Climate Projections and Drivers in Kansas

Joshua K. Roundy
Department of Civil, Environmental, and Architectural Engineering
University of Kansas

Wednesday November 13, 2024

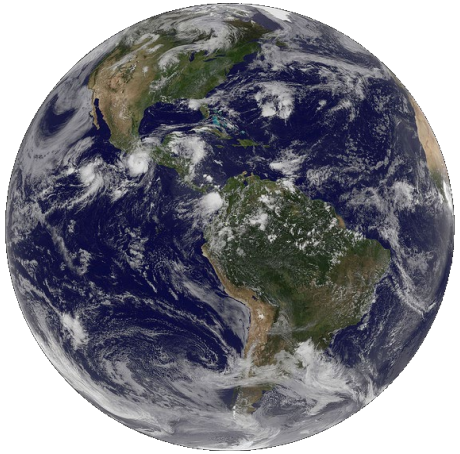
Governor's Conference on the Future of Water in Kansas
Manhattan, Kansas

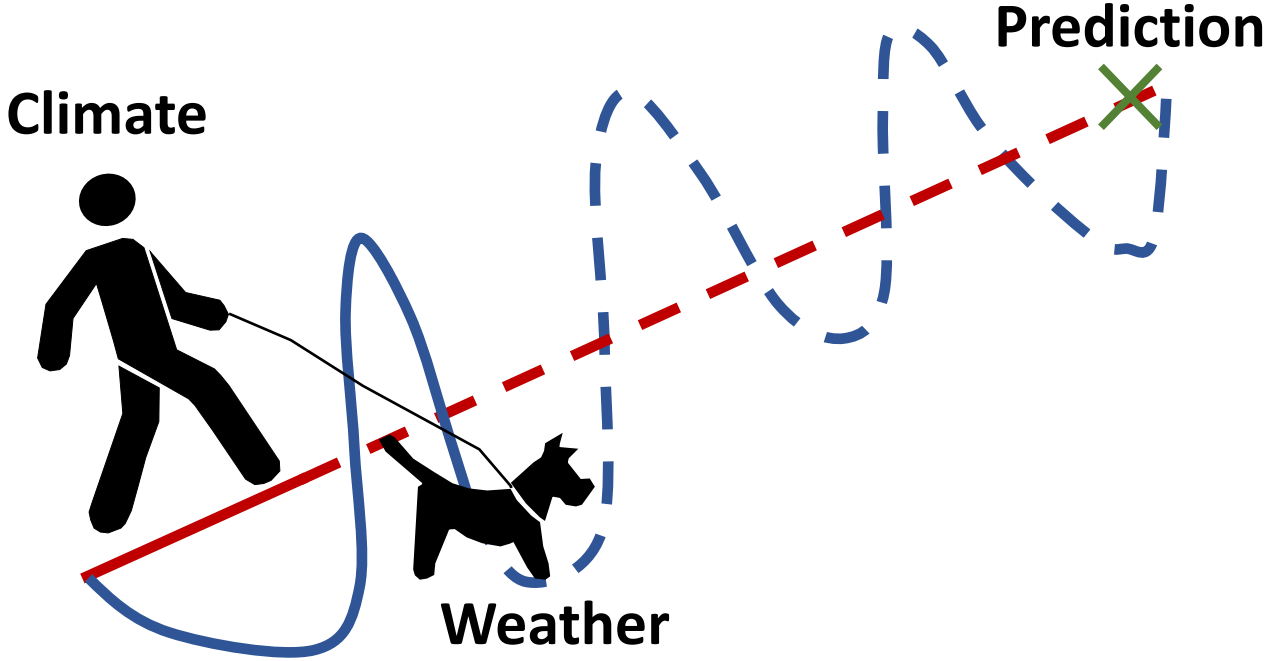
What is Climate?

Climate is the description of the long-term weather patters for a particular region

Weather and climate are intertwined but have distinct differences.

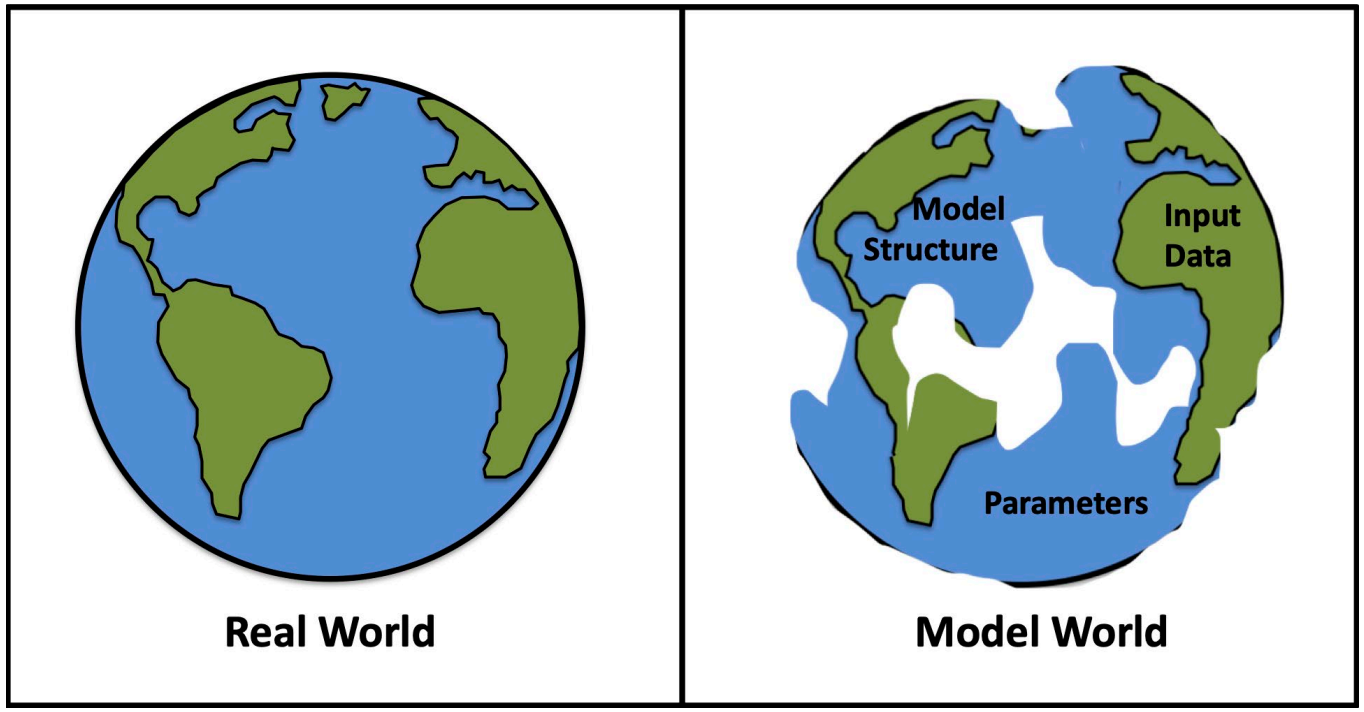
Here is a great analogy for describing the difference between weather and climate

