Climate Change and Drought in a Warmer World

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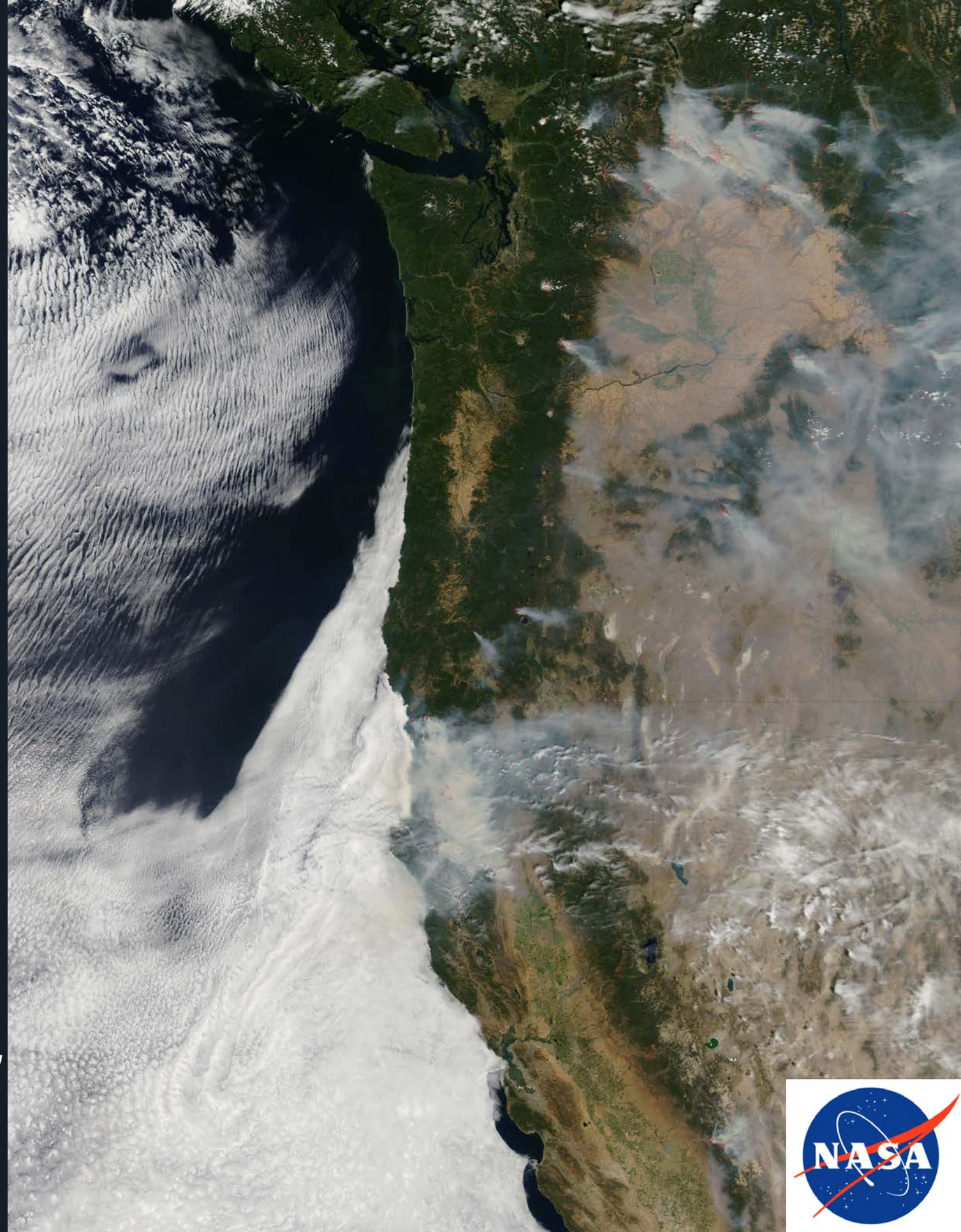
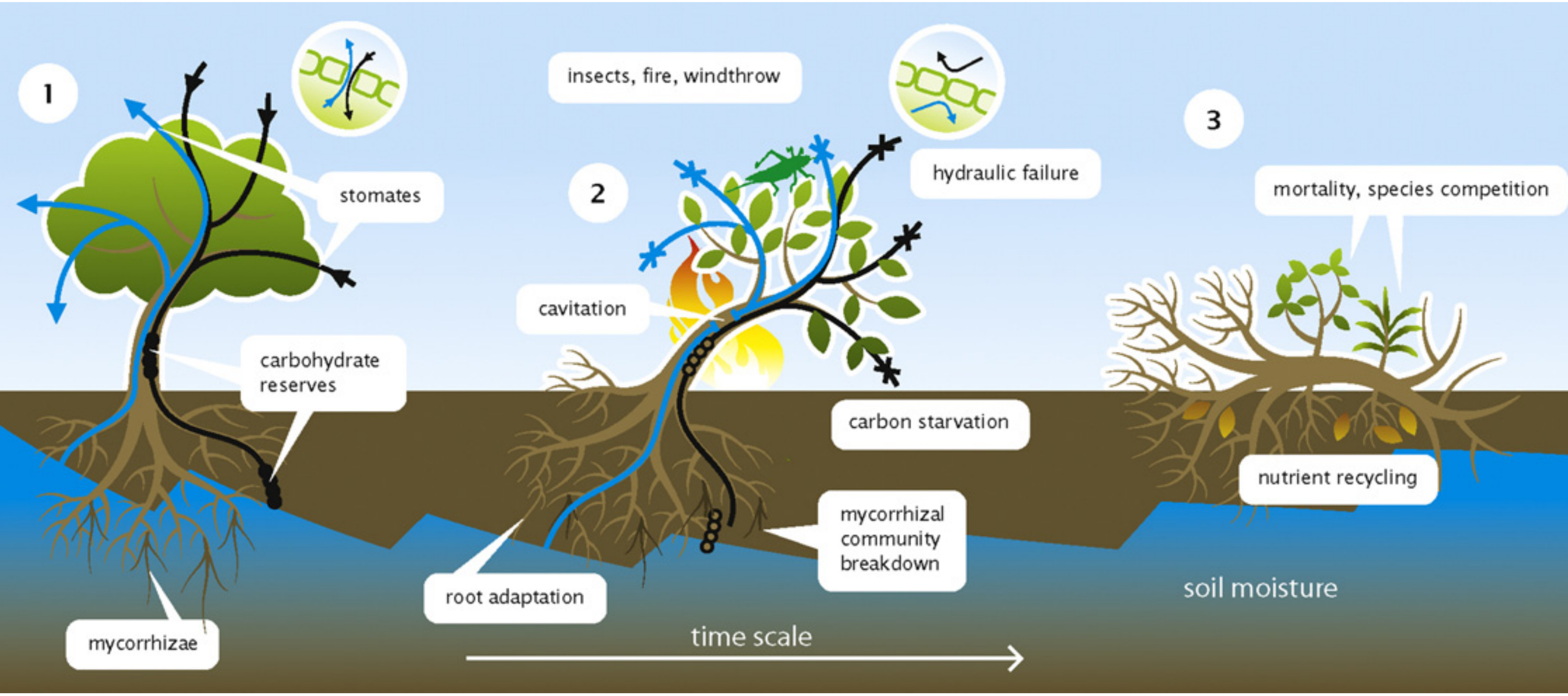




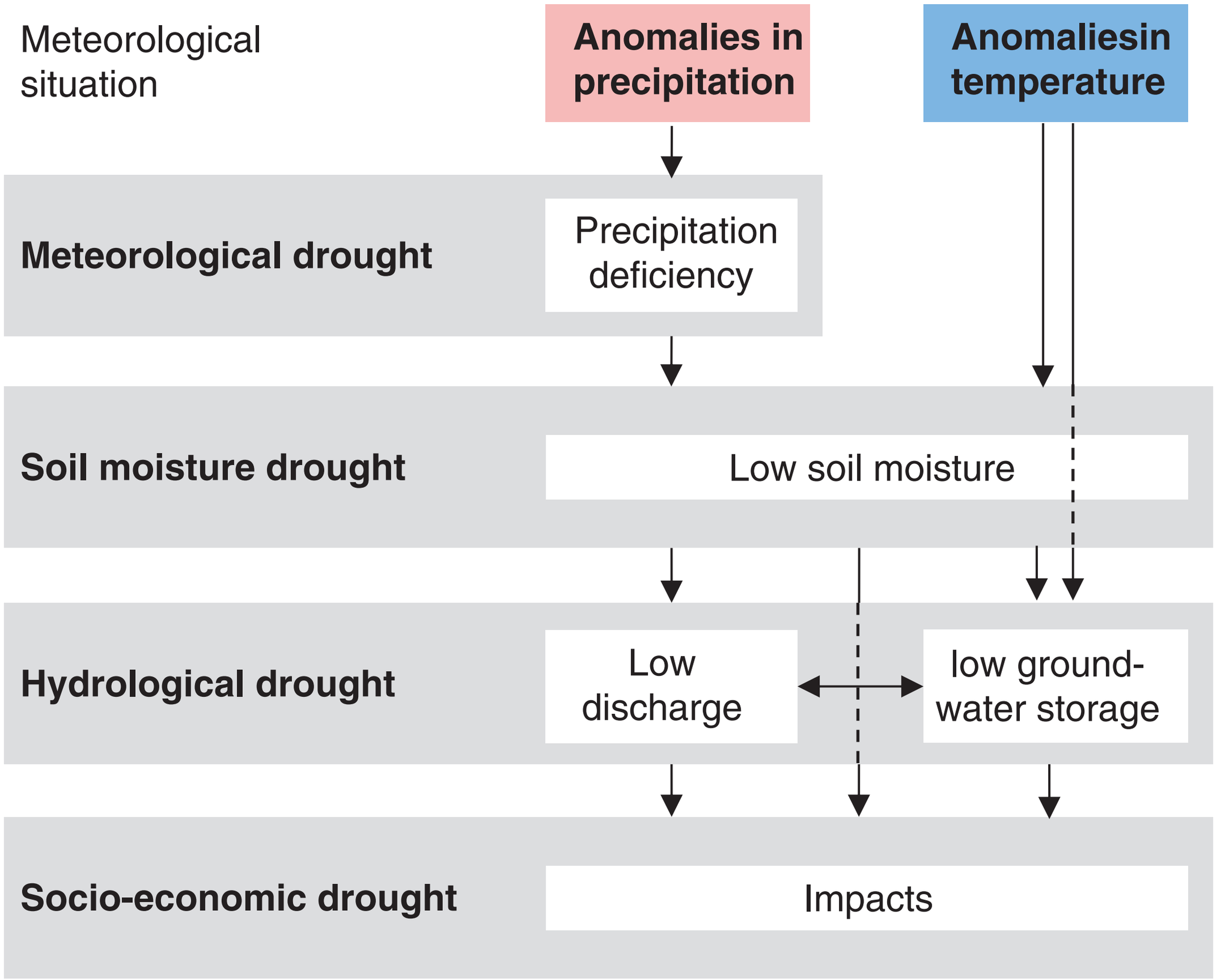
Drought Impacts

van der Molen, et al (2011): Agricultural and Forest Meteorology

66 million trees killed since 2010 in California, as of August 2016

http://www.nbcbayarea.com/news/local/Bark-Beetle-Outbreak-Kills-Millions-of-Trees-Across-California-389122102.html

