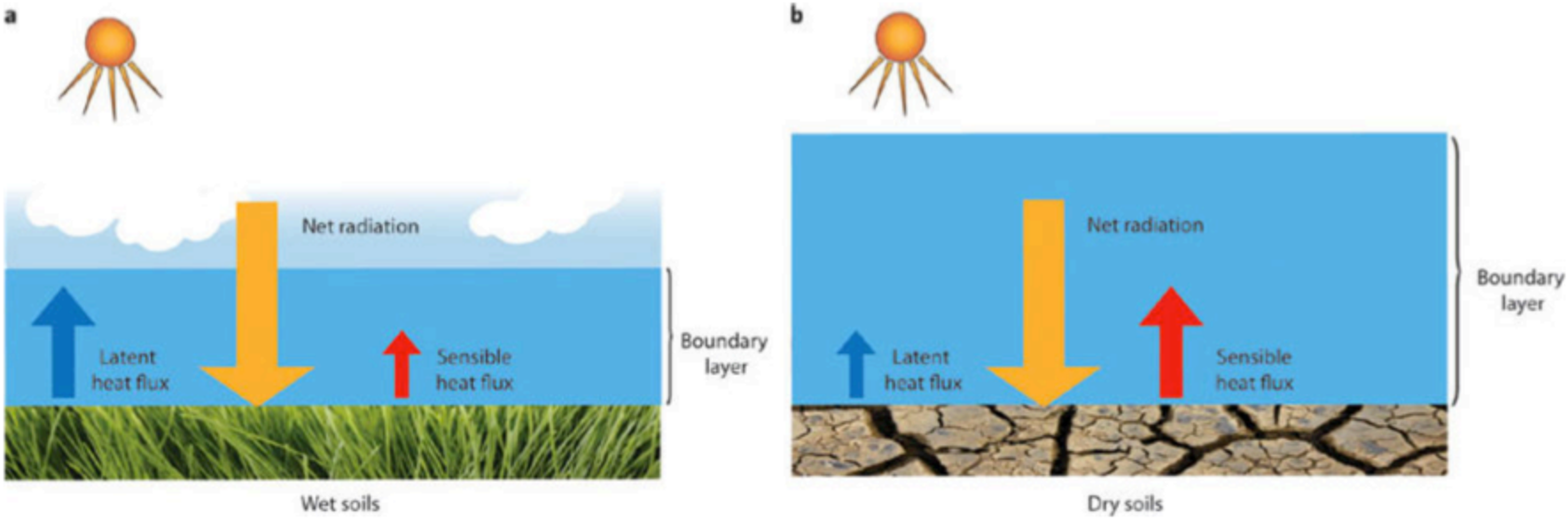
Accelerated Warming of Temperatures during Droughts

Felicia Chiang, Omid Mazdiyasni, Amir AghaKouchak
University of California, Irvine
GEWEX - Extremes and Water on the Edge
8 May 2018

Image: https://www.digitaltrends.com/cool-tech/heat-wave-prediction/

Motivation

- Concurrence of droughts and heatwaves have caused severe stresses in recent years



From Alexander 2010

Study Objectives

- What is the relationship between existing moisture conditions and temperature?
- Are long-term shifts in temperatures occurring during dry periods?
  - Have temperatures during droughts experienced changes in the 20th century? Projections in the 21st century?
  - Are land surface-atmosphere interactions and feedbacks contributing to conditional temperature shifts?
  - Are atmospheric moisture trends contributing to the temperature shifts?