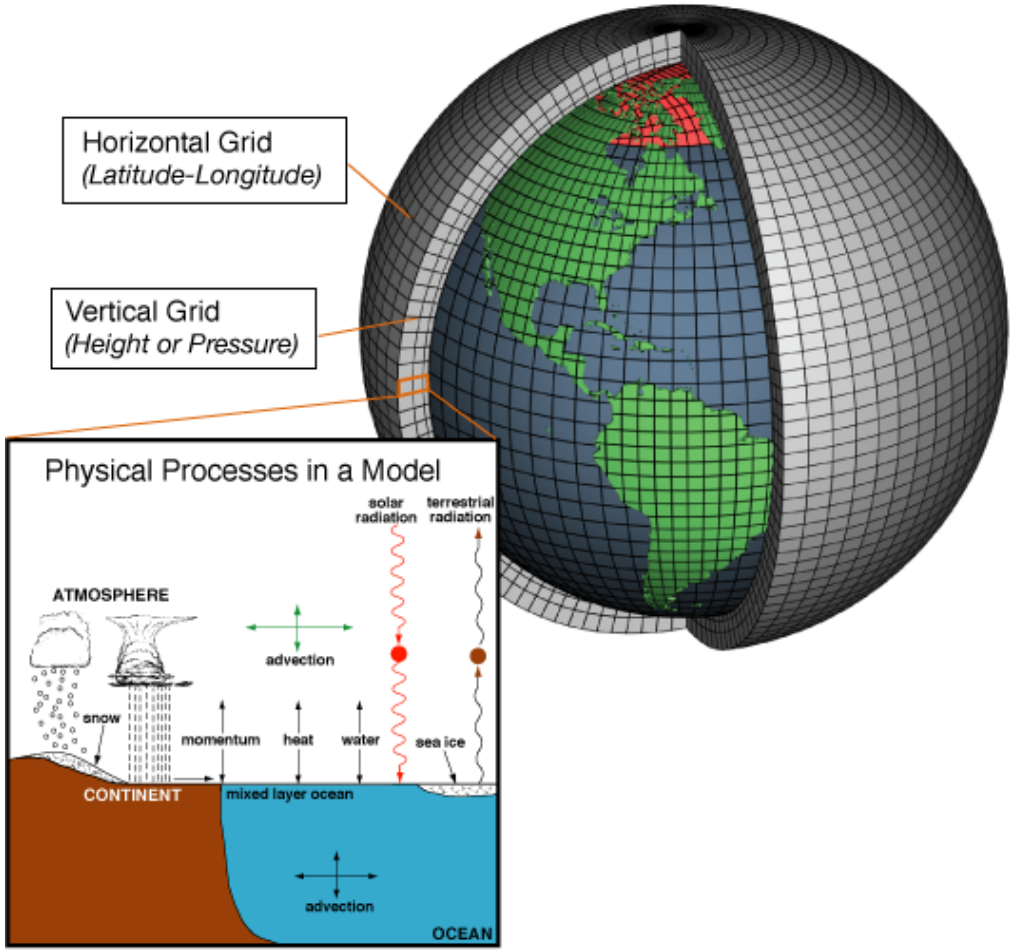




Climate Models

Each cell is represented by mathematical equations based on fundamental laws of physics, fluid motion, and chemistry that describe how energy, water and other constituents move through the earth system.