Drought is NOT just precipitation

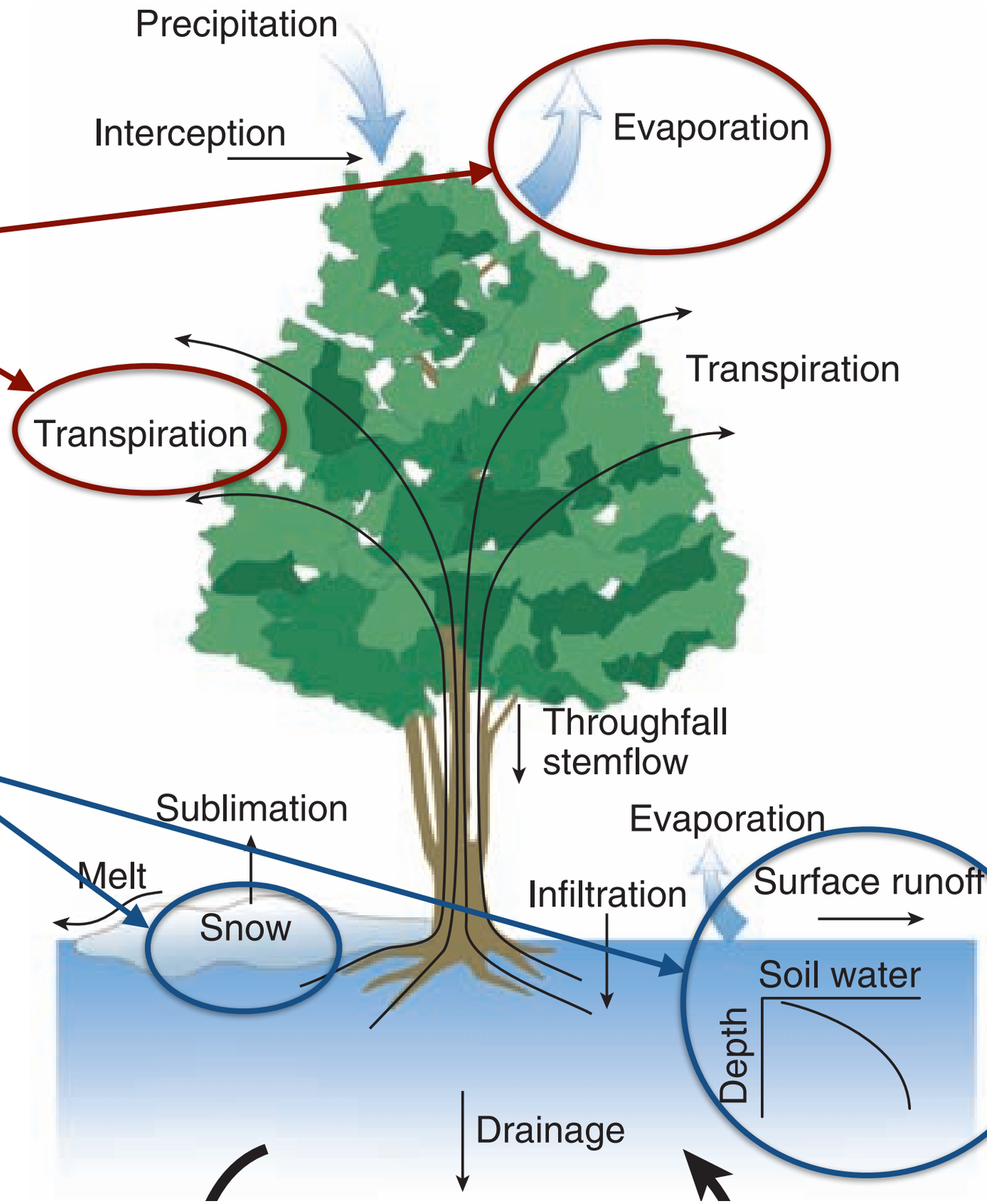


Van loon (2016), WIREs Water

The Water Budget

warming means more of this…

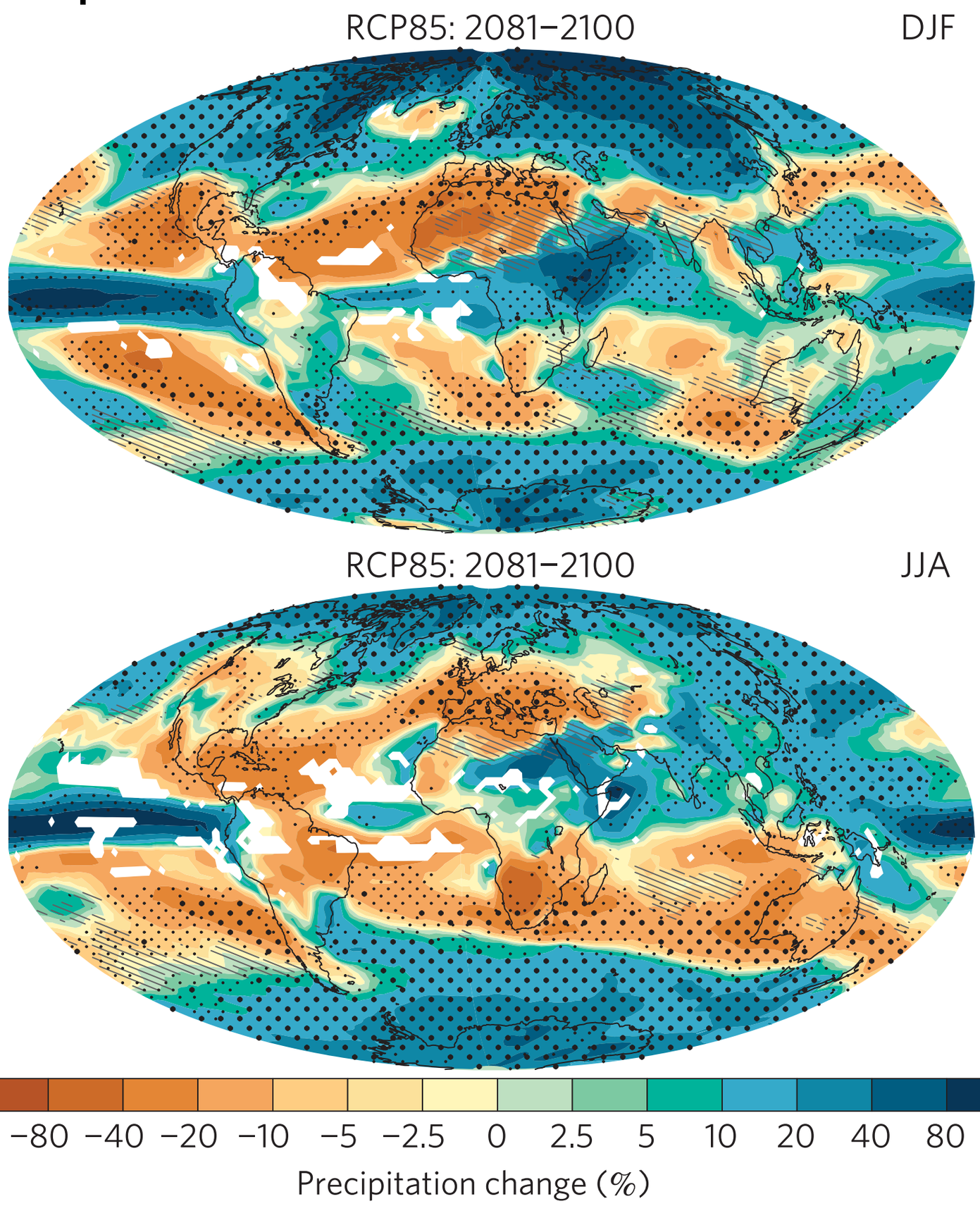
…and less of this



Precipitation

Heterogeneous precipitation response

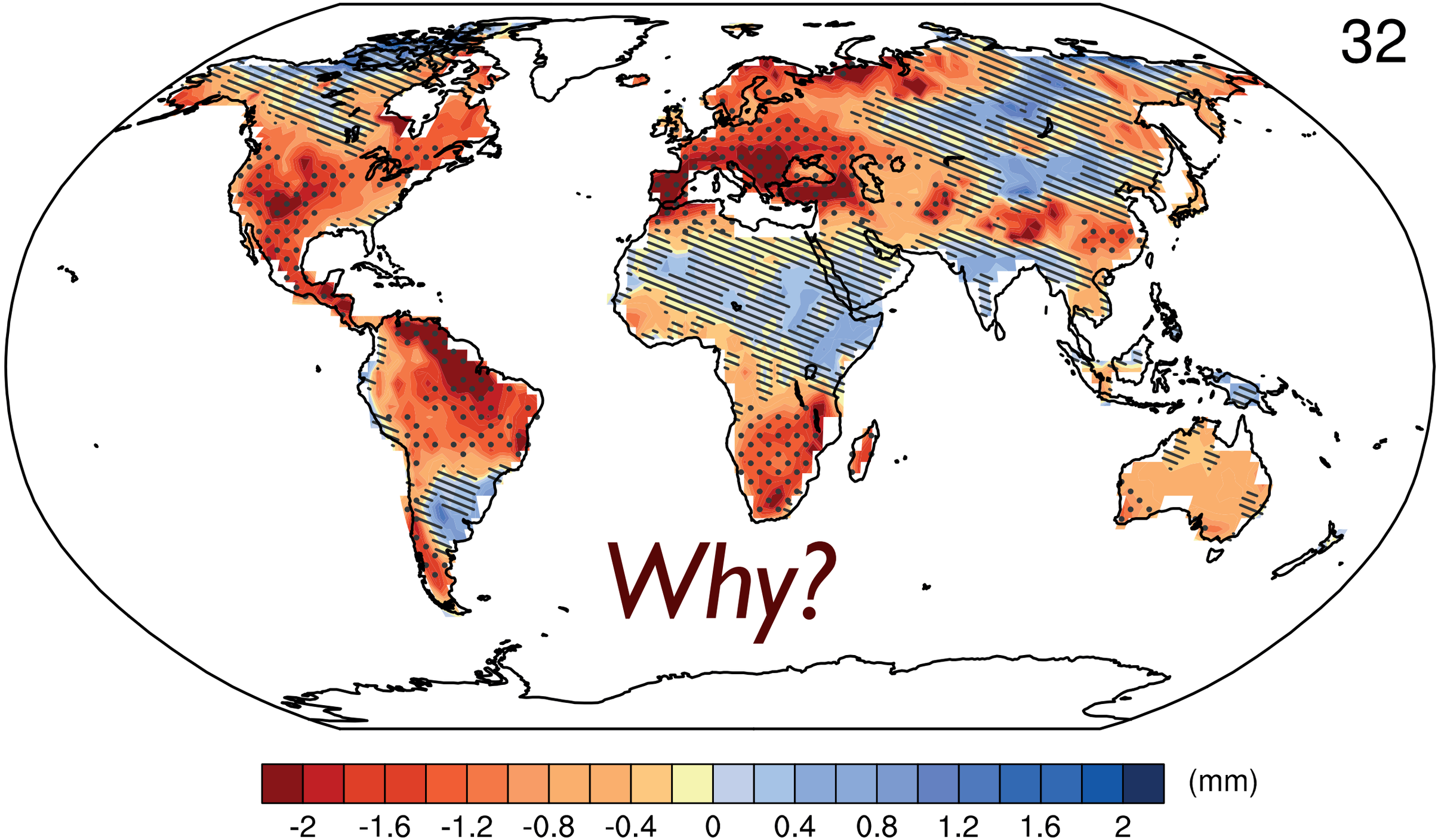
Low confidence in some regions



