwater flows into Gulf Coast estuaries to assist regional decision-makers responsible for at-risk fish and wildlife populations (threatened and endangered species, species of greatest conservation need).</p>
	<p>Identify monitoring and climate modeling gaps to examine long term trends of extreme hydrologic events on salinity and water quality in the intercoastal waters along the Gulf Coast of Louisiana and Texas.</p>
	<p>Forward research to improve the resilience of vulnerable communities in coastal Texas and Louisiana to climate change impacts.</p>
	<p>Evaluate how rising sea levels impact cultural and archaeological resources, focusing on assessing vulnerability, analyzing impacts, developing adaptation strategies, formulating management policies, and raising public awareness to mitigate damage and preserve these assets for future generations.</p>
	<p>Examine the seasonality, intensity, duration, and frequency of hydrometeorological extremes in combination with phenology, land use practices, and water management plans for entire river systems (mainstem and tributaries) to evaluate the quality and quantity of freshwater inflows to coastal watersheds along the Gulf Coast of Louisiana and Texas.</p>
	<p>Examine seasonal trends in climate scenarios for hydrometeorological variables that affect critical habitats within entire river systems and flyways for migratory species.</p>

Management Challenge 5: Barriers, opportunities, and unintended consequences of adaptation

Adapting to climate change involves complex considerations for managing natural resources, with various barriers, opportunities, and unintended consequences shaping the process. Even as the evidence base for adaptation grows, implementation actions by decision-makers may lag due to institutional, financial, or other barriers. Resource managers are challenged by planning and implementing on-the-ground strategies to achieve management objectives within their jurisdictional authority that sustain benefits for

DRAFT IN REVISION – 9/6/2024

their own constituencies. Their jobs are made more challenging by trying to account for how warming temperatures, changing precipitation patterns, and shifting habitat and species assemblages affect their management strategies. Their management decisions vary considerably in both spatial and temporal scales, so a one-size-fits-all approach will likely fall short of meeting the needs of decision makers in the region. Financial constraints often pose a significant obstacle, as implementing adaptation measures for natural resource management—such as restoring ecosystems and developing climate-smart agricultural practices—can require substantial investment.

Institutional and policy challenges further complicate adaptation efforts. Fragmented governance structures and conflicting policies can obstruct the coordinated action needed for successful adaptation. For example, inconsistent regulations across different levels of government may impede the implementation of comprehensive water management or land-use strategies. Socioeconomic inequities also play a crucial role in adaptation. Marginalized communities often face greater challenges in accessing and implementing adaptation measures due to limited resources that exacerbate existing vulnerabilities and disparities. Further socio-ecological research that spans across traditional academic disciplines and centers the values, cultures, and perspectives of affected people is needed to advance feasible interventions that overcome identified adaptation barriers especially in marginalized communities.

Adaptation also presents significant opportunities. Ecosystem-based approaches, such as the restoration of wetlands and sustainable land management, offer cost-effective solutions that provide multiple environmental benefits while enhancing ecosystem and social resilience. Engaging communities in the adaptation process can lead to more tailored and culturally appropriate solutions, improving both effectiveness and acceptance. Collaborative partnerships between governments, non-profits, and the private sector can also provide the necessary resources and expertise to support adaptation initiatives. Training in climate literacy and management decision-making under uncertainty, translating research into public awareness and community engagement, and advancing synthesis and accessibility of existing information are all critical opportunities to implement and refine adaptation practices.

Despite these opportunities, adaptation efforts can lead to unintended consequences. For example, measures designed to protect one area might inadvertently increase risks elsewhere. Adaptation measures that benefit certain groups, species, or regions might exacerbate existing social and economic disparities elsewhere and leave other areas more vulnerable. Overall, while adaptation strategies offer promising solutions for managing natural resources in the face of climate change, careful consideration is needed to navigate barriers, leverage opportunities, and address potential unintended consequences. Effective natural resource management requires a balanced approach that integrates social, financial, informational, and policy considerations while promoting equitable and sustainable adaptation practices.

There is a need for proactive research to support the understanding, identification, and monitoring of nascent climate threats to enhance preparedness and resilience at multiple scales. Additionally, research is critical to identify thresholds and tipping points to identify risks that pose the potential for systems to

DRAFT IN REVISION – 9/6/2024

undergo accelerated and irreversible transformation. Finally, developing criteria to evaluate climate adaptation success at the project and system level is necessary to reduce the risk of maladaptive practices.

