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

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Acknowledgments

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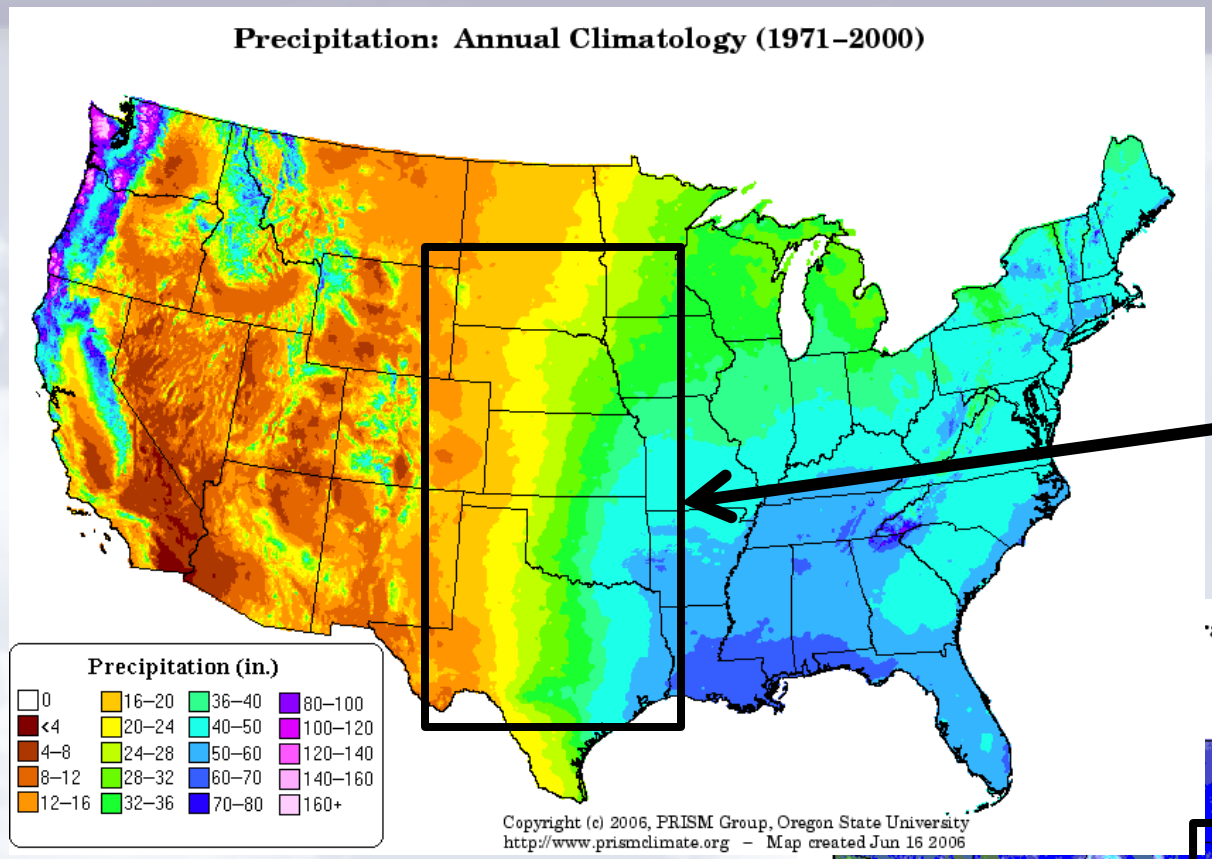
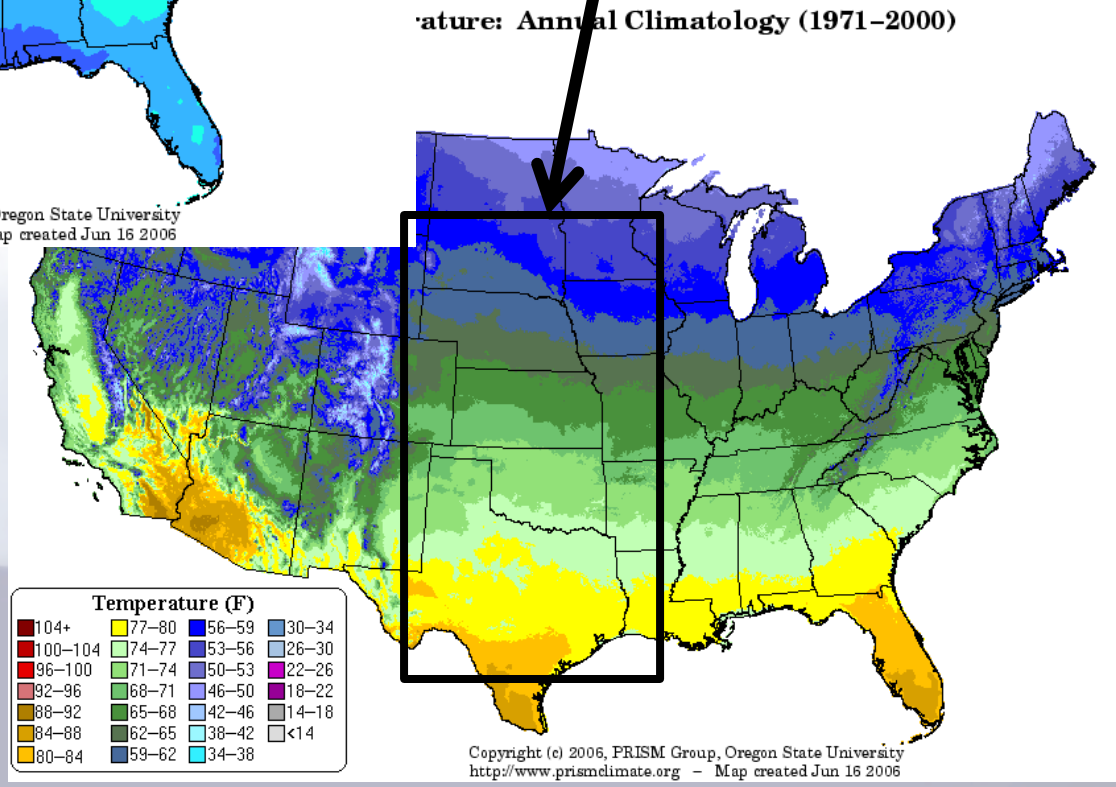
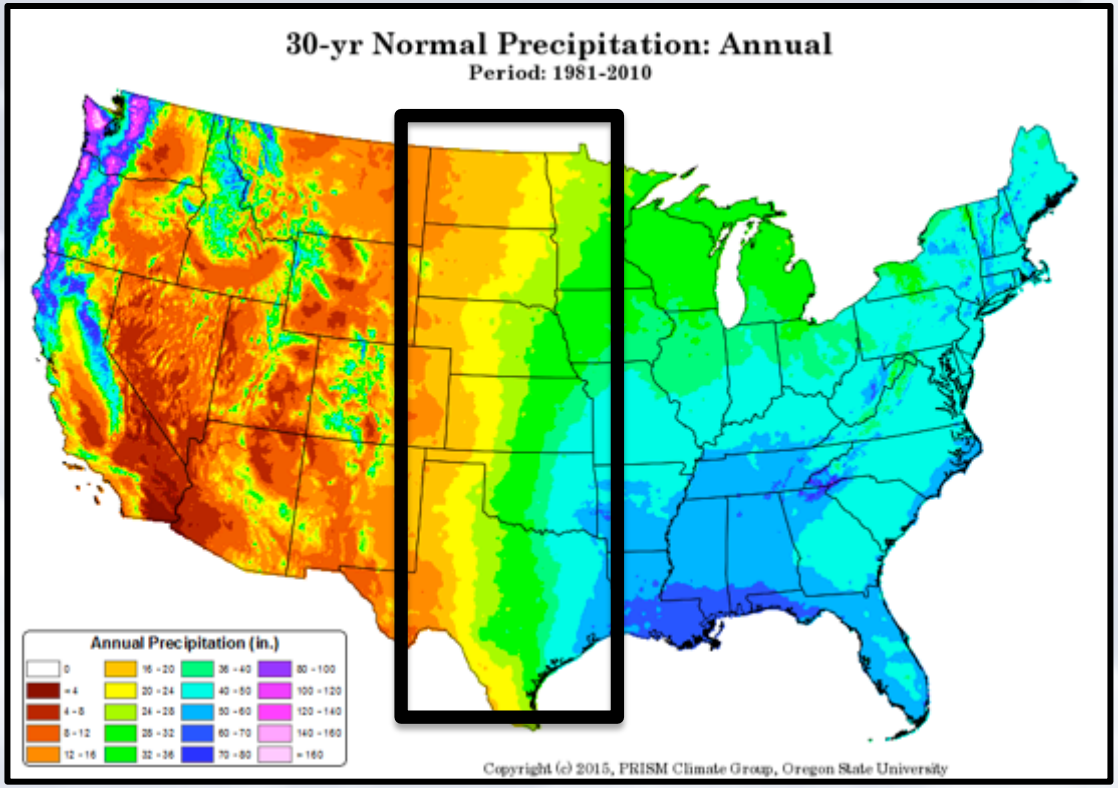