Methodology

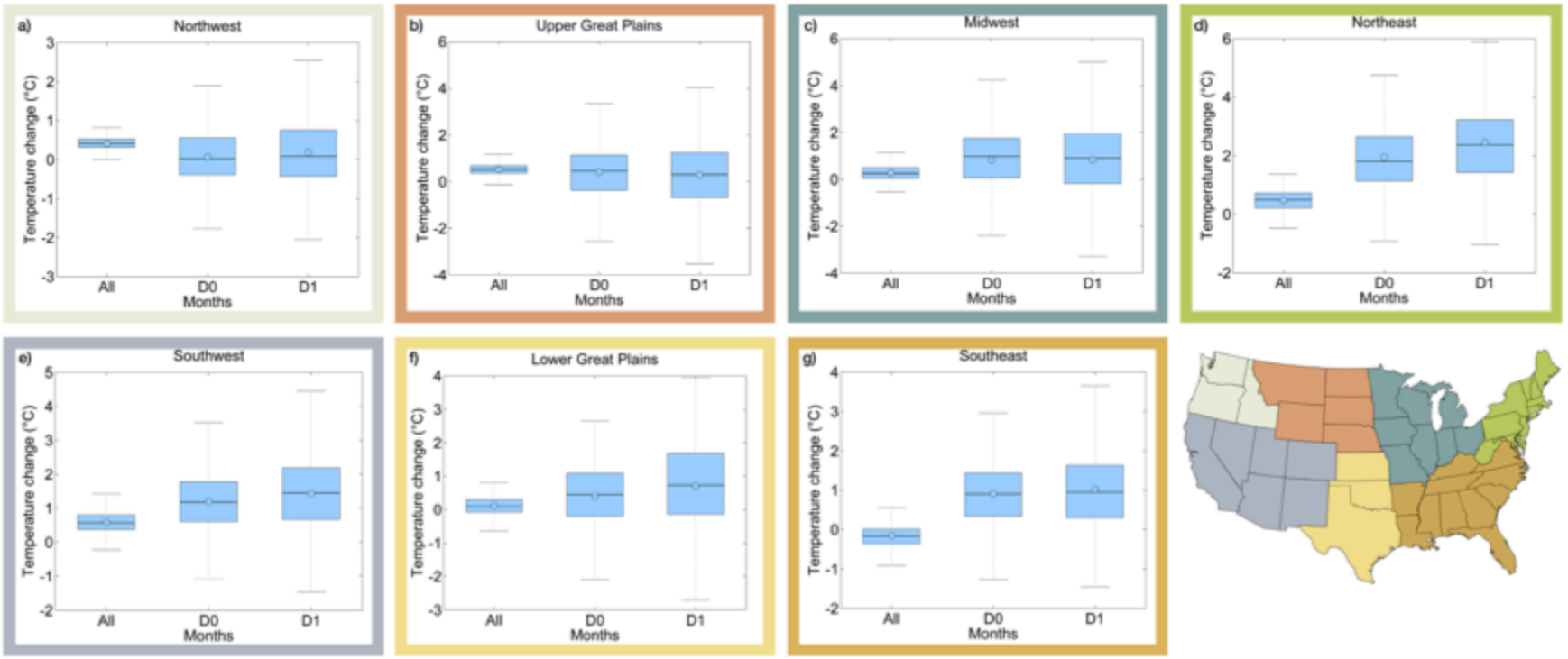
- Climatic Research Unit (CRU) TS 3.23 gridded climate dataset
- BCSD downscaled CMIP5 models (RCP 8.5 scenario)
- 6-month standardized precipitation index (SPI) – a measure of the relative meteorological dryness of each pixel in the area
- Split datasets into two periods to find the shift for each variable
  - Early and late 20th century
  - Late 20th and late 21st century

Methodology

Category	Description	Potential Impacts	SPI
Average climate	All months	Range of wet and dry	All values
D0 Threshold	Abnormally dry months	Slow growth of plants	< -0.5
D1 Threshold	Moderate drought months	Some damages to crops, pastures, low levels of streams, developing water shortages	< -0.8

