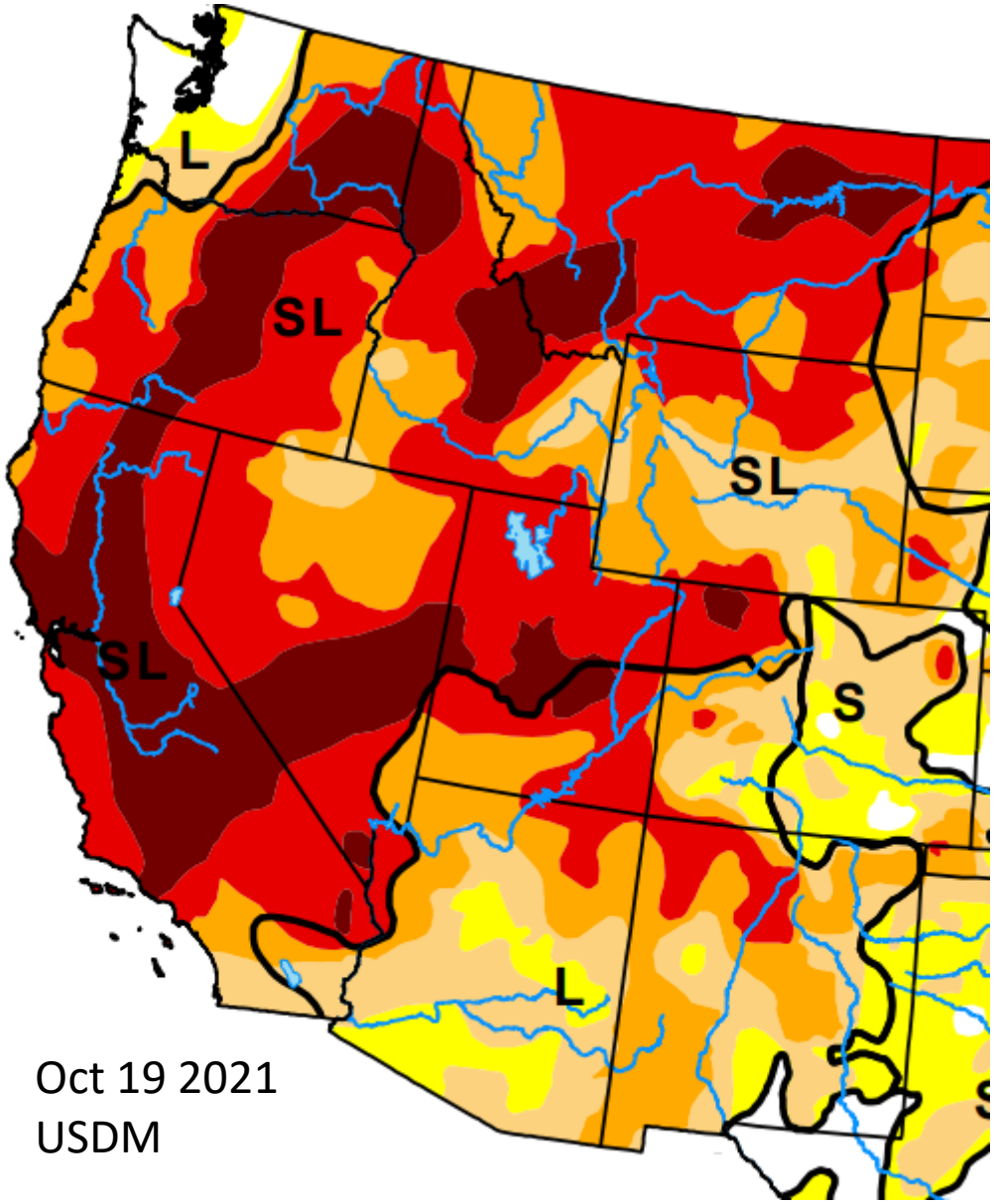


Oct 19 2021
USDM

Fewer troughs, not more ridges, led to the drying trend in the western US

Wei Zhang

Department of Plants, Soils and Climate,

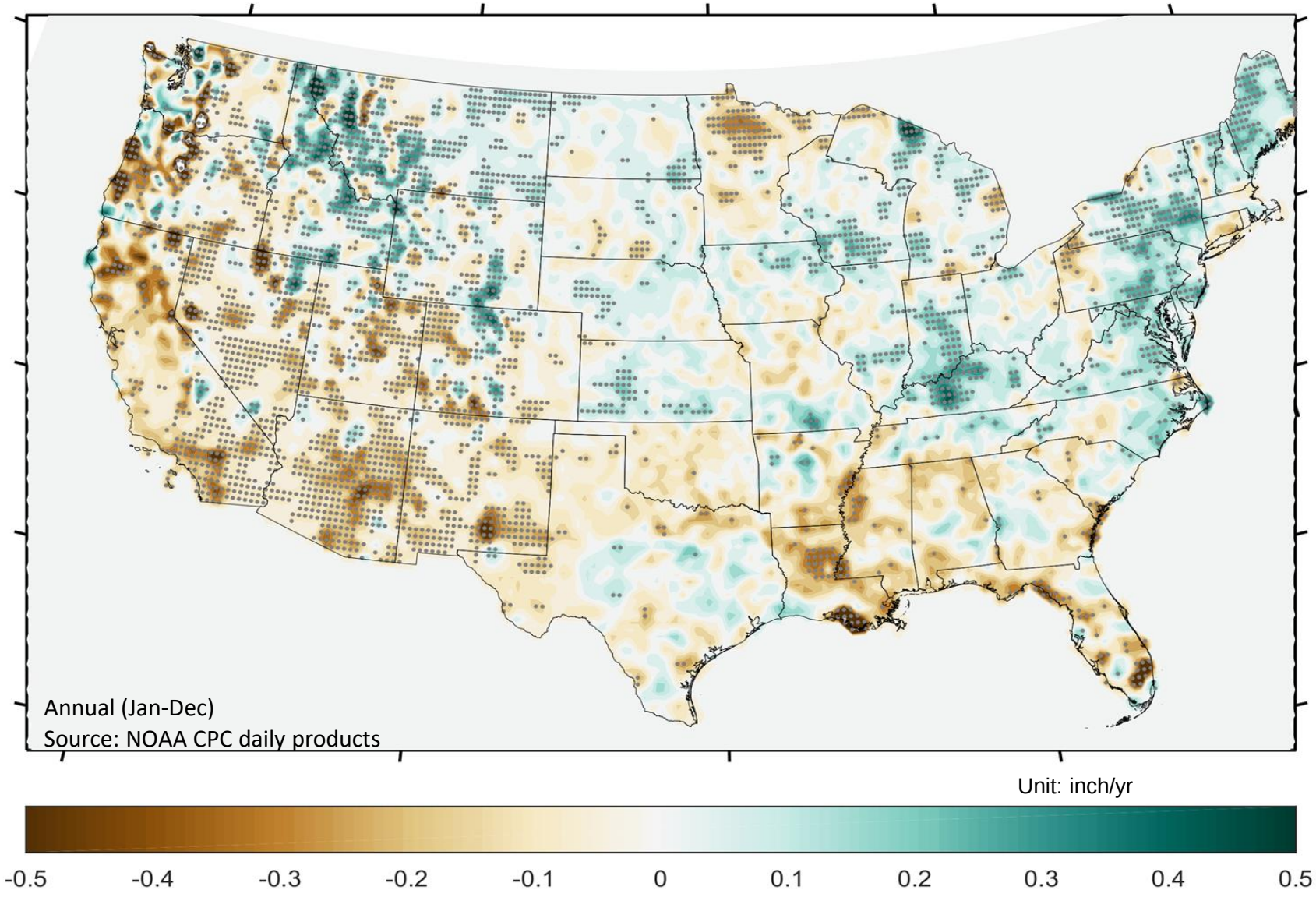
Utah State University

Email: w.zhang@usu.edu

Collaborators:

Vittal Hari, Simon Wang, Matthew D. LaPlante, Gregg Garfin, and Rohini Kumar

Significant decreasing trends in annual total precipitation exist across the western US during 1980-2018.

