Mechanisms of tropical Atlantic influence on US Precipitation: A case for an inter-ocean interaction

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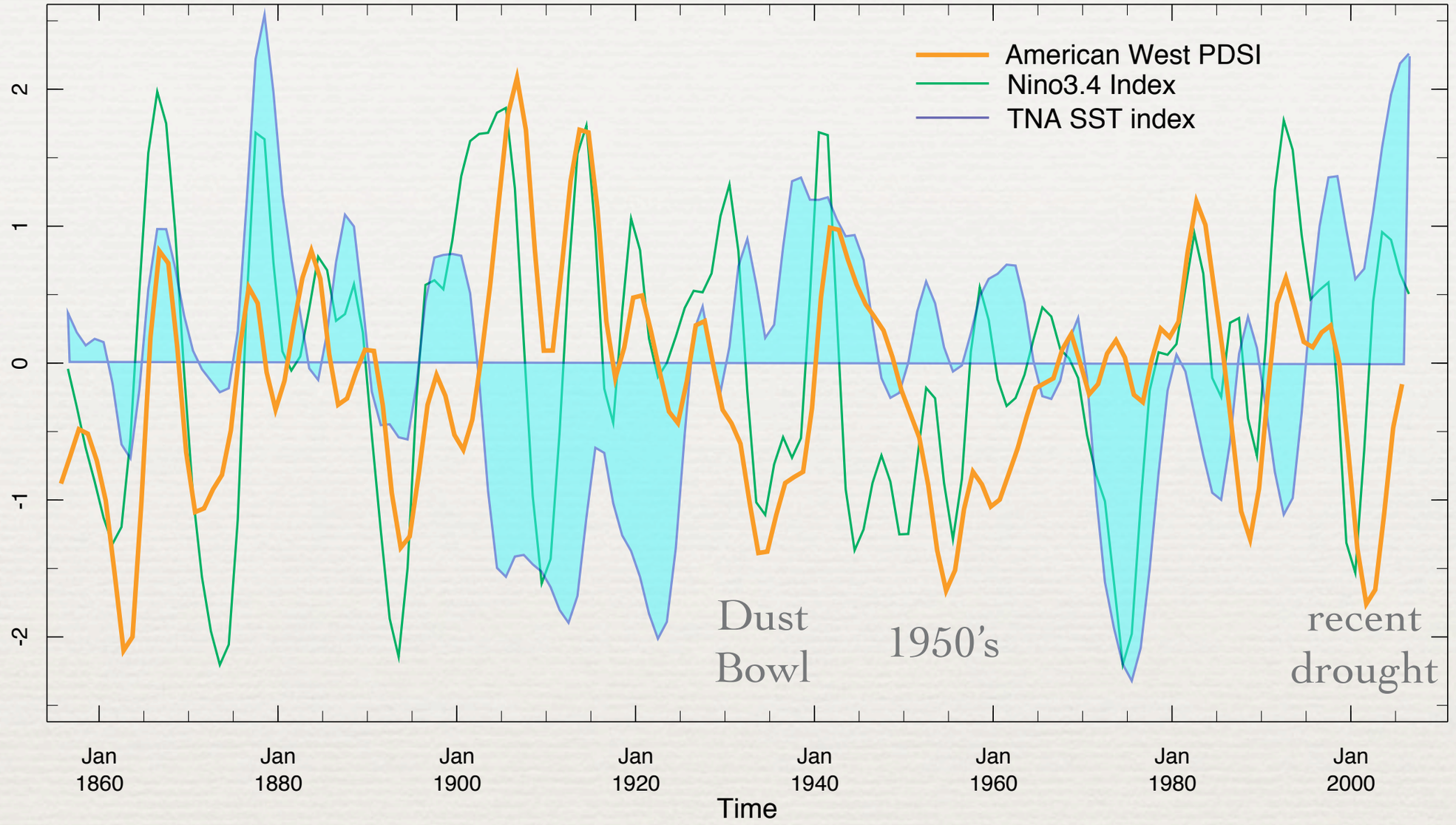

The idea that both the Pacific and the