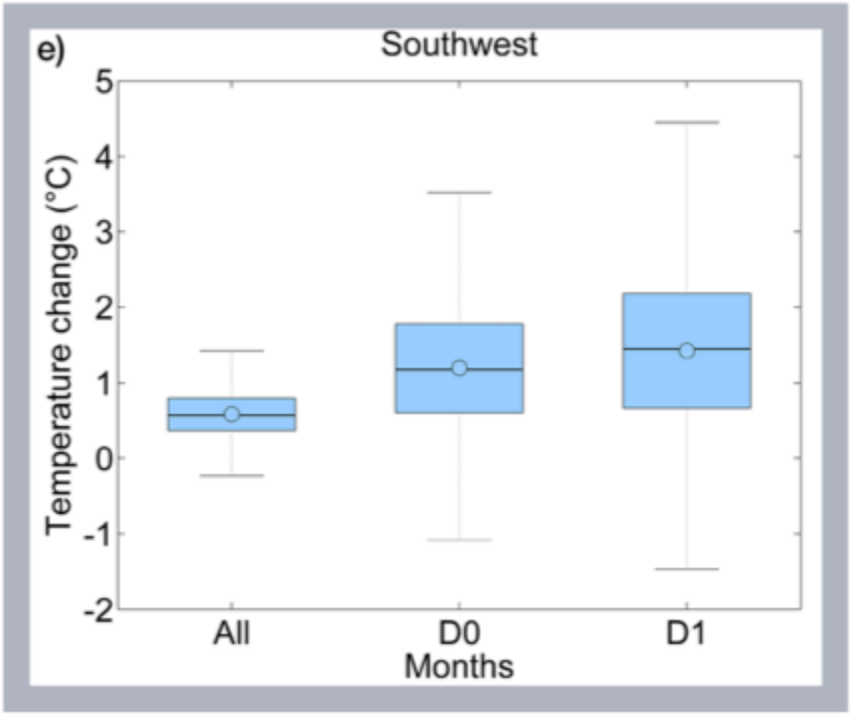
From U.S. Drought Monitor

Observed Temperature Shifts (Early vs. Late 20th Century)



