Climate Change Hazards:
Extreme Precipitation & Flooding in Oklahoma's Tribal Nations

Kristina Mazur[1], Esther Mullens[2], Derek Rosendahl[2], & April Taylor[2]

[1]National Weather Center Research Experiences for Undergraduates Program, Rutgers University; [2]South Central Climate Science Center

1. Introduction

Climate variability and change can influence the characteristics of extreme weather events such as the intensity, frequency, and duration of precipitation. It is predicted that the hydrologic cycle will intensify resulting in more heavy rain events, which in turn can exacerbate flooding. Citizen Potawatomi Nation, Choctaw Nation of Oklahoma, and Chickasaw Nation, within the state of Oklahoma, are susceptible to extreme precipitation events and flooding, often from convective thunderstorms, especially in the late spring and summer. Identifying and planning for the impacts of climate change on potentially flood-inducing precipitation will help these Nations create appropriate adaptation strategies.

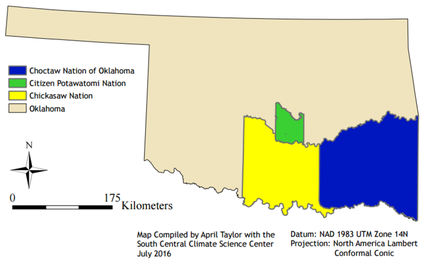

Figure 1: Map of Oklahoma highlighting the jurisdictions of the three tribal nations

BNU-ESM	inmcm4
CanESM2	IPSL-CM5A-LR
CCSM4	IPSL-CM5A-MR
CNRM-CM5	MIROC5
CSIRO-mk3-6-0	MIROC-ESM-CHEM
GFDL-ESM2G	MIROC-ESM
HadGEM2-CC	NorESM1-M
HadGEM2-ES	

Table 1: The 15 CMIP5 models used in this analysis

2. Data/Methods

Interviews with Tribal emergency managers:

- Tim Zientek from Citizen Potawatomi Nation
- Jeff Hansen from Choctaw Nation of Oklahoma
- Sara Jones from Chickasaw Nation

The top hazards discussed included flooding, winter weather events, extreme heat events, and drought.

During May 2015 Oklahoma experienced extreme flooding throughout the state.

- 24-hour high precipitation totals predominantly ranged between 2 and 6 inches of rain
- Thresholds of 2 and 4 inches, and 5-day total accumulation above 8 inches were chosen.
  - These describe a period of excessive rainfall that could potentially cause flooding in these regions as described by the tribal emergency managers.

Data used for this project included Multivariate Adaptive Constructed Analogs (MACA; Abatzoglou & Brown 2012), a statistically downscaled set of climate projections, based on the Coupled Model Intercomparison Project Phase 5 (CMIP5; Karl 2012). Downscaled precipitation accumulation was investigated for historical (1950-2005) and future (2006-2099) conditions using 15 CMIP5 models (Table 1).

3. Select Results

Average Number of 2 in. Rainfall Days per Year

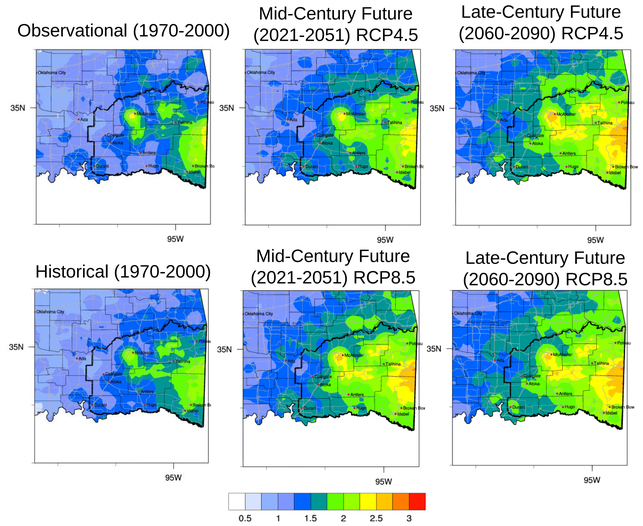

Figure 3: Choctaw Nation's historical multi-model mean average shows about one to two, 2-inch rain days per year. There is about a 15% - 40% increase for most of the nation in the mid-century time period for both RCP4.5 and RCP8.5 scenarios. However, there is not much of a change from the mid-century to late-century time periods The late-century multi-mean model projections remain at two, 2-inch rain days per year for most of the nation with the southeast region receiving close to three, 2-inch rain days per year.