Atlantic control multi-year hydroclimate variability in the Americas is not new (Enfield et al. 2001; MacCabe et al. 2004; Schubert et al. 2004; Sutton and Hodson, 2005 & 2007; Seager et al 2005, 2007 & 2009; Feng et al. 2008)

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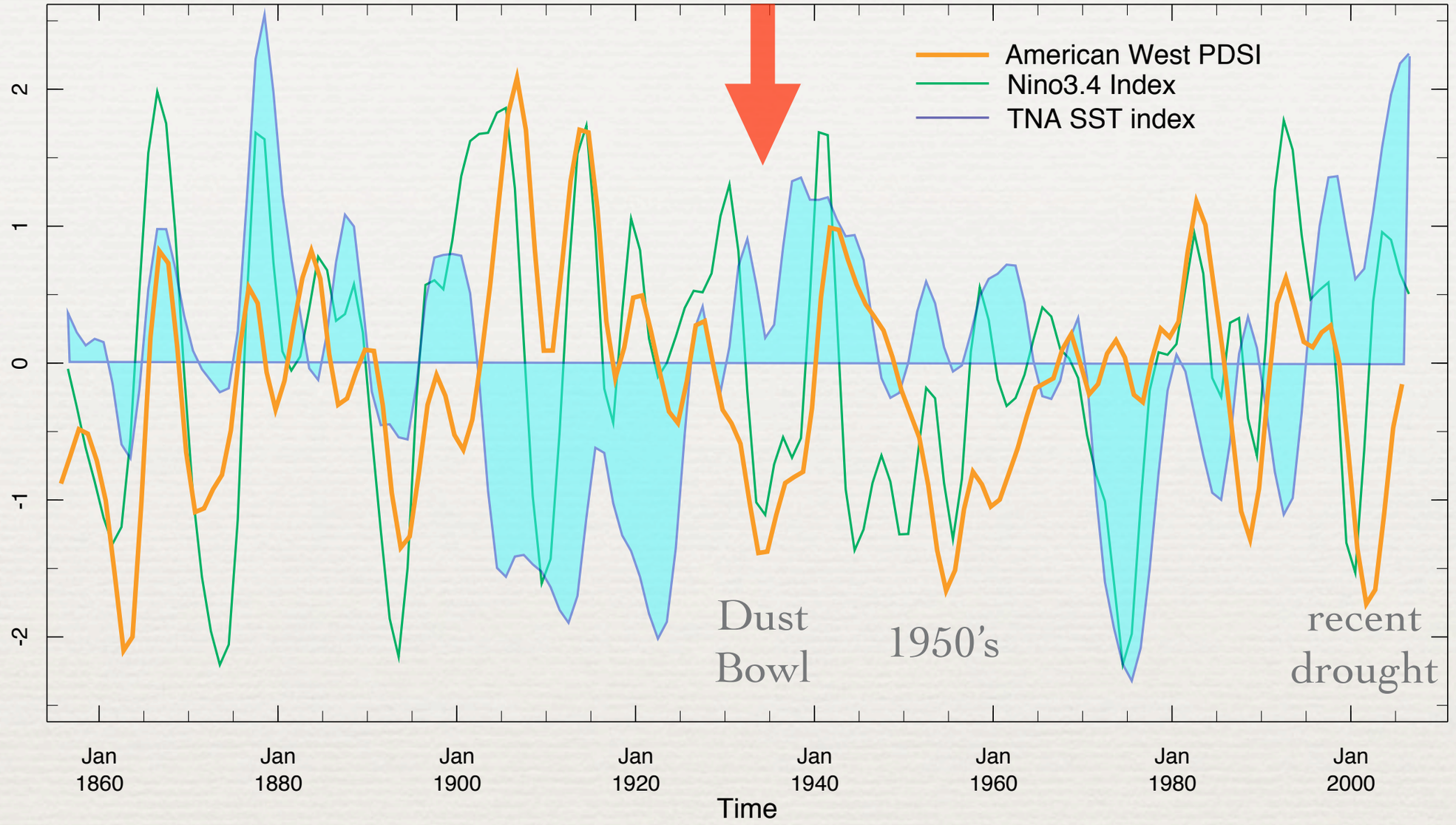
- *American West = 25°N-50°N and 125°W-90°W.*



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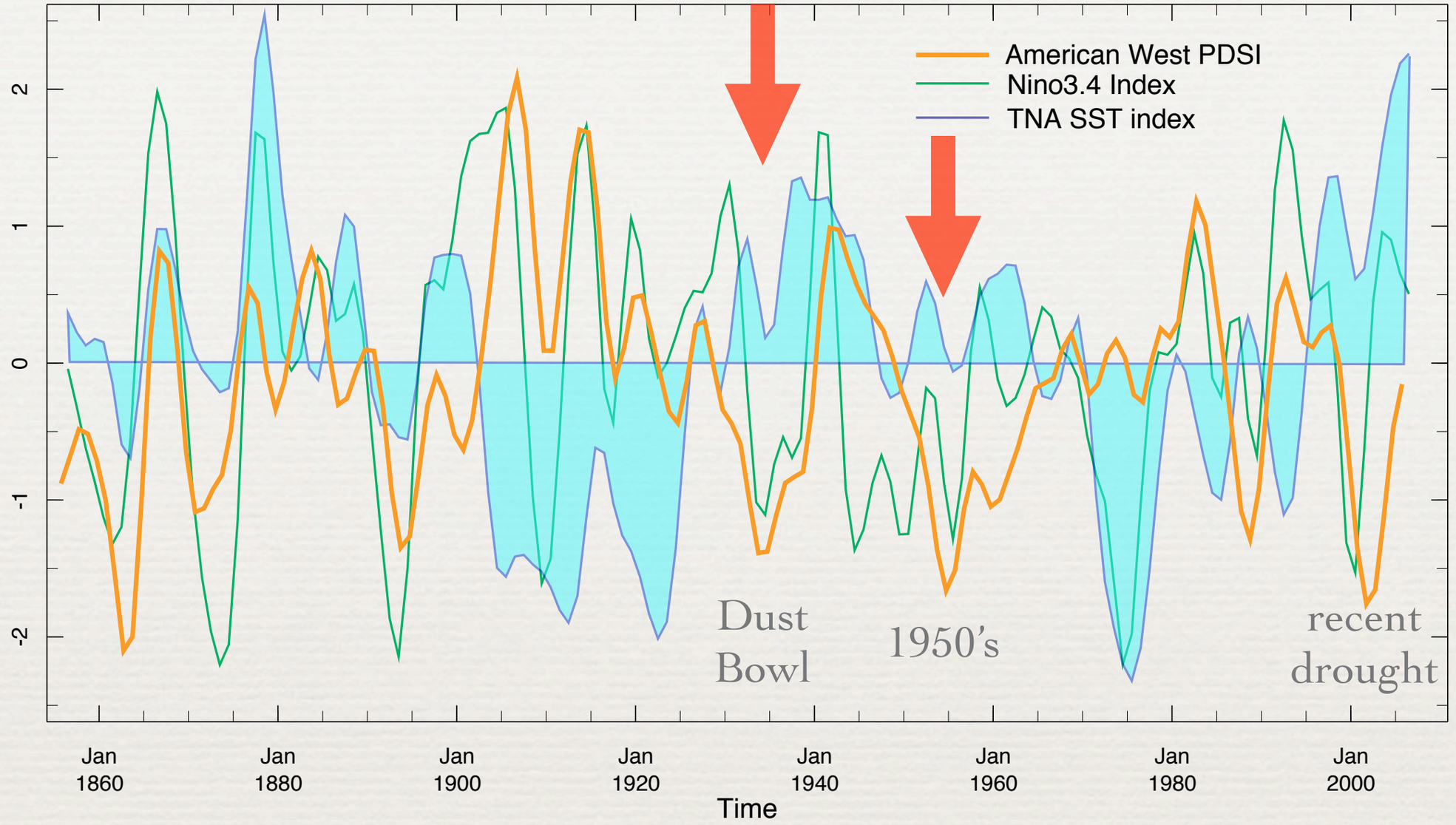