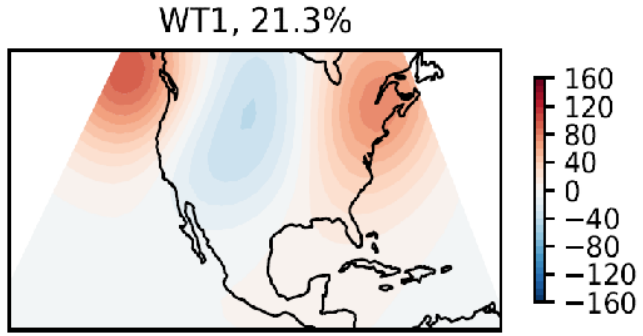


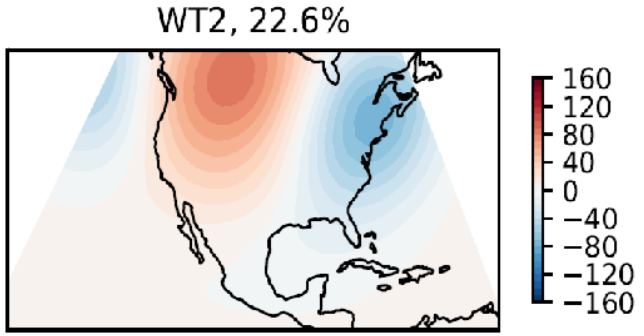
Questions to be addressed

- What large-scale circulation patterns (e.g., weather types) are responsible for the decreasing trend in precipitation across the western U.S. during 1980-2018?
- How do weather types shape precipitation in the western U.S.?
- How did weather types change over time? Are there more ridges since 1980?
- What are the roles of anthropogenic and natural forcing in shaping the trend of weather types?