Management Challenge #5	Science Priority
<p>Barriers, opportunities, and unintended consequences of adaptation</p> <p>Climate change alters the feasibility of management goals and suitability of management tools.</p>	Inform the design of monitoring programs and early warning systems to detect and respond to climate change.
	Investigate how cultural values, beliefs, and practices, influence adaptation decisions and identify ways to integrate traditional knowledge into adaptation strategies.
	Conduct research on effective practices for adaptation to climate change that reduce the risk of maladaptation.
	Implement and evaluate pilot projects and case studies to test adaptation strategies in different contexts, providing valuable lessons and scalable solutions.
	Determine perceptions of and acceptance for climate adaptation for fish, wildlife, and ecosystems, including by communities, private landowners and Indigenous communities designed to yield co-benefits.
	Enhance research, management, and adaptation planning to account for the cumulative effects of compounding extreme events.
	Conduct research on effective practices for the design of climate monitoring programs, early warning systems, and adaptation strategies that reduce the risk of maladaptation.
	Further refine climate-driven response models to address data scarcity, uncertainty, and other limitations of predictive modeling.
	Include Indigenous Knowledge (IK), social science, and other high-quality information, where appropriate and available, to fully integrate qualitative data to inform our understanding of climate change effects, baseline climate and ecosystem conditions, future conditions, ecosystem thresholds, and scenario selection.

DRAFT IN REVISION – 9/6/2024

	<p>Support interdisciplinary multi-organizational assessments focused on understanding the complexity of socioeconomic factors within vulnerable communities that limit their adaptive capacity to climate change.</p>
	<p>Identify thresholds and tipping points that pose risks for ecological systems to undergo accelerated transformations. Research when, where, and how these transformations may occur and implement frameworks such as “Resist, Accept, Direct” for managing them.</p>
	<p>Apply principles, processes, and methods of the social sciences to tool development, climate science communication, and decision making.</p>
	<p>Identify opportunities to reduce the burden on underserved communities when applying for funding opportunities and responding to requests from multiple federal agencies to support co-production of climate adaptation strategies.</p>

Current and Prospective Research Focal Areas

Research Focal Areas draw on the broader management challenges but are narrower in scope, highlighting specific knowledge gaps that will be the focus of subsequent Project Solicitation cycles. Research focal areas are designed with input from the South Central CASC Science Advisory Committee (SAC). The SAC consists of representatives of State, Federal, and Tribal agencies within region that make use of the information that results from CASC-funded projects. Member agencies are invited to participate on the SAC by the Regional Administrator, and these agencies choose their representative.

Current, active member agencies on the SAC include representatives from: U.S. Department of Agriculture (USDA), Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), National Parks Service (NPS), Louisiana Department of Wildlife and Fisheries (LDWF), Bureau of Indian Affairs (BIA), USGS Southeast Region, New Mexico Interstate Stream Commission (NMISC), Cheyenne and Arapaho Tribes, Texas Parks and Wildlife (TPW), Oklahoma Water Resources Board (OWRB), Oklahoma Department of Wildlife and Conservation (ODWC), Bureau of Reclamation (USBR), and U.S. Forest Service (USFS). A priority short-term goal of the USGS arm of the Center is to expand membership on the SAC to better represent and reflect the diversity of stakeholders and rights-holders within the region.

The SAC provides advice to the Regional Administrator on funding decisions and program operations. This is achieved through two mechanisms: (1) setting annual Research Focal Areas and (2) Project Solicitation submission review and ranking. Summaries and deliverables of previously funded projects can be found using the CASC Project Explorer (<https://cascprojects.org/#/>). The table below outlines previous Research Focal Areas for the region set by the Science Advisory Committee, as well as future Research Focal Areas established for 2025-2030.

2018-2024 Research Focal Areas	2025-2030 Research Focal Areas
Region-Wide	At-Risk Species
Agroecosystems	Agroecosystems as Natural Resources
Cultural Resources	Cultural Resources
Coastal Resources	Freshwater hydro ecosystems
Rio Grande Basin	Gulf Coast
	Rio Grande Basin
	Pilot Research Grants

Table 2. Previous (2018-2024) and future (2025-2030) research focal areas for the South Central CASC.

The Research Focal Areas established for 2025-2030 are described below:

DRAFT IN REVISION – 9/6/2024

At-Risk Fish and Wildlife

Much of the South Central CASC research portfolio consists of projects focused on suites of species (e.g. threatened and endangered species across New Mexico) or specific ecosystems (wetlands in the Southern Great Plains), yet there has not been a research focal area that includes SAC members in this area. In light of this and the suggestions from the SAC interviews, this topic will become the focal area of a new SAC committee.