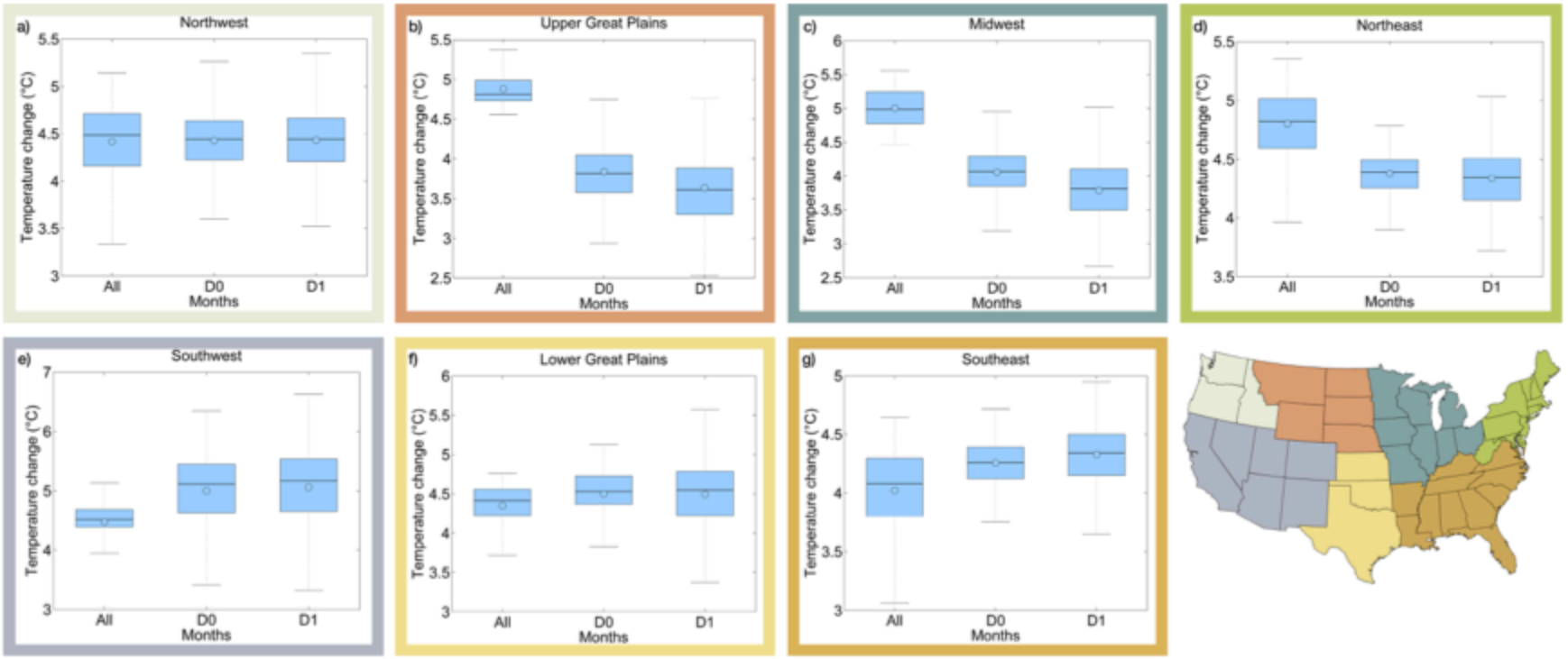
From Chiang et al., Under Revision

Observed Temperature Shifts (Early vs. Late 20th Century)



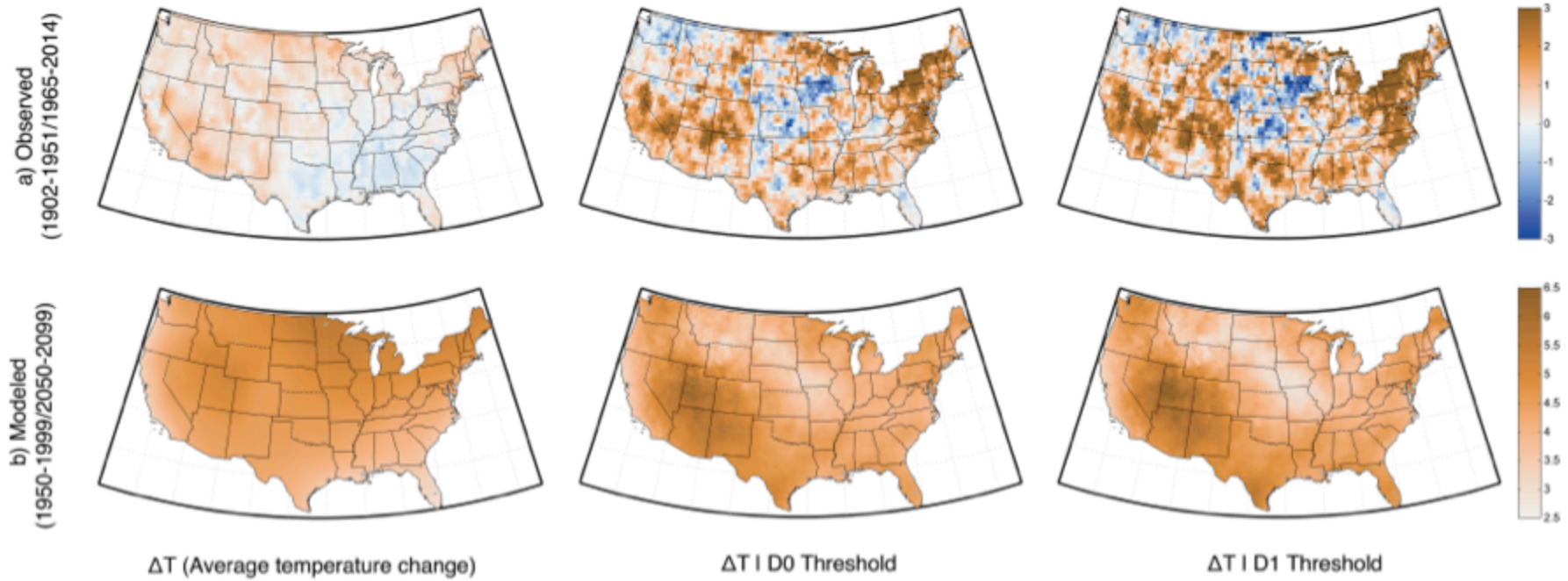
From Chiang et al., Under Revision

CMIP5 Projected Temperature Shifts (Late 20th vs. Late 21st Century)