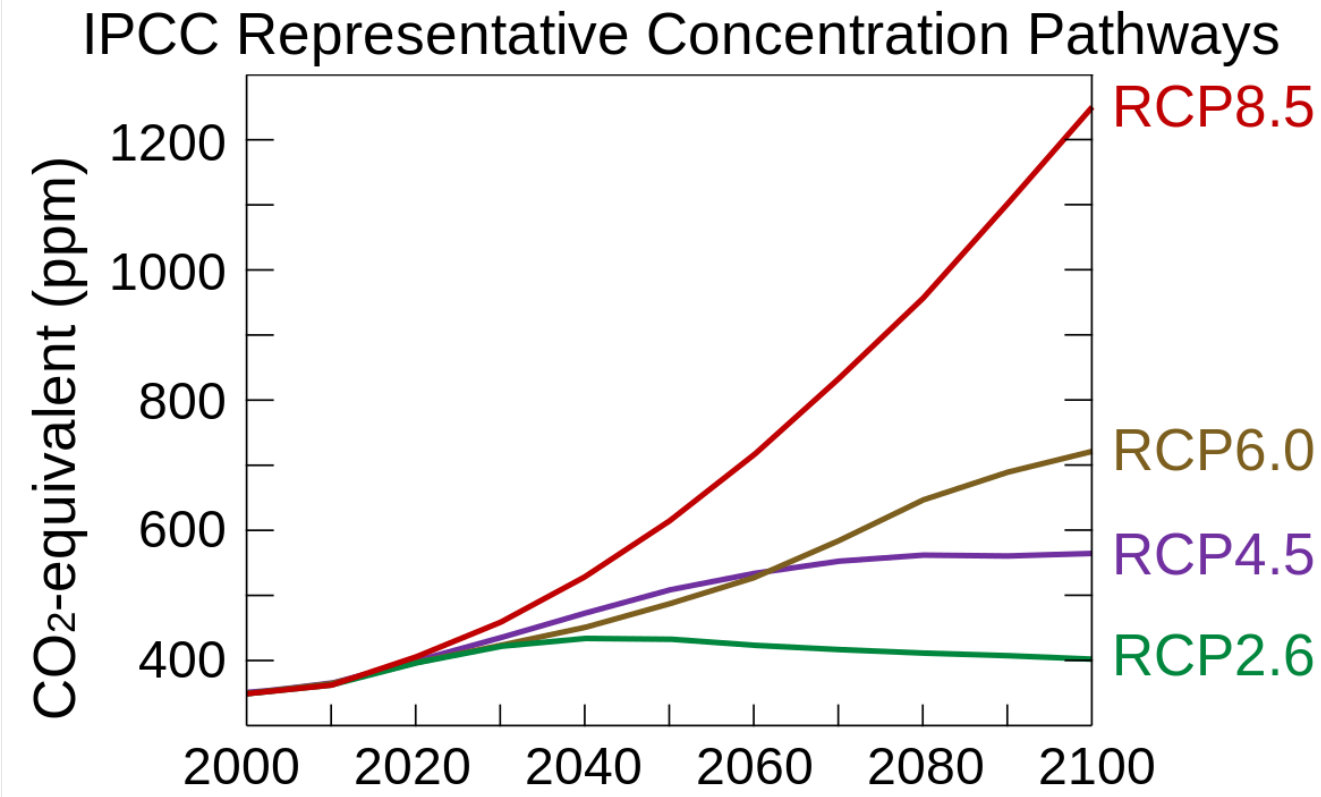




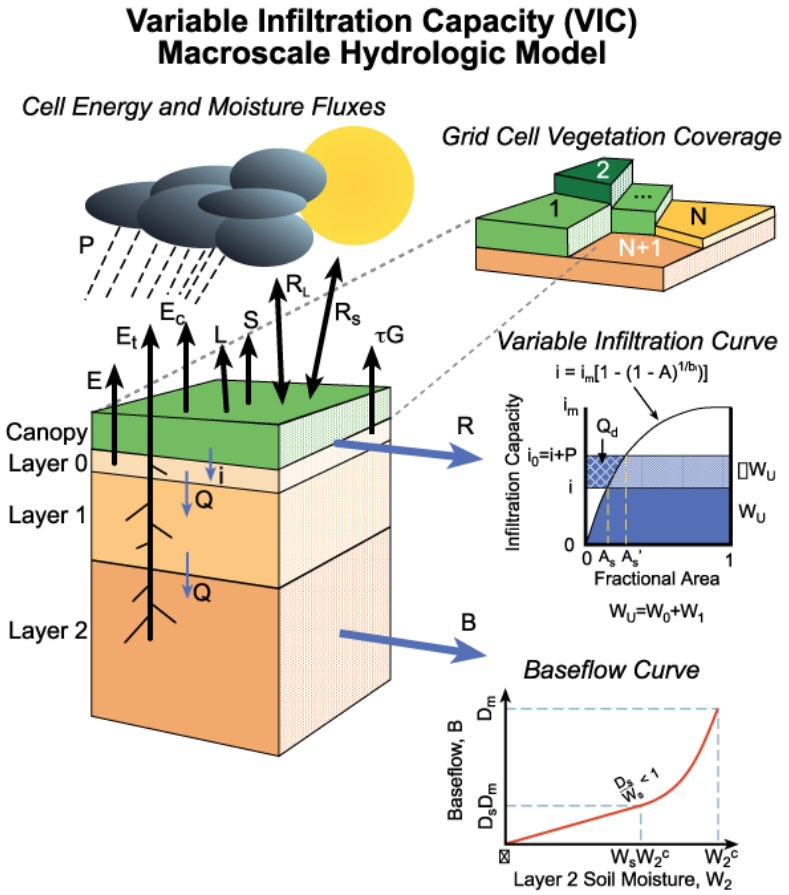
https://www.climate.gov/file/atmosphericmodelschematicpng