The members of this committee will develop their own definition of what they see as their scope, but it is intended to cover the entirety of the South Central CASC's region. Furthermore, it is expected that this scope will not be limited to the species themselves but will include their habitat and the greater ecosystem as well, with a focus on priority management needs for at-risk fish and wildlife.

Agroecosystems as Natural Resources

Since 2020, the South Central CASC has invested in research targeted toward adaption of the natural ecosystems associated with agriculture. The SAC interviewees expressed support for continuing these investments, especially regarding reduced water availability, increased fire risk, and disruptions to nutrient cycles in the region. The South Central CASC will continue to fund research projects that address this priority area.

The committee has defined agroecosystems as: semi-natural systems managed for the purpose of producing food and fiber. This excludes highly managed agricultural systems such as row crops, turf grass, grain production, etc., but does include native rangelands, forest systems, and natural areas adjacent to highly managed systems.

This committee has established that agroecology projects must consider the following:

- Explicitly demonstrate that research questions, methodologies, and anticipated outputs and outcomes are co-developed in partnership with stakeholders and end-users who manage semi-natural systems for the purpose of producing food and fiber that have firsthand, practical knowledge of the environment in which they work, as well as the ecosystem services provided by their environment.
- Research is authentically co-produced with end-users to ensure that adaptation strategies arising from the research are actionable and that potential challenges have been identified and addressed to ensure successful implementation.
- If the proposed work includes the development of decision-support tools, there must be clear evidence that the intended end-users have expressed a need for these tools and that end-users have been included at every stage of the tool development.

DRAFT IN REVISION – 9/6/2024

Cultural Resources

Since 2020, the South Central CASC has intentionally invested in research on the impacts of climate change on cultural resources and the identification of effective adaptation measures. This priority developed from a realization that although the mission of the CASCs' includes both cultural and natural resources, little funding had been channeled towards projects that investigate impacts and adaptation options for cultural resources in the region. The focus on cultural resources has been met with significant interest from researchers and the CASC will continue to invest in this area under the broad guidance of the Cultural Resources Subcommittee. The USGS staff will work to add additional members to this committee, including Tribal Historic Preservation Officers (THPOs), Historic Preservation Officers (HPOs), State Archeological representatives, and Tribal cultural resource managers, among others.

Two projects have been initiated recently (Dr. Renia Ehrenfeucht and Dr. Justin Reedy) which provide important information for informing and planning a course of action for the CASCs engagement in cultural resources. The project led by Dr. Ehrenfeucht will provide a roadmap for addressing climate change impacts and adaptation needs in the south central U.S. Similarly, the project led by Dr. Reedy will provide a needs assessment for cultural resource adaptation in our region. Insights learned from these projects will inform the future development of the cultural resource focal area.

Recent priorities of the cultural resources committee focused on developing elements to inform a Climate Action Roadmap to increase the resiliency of cultural resources impacted by climate change. The roadmaps are designed to increase the understanding of "thresholds" for various structural material types and construction elements, comprehensive ways to track condition changes over time, and support outcomes that increase the effectiveness of management solutions for complex archaeological/historical/cultural sites. Focus areas are inclusive of buried and standing archeological sites, historical structures and/or NAGPRA (Native American Graves Protection and Repatriation Act) sites relevant to Federal, State, and Tribal agencies. This Roadmap include the following elements:

- Knowledge gathering: A summary and synthesis of topical literature and knowledge including oral histories and other types of documentary evidence
- Assessment: Identification of critical variables, thresholds, and knowledge gaps
- Results: Recommendations for bridging gaps and evaluation of climate change risks
- Recommendations: Next steps that will advance our understanding of climate change impacts (including long-term monitoring) and our ability to respond with effective management solutions
- Adaptation: Delineating potential measures to bolster adaptation by emphasizing sustainability

Freshwater Hydro Ecosystems

Since its inception in 2012, the South Central CASC has provided funding support and fostered interdisciplinary multi-institutional collaborations to understand current and projected effects of climate change on surface and groundwater water quality and quantity. These collaborations across the South Central CASC region have supported the co-production of climate scenarios and adaptation strategies with local and regional water districts, aquifer management agencies, and river authorities, among others.