Knutti & Sedlacek (2013), Nature

Soil moisture changes much more widespread

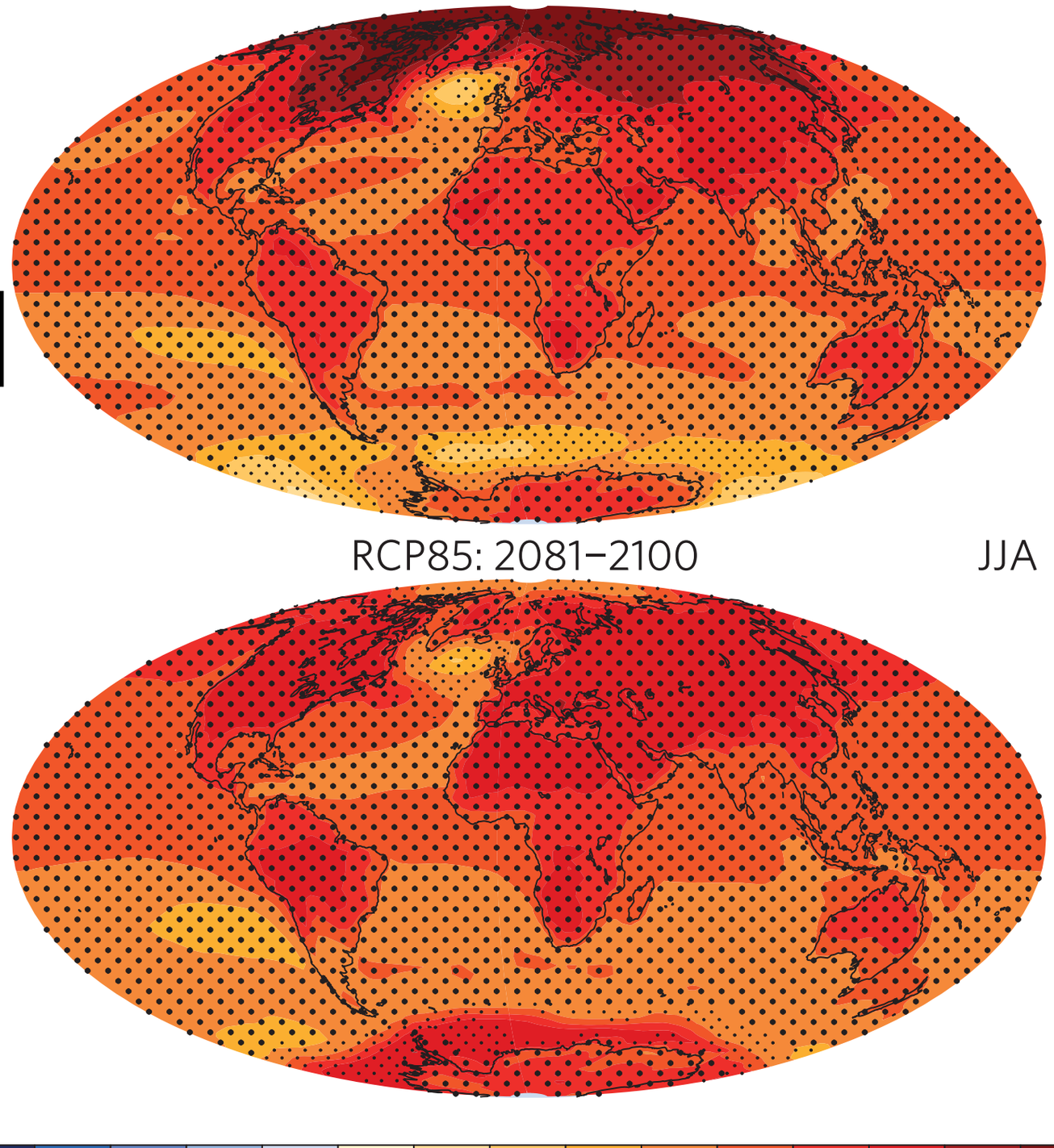
RCP8.5



IPCC, Fifth Assessment Report (Chapter 12)

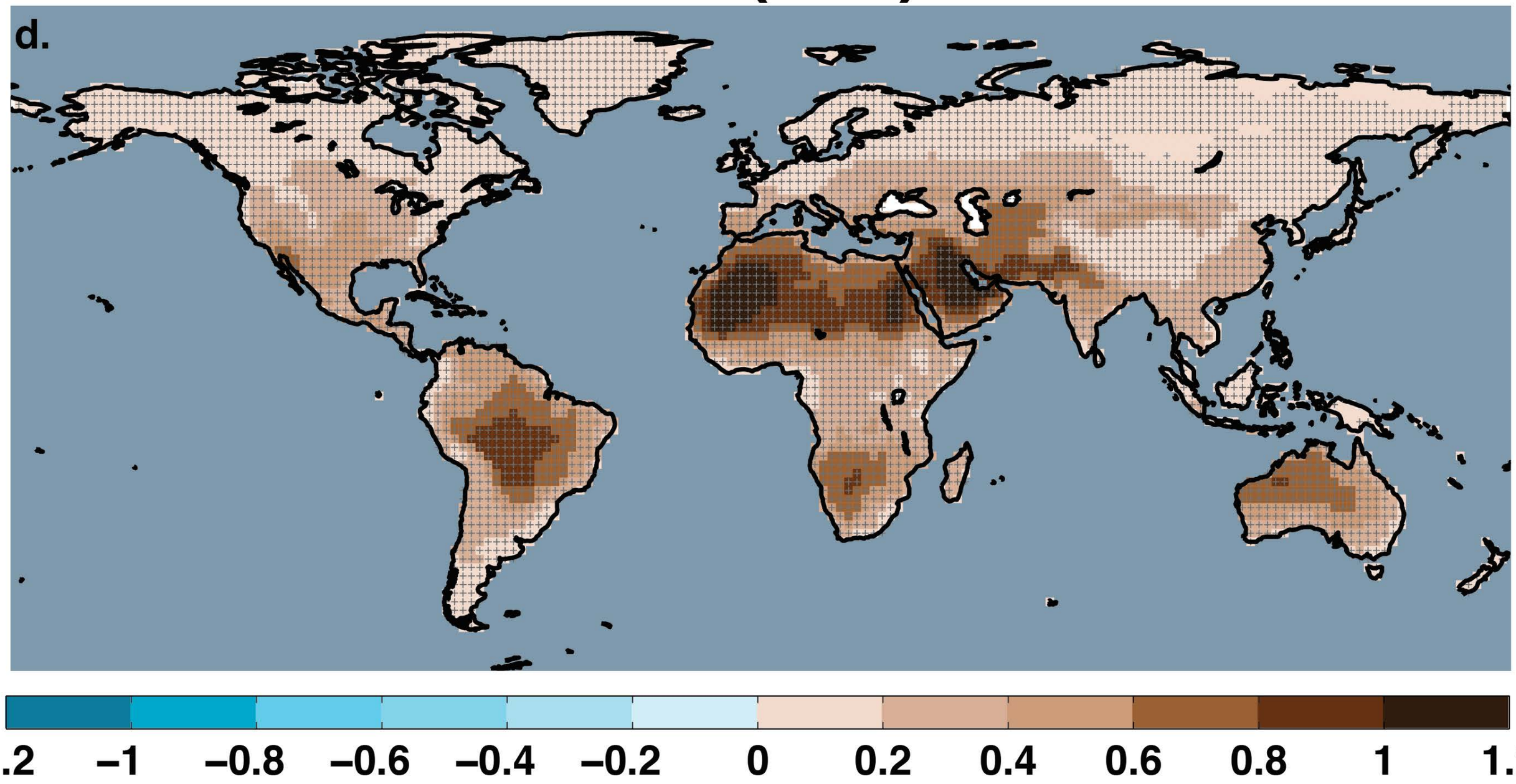
Temperature

Widespread and robust warming, all seasons



Knutti & Sedlacek (2013), Nature

ΔVPD (kPa)