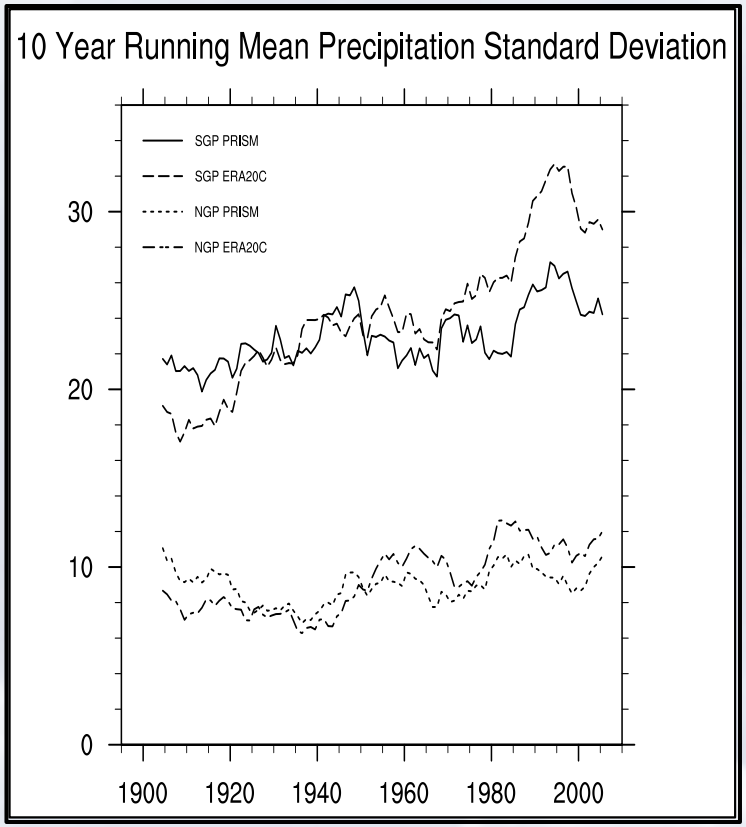
Orthogonal Gradients of Temperature and Precipitation



Dynamic Climate

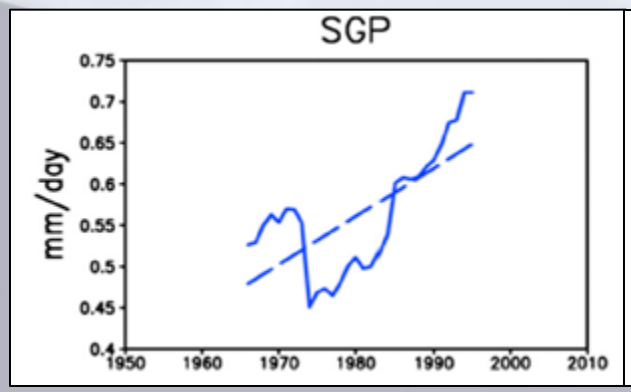
Trends in Precipitation Variability in the GP

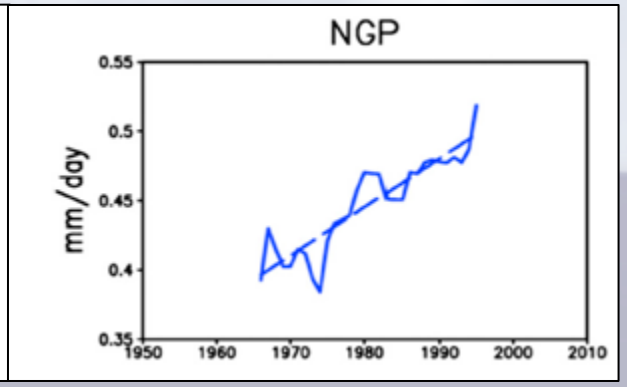




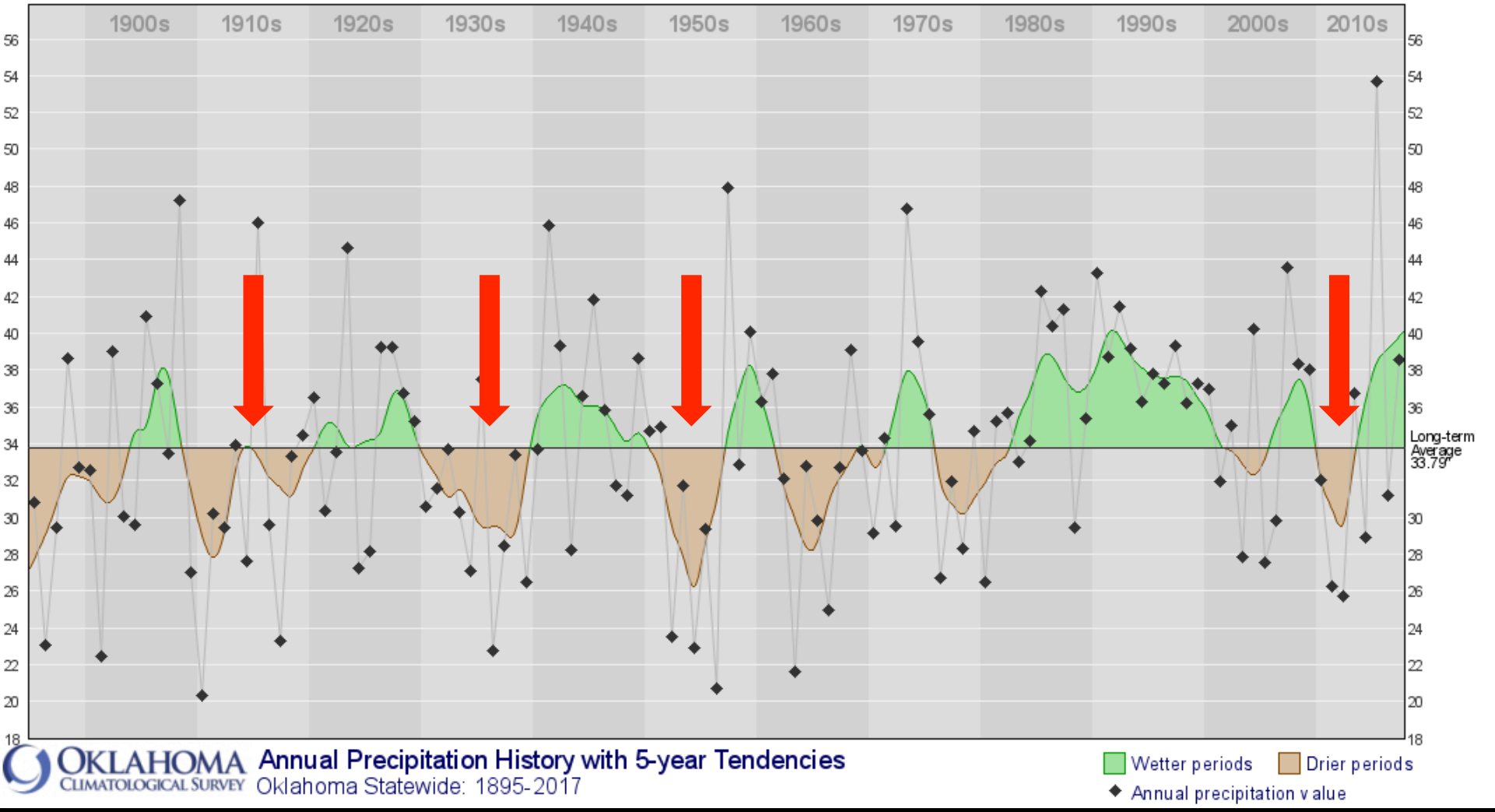
Weaver et al. (2016)

Flanagan et al. (2016)





Historical Droughts in Oklahoma



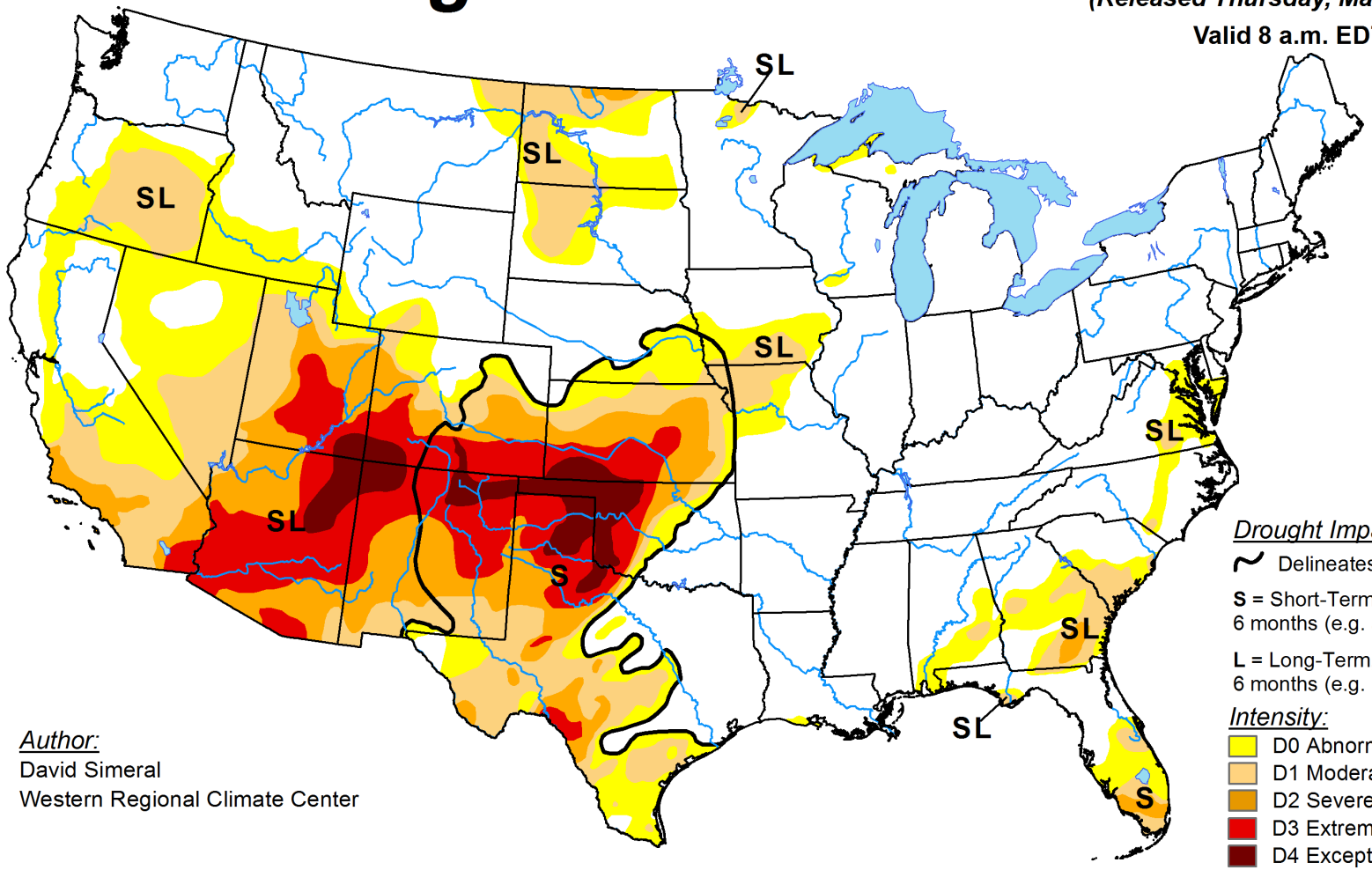
Basara, J. B., J. N. Maybourn, C. M. Peirano, J. E. Tate, P. J. Brown, J. D. Hoey, and B. R. Smith, 2013: Drought and associated impacts in the Great Plains of the United States – A review. *International Journal of Geosciences*, 4, 72-81.