The members of this committee will develop their own definition of what they see as their scope, but this research focal area is intended to identify and then prioritize research activities to investigate climate-induced changes to freshwater ecosystems within and/or reliant on water within aquifers and permanent and ephemeral ponds, lakes, rivers, streams, and drainage ways. This research should endeavor to increase partner understanding of, and access to, practical guidance for making smart adaptation decisions for water supplies in the face of climate and land use change.

Gulf Coast

For the past several years, the South Central CASC has focused a portion of its annual research budget on adaptation for coastal resources in Texas and Louisiana. Based on the results of interviews with key stakeholders and rights-holders, the CASC will continue to invest in this portion of its research portfolio, which has historically received the most submissions to the research competition.

This subcommittee has developed the following definition for the scope of their work:

The coastal zone includes coastal waters, adjacent lands, and related aquatic and terrestrial biota that together form an integrated coastal ecosystem. Coastal resources include natural resources occurring within the coastal zone. A better understanding of coupled social–ecological interactions within coastal areas is vital for implementing climate adaptation strategies that optimize human well-being and sustain the ecosystems associated with coastal systems.

Two areas were mentioned in the interviews of stakeholders as potential areas of emphasis along the coast (1) inshore fisheries and (2) storm surges or coastal inundation. Recent Research Focal Areas established by the Gulf Coast Committee include assessing the impacts and long-term effects of climate change on Gulf Coast habitats, coastal plants and wildlife, state or federally listed species, coastal communities, and/or coastal restoration efforts for the topics:

- Changes in freshwater inflows, saltwater intrusion, flooding, drought, fire, extreme heat, sea level rise, or other effects exacerbated by climate change and variability.
- Changes in tidal cycles and weather patterns including frequency, intensity, duration, seasonality, and extreme weather events such as winter storms, atmospheric rivers, hurricanes, etc.

DRAFT IN REVISION – 9/6/2024

The committee has established that assessments may include evaluation of existing data, collection of new data, modeling, scenario planning, or some combination, and may focus on natural and/or social sciences. Results of research should directly inform management of or restoration practices for natural resources in specific places within the coastal zone.

Rio Grande Basin

The Rio Grande Basin priority has been the purview of a standing committee of the SAC, which is known as C3FRio (Climate Change Committee Friends of the Rio). This subcommittee functions differently than the other subcommittees, in that a broader group meets monthly and serves a convening function to bring together those interested in the impact of climate change on the natural resources across the Rio Grande Basin. Since its inception, the focus of the subcommittee has been on research to increase the understanding of ecological transformation in forest and riparian habitats, and to identify actions to manage and direct these changes. A sub-group of the C3FRio committee made up of state and federal agency members (excluding broader C3FRio members who represent Universities and thus may be eligible to apply to the grant competition) convenes separately to develop the Research Focal Area for the grant competition and review/score research projects.

Research projects submitted to the Rio Grande Basin Research Focal area are focused on increasing our understanding of climate change-induced landscape and ecological transformation in forests and riparian habitat (including characterizing current and future trends and impacts) and the effects on hydrology, stream habitat, riparian community, alluvium and fish and wildlife resources in the Rio Grande Basin. Projects should identify viable pathways and best practices for managing and directing these changes. Research projects will support an interconnected whole-system approach (from the headwaters to the Gulf) to understand downstream consequences on endangered species from wildfire and headwaters issues to address management challenges in the Rio Grande Basin.

Pilot Research Grants:

In recent years, the Project Solicitation has included calls for pilot research grants. These are projects of 1-year duration with a funding level of up to \$50,000 (not including overhead). These projects must have a clear research focus and are intended to support opportunities for researchers and end-users, inclusive of underserved communities, to co-develop areas of climate science research. These funds may be used for a proof-of concept research effort that demonstrates the feasibility of a novel tool, method, framework, or approach. These projects can also provide funding support for research workshops, including travel for planners and attendees, salary for workshop planning, and other meeting expenses. Research grants requesting funding to support the writing of a subsequent full proposal are not allowed. A broader goal of the pilot research grants is to encourage and invest in research that emphasizes innovation and innovative approaches to conducting research. The Center will continue to promote pilot research grants to support the co-development of key actionable science outcomes.