Five clusters or weather types (WTs) are identified from the 500-hPa geopotential height anomaly by K-means cluster analysis.

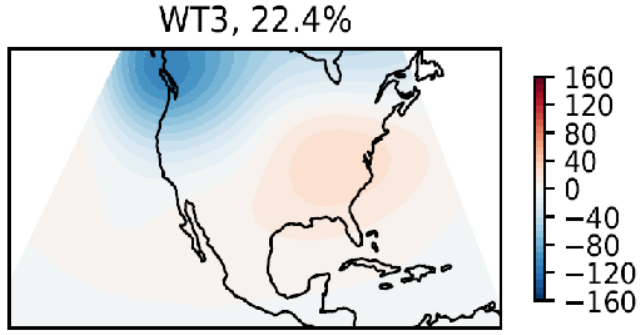
Midwest Water Hose (2019 Spring Midwest Flooding)

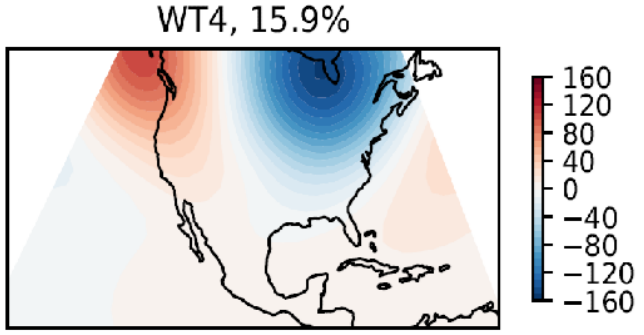




Pacific North America (PNA)

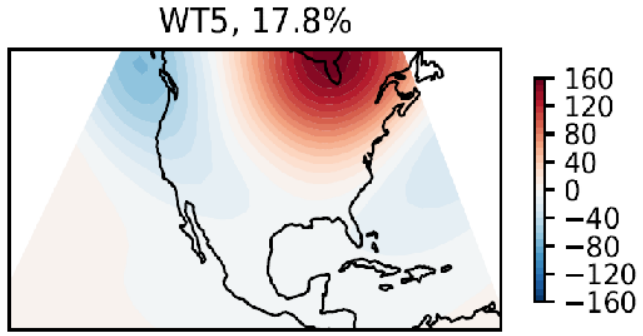
Western Trough (WT3)