CMIP5 Climate Model Projections

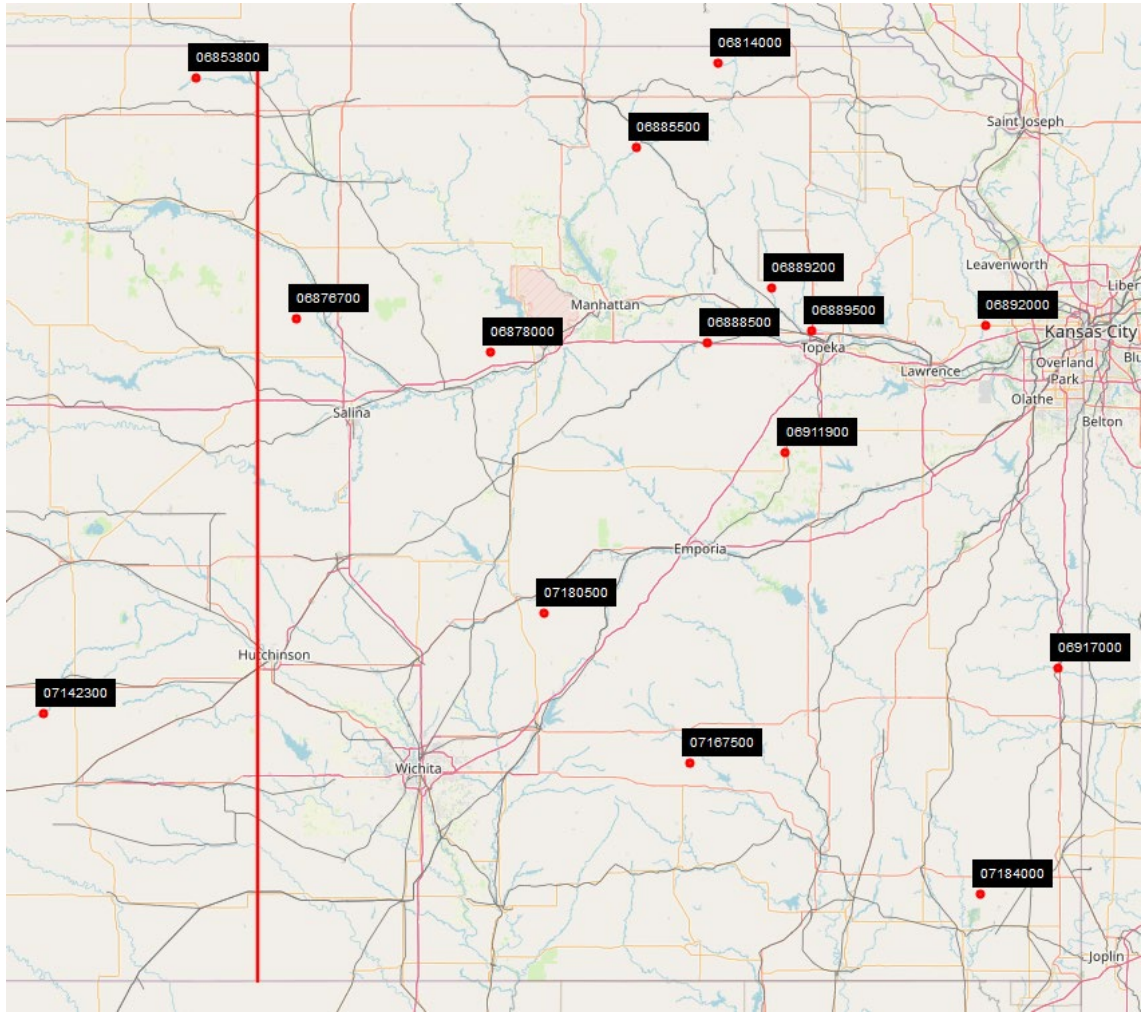
Considered 4.5 and 8.5



Downscaled, Land surface model and bias corrected streamflow.



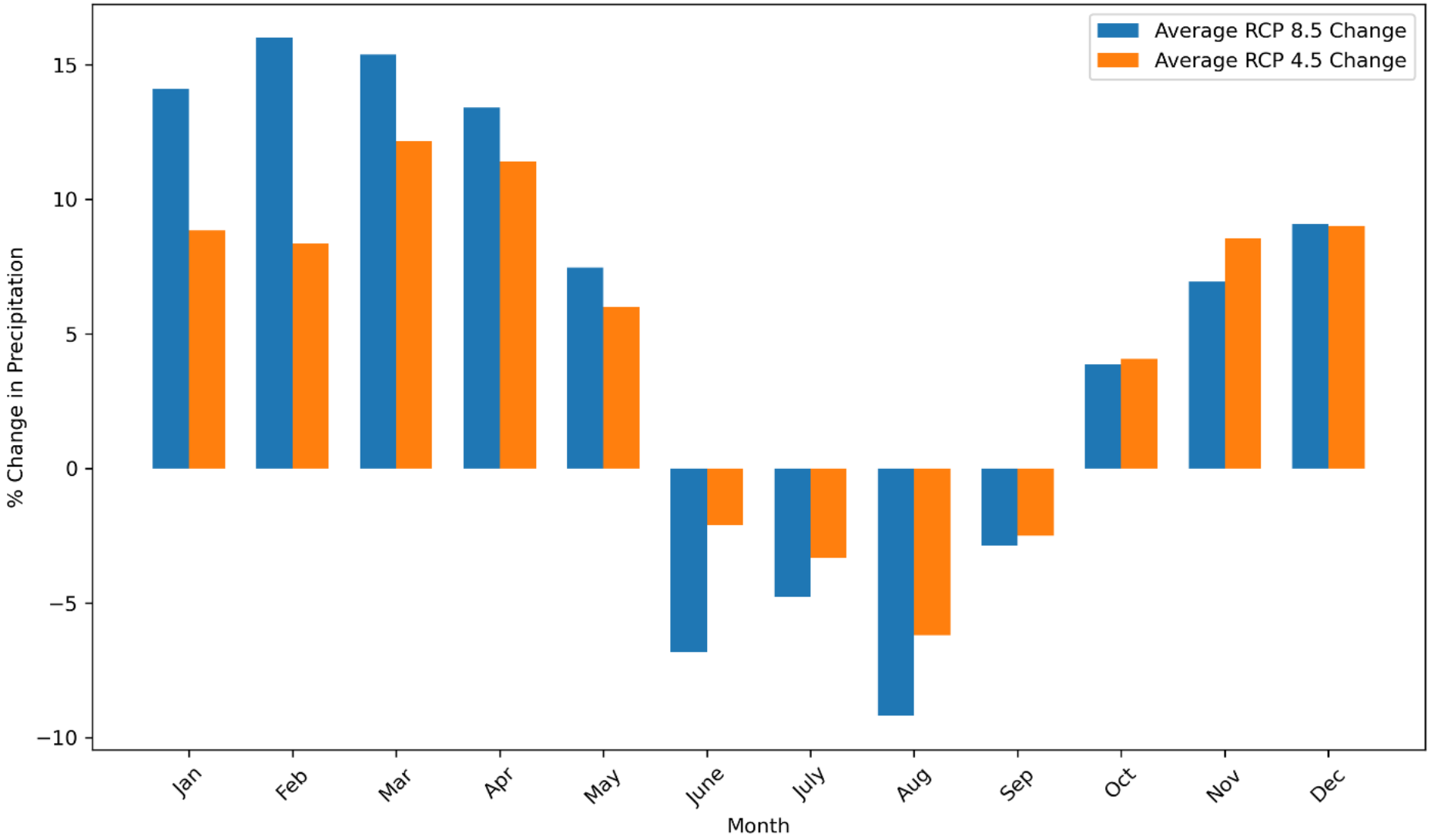
Analyze CMIP5 Climate Projections for Kansas