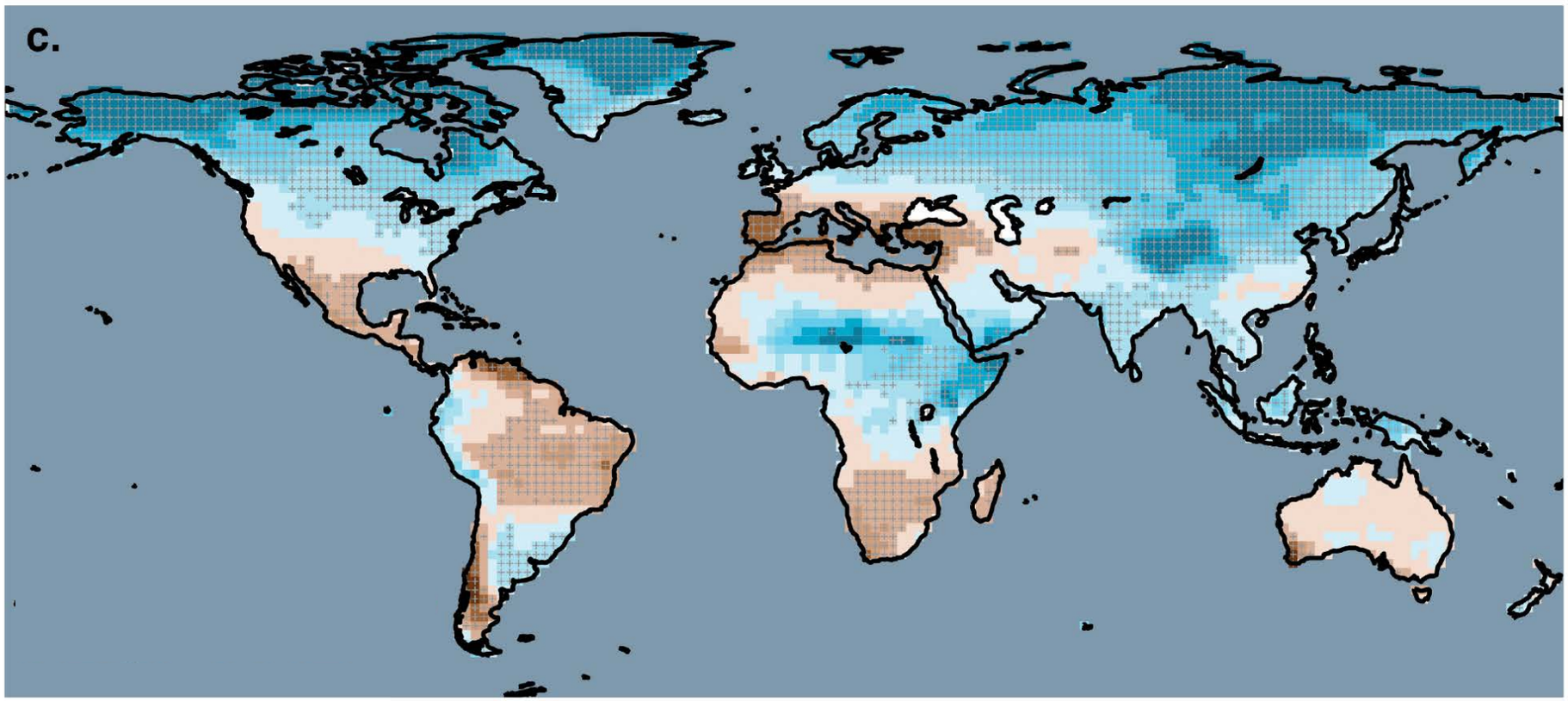


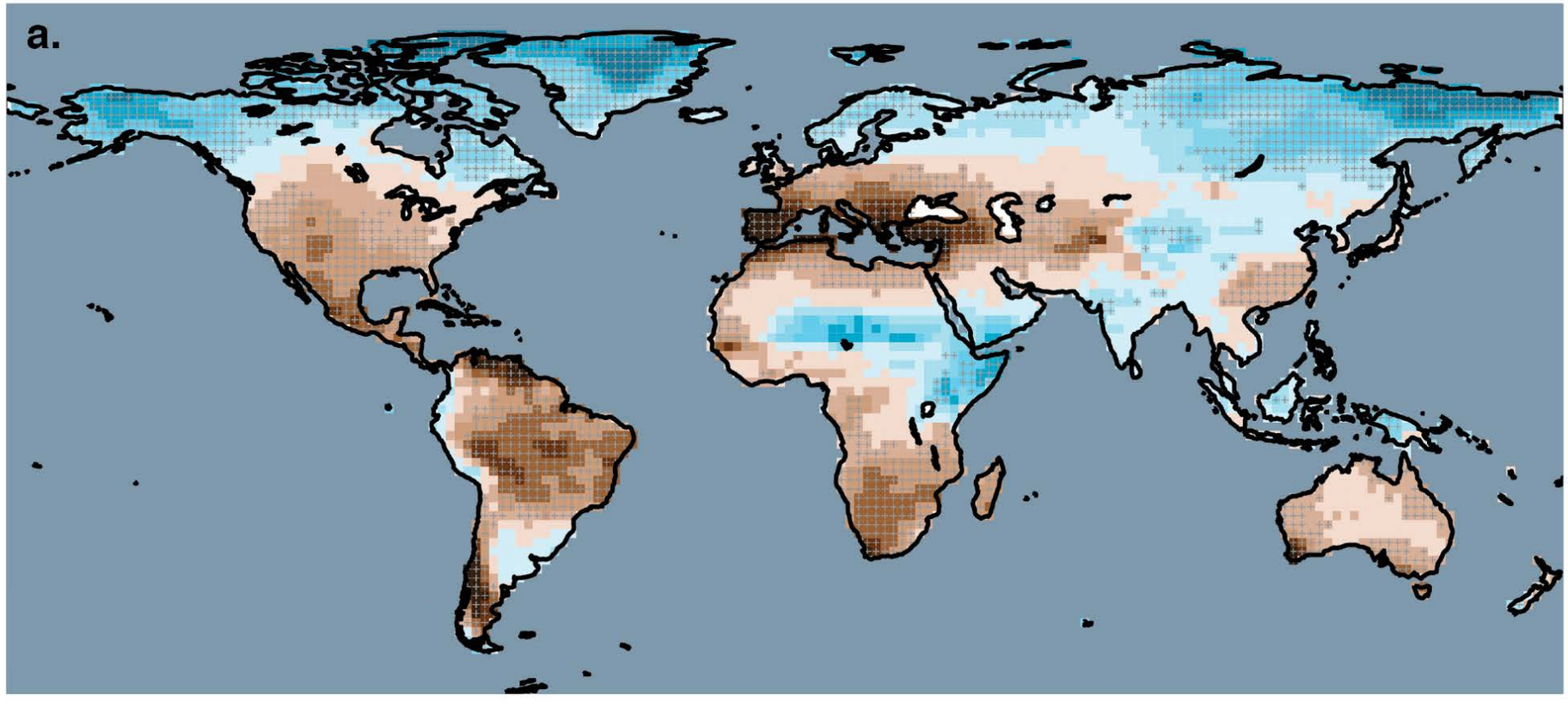
Warming increases atmospheric demand for water

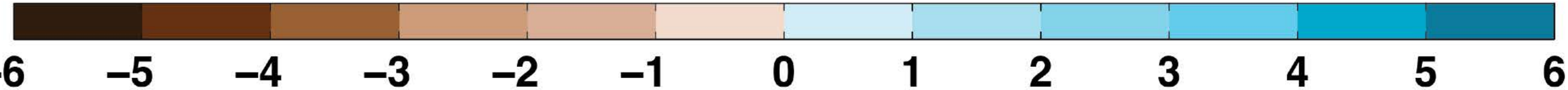
PDSI
(2080-2099)

