New Insights into Seasonal to Interannual Water Cycle Variability Across the Great Plains

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Dynamic Climate

Orthogonal Gradients of Temperature and Precipitation
Historical Droughts in Oklahoma

Figure 8 Population declines. (Data source: U.S. Bureau of the Census.)
Historical Droughts (and Pluvials) in Oklahoma

Annual Precipitation History with 5-year Tendencies
Oklahoma Statewide: 1895-2017

- Wetter periods
- Drier periods
- Annual precipitation value
Annual Precipitation History with 5-year Tendencies

OK-CD5 (5-Central): 1895-2016

- Green: Wetter periods
- Brown: Drier periods
- Diamond: Annual precipitation value
Dipole Transitions


- A pair of equal and opposite electric charges or magnetic poles of opposite sign separated especially by a small distance.
- An abrupt year-to-year transition from drought to pluvial (flood).
- Able to erase multi-year droughts in a matter of months.

**Droughts of Record**

Probability of a significant drought year followed by a pluvial year:
- SGP: 25%
- NGP: 25%
- HP: 16%
Southern Great Plains Hydroclimate: Importance of water resources


Conceptual Diagram – Temperature/Precipitation Relationship in the SGP

Concept from Flanagan et al. 2017

Illston et al. 2004

The overall variability is increasing.
Trends in Precipitation Variability in the GP

Weaver et al. (2016) Flanagan et al. (2018)
How does excessive rainfall occur?

1. Warm tropical SST anomalies
2. SST anomalies cause a strengthening of the Aleutian Low
3. Height pattern accelerates westerly flow; shifts jet stream to the south!
4. Waves travel along jet stream, cause height anomalies across southwestern Great Plains
5. Southerly flow enhanced, more moisture!
6. More precipitation over the Southern Great Plains!

Drought Versus Pluvial – Land-Atmosphere Coupling

Take-Away Message
• The Great Plains domain is a region defined by dynamic weather/climate variability – includes subseasonal to seasonal extremes.

• Precipitation “variability” is increasing, especially the temporal aspect – Process “variability” is increasing.

• The results of the increase in precipitation variability is that:
  • Increased frequency in the oscillations between drought/pluvial periods,
  • Impacts the asnychonicity between the annual peaks in temperature and precipitation,
  • Along with local coupling, may be impacting the generation of flash drought conditions,
  • “Driven” by to local to global processes.

• Impacts span many local socioeconomic sectors … especially agriculture.

• Much work to be done … Additional Drivers? Predicability? Projections?
Questions?

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