U.S. Drought Monitor

May 1, 2018

(Released Thursday, May. 3, 2018)

Valid 8 a.m. EDT



Author:
David Simeral
Western Regional Climate Center

Drought Impact Types:

~ Delineates dominant impacts

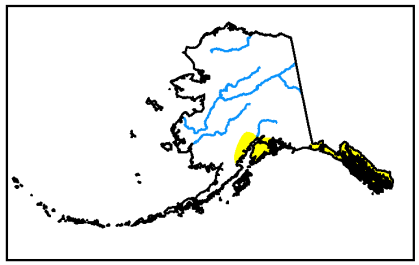
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

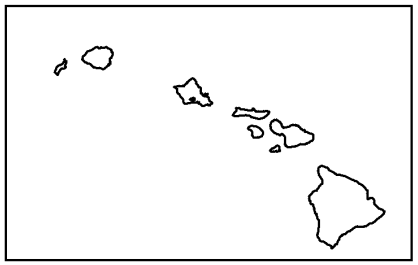
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

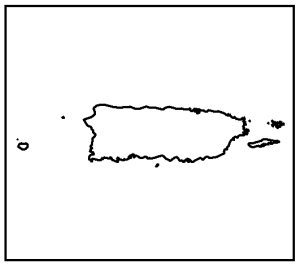
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