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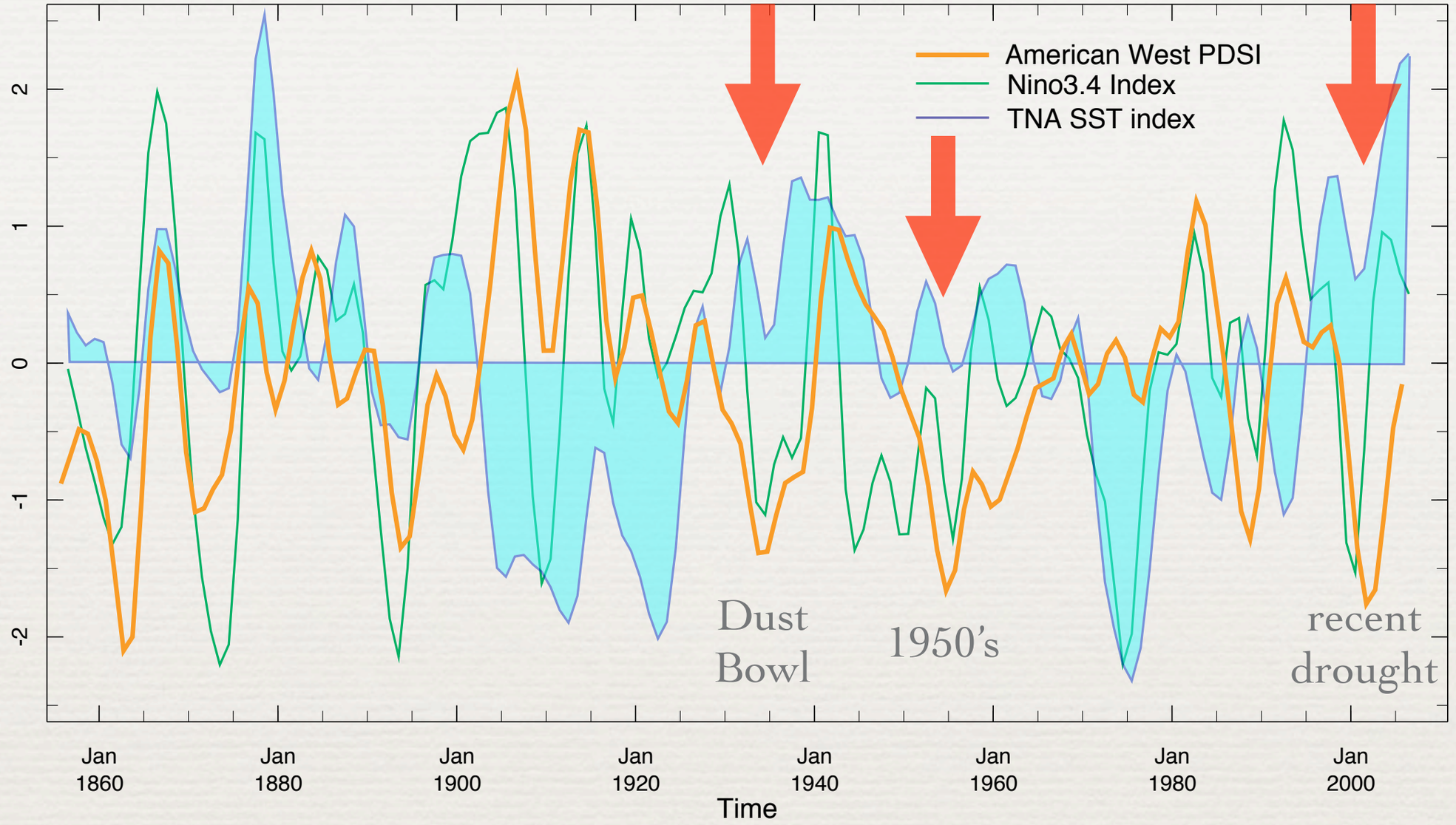

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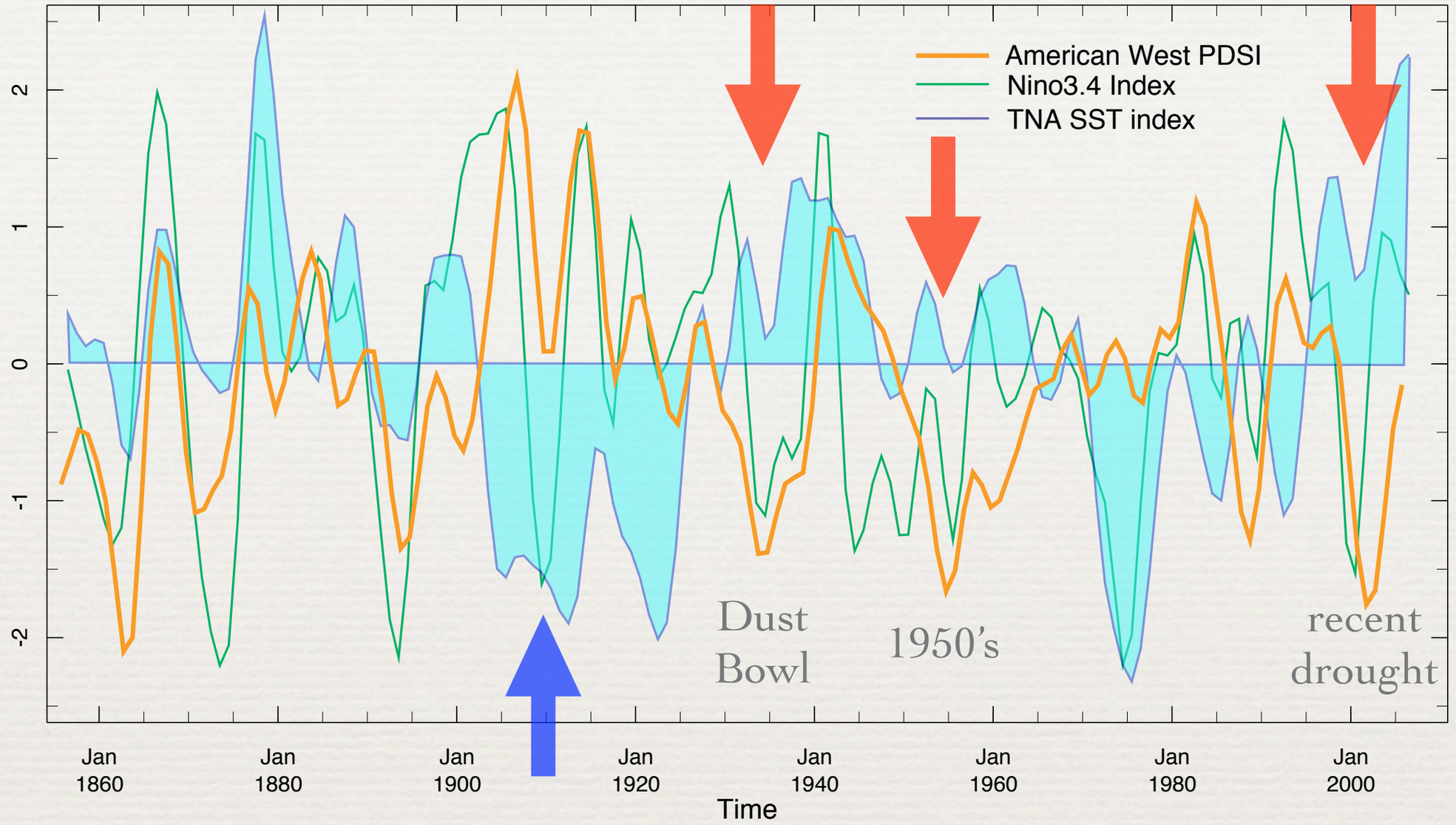

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