#### Impacts of a Changing Climate in the U.S. Southern Great Plains

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November 24, 2022

#### Abstract

The Southern Great Plains (SGP) experiences weather that is dramatic and consequential, from hurricanes and floods to heat waves and drought. A changing climate exacerbates these extremes, further stressing infrastructure and seriously impacting the socioeconomic systems of its rapidly growing and diverse 34-million population, as well as the natural environment (e.g., ecology, coastal systems). This poster will outline some of the key climate-related stressors for the SGP, and discusses the process of developing the SGP chapter and its key messages/focus areas, for the U.S. Global Change Research Program's (GCRP) Fourth National Climate Assessment (NCA4). NCA4 fulfills a congressional mandate to provide comprehensive information on climate change impacts, adaptation, and resiliency, and is the preeminent source for climate change information within the United States. The SCP chapter is new for NCA4, providing more regional context and detail relevant to the region's public and decision-makers than NCA3 (2014), the former of which amalgamated climate projections and impacts for the northern and southern Great Plains. Furthermore, the chapter incorporates some new ways of evaluating risk, such as risk-based framing, or in providing some more relevant context, by including potential economic impacts, and also in considering case studies of successful adaptations to current climate-related stressors. A team of regional experts consisting of climatologists, researchers, and federal scientists, spanning multiple sectors (agriculture, economy, climate science, tribal professional, infrastructure, health and water resources among others) were selected to develop this chapter. The team solicited expert input from regional stakeholders, and the final chapter underwent multiple rounds of public and governmental review. Each stage of the process and some key outcomes will be described.



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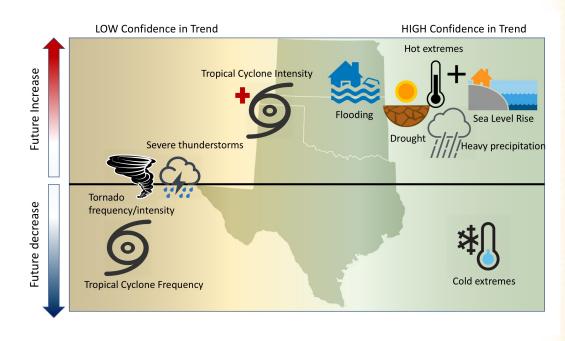
## Impacts of a Changing Climate in the U.S. Southern Great Plains

Bill Bartush (U.S. Fish and Wildlife Service), Kevin Kloesel (University of Oklahoma), Jay Banner (UT Austin), David Brown (USDA-ARS, El Reno, OK), Jay Lemery (University of Colorado), Xiaomao Lin (Kansas State University), Cindy Loeffler (Texas Parks and Wildlife), Gary McManus (OK Climatological Survey), Esther Mullens (University of Florida), John Nielsen-Gammon (Texas A&M University), Mark Shafer (SCIPP), Cecilia Sorenson (University of Colorado), Sid Sperry (Okla Assoc. Electric Cooperatives), Daniel Wildcat (Haskell Indian Nations University), Jad Ziolkowska (University of Oklahoma)

## **1. Climate Change Context**

- Days > 100°F increase by up to 30-60 days per year
- Annual average temperature increase of **3.6-5.1°F** by the **mid 21**<sup>st</sup> century
- Historical sea level rise of 5-17 inches along the Gulf coast, with a projected further *increase* of 1-4 ft by 2100
- Increases in both extremely heavy rainfall, and drought
- *Increases* in damaging storm surges when tropical cyclones occur
- Future trends in tropical cyclone frequency, tornadoes and severe local storms are *uncertain*
- Decreases in winter weather and extreme cold

The Southern Great Plains is a region of dramatic and extreme weather, which already have pronounced impacts on its 34 million residents. Climate change is anticipated to shift the frequency of extreme events, increasing the risks of heatwaves, drought, coastal and inland flooding, but decreasing the risk of extreme cold.

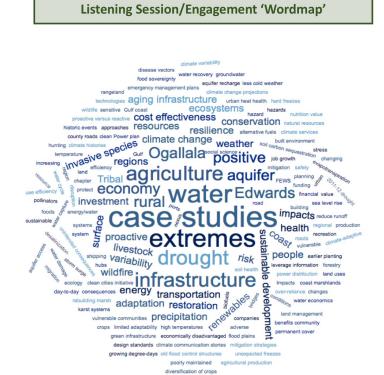


### 2. Author Selection and Public Engagement

The SGP author team expertise included climate research and services, agriculture, medical research, economics, energy & utilities, ecology & conservation, and tribal/indigenous professionals.

The Key Messages (KM), case studies, and background material forming this chapter was developed in part through stakeholder engagement. On March 2 2017 the team held a listening session in Norman, OK, with a satellite location of Austin, TX. This session collected a diverse range of information provided by professionals throughout various climate-impacted sectors. The word map below summarizes the notes from this meeting in terms of the frequency with which topics/keywords were mentioned. In addition to highlighting current climate-related concerns, participants placed emphasis on including relevant case studies, containing not only challenges but success stories as well. Case studies therefore are a very important component of this chapter.