Δ*P*

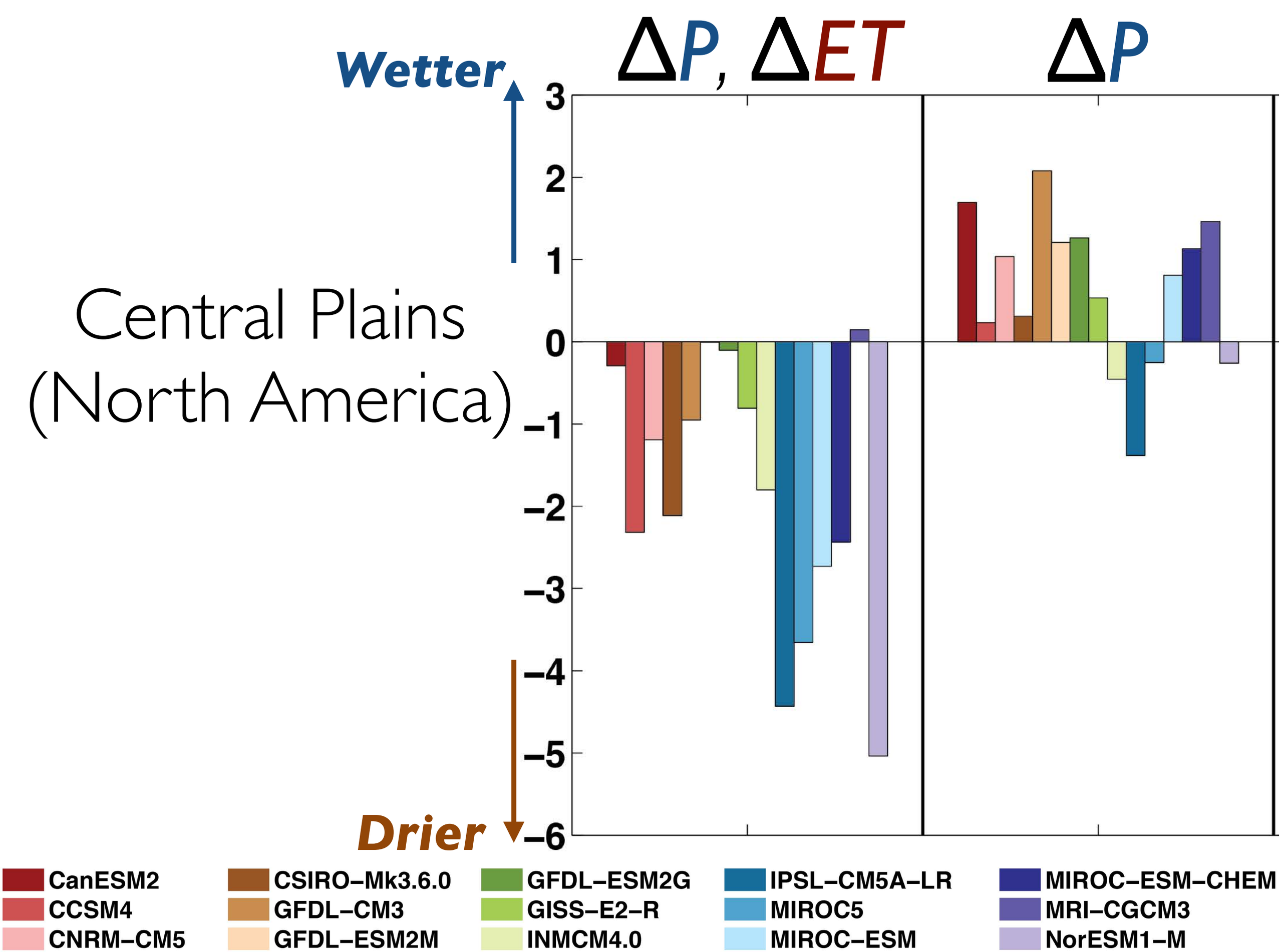
Δ*P*,
Δ*ET*



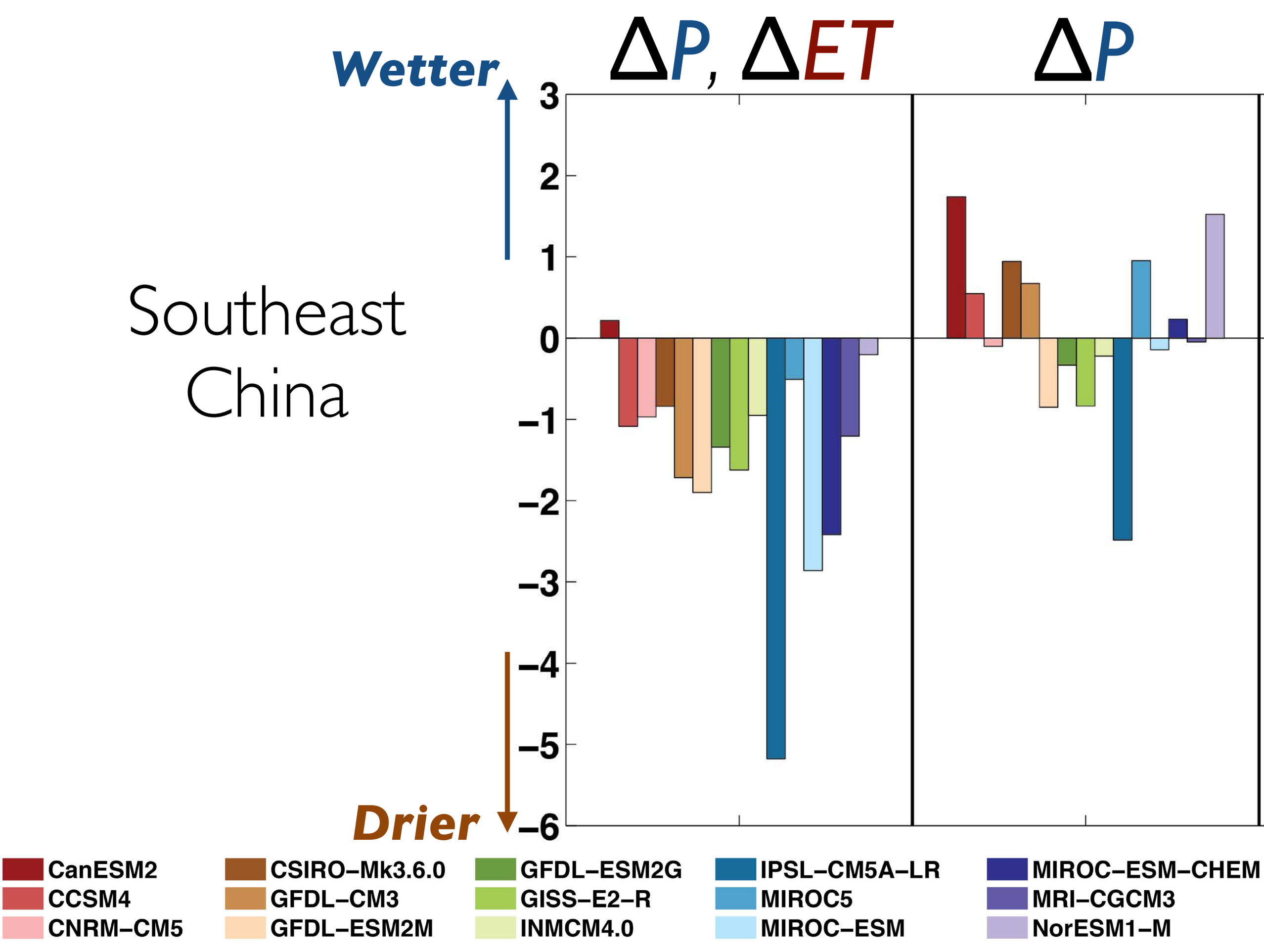




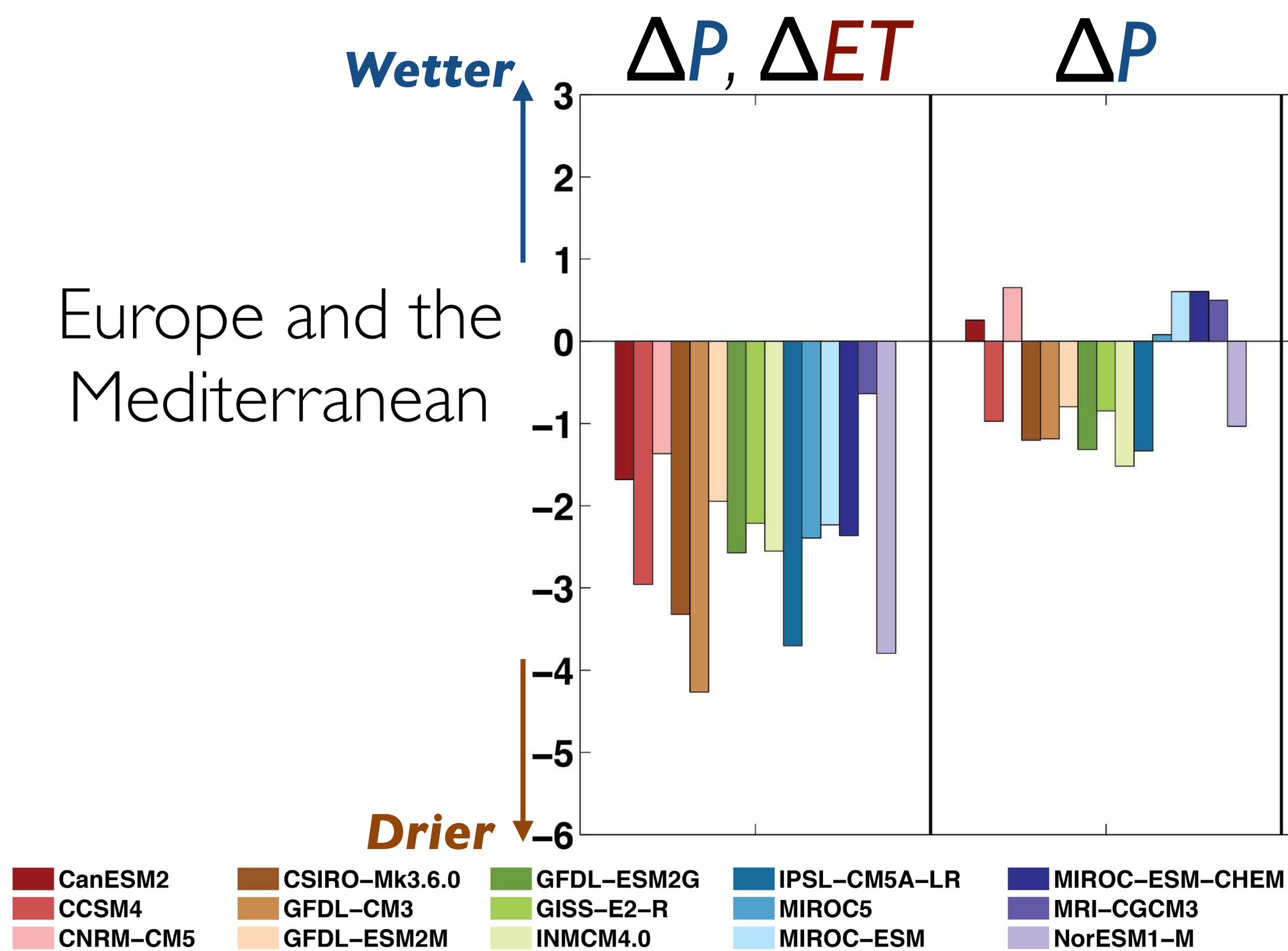
Central Plains (North America)