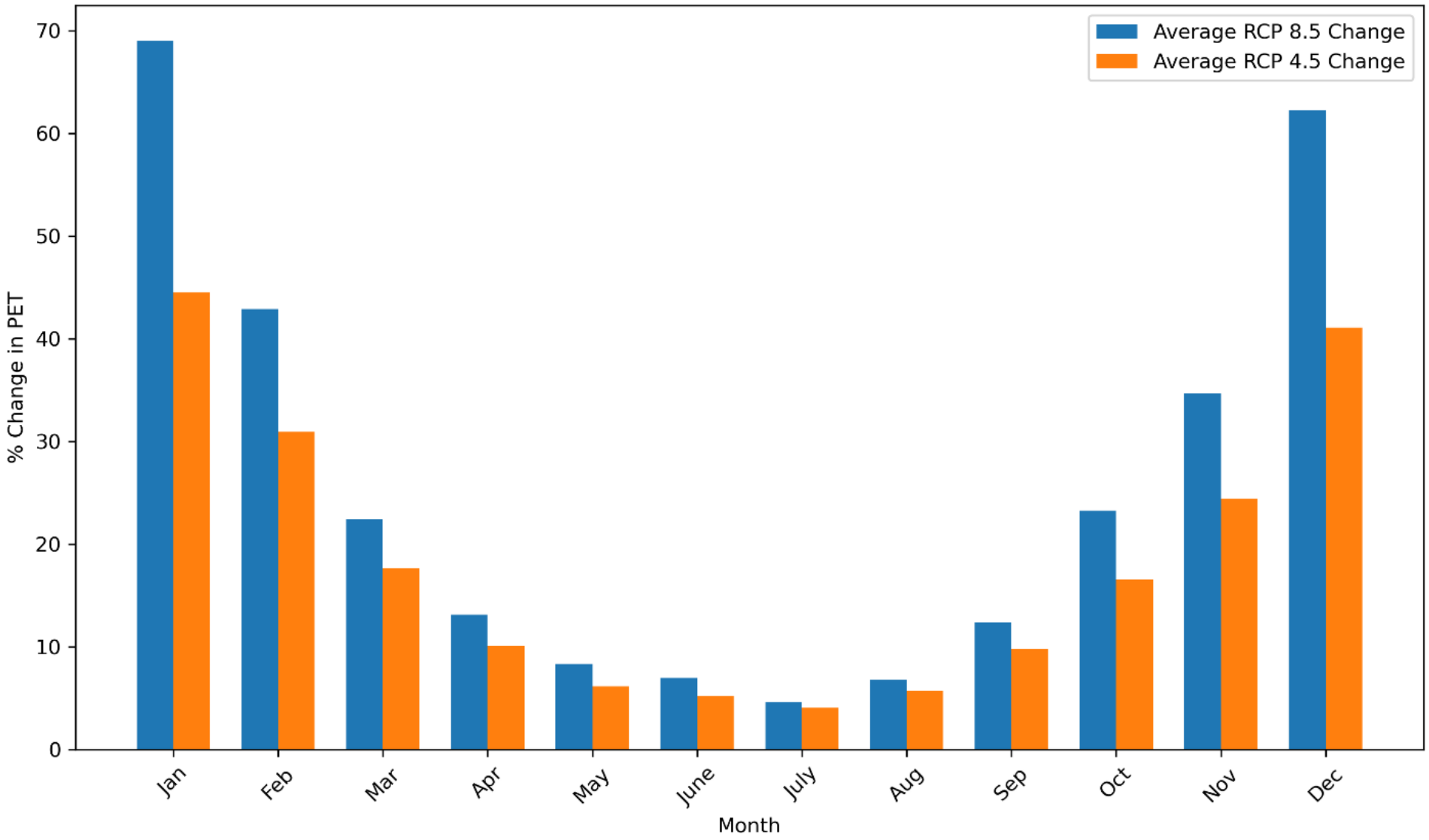
- USGS Hydro-Climate Data Network 2009 (HDCN)
  - Naturalized gages
- 1960 or earlier
- 15 gages selected for final analysis

This work was done by **Colton Chapman** as part of his Master's Thesis.

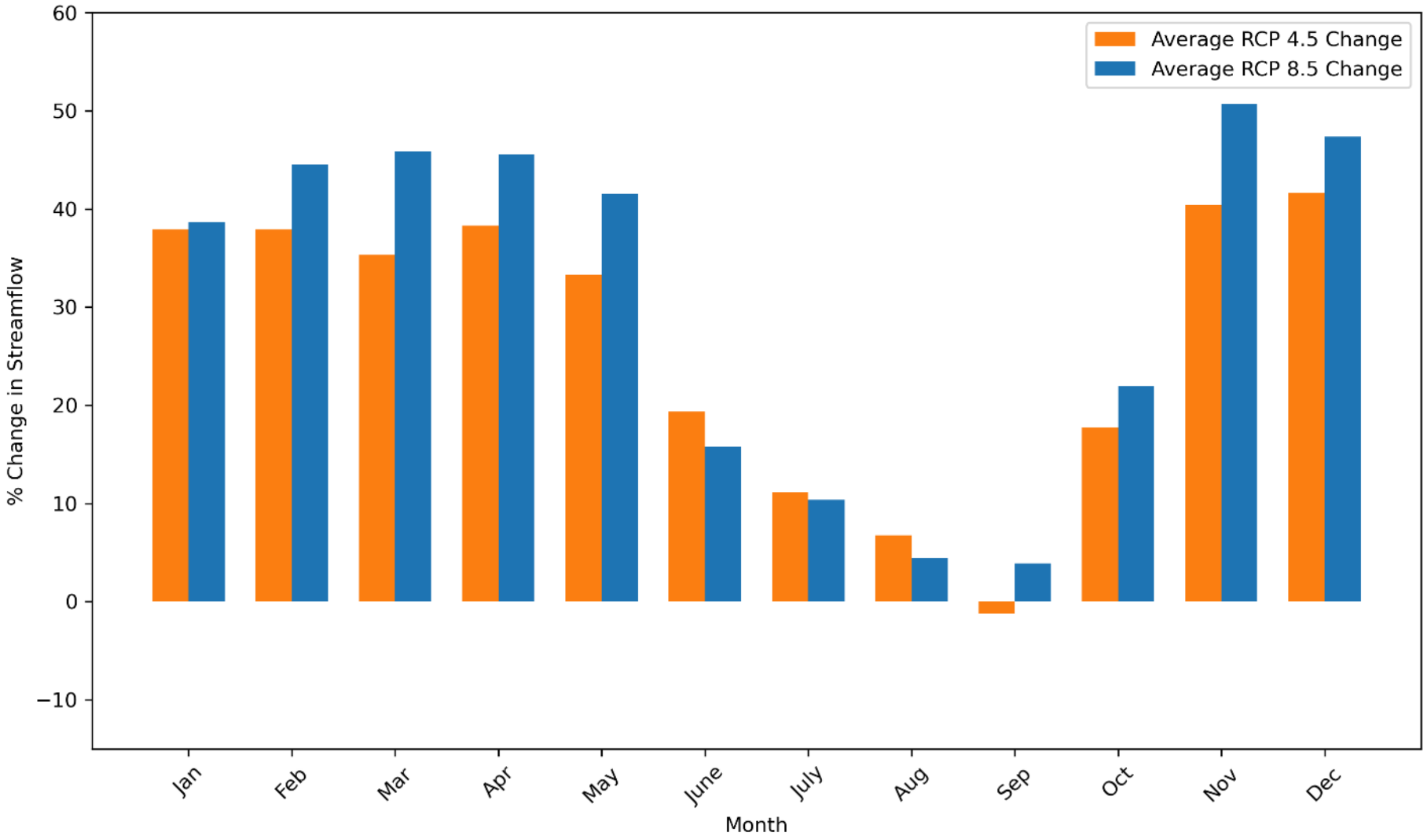
Average Precipitation shows a seasonal change