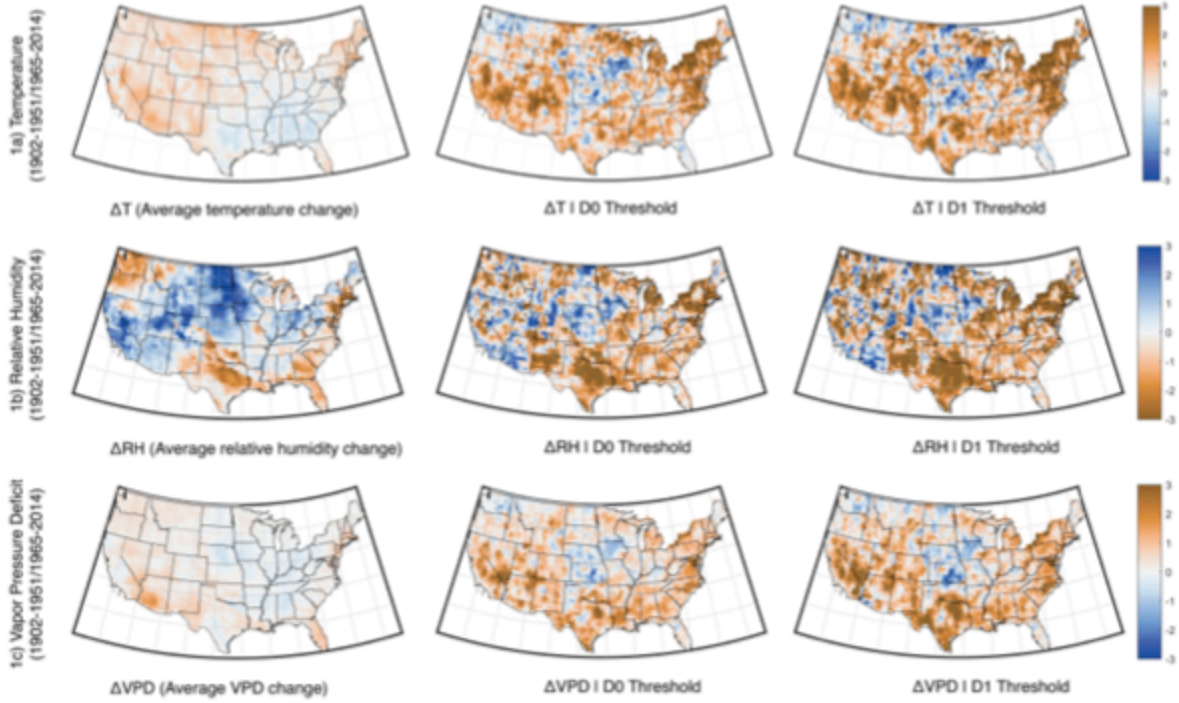
From Chiang et al., Under Revision

Gridded Average Temperature Shifts



From Chiang et al., Under Revision

Concurrent Shifts in Temperature, Relative Humidity, Vapor Pressure Deficit



From Chiang et al., Under Revision

Key Points

- Droughts have warmed faster than the average climate in the southern and eastern U.S.
- Concurrent changes in atmospheric moisture have occurred in regions experiencing amplified warming under droughts
- Both temperature and atmospheric moisture shifts are interacting and amplifying under our defined drought conditions
- Meteorological drought strengthens the correlation between changes in atmospheric moisture and temperature

Impacts of Work

- Under future projections of amplified temperature shifts under droughts, occurrence of concurrent extremes will likely increase
  - Magnified impacts in comparison to individual extremes
- Dry lands are anticipated to become more widespread under climate change, widening the projected temperature impact
- What are the ramifications of these conditional temperature shifts?

Thank you!