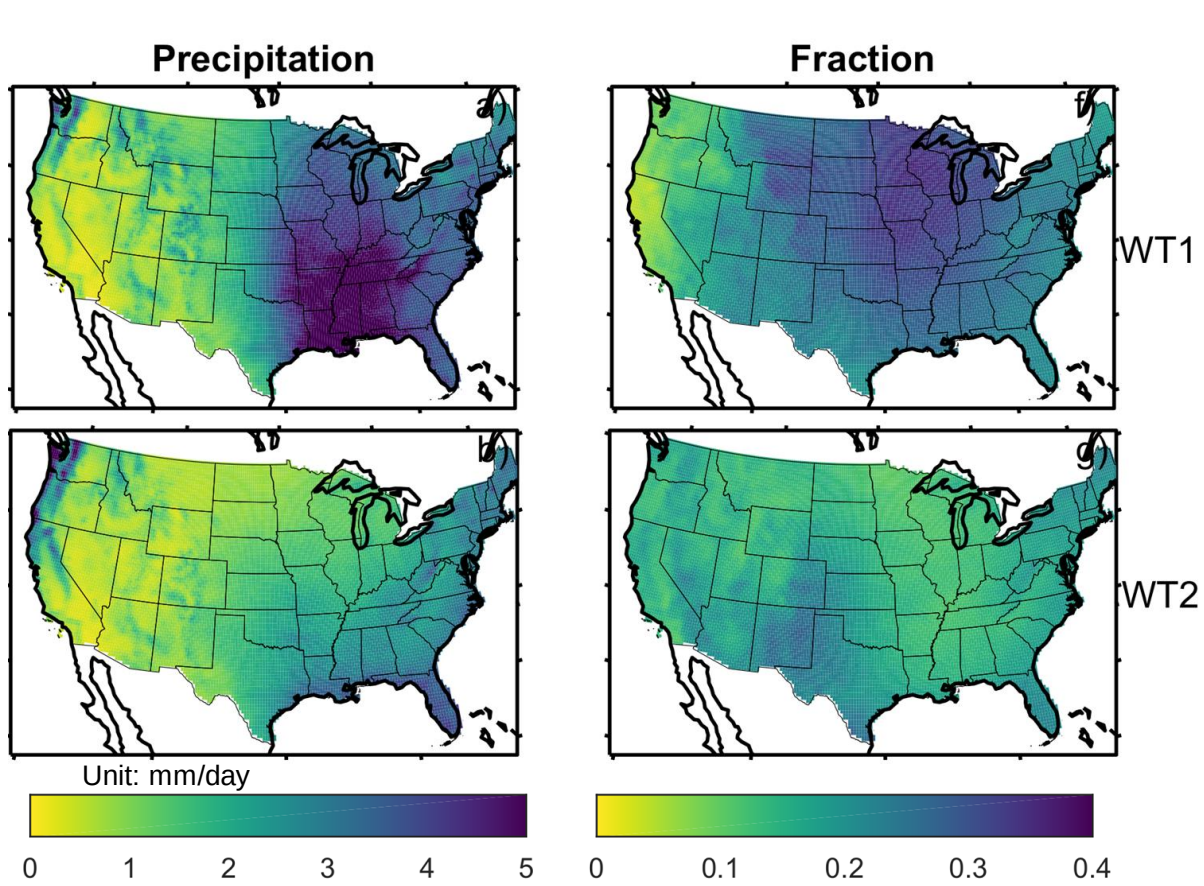
Western Ridge (WT4)

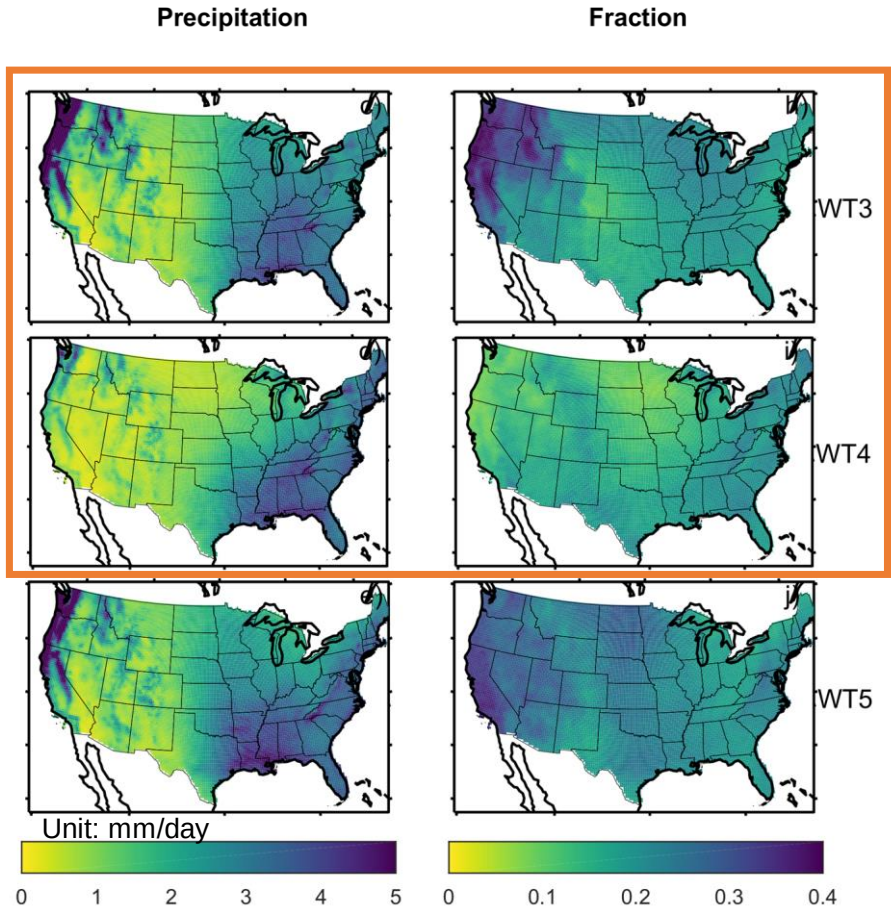
Arctic Amplification-Like



Zhang et al. 2019; 2021

WT3 makes the largest contribution to annual precipitation in the western Untied States in the five WTs.