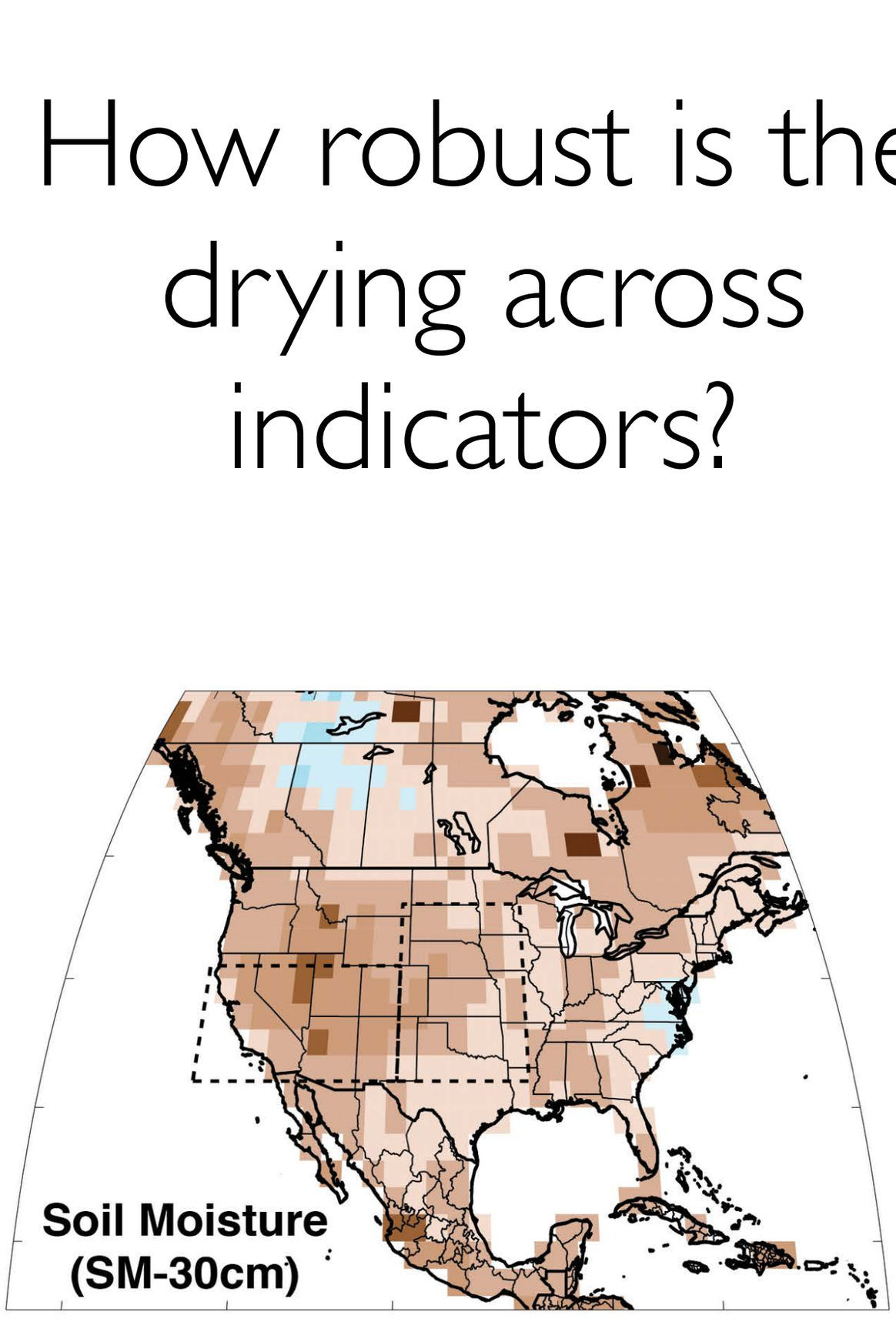
Southeast China

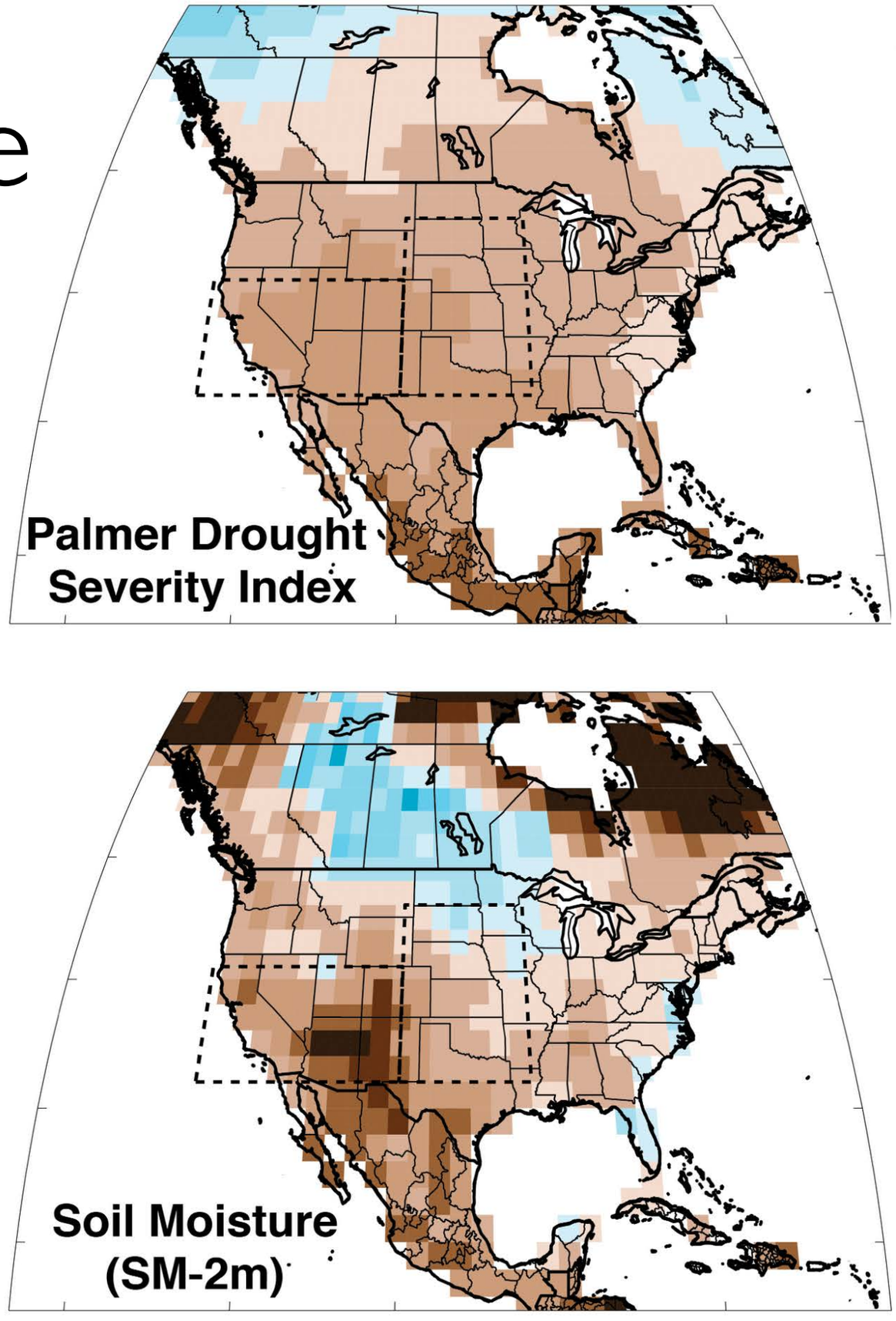


Europe and the Mediterranean

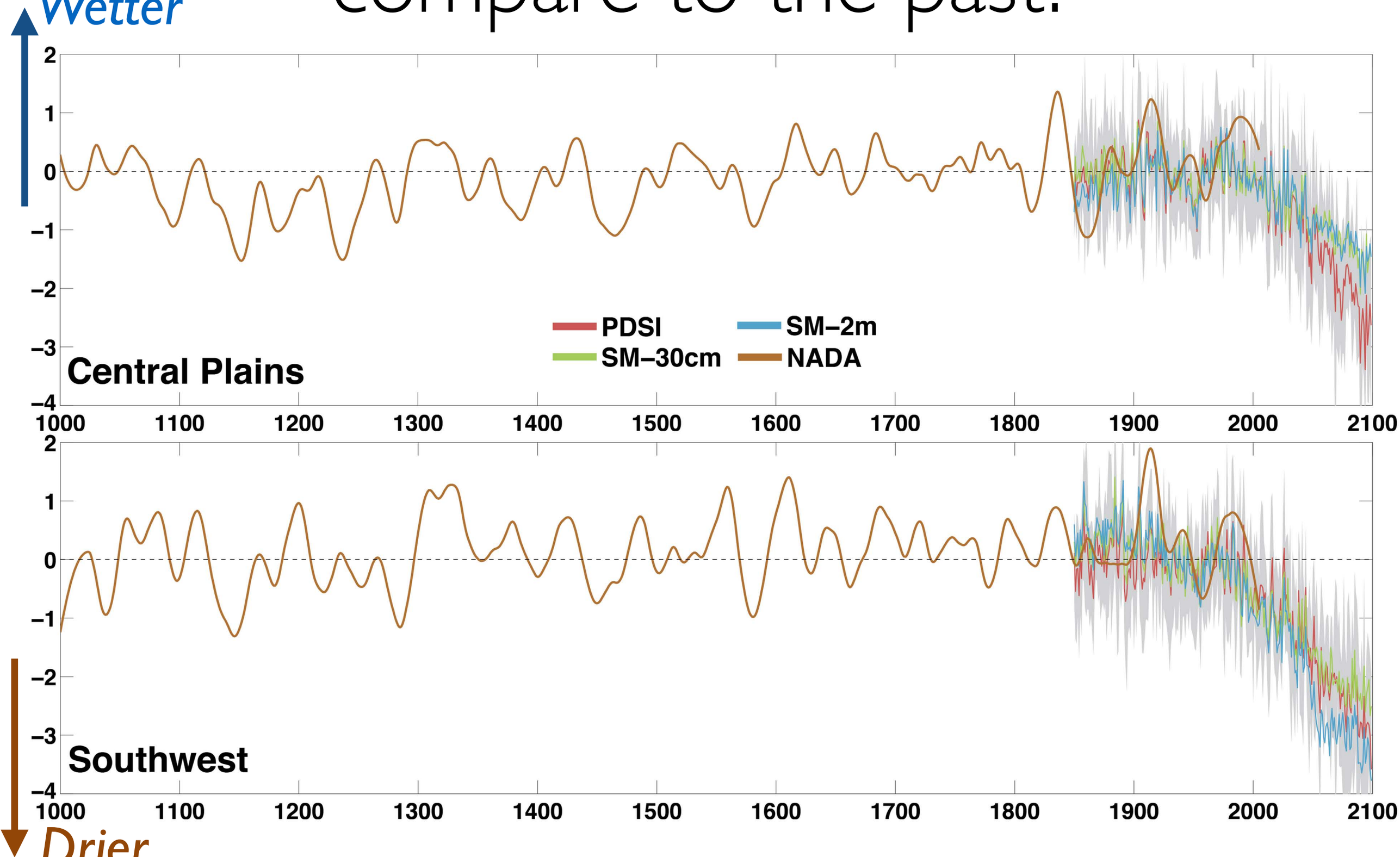


How robust is the drying across indicators?





