

Near term rapid climate change: The case of imminent drying of the U.S. Southwest

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copies of text and figures at:

<http://www.ldeo.columbia.edu/res/div/ocp/drought/>

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(opinions mine, not theirs)

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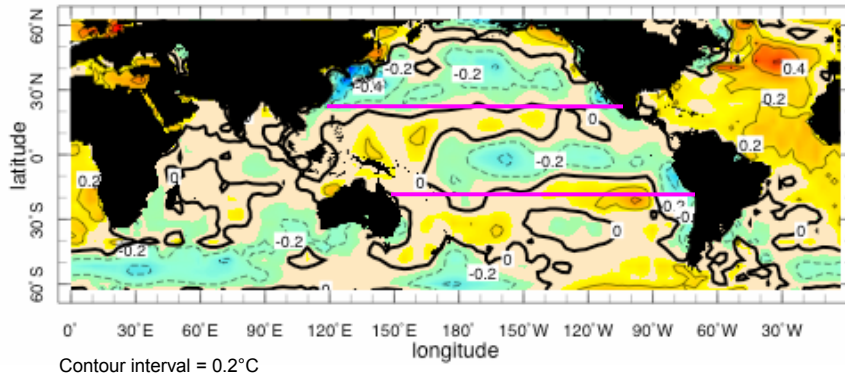
The Dust Bowl drought of the 1930s ...



Was caused by ...

Sea Surface Temperature Anomaly 1932-1939

OBSERVED

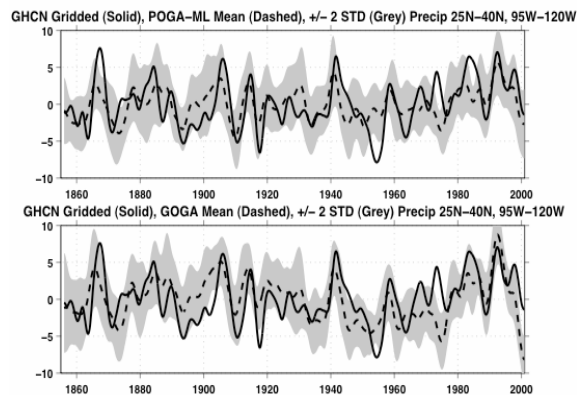


Critically, a cold, La Nina-like, tropical Pacific Ocean

Conclusion based on 3 large ensembles of atmosphere model simulations forced by observed sea surface temperatures (SSTs):

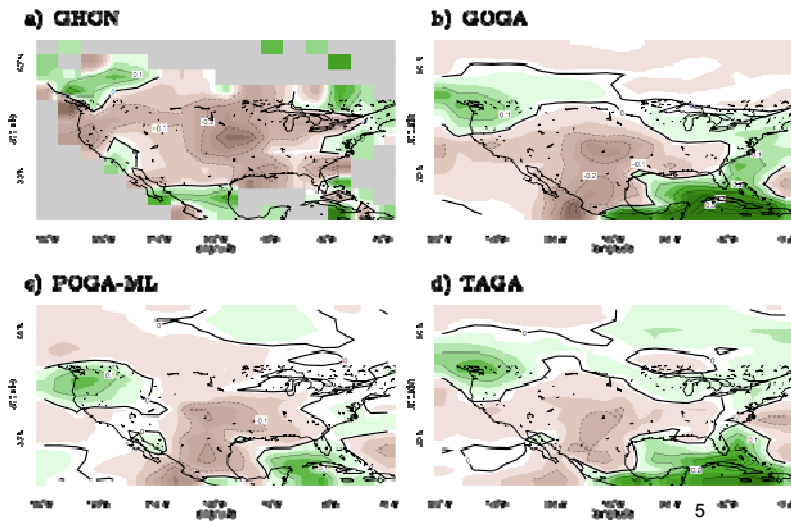
1. Tropical Pacific SSTs only
2. Global SSTs
3. Tropical Atlantic SSTs only

All simulations cover 1856 to 2005



The Dust Bowl: a case of cooperative Pacific and Atlantic SST anomalies

Precipitation 1932-1939



Dynamics of tropical forcing of North American droughts:

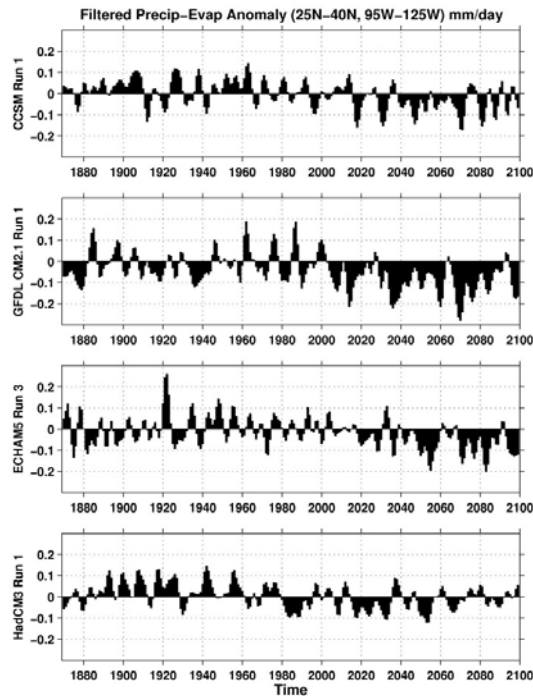
- 1. Rossby wave propagation from atmospheric heating anomalies forced by cold Pacific ocean temperature anomalies*
- 2. Poleward shifted subtropical jet and associated subsidence over subtropics and mid-latitudes*

Reasonably well understood

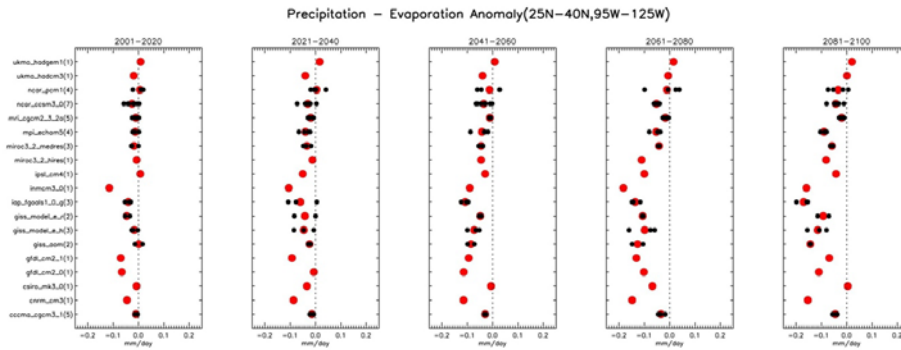
What are the most likely mechanisms for near-term abrupt climate change?

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IPCC AR4 models predict a rapid drying of the US Southwest - *beginning now* - to a perpetual state of 1950s drought-style aridity



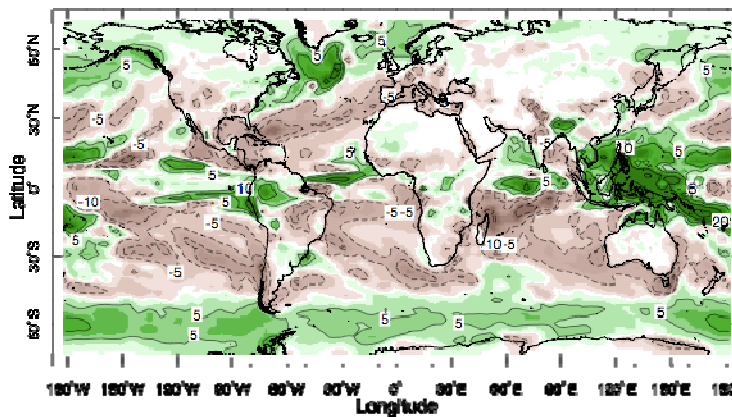
- Substantial agreement on SW drying amongst 19 IPCC models
- Beginning now



data shown for each of 19 models (line) for two decade periods in 21st C (column) relative to 1950-2000 climatology

red dots - ensemble means; black dots - ensemble members₉

Precipitation-Evaporation change in the GFDL model:
2021-2040 minus 1950-2000 (mm/month)



SW drying is part of general subtropical drying

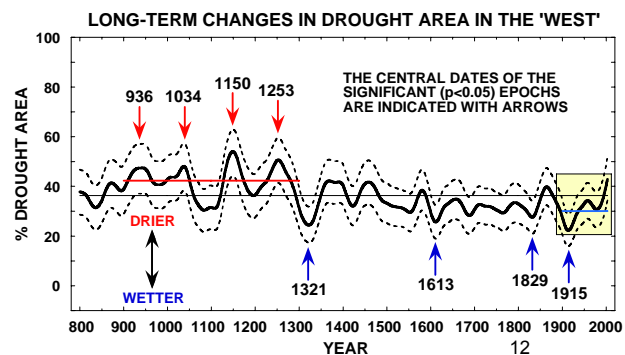
So, the answer is ...