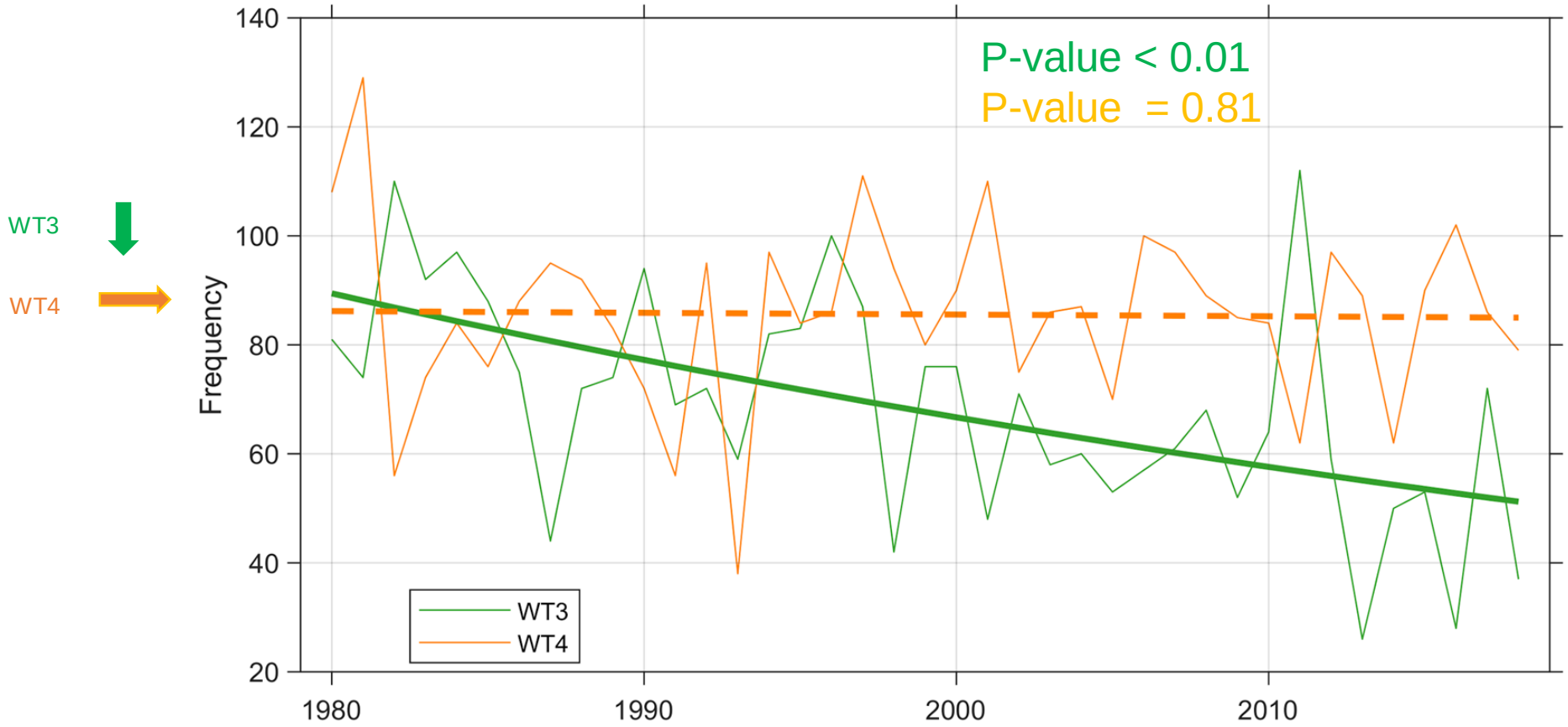




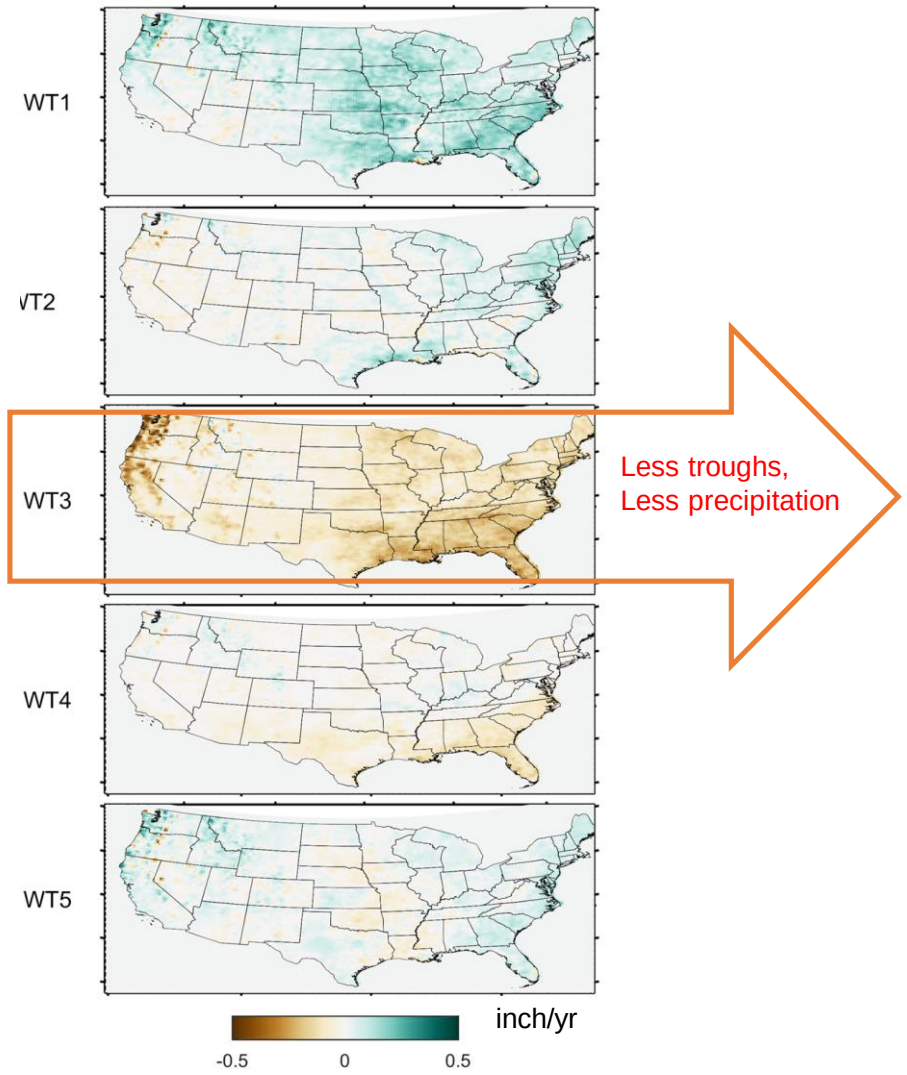
Western Trough (WT3)

Western Ridge (WT4)

A significant decreasing trend in WT3 (trough) was observed during the period 1980-2018, indicating less western troughs. By contrast, WT4 (ridge) exhibits no significant trend.