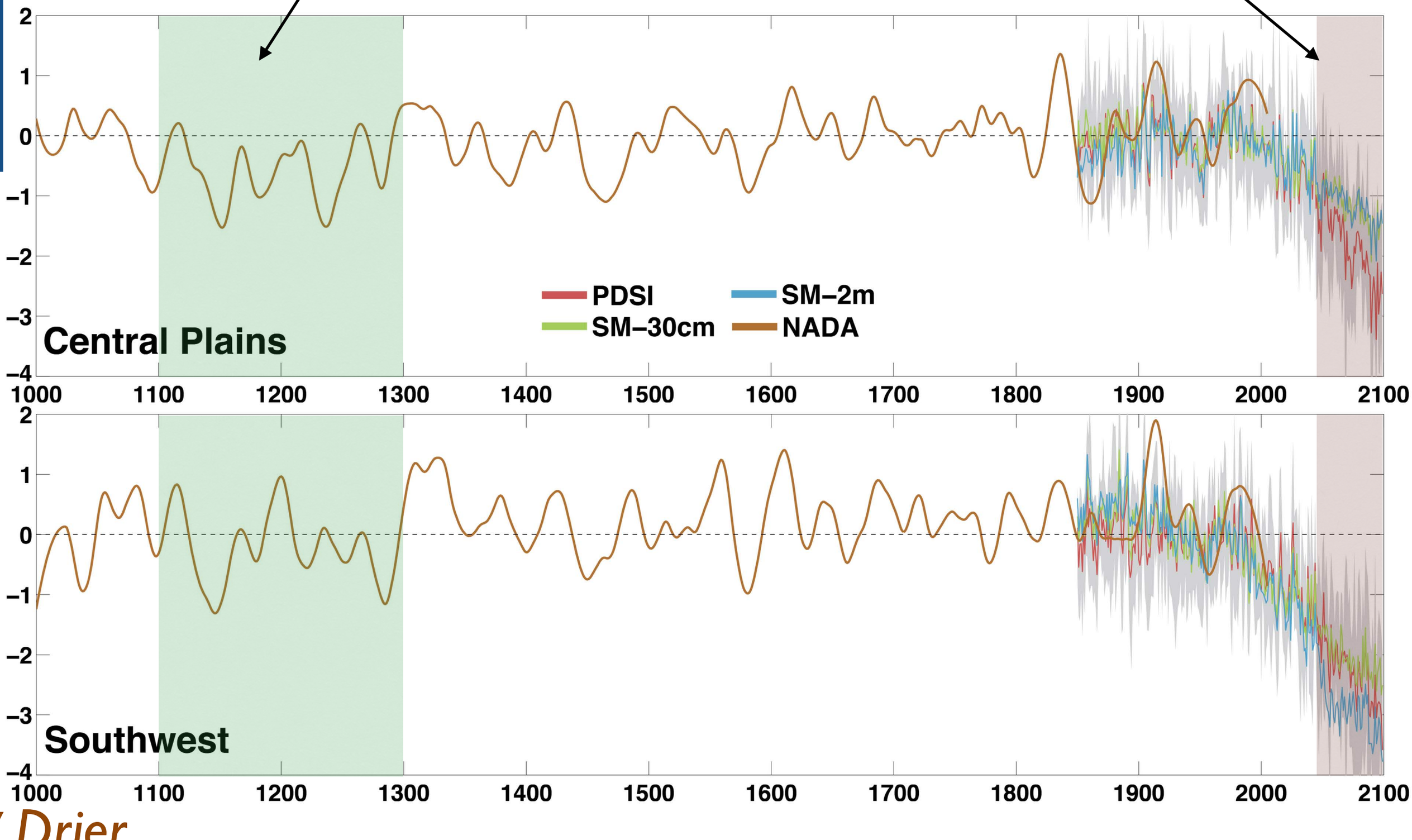
How will future droughts compare to the past?



