2013-14 California drought and ENSO: What caused the drought? And What will happen in the future?

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The upper tropospheric circulation pattern

Geopotential height @250hPa

This winter

Normal

This winter minus Normal

Precipitation ratio

[Map showing geopotential height contours and precipitation ratio]
CESM1 simulations supports this precursor pattern is enhanced by GHGs.
California Drought Linked to Human-caused Global Warming

Objective

- Identify weather or a climate patterns that link to a recent severe California drought

Approach

- Use Community Earth System Model, a coupled climate model simulation, to identify a potential link to human-caused global warming
- Identify the “Dipole” pattern observed in CA drought
- Vary forcing agents in the Community Earth System Model (CESM) simulations to evaluate the dipole response

Impact

- The persistent dipole and the subsequent California drought is linked to El Niño’s initiation phase, rather than El Niño itself
- This link has been strengthening in recent years, likely due to increased greenhouse gases in the atmosphere


Top: The high-low pressure “dipole” pattern that caused drought in California and frigid temperature in the East and Midwest.

Bottom: Change of intensity of the dipole patterns from observation (OBS), climate model simulation forced by greenhouse gases (GHG) and natural forcings (NAT).