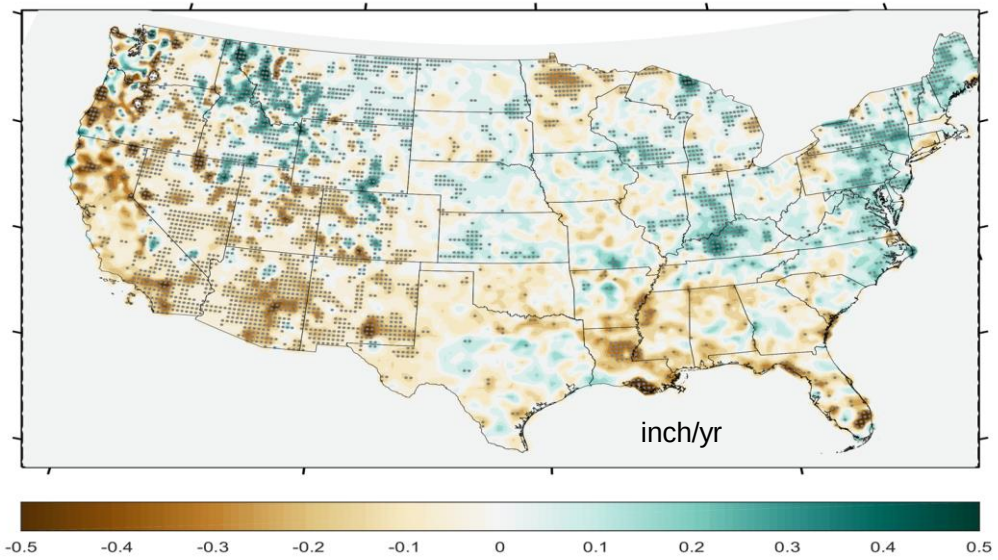


Precipitation associated with WT3 (trough) has been decreasing during 1980-2018, suggesting that WT3 (trough) may play an important role in driving the western droughts. In contrast, WT4 (ridge) plays a secondary role.