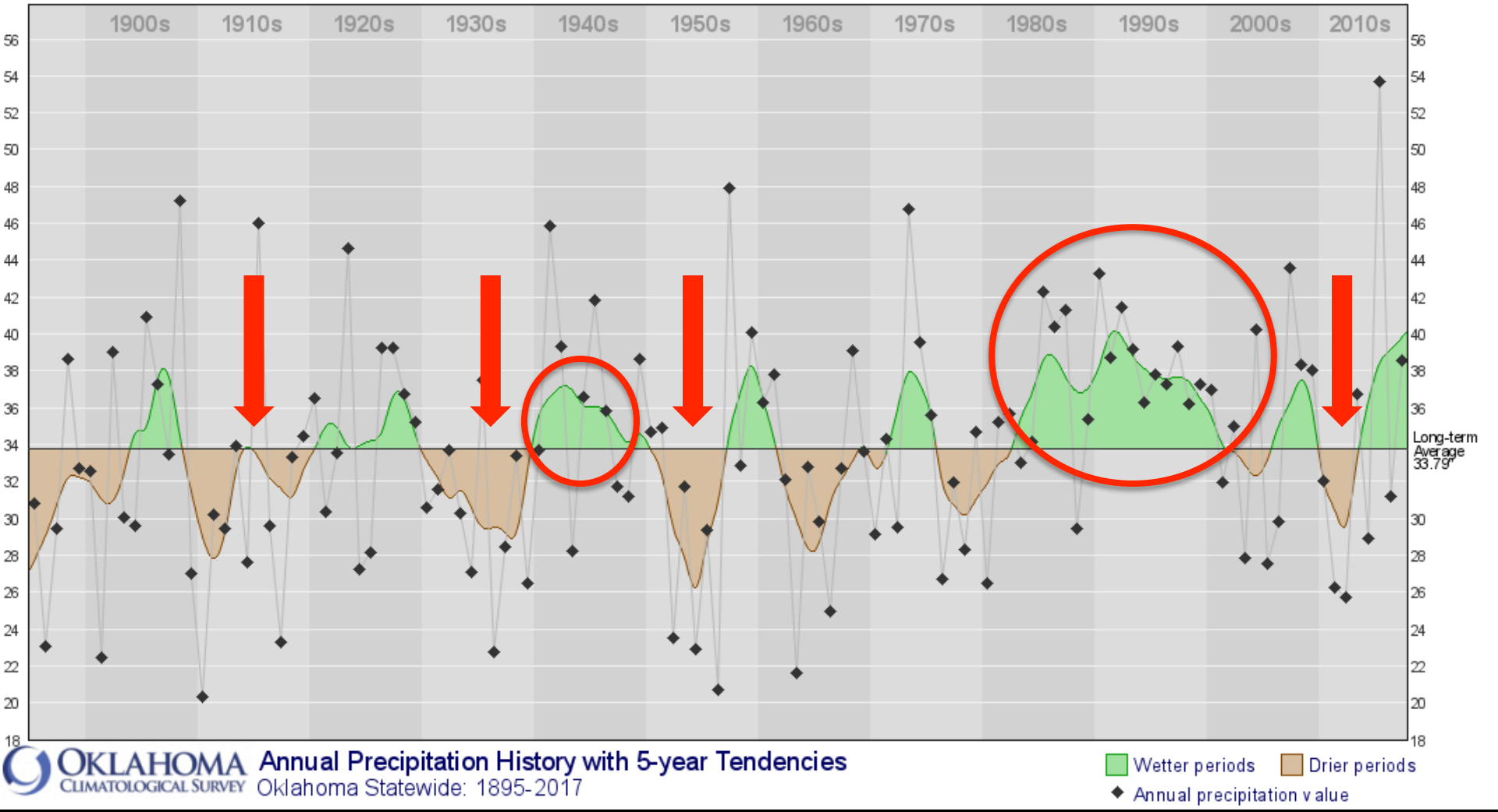


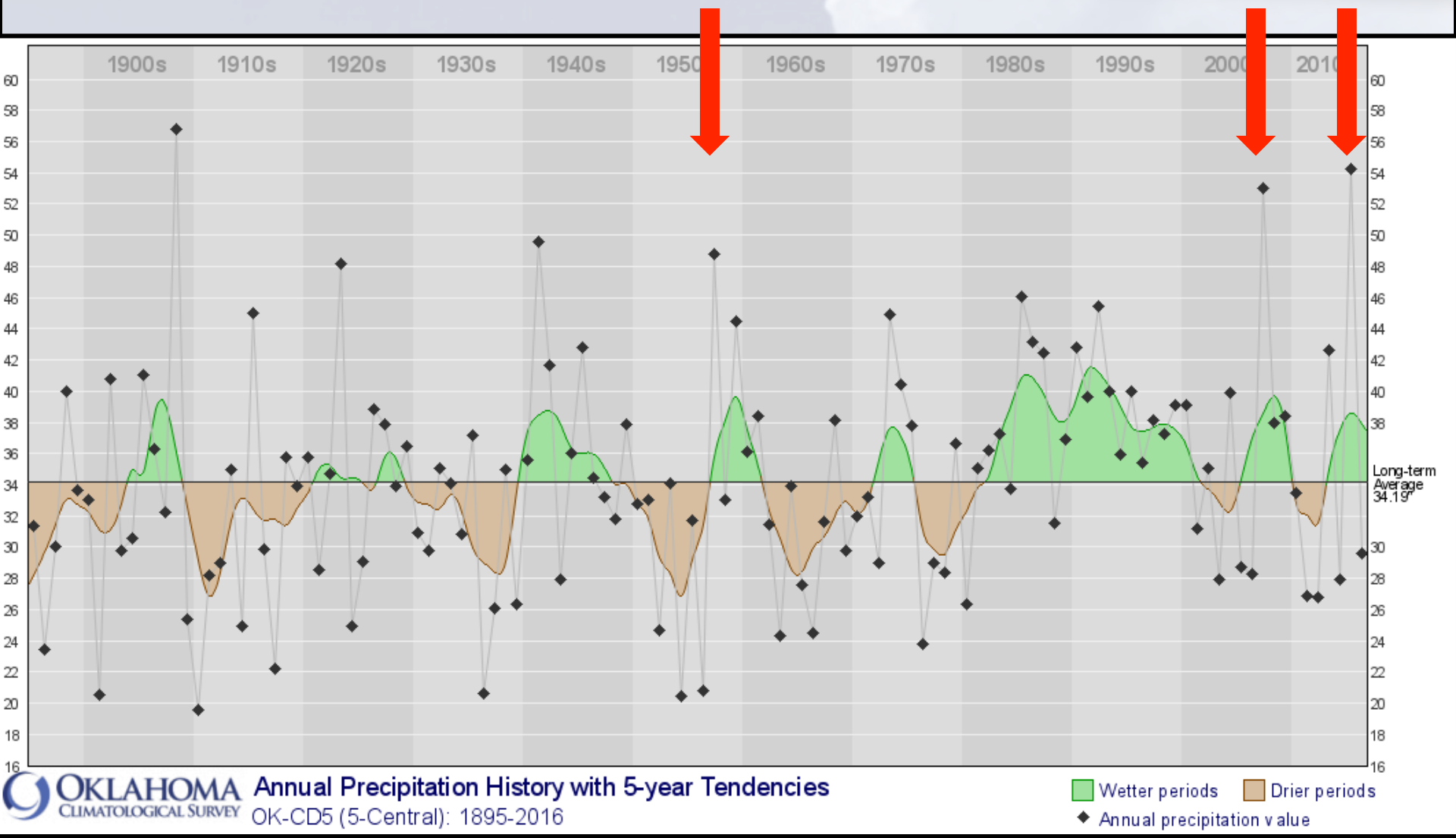


USDA NDMC DEPARTMENT OF COMMERCE NOAA

http://droughtmonitor.unl.edu/

Historical Droughts (and Pluvials) in Oklahoma




1900s
1910s
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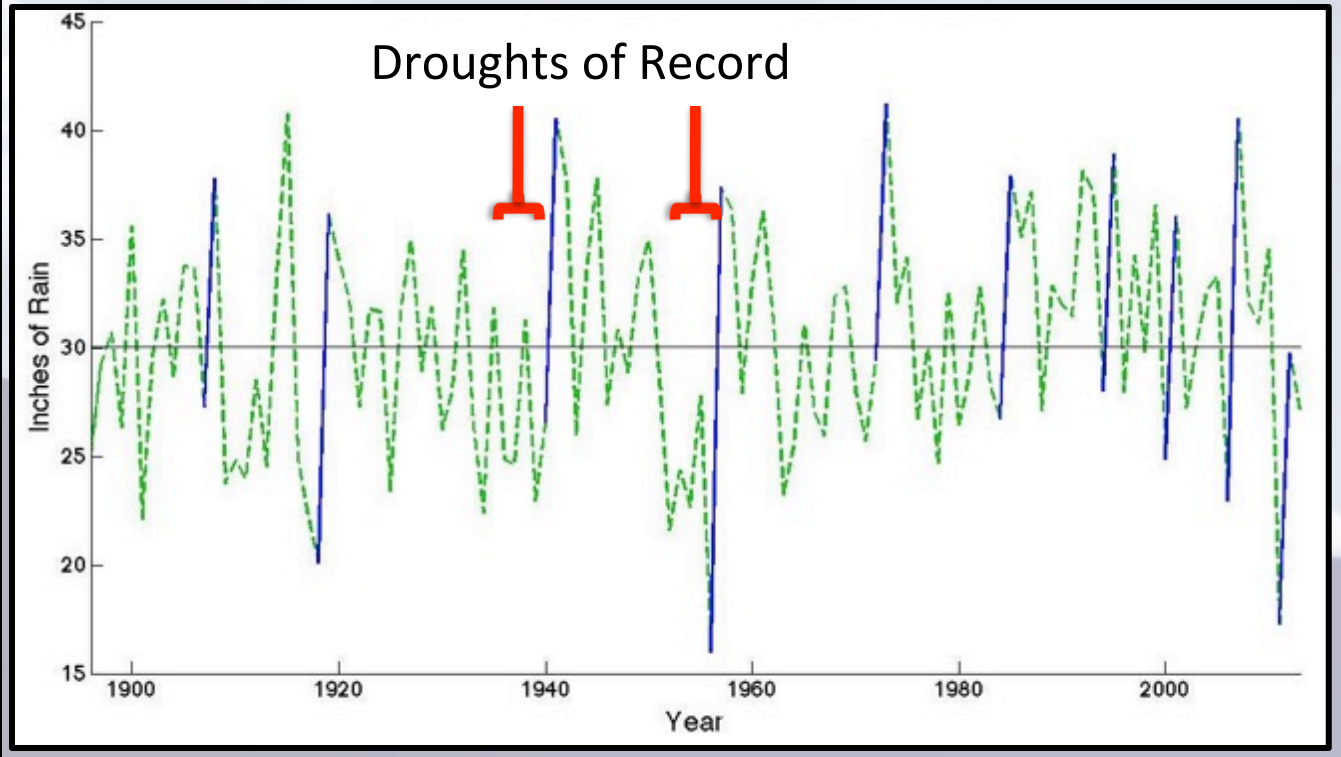
Long-term Average 34.19"
OKLAHOMA CLIMATOLOGICAL SURVEY
Annual Precipitation History with 5-year Tendencies
OK-CD5 (5-Central): 1895-2016
Wetter periods
Drier periods
Annual precipitation value

Dipole Transitions

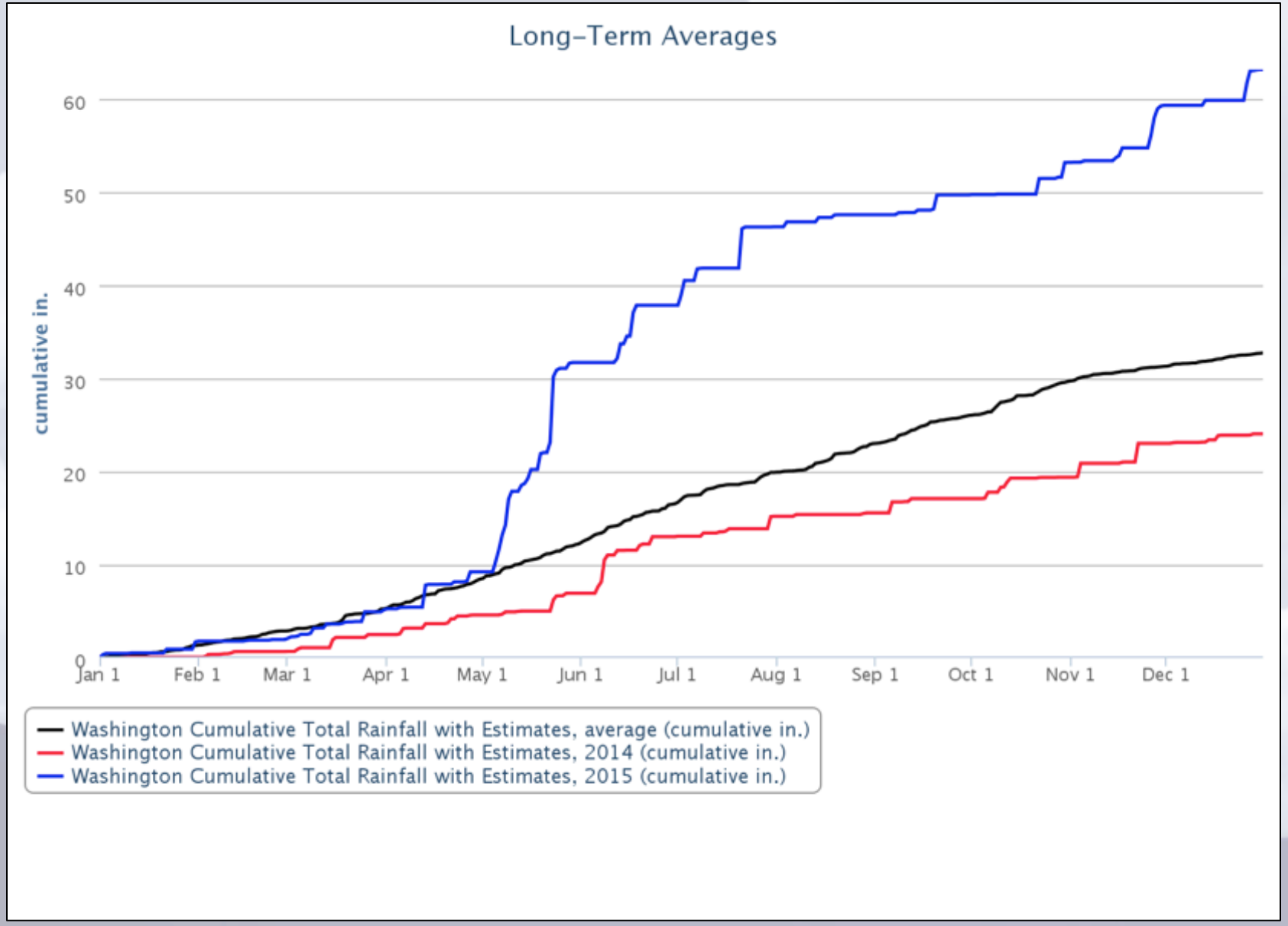
Christian J., K. Christian, and J. B. Basara, 2015: Drought and Pluvial Dipole Events within the Great Plains of the United States. *J. Appl. Meteor. Climatol.*, **54**, 1886–1898.

- 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.



Probability of a significant drought year followed by a pluvial year:
- SGP: 25%
- NGP: 25%
- HP: 16%

Impacts of Dipole Precipitation



Precipitation Observations from the WASH Oklahoma Mesonet site.