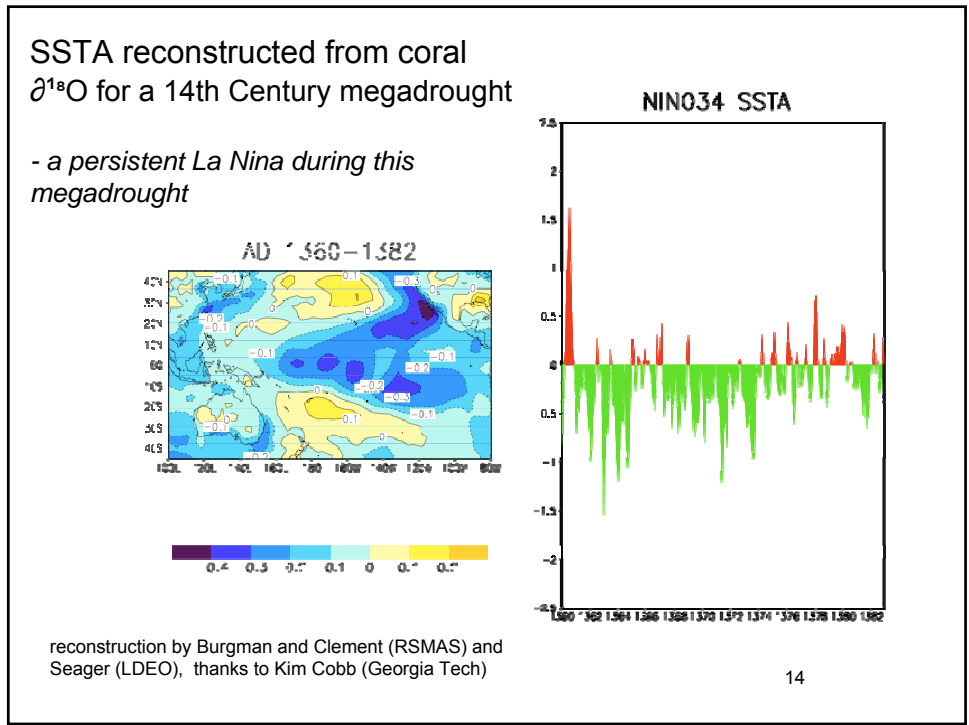
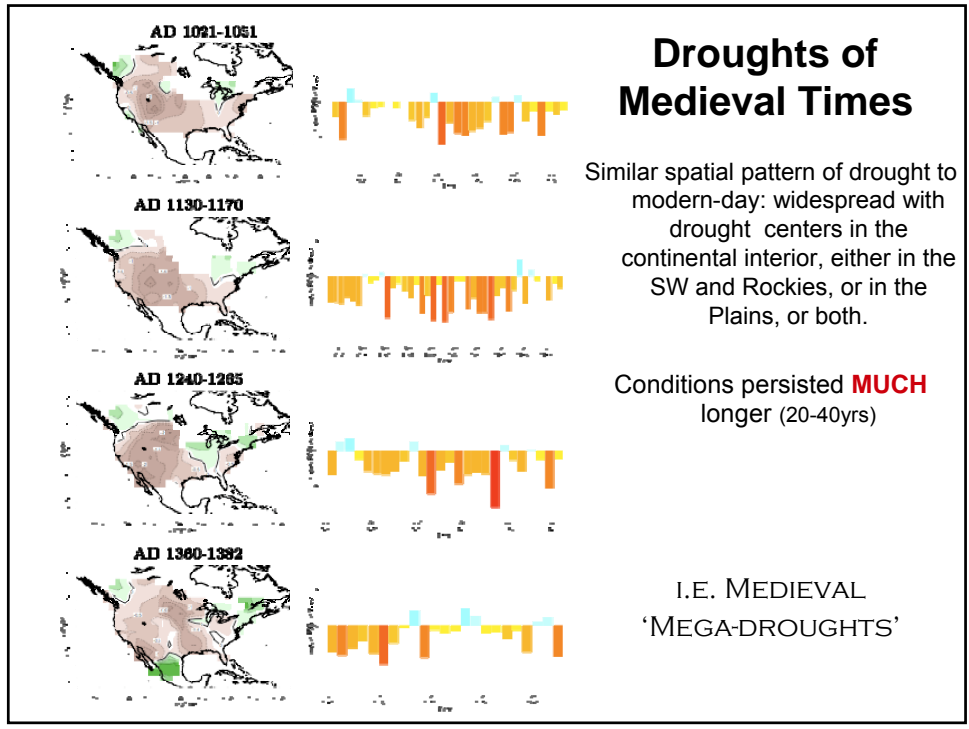
- a shift in the atmospheric circulation regime, induced by surface warming and orchestrated by ***transient eddy-mean flow interaction***
- (Ocean largely passive)