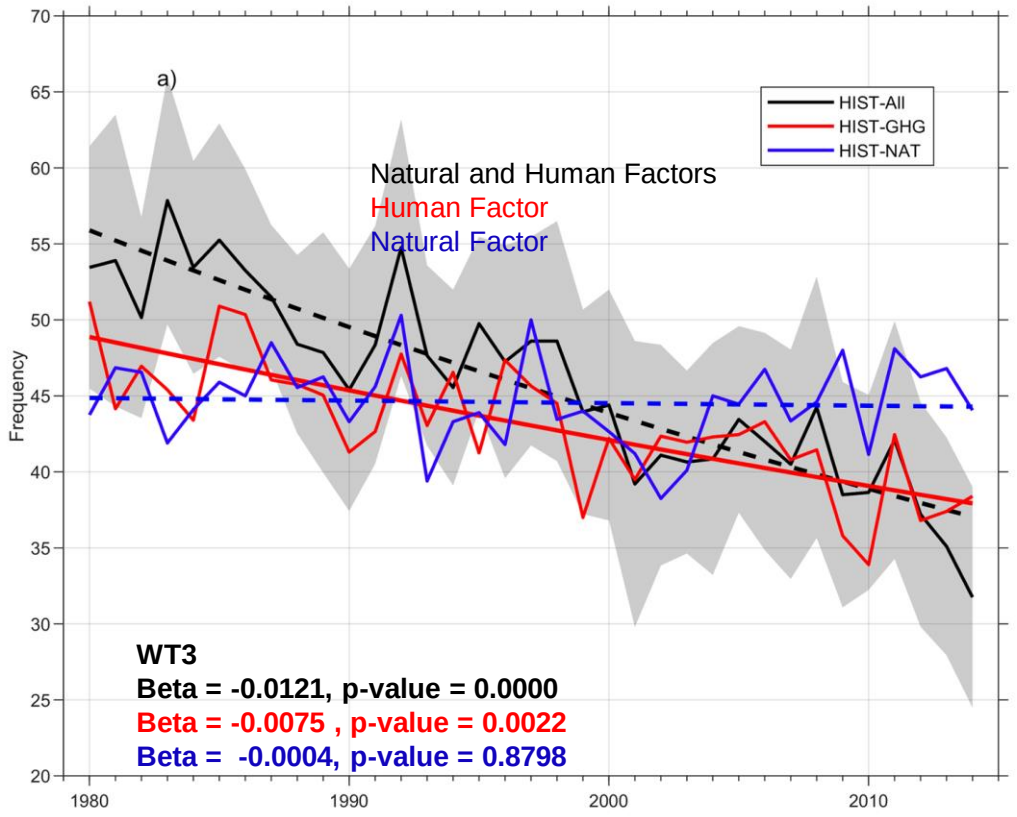
Less troughs,
Less precipitation

Trend in Annual Total Precipitation during 1980-2018

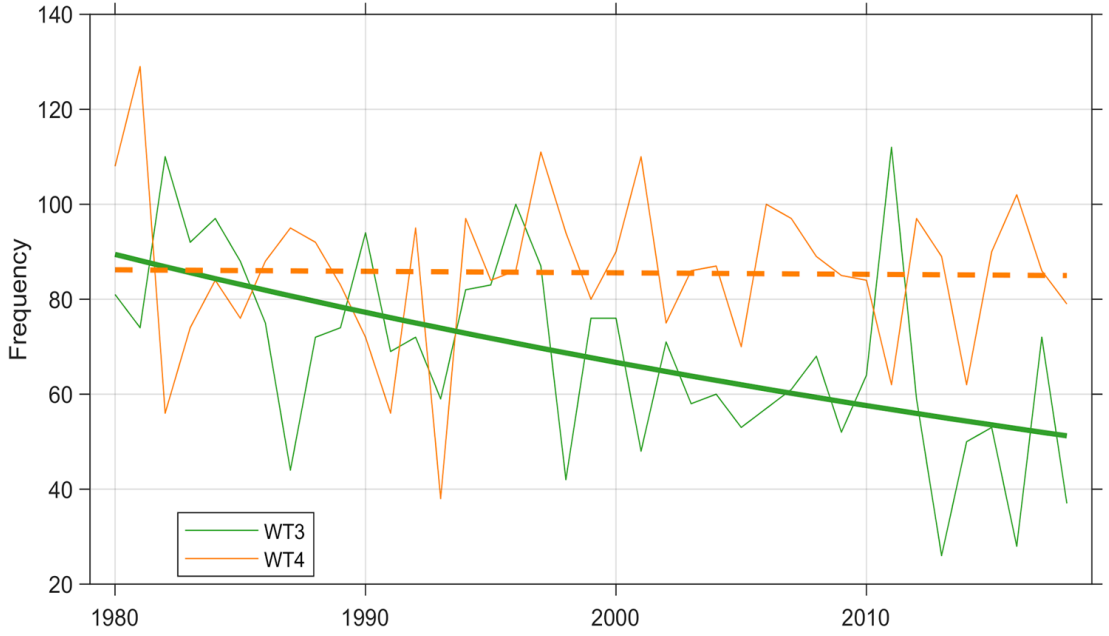


Attribution analysis using CMIP6 outputs suggests that the significant downward trend of WT3 (trough) was mainly driven by greenhouse gases, rather than natural forcing.