Average Number of 4 in. Rainfall Days per Year

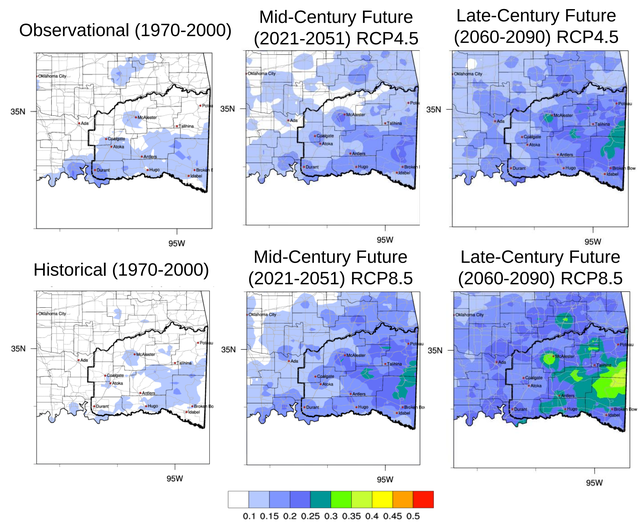

Figure 4: For Choctaw Nation's historical time period, there were approximately 0-0.1, 4-inch rain days per year. As shown within this dataset, an event of this magnitude occurred roughly once every ten years on average. A 60% - 100% increase is projected for the RCP8.5 scenario from the historical to mid-century future time period, where a 4-inch rain event is expected about every four years. Looking at the late-century future time period, a 100% - 150% increase is expected from the historical time period. This suggests that higher emissions lead to more extreme precipitation events such as 4-inch rain events as opposed to 2-inch rain events as seen in Figure 3.

Average 5-Day Total Accumulations Above 8 in. per Year

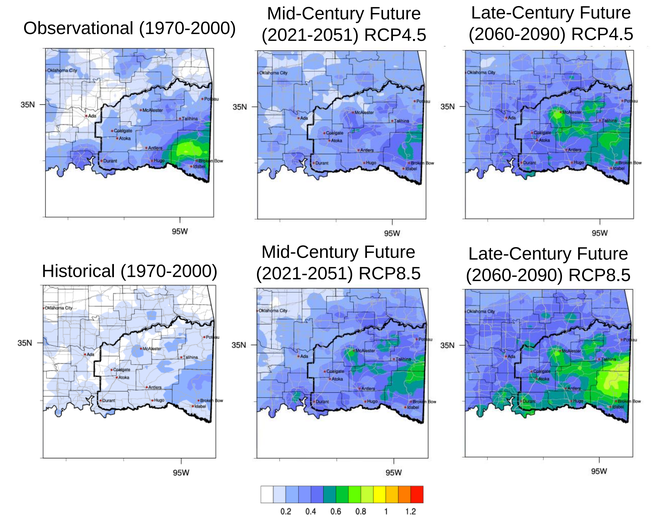

Figure 5: Choctaw Nation's historical multi-model mean projected about 0.3-0.4, 5-day total accumulations above 8 inches per year. In the southeast, rain totals increase to about 0.6 days in mid-century future, and later increase to about 0.8 events in the RCP4.5 scenario or 1 day in the RCP8.5 scenario for the late-century future. This suggests an event that previously might have occurred once every 2-3 years is likely to occur nearly every year in the future projection.

4. Conclusions

The number of rain days above 2 and 4 inches, and 5-day total accumulations above 8 inches are likely to increase in the future, as indicated by the spatial map projections produced. According to the multi-model mean projections, there is reasonable confidence in extreme precipitation changes across these tribal nation regions. Overall, climate change can have an impact on the number of extreme precipitation events, which could result in more flooding. Emergency tribal managers of the Citizen Potawatomi Nation, Choctaw Nation of Oklahoma, and Chickasaw Nation should expect an increase in the number of extreme rainfall events in the future, not necessarily more annual rainfall. They should plan accordingly to reduce the damaging effects these events could produce.

5. References

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6. Acknowledgements

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