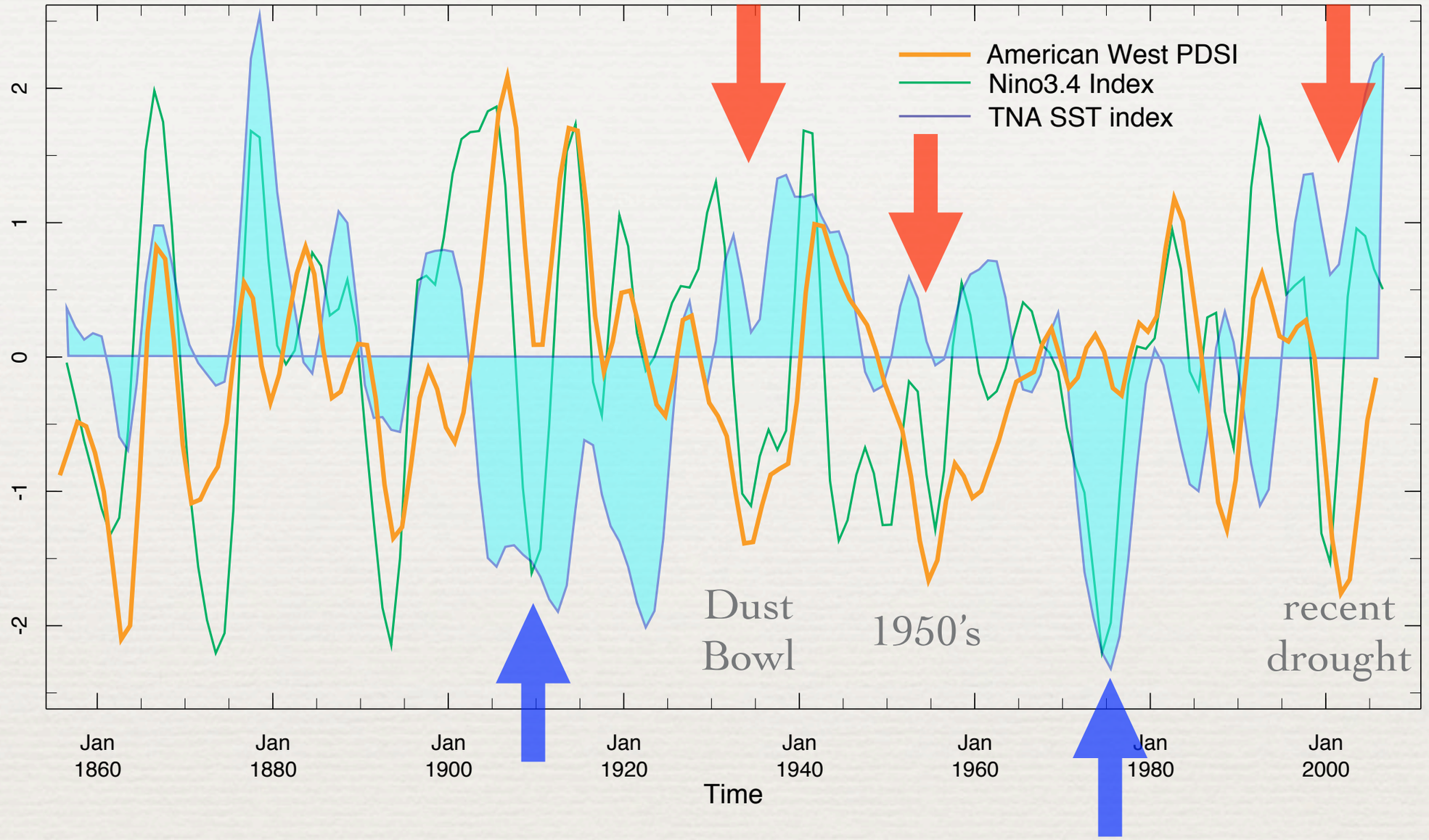

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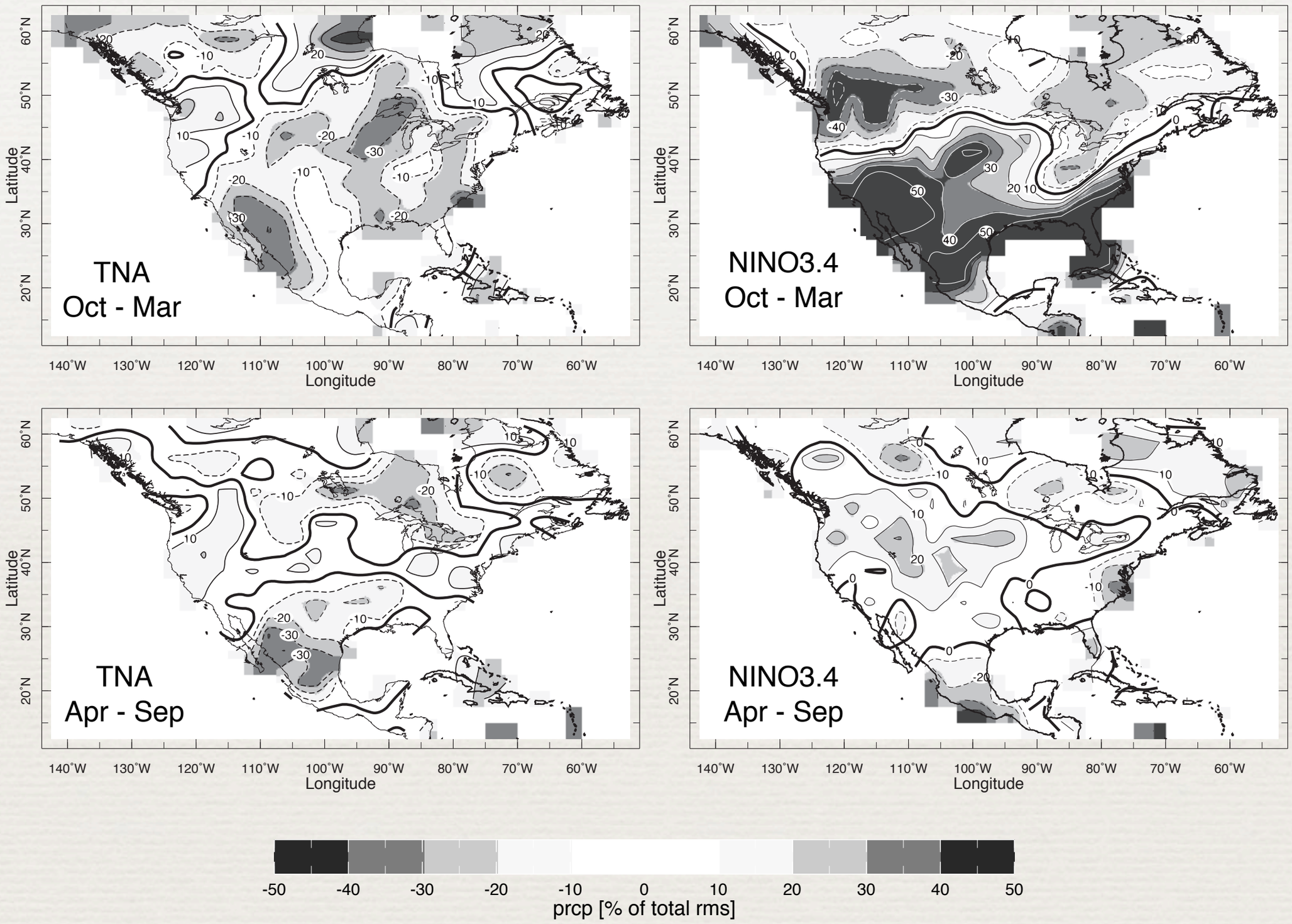
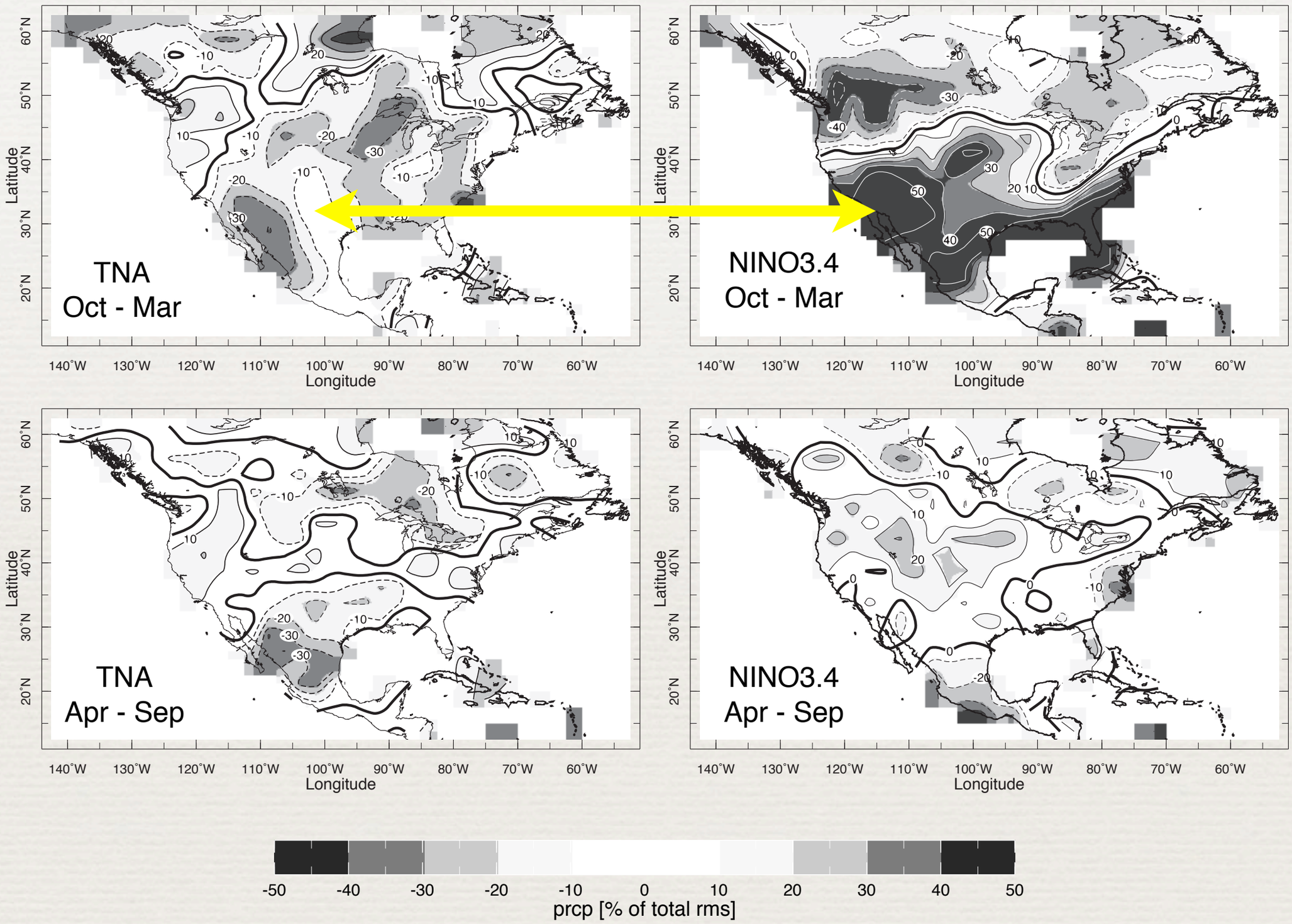
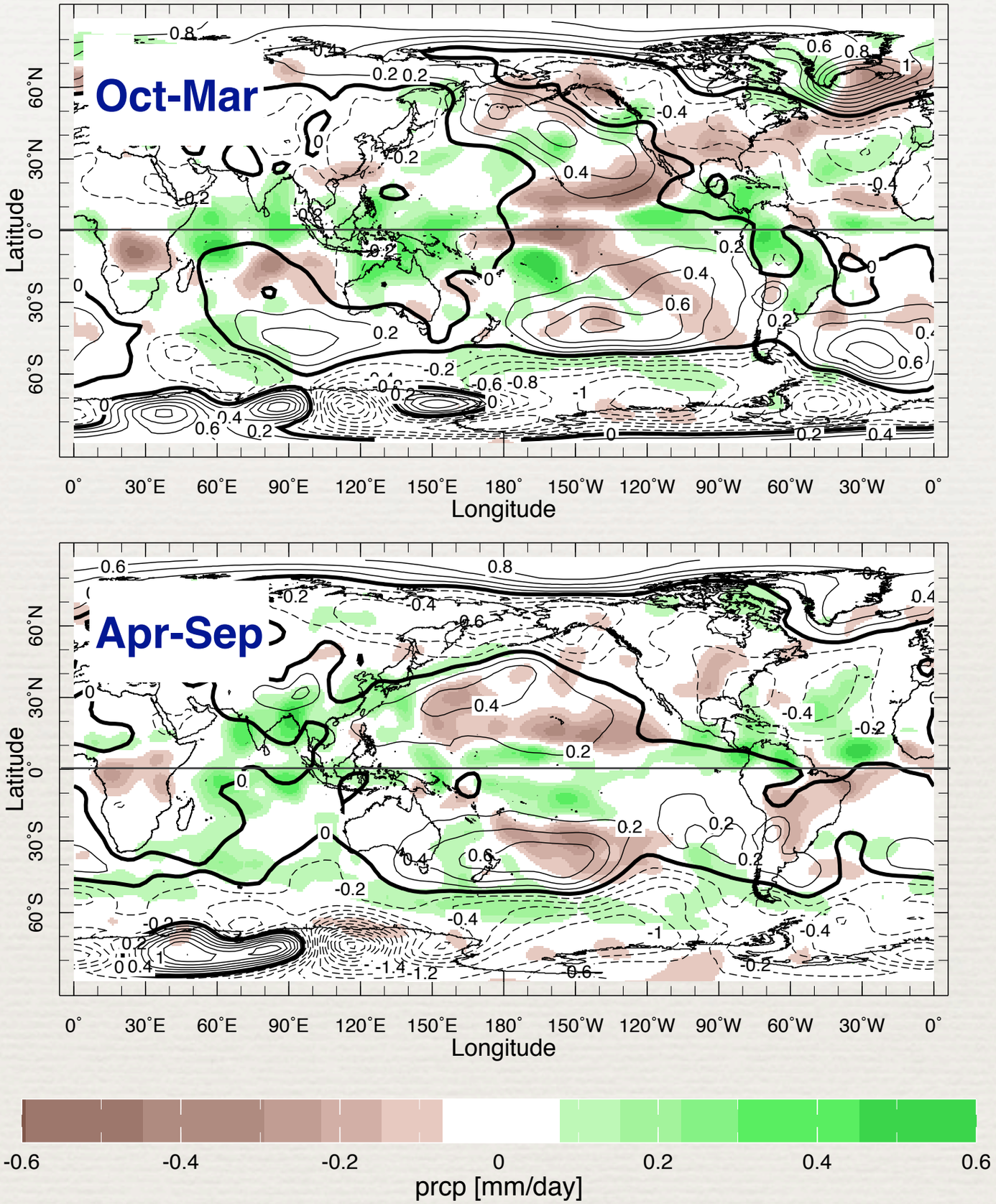


Precipitation data from NOAA PREC/L (Chen et al. 2002), seasonal means 1948-2007



Precipitation data from NOAA PREC/L (Chen et al. 2002), seasonal means 1948-2007

- Sea level pressure (contours, mb) and precipitation (colors) associated with TNA SSTAs*: 1979-2007.
- The effect of tropical Pacific SST was removed using multiple regression analysis.
- SLP is from the NCEP-NCAR Reanalysis and precipitation from GPCP (smoothed in space with two passes of a binomial 1-2-1 filter).