Opportunity Areas for the South Central CASC Research Portfolio

In 2023, the South Central CASC federal team began the process of conducting a Portfolio Analysis in which the portfolio of USGS funded projects from 2012-2022 were quantitatively reviewed to identify strengths, gaps, and opportunities related to Project Solicitation Research Focal Areas. The Portfolio Analysis was complete in 2024 and provides insights on areas the CASC has not addressed extensively in research in the past. Additionally, CASC staff have routinely visited managers within the region to identify priority management concerns. Appendix B contains links to reports from each of these visits. The lists below outline potential considerations for future Research Focal Areas based on input from State Visits and the Portfolio Analysis.

- **Portfolio Analysis Results: Areas the CASC has not addressed extensively in research**
 - Urban ecology
 - Climate change impacts on archaeological resources
 - Invasive species
 - Human health
 - Wildlife disease
 - Ecosystem-based approaches: Projects that directly address climate impacts on ecosystem health, populations of species, and migration
 - Many projects indirectly address ecological impacts, but only secondary to physical impacts
 - Projects that directly address the impacts of climate change on human communities, such as human health, native cultural heritage and tribal sovereignty, and ecosystem services
 - Human impacts addressed in research are far less common than physical impacts such as precipitation and temperature.
 - Projects that are co-produced with tribal natural and cultural resource managers and other relevant tribal partners and Tribal PIs.

- **State Visits: Key needs emerging from listening sessions over the last 2 years**
 - Impacts of Harmful Algal Blooms (HABs - Freshwater and Saltwater)
 - What impacts do HABs have on the reproduction, growth, and fatality of oyster populations?
 - Management concerns around summertime fish kills due to hypoxia & stagnant waters in the Gulf Coast
 - Climate change and habitat loss impact on the alteration of migratory bird stopover location and habits
 - Vanishing coastal prairies
 - Floodplain conservation
 - Prescribed burning – connections and collaboration through cultural practices
 - Compound flooding events

DRAFT IN REVISION – 9/6/2024

- Loss of wooded and natural areas due to drought impacting sentinel landscapes
- Better understanding of groundwater depletion
- Impacts of climate change on local and traditional knowledge
- Role of social capital on cultural and resource management practices (prescribed burning, agriculture, water management)

Geographic Priority Areas

In addition to the ongoing focus on the Rio Grande Basin, the Center has identified two geographic priority areas in the region that span a range of critical management issues and science priorities. These focal areas are critical to advancing our mission and will be strategic areas of research investment for the next 5 years.

Red River Basin

The Red River Basin is a vital source of water in the South Central U.S., supporting ecosystems, drinking water, agriculture, tourism and recreation, and cultural ceremonies. Stretching from the High Plains of New Mexico eastward to the Mississippi River, the Red River Basin encompasses parts of five states – New Mexico, Texas, Oklahoma, Arkansas, and Louisiana. Further, 74% of the jurisdictional boundaries of the Chickasaw Nation and Choctaw Nation of Oklahoma are located within the basin. Water resources in the basin have been stressed in recent years due to prolonged droughts and increasing demands for consumptive water use by metropolitan areas in Oklahoma and Texas.

The Red River has been the focal point of several studies funded by the South Central CASC over the past decade, including multiple grants to the Chickasaw Nation. The CASC will continue to support research to understand how climate change is impacting water resources in the Red River Basin and develops tools to inform water management in the area. Specific climate science topics include ecology of riparian areas, aquatic ecology, hydrology, and water quality.

Mississippi/Atchafalaya River Basin (MARB)

The Mississippi/Atchafalaya River Basin (MARB), which encompasses both the Mississippi and the Atchafalaya River Basins, is the third largest river basin in the world. Originating as an outlet stream in northern Minnesota, the river is joined by hundreds of tributaries before reaching the Gulf of Mexico. Water from 31 states drains into the river, creating a drainage basin of over 1,245,000 square miles. Ninety percent of all U.S. agricultural exports are grown within the Mississippi River Basin, and about 40 percent of the nation's total exports are transported through its major rivers.

The MARB floodplain supports over 40 percent of North America's wading birds and waterfowl and contains over 180 National Wildlife Refuges. Climate change is projected to continue to disrupt the

DRAFT IN REVISION – 9/6/2024

amount, frequency, extent, and timing of precipitation events across the MARB. These changes have direct and indirect impacts on aquatic and riverine ecosystems. An all-basin approach to understanding the impacts of climate change in the Mississippi River Basin is necessary, yet most studies to date have focused on sub-basins.