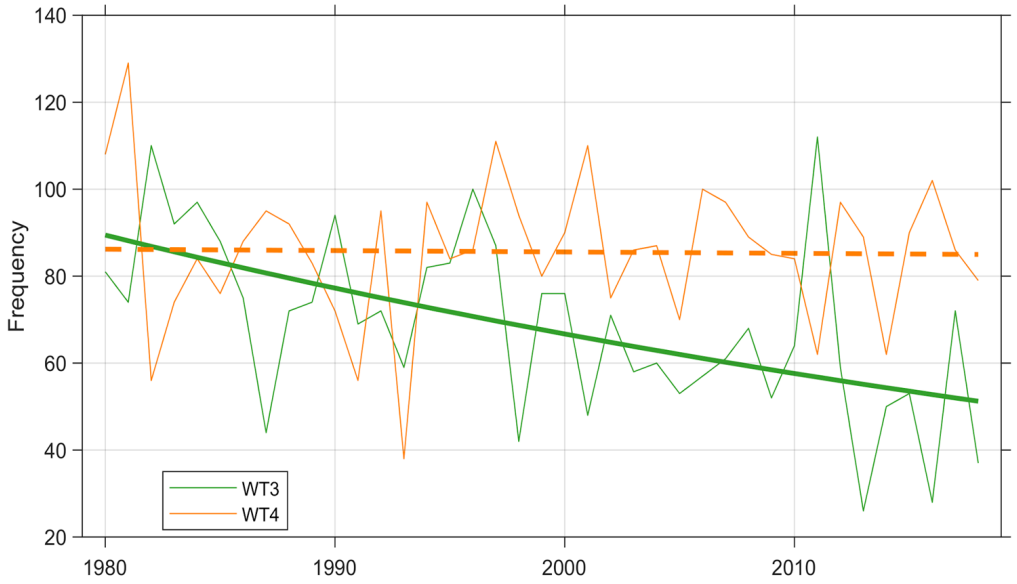
CMIP6 (WT3)

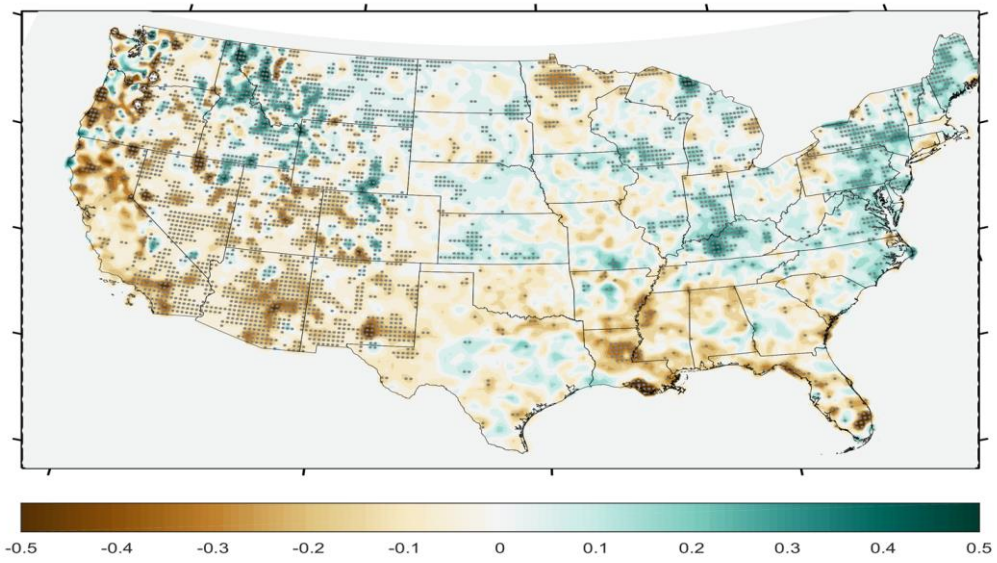


Observations (WT3 and WT4)



Summary





Precipitation associated with WT3 (trough) has been decreasing during 1980-2018, suggesting that WT3 (trough) may play an important role in driving the western droughts. In contrast, WT4 (ridge) plays a secondary role.