October 2014

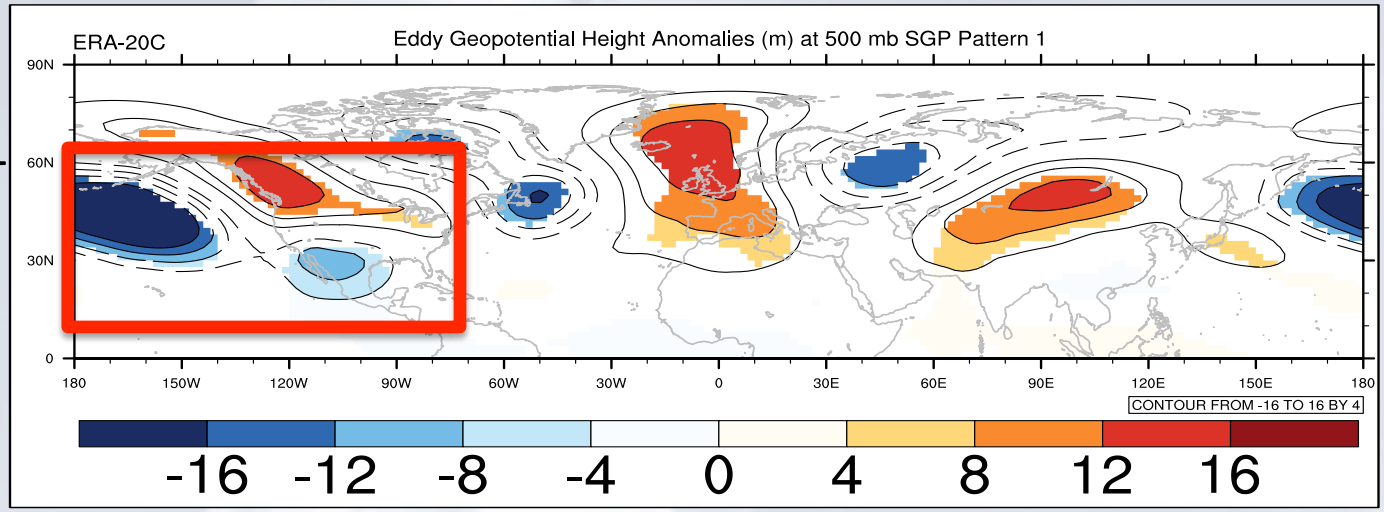

May 2015

SGP Pluvial Year Atmospheric Pattern

Flanagan, P., J. Basara, J. Furtado, and X. Xiao, 2018: Primary Atmospheric Drivers of Pluvial Years in the United States Great Plains. *J. Hydrometeor.*, ***19***, *643–658.*

Eddy Geopotential Height anomalies –

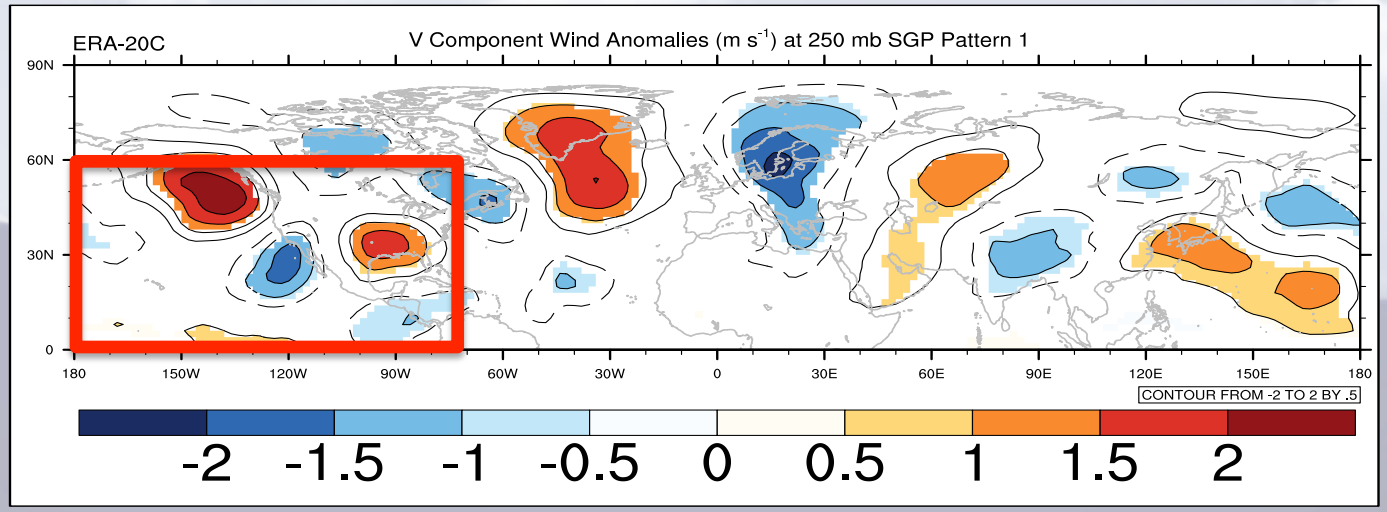
Shows wave features that are separate from the mean flow.



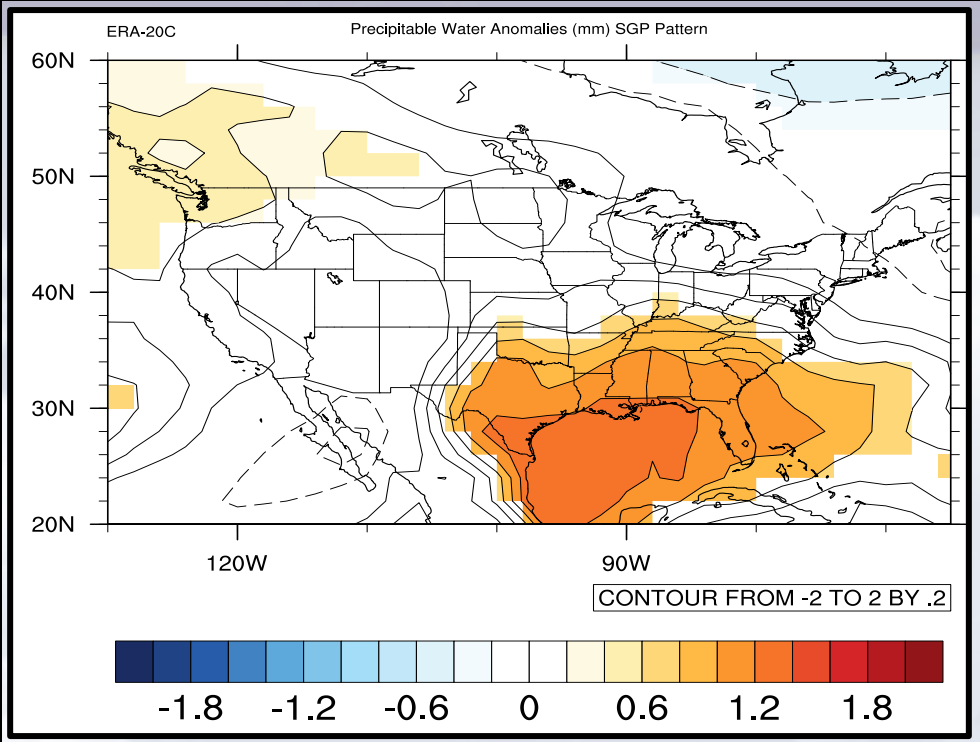
ERA-20C dataset

v (north/south) wind component

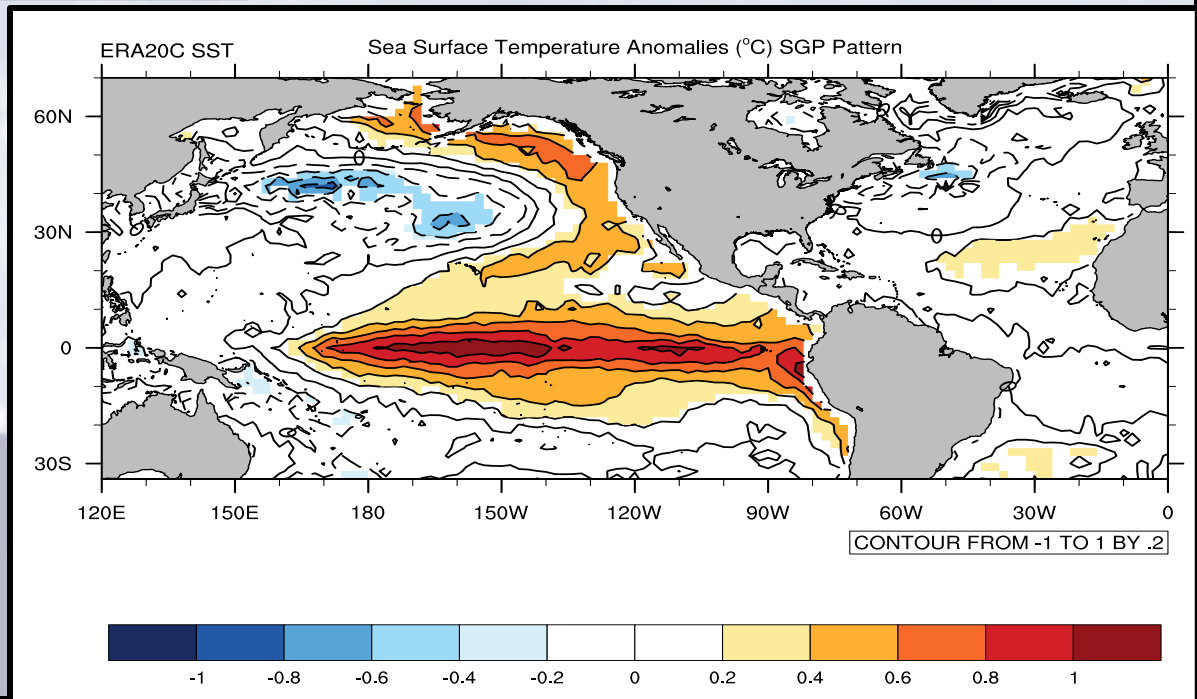
Couplets show wave features that distort the mean flow