The South Central CASC is interested in pursuing multi-center and multi-agency efforts to better inform the managers of the MARB regarding the impacts of climate change on the entire basin. The South Central CASC has funded a few projects in the MARB, including the development of an integrated socio-environmental model of river and an effort to downscale the CMIP-6 global circulation models to the basin. The center will continue to prioritize research in this area in the coming years. Because this effort will involve many organizations which are external to the South Central CASC and its region, this effort will involve partnerships with other CASCs in addition to many stakeholders and rights-holders.

Implementation Approach

Implementation of the South Central CASC Science Agenda will guide the work of the South Central CASC – both the USGS and the Consortium– over the next 5 years. Key considerations for implementation of this plan are highlighted below:

- **Forward actionable science:** Center user-driven science that addresses the information needs of regional partners and support approaches that enable iterative dialog to define research questions, integrate multiple knowledge systems, and support decision-making.
- **Emphasize interdisciplinarity:** Effectively advancing the adaptation of fish, wildlife, habitats, and cultural resources to the impacts of climate change is an interdisciplinary endeavor. The South Central CASC will work to support interdisciplinary approaches to adaptation that draw on diverse disciplines to understand how organizations, human communities, ecosystems, etc. adapt to a changing environment. We will work to foster collaborative spaces, such as workshops, webinars, and Ideation Events, where researchers can connect and explore research topics across disciplines, departments, and Universities.
- **Expand and sustain partnerships:** Bring together the expertise of scientists, managers, and partners to design, develop, and implement research to inform effective climate adaptation efforts. Strengthen partnerships with Tribal governments, Indigenous communities, and inter-Tribal organizations involved in climate adaptation to support tribal climate adaptation needs. Develop partnerships with organizations that are connected to historically marginalized and underserved populations, e.g., HBCUs (Historically Black Colleges and Universities), TCUs (Tribal Colleges and Universities), and HSIs (Hispanic Serving Institutions), as well as community-serving and other non-profit organizations.

DRAFT IN REVISION – 9/6/2024

- **Advance technical assistance and climate literacy initiatives:** Build regional capacity to access, interpret, and apply climate science information and tools. In the next phase of our Science Agenda, we aspire to expand training efforts to increase the climate literacy of natural and cultural resource managers in our region and beyond. This will include nurturing the next generation of ecosystem researchers, climate stewards, managers, and decision-makers as well as building the capacity of natural and cultural resource managers to make collaborative and climate-informed decisions.
- **Prioritize science communication:** Translate current research and knowledge into public awareness and community engagement. This involves communicating research findings in engaging and accessible formats tailored to the needs of diverse audiences and educating partners and other users on how to apply South Central CASC-generated information in their decision processes. The Center will prioritize sharing management priorities and science needs gleaned from the Science Advisory Committee, state visits, listening sessions, and from liaisons embedded on the landscape back with researchers to catalyze actionable science that addresses priority management needs.
- **Integrate best practices in tool development:** Continue to develop effective and user-friendly tools that bridge the gap between researchers and partners. Tools produced through funded projects should emphasize the importance of usability for managers, ensure regular updates, and should engage end users at every stage to inform design and implementation.
- **Incorporate downscaling and application of Global Climate Models (GCMs):** Prioritize the downscaling of Global Climate Models and the production of ecologically significant variables to support ecological forecasting. This will provide resource managers with more precise, localized data that enhances preparedness, adaptation, and resilience strategies, ensuring that climate adaptation efforts are grounded in the most relevant and actionable science.
- **Consider attentiveness to scale in decision-making:** Ensure climate-related data, models, tools, and information are developed at appropriate management scales to enhance their usability and applicability in management contexts.
- **Forward ecosystem-based approaches to research and management:** Promote holistic, ecosystem-scale approaches to research and management, as emphasized by agency personnel and in listening sessions, to ensure comprehensive and effective environmental stewardship.
- **Implement monitoring and evaluation:** Establish robust monitoring and evaluation frameworks for adaptation initiatives to ensure continuous improvement and effectiveness. Regularly assess and update these initiatives based on performance data, stakeholder feedback, and emerging climate trends to enhance resilience and adaptability.

DRAFT IN REVISION – 9/6/2024

- ***Center equity and Environmental Justice:*** Integrate and operationalize best practices in equity and environmental justice into research to ensure inclusive and fair outcomes. Prioritize the voices and needs of marginalized communities and ensure that research processes and outcomes address and mitigate environmental disparities.
- ***Leverage science synthesis and interpretation of existing information and data:*** Synthesize existing research to support climate adaptation decisions and actions. Integrate research findings into comprehensive insights to inform decision-making, identify knowledge gaps, enhance reliability to forward interdisciplinary solutions and evidence-based practices.