EXPERTISE REPRESENTED BY STAKEHOLDERS: Health, air quality, water resources agriculture, energy, climatology, ecology, conservation, land management, tribal communities

#### **3. Key Messages**

Uncertainties: How tribes can integrate climate information both from within and with interaction across diverse communities.

when participating in the ceremony.

#### KM 4

displaced.



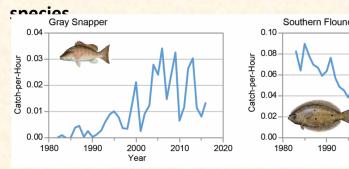
Uncertainties: Difficult to isolate climate impact from other habitat stressors. Increase in animal and plant diseases is anticipated but uncertain.

Kloesel, K., B. Bartush, J. Banner, D. Brown, K. Hayhoe, J. Lemory, X. Lin, G. McManus, E. Mullens, J. Nielsen-Gammon, M. Shafer, C. Sorenson, S. Sperry, D. Wildcat, and J. Ziolkowska, 2018: Southern Great Plains. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. REFERENCES Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC. doi: 10.7930/NCA4.2018.CH23 USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA. doi: 10.7930/NCA4.2018



#### KM 5 KM 1 Tribal and Indigenous communities are particularly A changing climate coupled with increasing populations and rural-urban migration vulnerable due to the detrimental effects of climate will redistribute demand and supply for food, energy, and water. Adaptation change across human and natural systems. Efforts to strategies, improved climate services, and decision support systems can help build community resilience are hindered by economic, manage the complex issues across the food-energy-water (FEW) nexus. political and infrastructure limitations. However, traditional knowledge and inter-tribal organizations Case studies explore sensitivities of vital water provide opportunities for adaptation. sources, such as the Rio Grande & Edwards Aquifer, to climate stressors such as drought and rainfall variability. Integrative solutions including To highlight the impacts of a changing climate on climate services, stakeholder engagement, and Indigenous Food-Energy Indigenous culture, Cheyenne tribal Chief Gordon technologic, conservation and regulatory Yellowman describes how the Sun Dance ceremony Peoples strategies are avenues being explored to adapt to Water has been under threat. Traditional natural materials future change. have been harder to find and choked by invasive plants. Heat-related illness has also presented risks context of climate change. KM 2 Health threats from diseases transmitted through food, water, and insects will increase as temperatures rise. Extreme weather events will also pose health challenges due to potential for injury and displacement. These Human Health Infrastructure threats are likely to create significant economic burdens. Adaptation strategies could include vulnerability and adaptation assessments, comprehensive response plans, seasonal health forecasts, and early warning systems. Hurricane Harvey resulted in extensive flooding in southeast Texas. Flooding overwhelmed multiple wastewater treatment facilities, leading to sewage overflow. Untreated human waste entered floodwaters and resulted in an national and regional level to incorporate climate increase of skin and gastrointestinal infections. Weather information in long-term infrastructure design. One such disasters such as this also lead to interruptions in medical example is how El Paso, TX is improving resilience of its care and supplies as societies and their facilities are water resources to drought, through use of desalination of Ecosystems the state. Expansion of desalination as a water source is **Uncertainties:** Quantitative recommended in the state's 2017 water plan. prediction of health impacts KM 3 limited by both health and meteorological data. **Desalination Plant Capacities** Terrestrial and Aquatic ecosystems are being directly and Uncertainties due to multiple indirectly affected by climate change. Some species will connected actions that influence health outcomes. adapt to the changes, while others cannot, resulting in significant impacts to both ecosystem services and people that occupy these ecosystems. Landscape-scale ecological services could increase the resilience of most vulnerable Recreation and fishing along the Texas coast are multi-billion dollar industries. The observed warming cnorios Gray Snapper Southern Flound of the oceans has changed the historical distribution 0.04

of certain aquatic species. The popular Southern Flounder has decreased in abundance, while the Gray Snapper is able to move further north along the coastal Gulf. As well as temperature shifts, growing human populations present ongoing challenges to water quality.





Uncertainties: FEW research is young and few studies examine all components holistically, particularly in the

The built environment is vulnerable to extreme weather, including increasing heat extremes, flooding, and sea level rise. The Texas coast continues to experience sea level rise of twice the global average. **Regional adaptation strategies that** incorporate climate projections to harden and/or relocate critical infrastructure can reduce the impacts of climate change.

We identify examples of actions that have been taken at the previously unusable brackish water that is abundant across



**Uncertainties:** Limited understanding of how existing infrastructure responds to weather & climate stressors as compared to other stressors such as construction, use, age, etc.

# U.S. Global Change Research Program