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And we still do not understand the causes of the Medieval North American megadroughts

Cook et al. (2004)

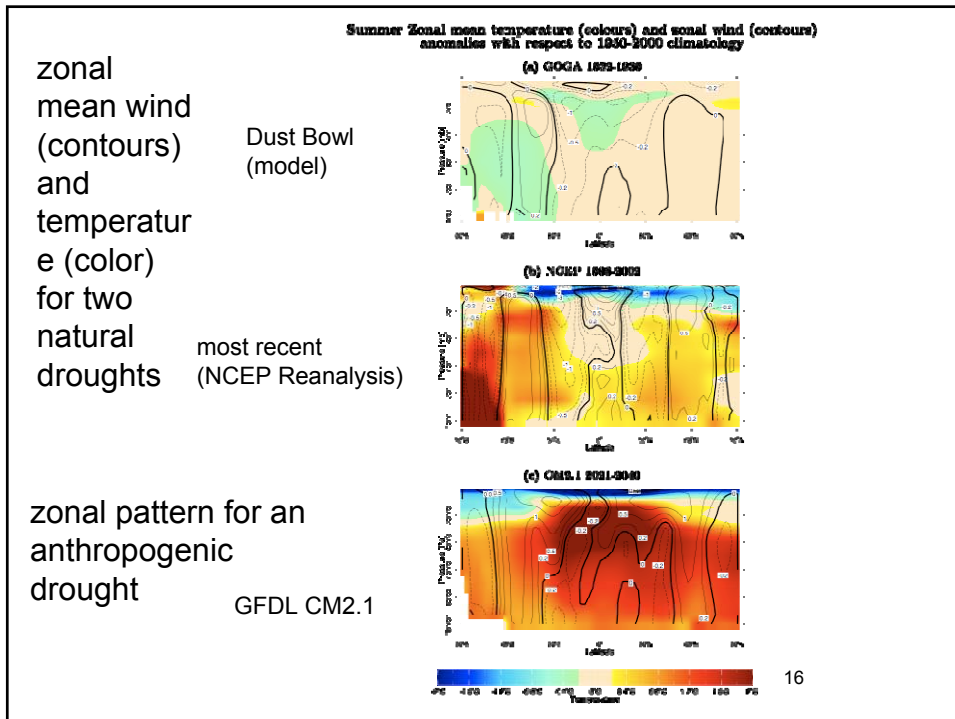




How will we know when human-induced drying of southwestern North America sets in?

It comes down to patterns of atmospheric circulation that are distinct for historical and future droughts ...

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Imminent rapid climate change: elevated aridity in Southwestern North America

1. Warming-induced change in atmospheric circulation will shift Southwestern North America and subtropics to an even more arid climate in the near future.
2. Rapid climate change can come from shifts in atmospheric circulation and water vapor transport.
3. The past, including Medieval megadroughts, cannot be the only guide to a future unlike any seen before - ***dynamical understanding has to be our verification of model projections.***
4. Discrimination of forced and natural climate change requires initialized climate change projections that account for both - a merging of climate prediction and climate change projection.