Appendix A: Summary of Science Advisory Committee Interviews

DJ Case and Associates was contracted to conduct interviews with non-consortium climate change partners in the region to identify priority areas for investment in climate science for the next five years. Those interviewed to inform this plan included administrators at sister agencies, natural resource program managers, and climate scientists representing broad geographic and disciplinary interests in the region. DJ Case interviewed 18 professionals in April and May of 2023 to accomplish three objectives:

1. Solicit recommendations for key science research needs over the next 5 years
2. Get feedback on the grant application and scoring process
3. Identify opportunities to strengthen connections with partners

The interviews informed the development of the recommendations that follow. The last section of this document provides a summary of things we heard from stakeholders. While the interviews were not intended to be an evaluation of the South Central CASC's past performance, many interview respondents took the opportunity to do so to provide context for their suggestions.

The feedback from those interviews reinforced several key principles that have guided the overall approach taken by the South Central CASC to deliver its mission. One, stakeholders stressed the importance of collaboration on the creation and dissemination of science. Collaborations with researchers and managers depend on relationship building, which is enhanced in face-to-face meetings. Two, stakeholders emphasized the need for applied science that explicitly addresses a management problem or decision. Many acknowledge their own agencies lack the expertise in climate science and rely on the South Central CASC to inform their understanding. Three, many of the people interviewed have served as reviewers of Statements of Interest and grant applications during prior rounds of South Central CASC funding. From that perspective, most believe that selection of funded projects over the years has successfully addressed a wide range of priorities and done so in a straightforward and equitable process. Consequently, the plan recommends only minor tweaks to the status quo where funding priorities and procedures are concerned.

Resource managers are challenged by planning and implementing on-the-ground strategies to achieve objectives within their jurisdictional authority that sustain benefits for their own constituencies. Their jobs, already difficult, are made more challenging by trying to account for how warming temperatures, changing precipitation patterns, and shifting habitat and species assemblages affect their strategies. Their management decisions vary considerably in both spatial and temporal scales, so a one-size-fits-all approach will likely fall short of meeting the needs of decision makers in the region. On the other hand, predicting climate change impacts to inform adaptation is inherently fraught with uncertainty, especially

DRAFT IN REVISION – 9/6/2024

at the local level or from year to year. Thus, some “needs” of managers of cultural and natural resources are more easily accommodated by application of climate adaptation than others. Still, collaboration, information sharing, and networking are the keys to serving the climate science needs in the region. This report takes a customer-centric approach to those tactics.

Facilitation support for this Science Plan development was provided under an existing IDIQ contract with the DOI Office of Collaborative Action and Dispute Resolution (CADR) by DJ Case & Associates as a subcontractor to Kearns & West, Inc.

Science Advisory Committee Insights on Science Support Needs

The strategy and recommendations outlined below aim to build on the core principles to enhance the delivery of CASC’s science mission. This section puts forth recommendations for providing strategic climate science support throughout the South Central region over the next five years by being responsive to the customers, or end-users. We organized the recommendations under three primary focal areas: funding, capacity building, and consultation & outreach. The focal areas have overlap in their strategies and in their desired outcomes (Figure 1). For example, grants awarded to early career scientists not only produce climate science but also increase the capacity for future work by helping those researchers get established. Having those scientists present findings of their work to consortium partners and stakeholders allows for shared learning through outreach.