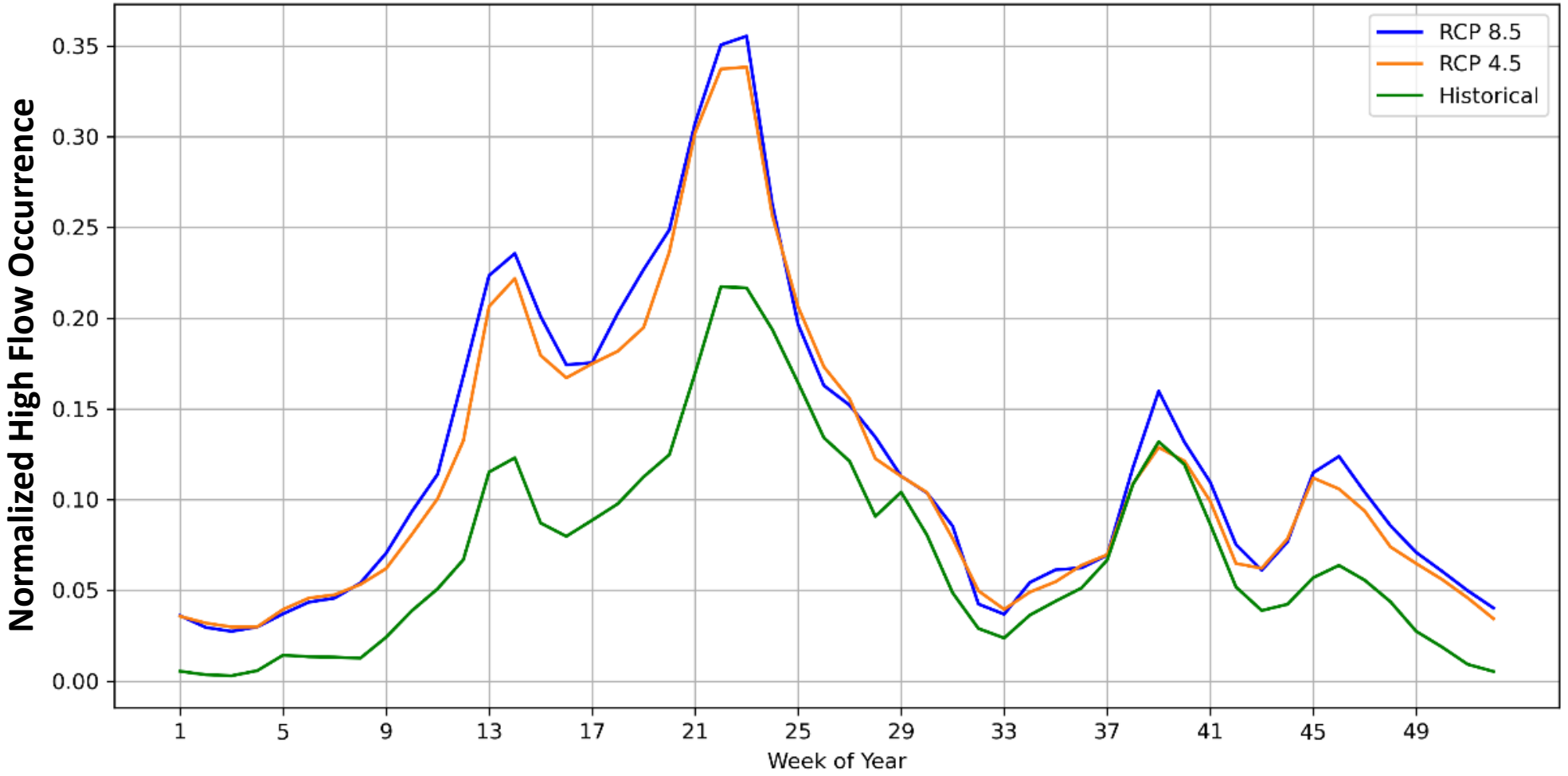
Average Potential Evaporation is going to Increase