Megadrought Centuries

2050-2099

Wetter



Drier

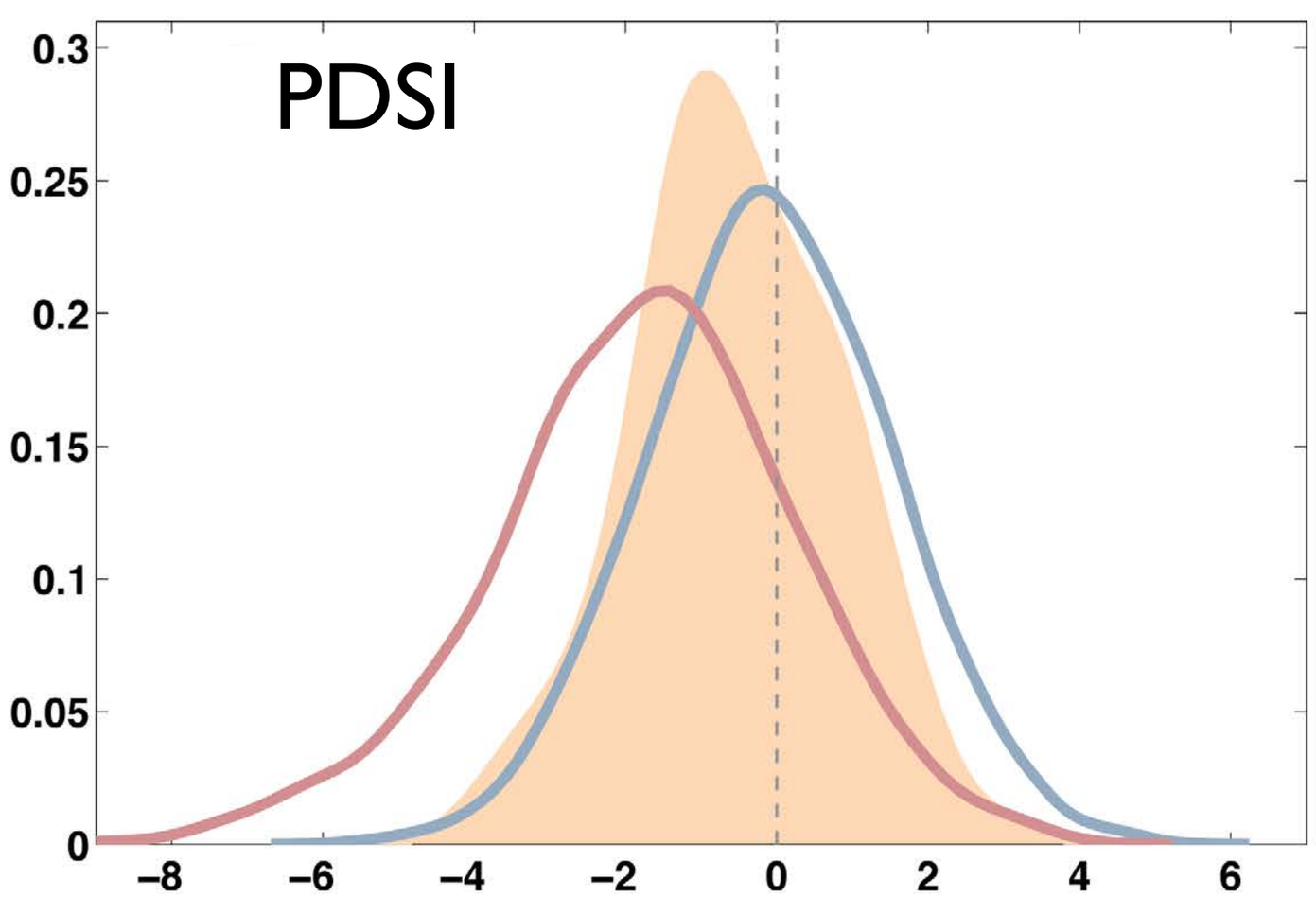
Central Plains

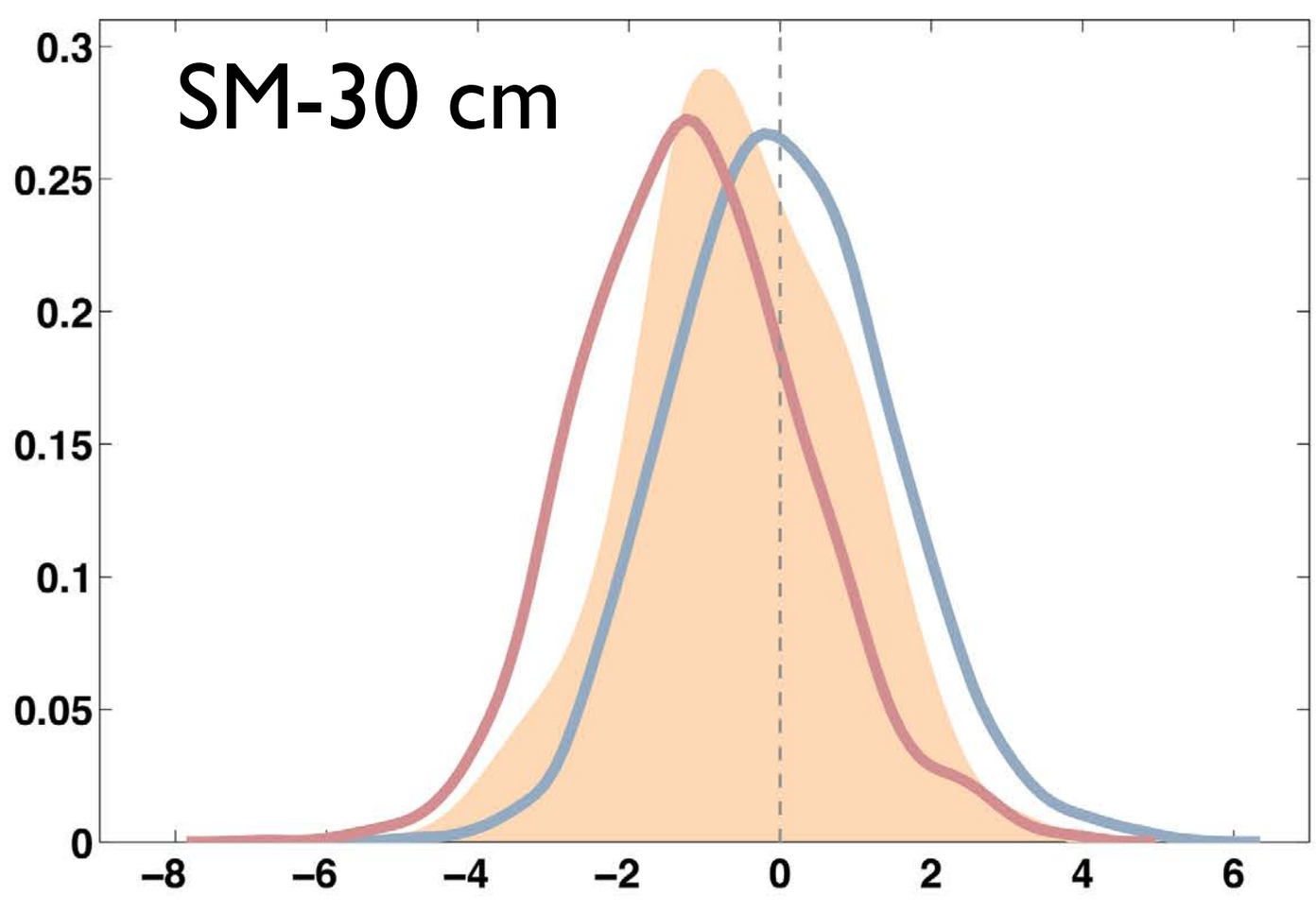
Most drying from increased evaporation

NADA (1100–1300)

Model (1850–2005)

Model (2050–2099)





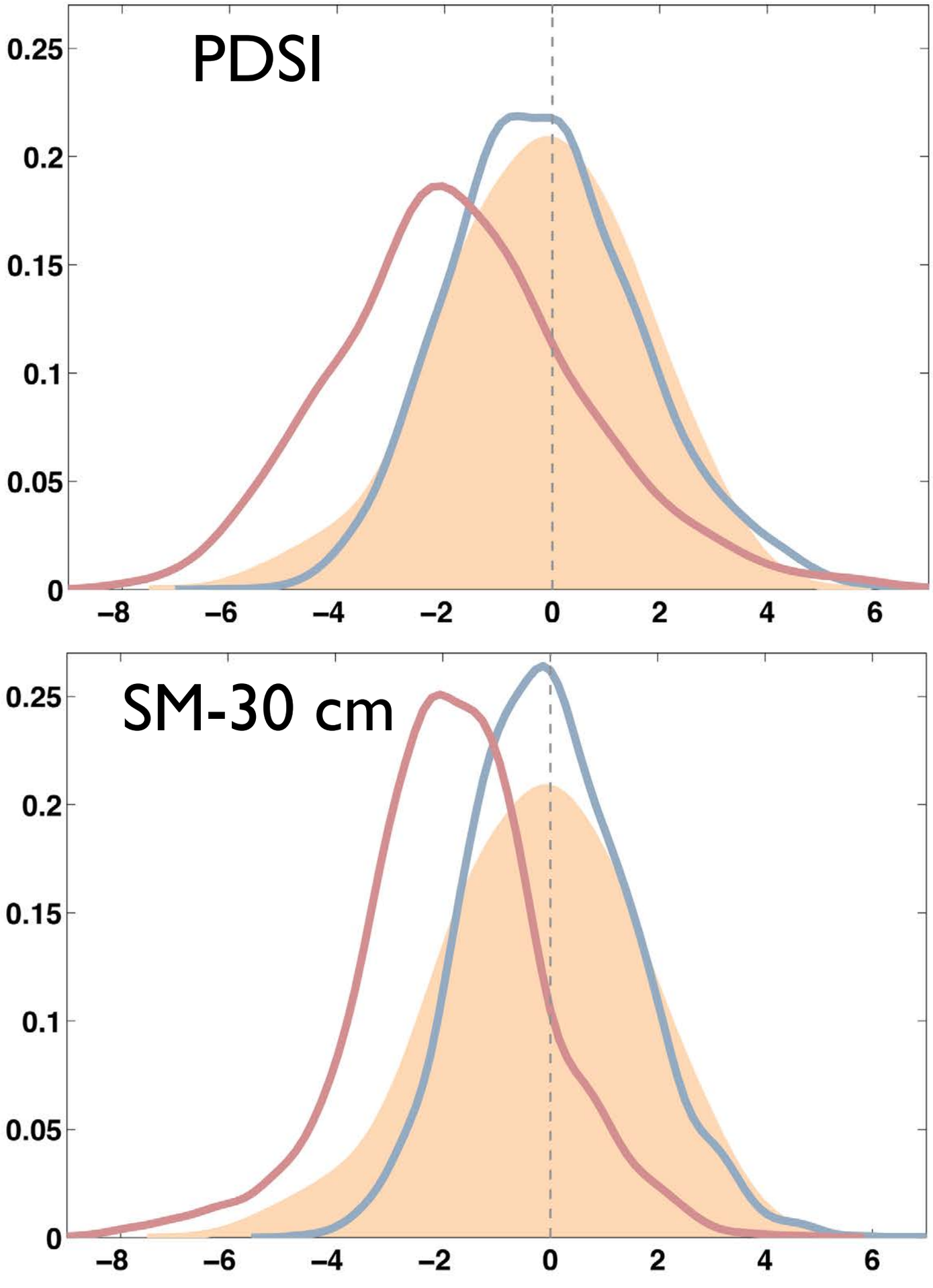
Southwest

Doubly hit by increased evaporative demand AND reduced precipitation

NADA (1100–1300)

Model (1850–2005)

Model (2050–2099)

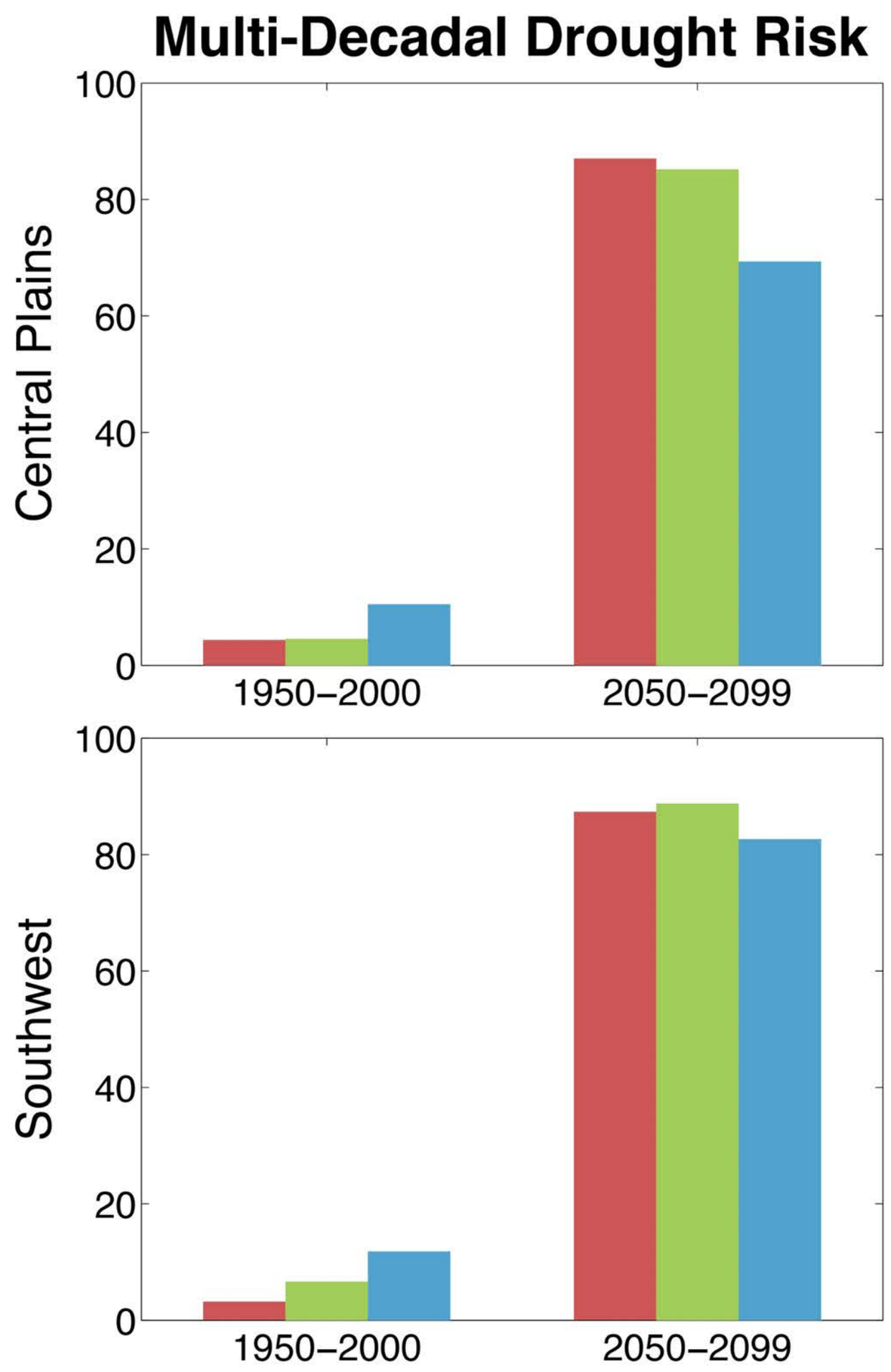


21st Century Risk of a multidecadal (>35 years) drought increases from

10-15%

to

>80%



Best Practices for Climate Models & Drought

Consider your drought variable.

What do you care about? Average aridity?
Recurrence intervals? Drought severity?

Embrace uncertainty across models,
regions, and indicators.

Think probabilistically, not deterministically.

Thank You

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