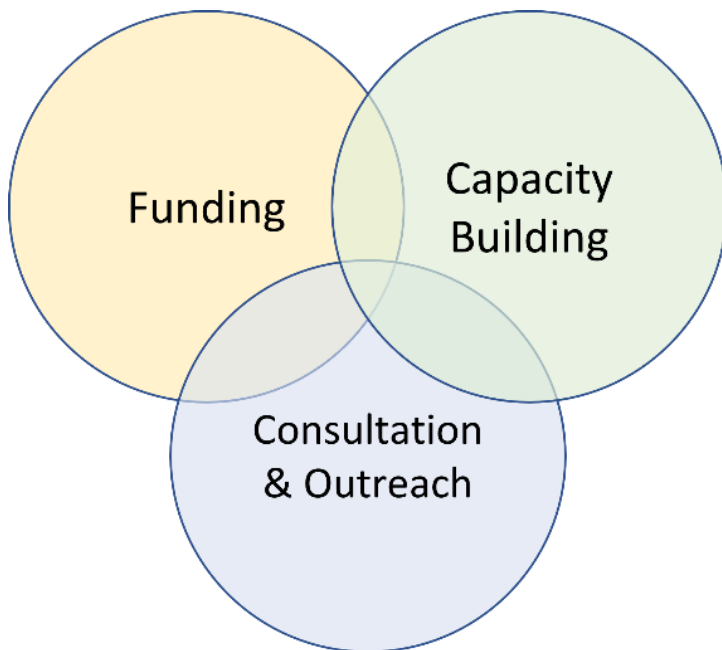


Figure 2. Focal areas for the USGS Science Support Service in the next 5 years.

DRAFT IN REVISION – 9/6/2024

Funding

Recommendation 1: Fund climate science projects that address critical climate driven threats to resources in the South Central Region (see Table 3).

Resource Needs/ Concerns	Climate threats
Water availability in rivers and reservoirs	Reduced water availability from changing precipitation patterns, increasing evaporation from warming temperatures
Coastal zone protection	Loss of barriers islands and freshwater estuaries from storm surges, intense and more frequent hurricanes
At-risk fish and wildlife populations (threatened and endangered species, species of greatest conservation need)	Shifting or degraded habitats for terrestrial and aquatic species resulting from warming temperatures or disruptions in phenological cycles
Cultural resource protection (Tribal and non-Tribal)	Loss or degradation of artifacts and historically significant places.
Loss of productivity in forest and agricultural ecosystems.	Reduced water availability, increased fire risk, and disruptions in nutrient cycling.

Table 3—Priority science needs as identified by stakeholders.

Recommendation 2: Fund climate science projects that include resource managers as co- principal investigators or in close consultation.

Recommendation 3: Fund climate science projects that clearly identify the management question or problem Statement addressed by the work and include a plan for science outreach.

Recommendation 4: Fund novel approaches to translating (existing) climate science in ways that increase its utility and applicability to resource managers.

Recommendation 5: Solicit/ encourage proposals that will benefit underrepresented or marginalized communities impacted by threats to natural or cultural resources.

DRAFT IN REVISION – 9/6/2024

Capacity Building

Recommendation 1: Embed Adaptation Specialists in State resource management committees/ teams on a rotating basis to create mutual learning and relationship building.

Recommendation 2: Integrate Communities of Practice groups with the Science Advisory Committee.

Recommendation 3: Support SC CASC and consortium partner participation in climate science work groups/ committees sponsored by partner agencies.

Recommendation 4: Develop an online information network that connects people, data, and experiences in conducting climate adaptation across the region.

Recommendation 5: Host annual science conference to foster networking and knowledge dissemination.

Recommendation 6: Provide staff and partners with training to accommodate Tribal needs in collaboration.

Outreach and consultation

Recommendation 1: Develop and promote a searchable online clearing house (using existing website) to tell the story of funded projects highlighting their key findings and implications for management.

Recommendation 2: Collaborate with consortium partners and others to develop “State of Science” synthesis on key resource issues.

Recommendation 3: Develop case studies that model effective partnerships in the design and implementation of climate science.

Recommendation 4: Establish and market “virtual office hours” where resource managers or stakeholder scientists can contact SC CASC staff to ask questions or seek resources.

Recommendation 5: Participate/support annual science conference to foster networking and knowledge dissemination.

Recommendation 6: Continue regular site visits and listening sessions with partners in the four states to monitor science information needs and build relationships.

DRAFT IN REVISION – 9/6/2024

Appendix B: Links to Reports from Recent State Visits and Listening Sessions

New Mexico Listening Sessions: <https://southcentralclimate.org/wp-content/uploads/2022/08/Synthesis-of-SC-CASC-NM-Listening-Session-Notes-.pdf>

Texas (West) Report: <https://southcentralclimate.org/wp-content/uploads/2023/07/EXTERNAL-West-Texas-Trip-Summary-2023-.pdf>

Texas (Central) Meeting Notes:
https://docs.google.com/document/d/197cfuldvgrzVsHsi5IaZTkqDjR7YKXSUcH2KflH6Gg/edit?usp=drive_link

Louisiana Meeting Notes:
<https://docs.google.com/document/d/1m0BOfcR5fqEwZO83FrQMkVRQTd4EwYMHozHEtEkvm1E/edit?usp=sharing>

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DRAFT IN REVISION – 9/6/2024

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