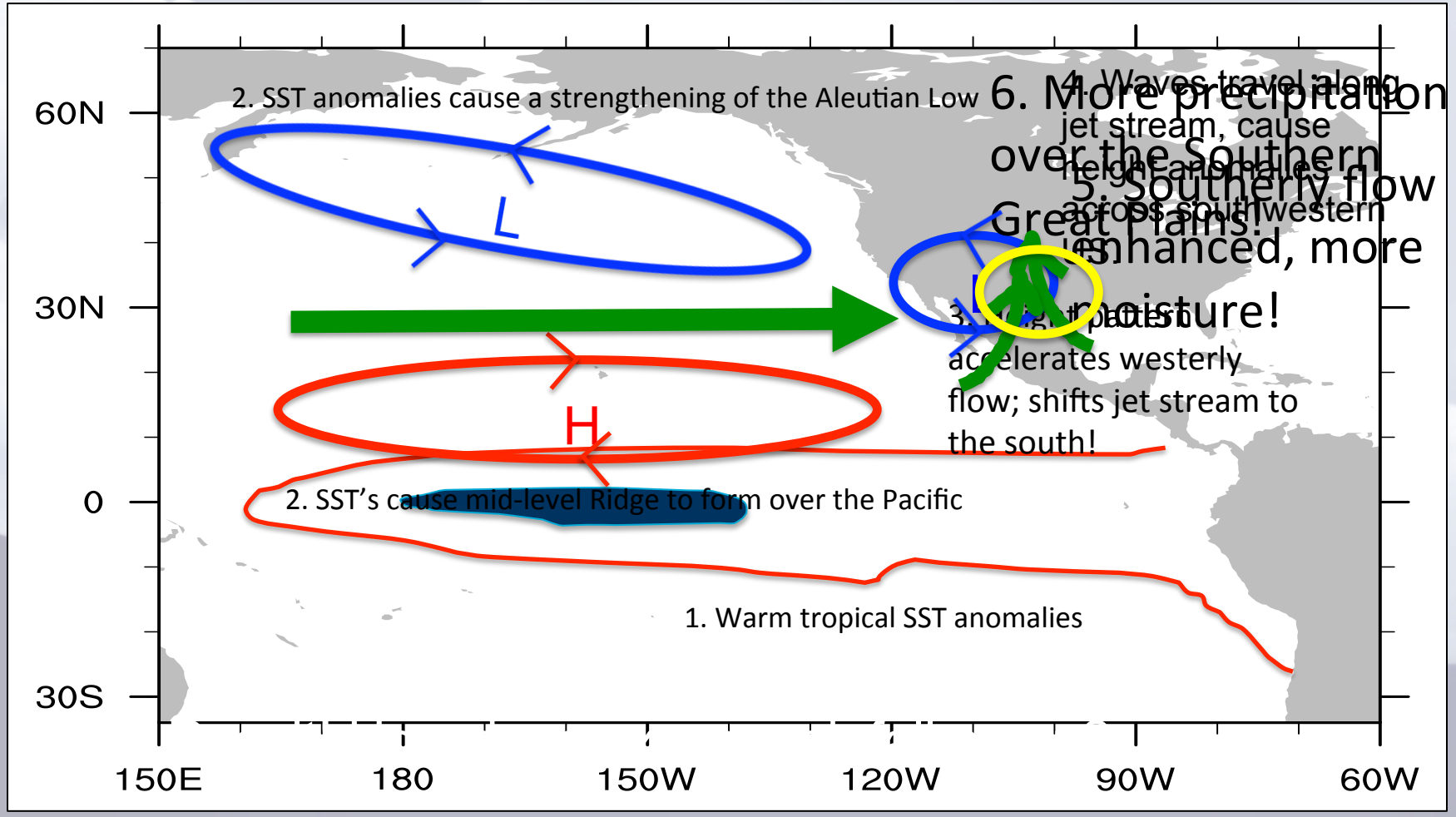
Precipitable Water Anomalies



Sea Surface Temperature Anomalies



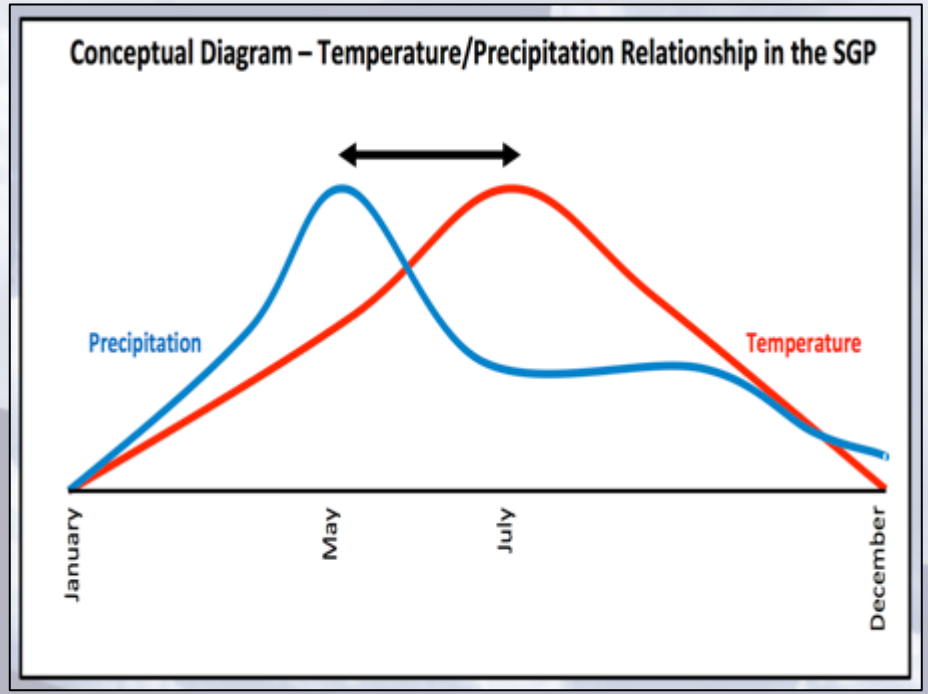
These fields represent the mean state of the atmosphere during pluvial events, not the day to day weather pattern!



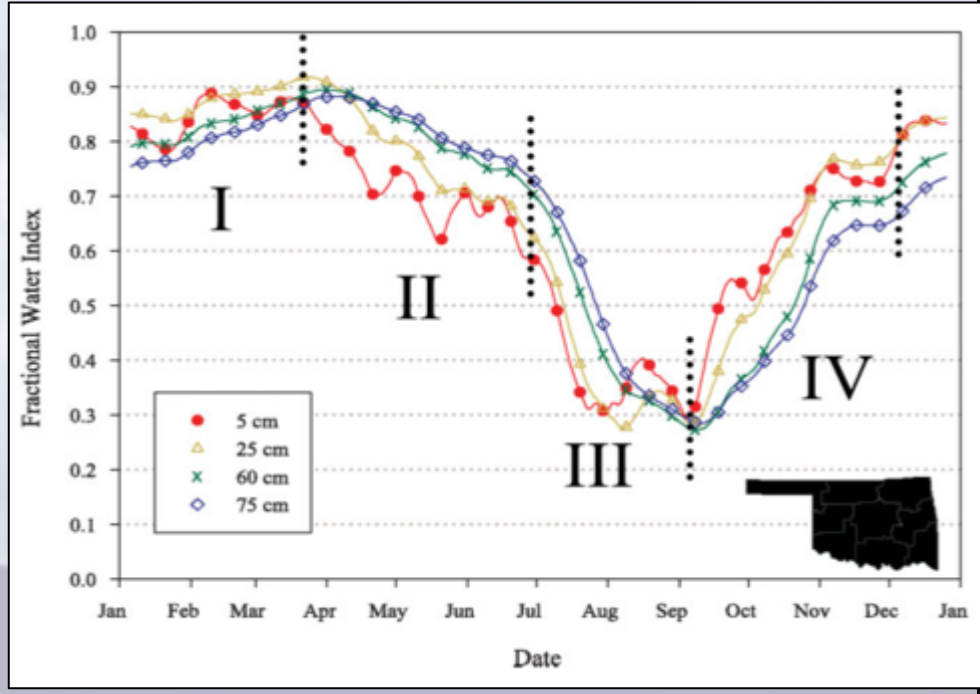
Southern Great Plains Hydroclimate: Importance of water resources

The Great Plains is an area with extensive agriculture practices (Fisher et al. 2007)

- Hence water is an extremely precious commodity!