Average Streamflow is going to Increase

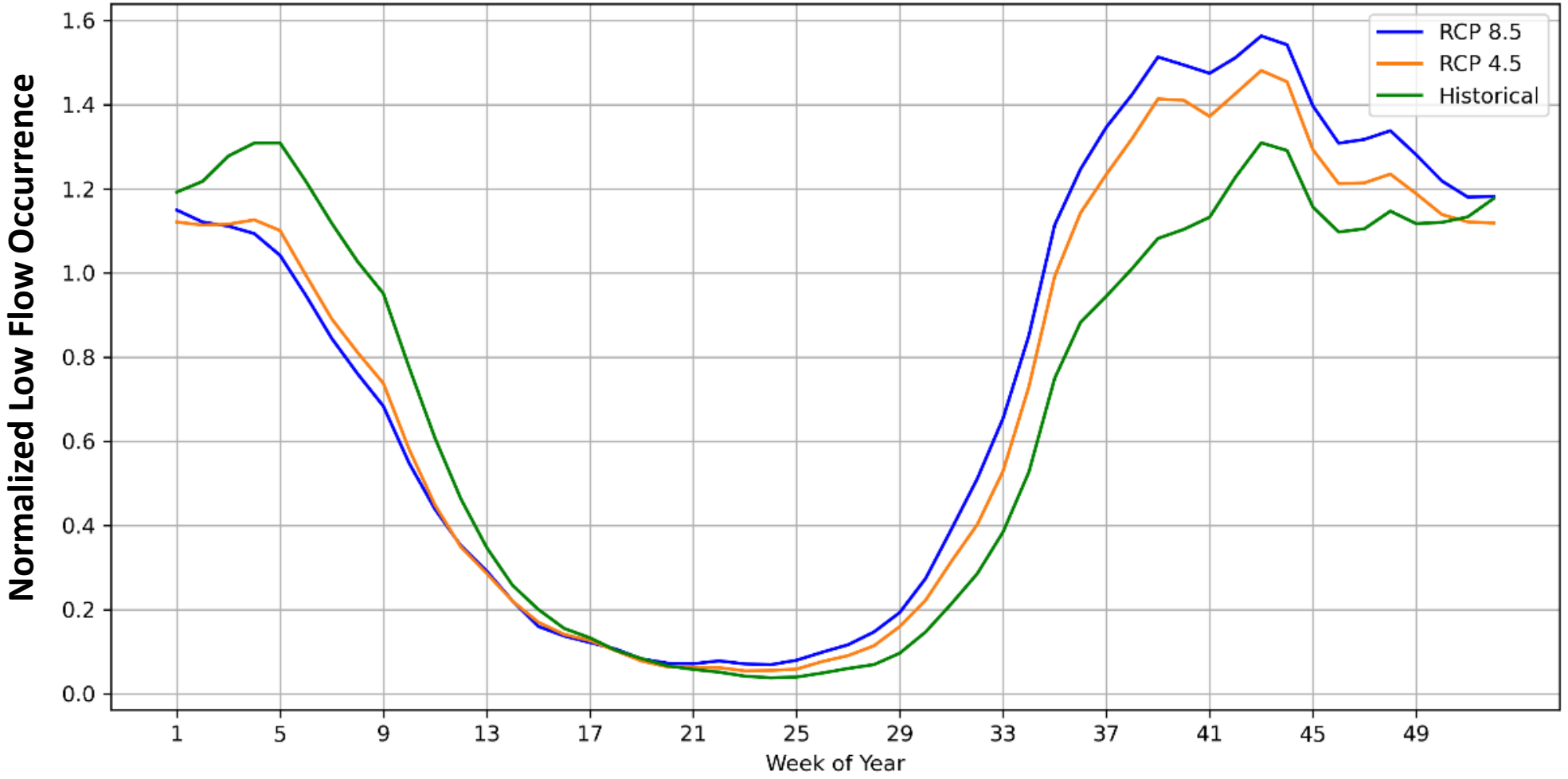


High Flow Occurrence Increases



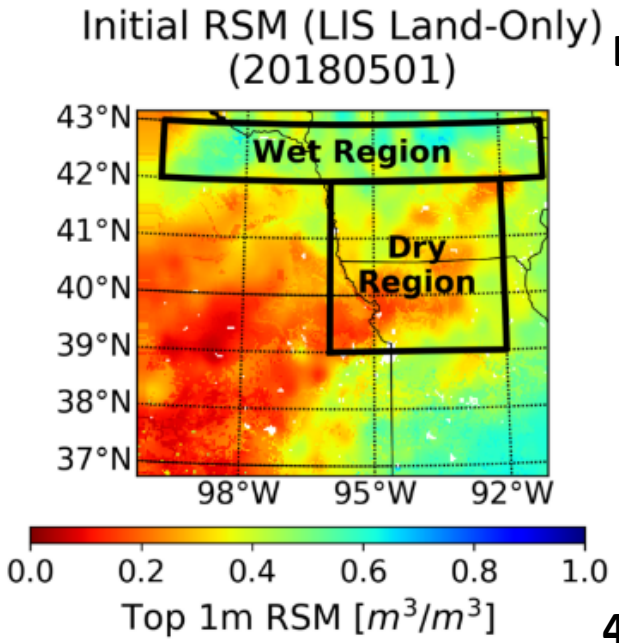
Low Flow Occurrence Increases

Peak occurrences shift from January to September



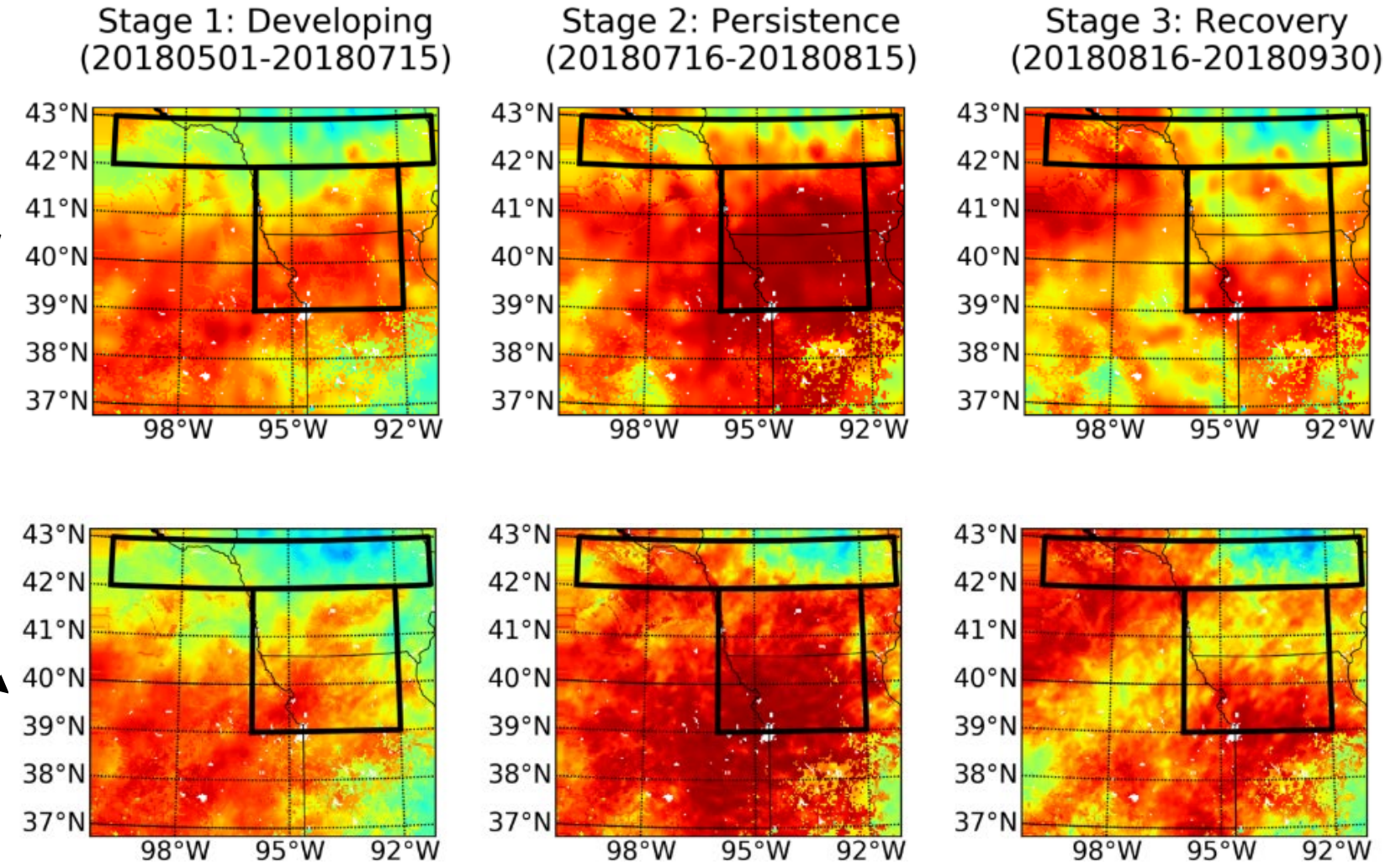
Evolution of the 2018 Drought

2018 Drought Kansas-Missouri-Nebraska, Iowa



LIS Land-Only NLDAS2

4km NU-WRF Coupled Run



Zhang et al. (in preparation)

Drought/Floods are linked with Mesoscale Circulation

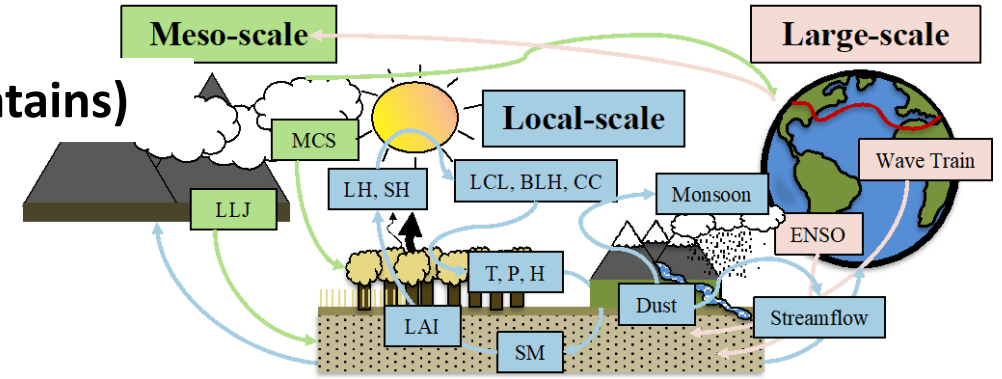
LC – Local Feedbacks

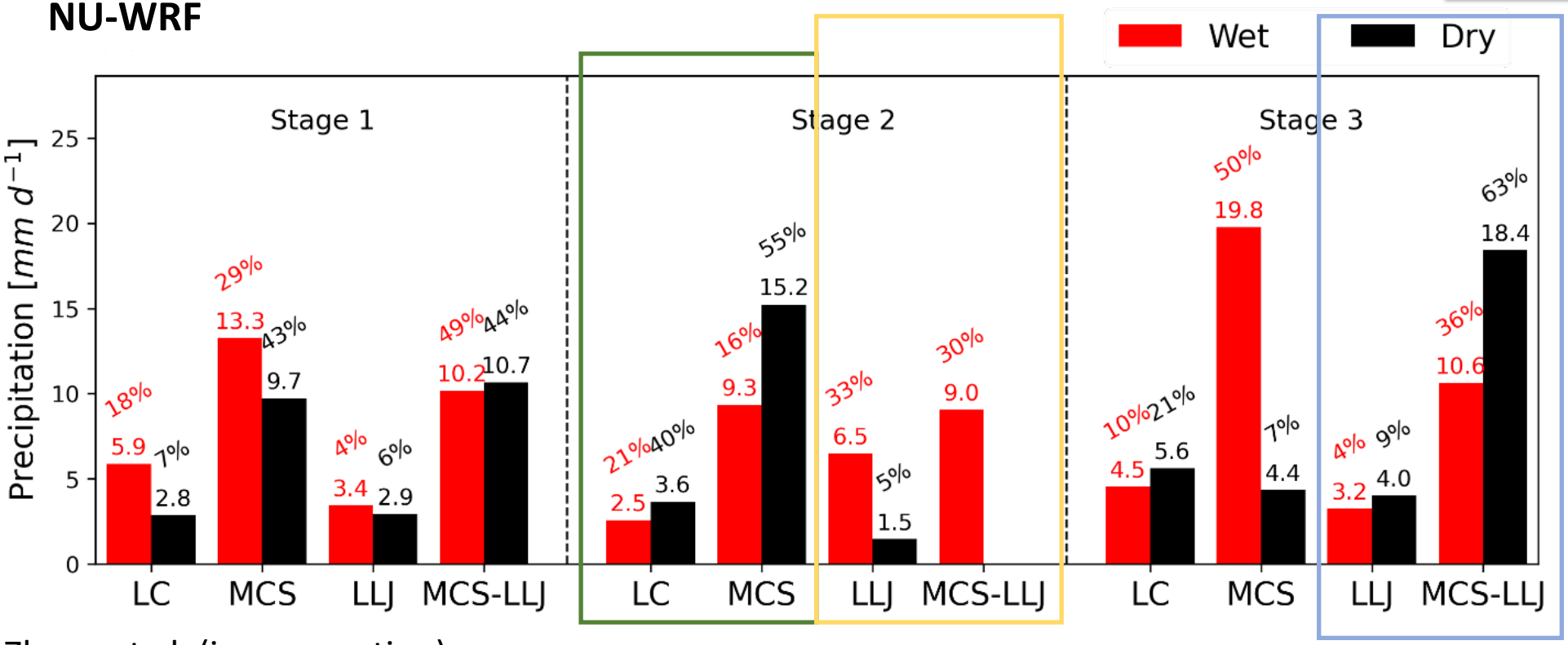
MCS – Mesoscale Convective System (Form off the Rocky Mountains)

LLJ – Low Level Jet (Brings Moisture from the Gulf of Mexico)

MCS-LLJ – Both MCS and LLJ

NU-WRF





Zhang et al. (in preparation)

Summary/Conclusions

Main takeaways:

- Precipitation Changes Seasonally
- Potential Evapotranspiration will increase
- Average Streamflow will increase
  - High Flow Occurrence will increase
  - Low Flow Occurrence will increase
- These changes are likely driven by the interaction of MCS and LLJs.
- **All of these changes will impact reservoir storage and management in Kansas.**