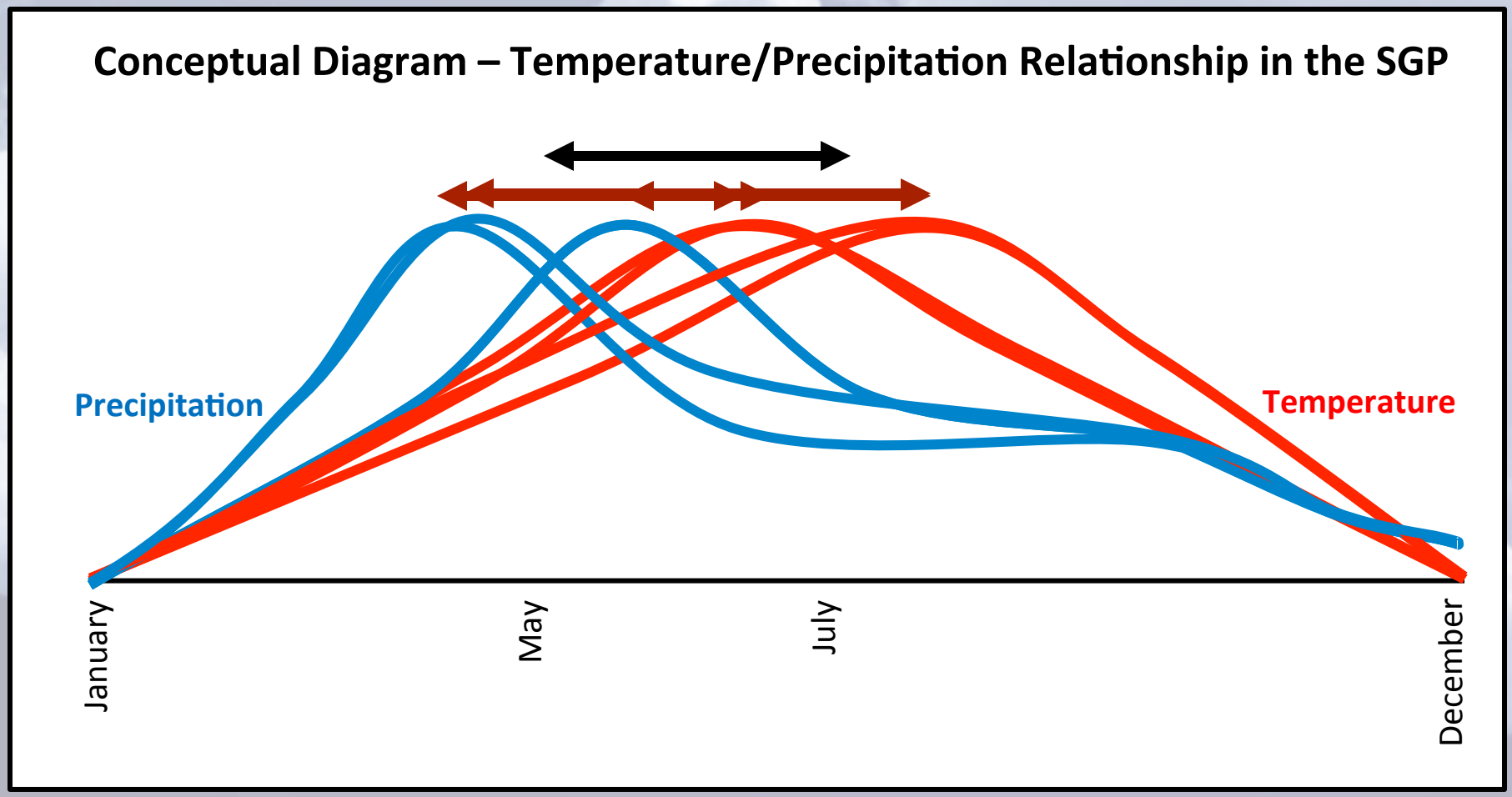


Concept from Flanagan et al. 2018

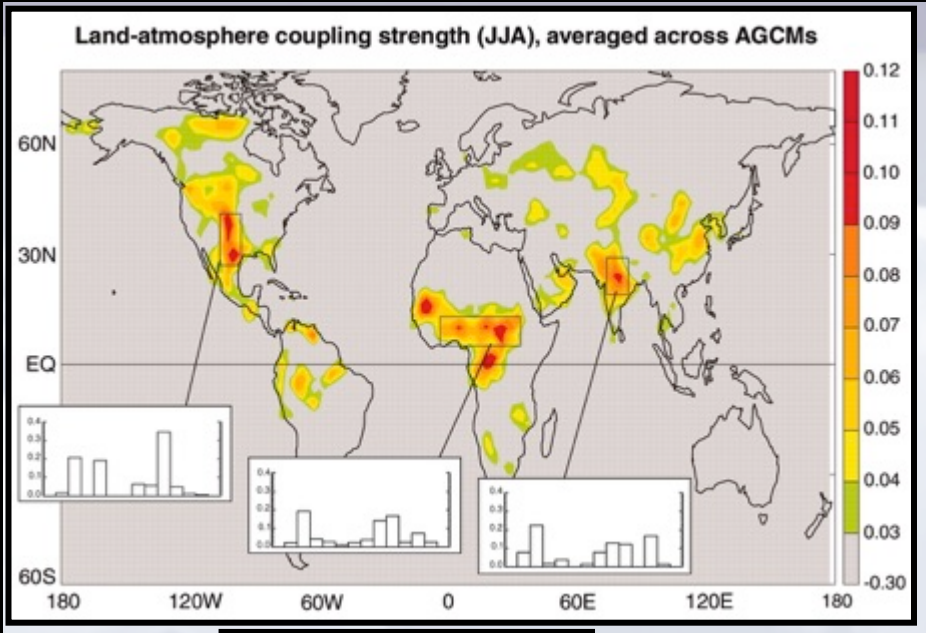


Illston et al. 2004

Flanagan, P. X., J. B. Basara, and X. Xiao, 2017: Long-term analysis of the asynchronicity between temperature and precipitation maxima in the United States Great Plains. *International Journal of Climatology*, **37,** 3919-3933.



The overall variability is increasing.



(Koster et al. 2004)

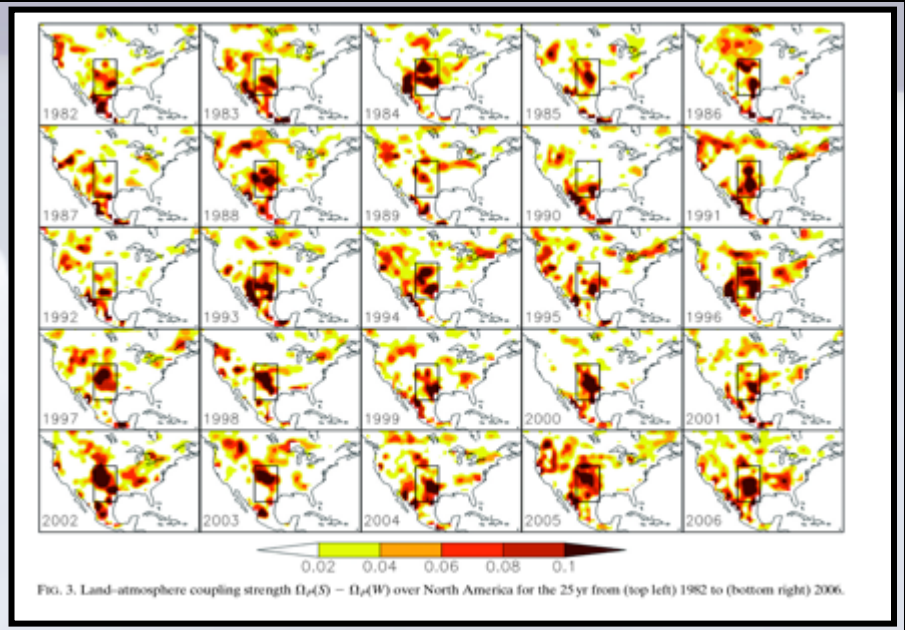
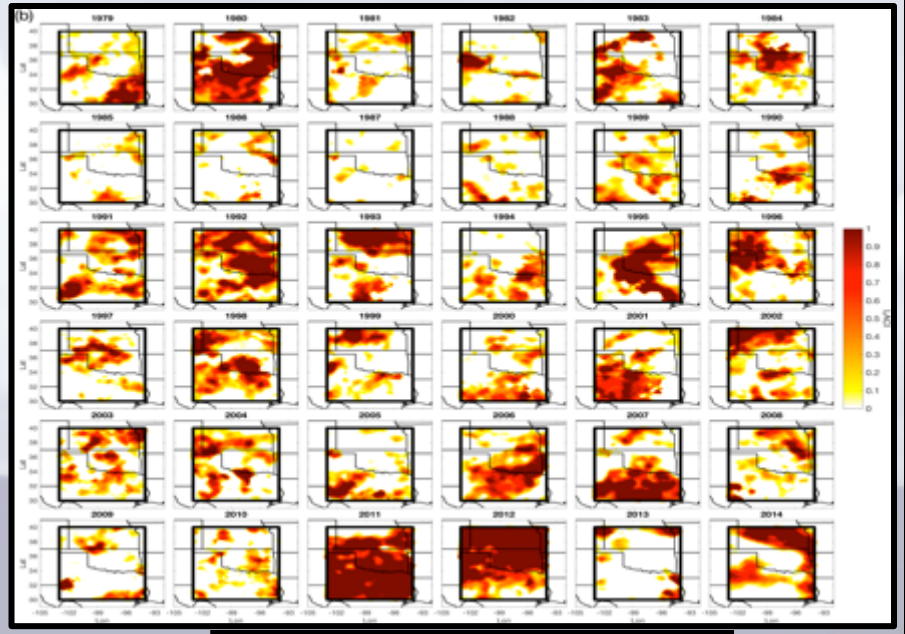


FIG. 3. Land–atmosphere coupling strength $\Omega_P(S) - \Omega_P(W)$ over North America for the 25 yr from (top left) 1982 to (bottom right) 2006.

Guo and Dirmeyer (2013)

Land-Atmosphere Interactions are a Critical Component of the Hydroclimate

Critical to feedback processes that enhance:
- Precipitation Recycling
- Intensification and Perpetuation of Drought



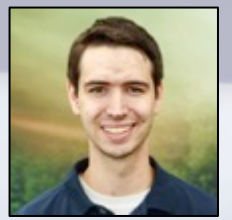
Basara and Christian (2018)

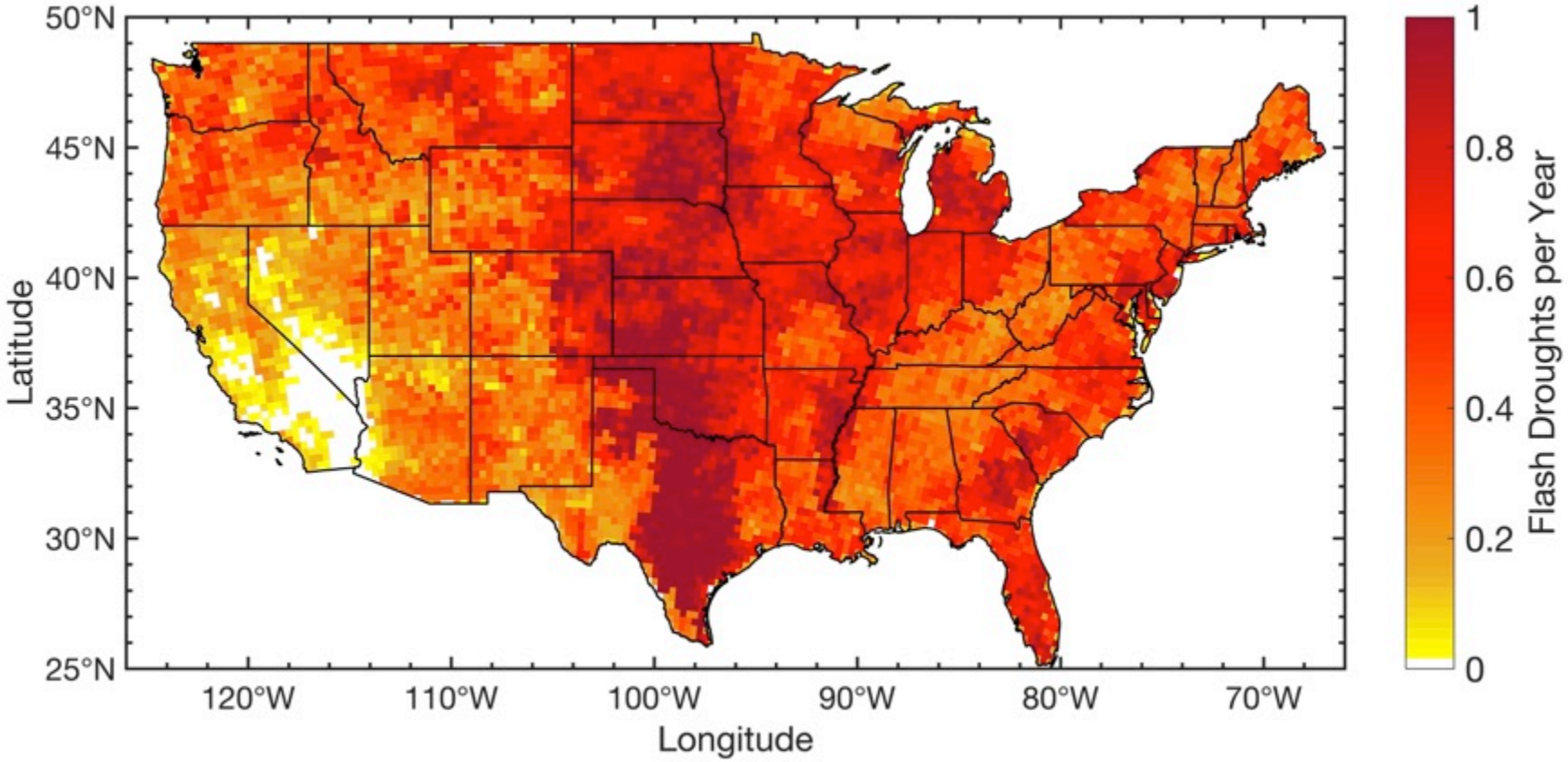
Vegetation Change at the MOISST Site During the 2012 "Flash" Drought

July 1, 2012

August 13, 2012

Climatological Analysis of Flash Droughts





Otkin, J.A., M. Svoboda, E.D. Hunt, T.W. Ford, M.C. Anderson, C. Hain, and J.B. Basara, 2018: Flash Droughts: A Review and Assessment of the Challenges Imposed by Rapid Onset Droughts in the United States. *Bulletin of the American Meteorological Society*, doi.org/10.1175/BAMS-D-17-0149.1.

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.

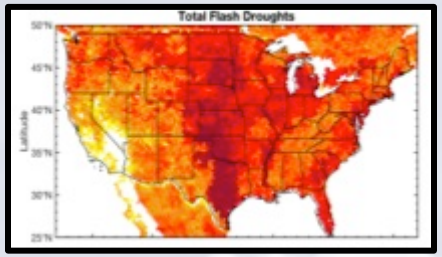
- Impacts span many local socioeconomic sectors … especially agriculture.

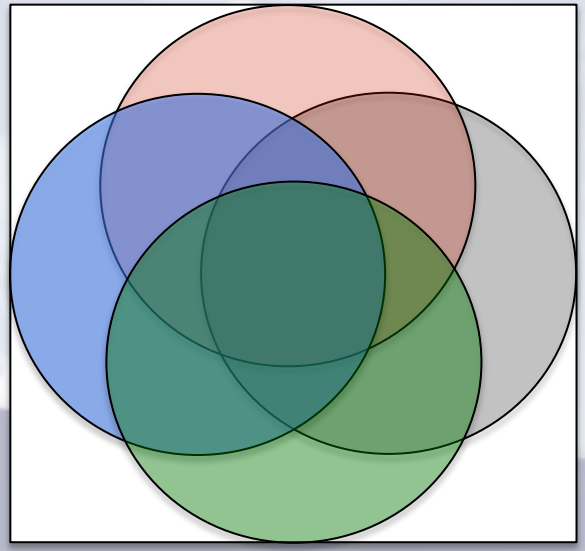
- Much work to be done … Additional Drivers? Predicability? Projections?

Questions?

jbasara@ou.edu

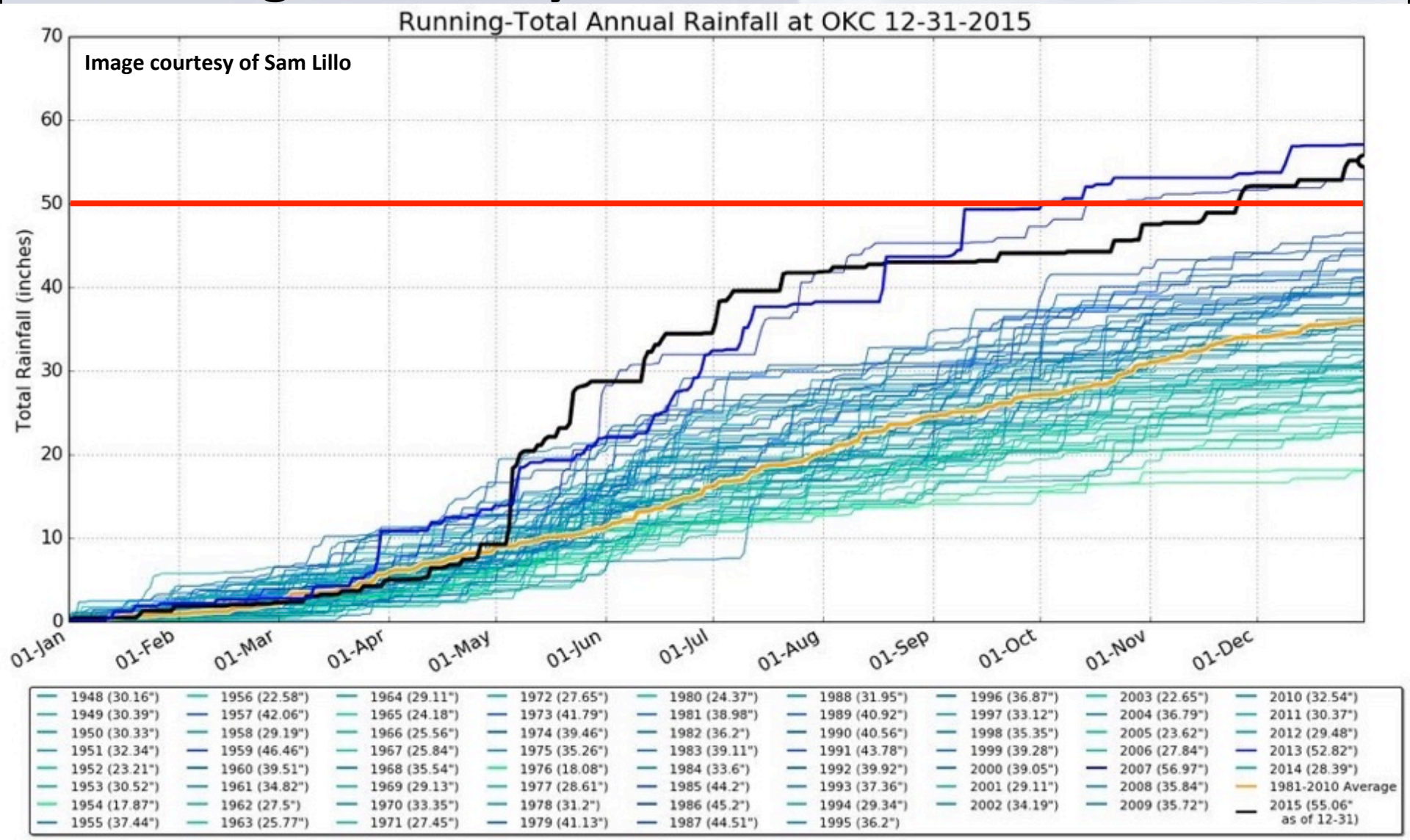
http://hydrometeorology.oucreate.com





CHEWe Research Group - Interdisciplinary Research Focus

Increasing Variability



Years in Oklahoma City with greater than 50” of rain: 1908, 2007, 2013, 2015