★ *TNA = Atlantic 0-30°N*

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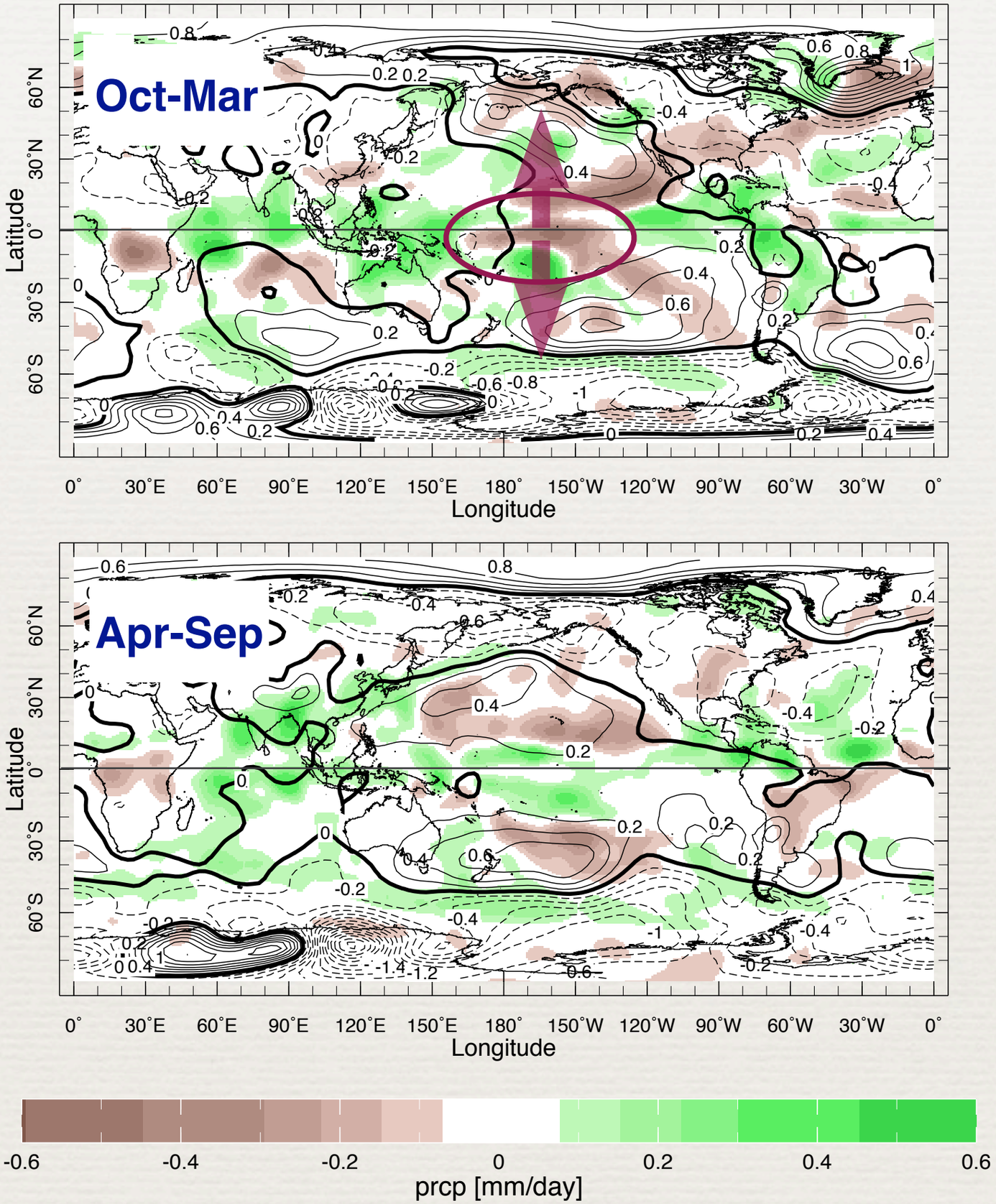
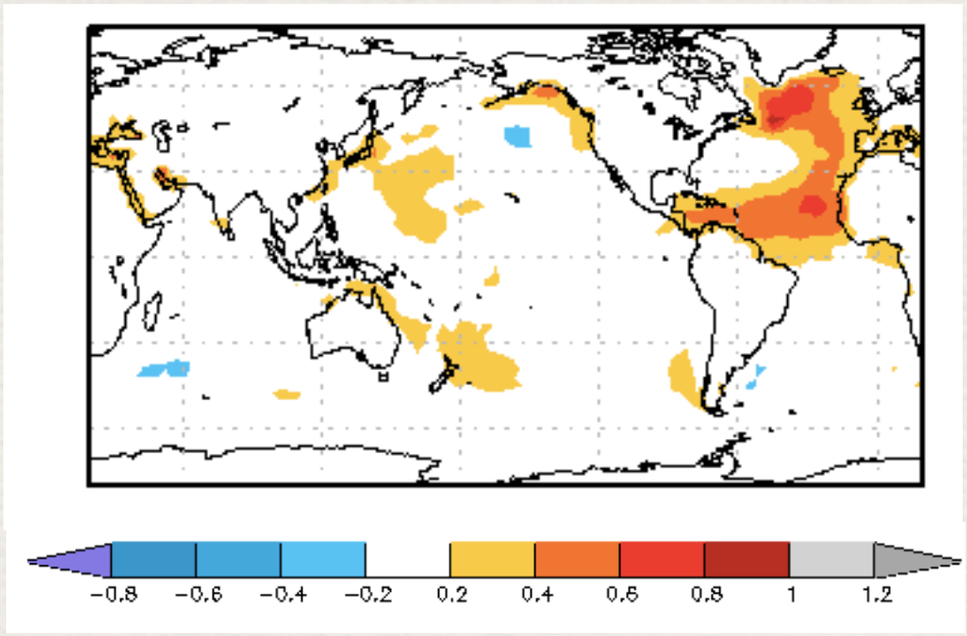
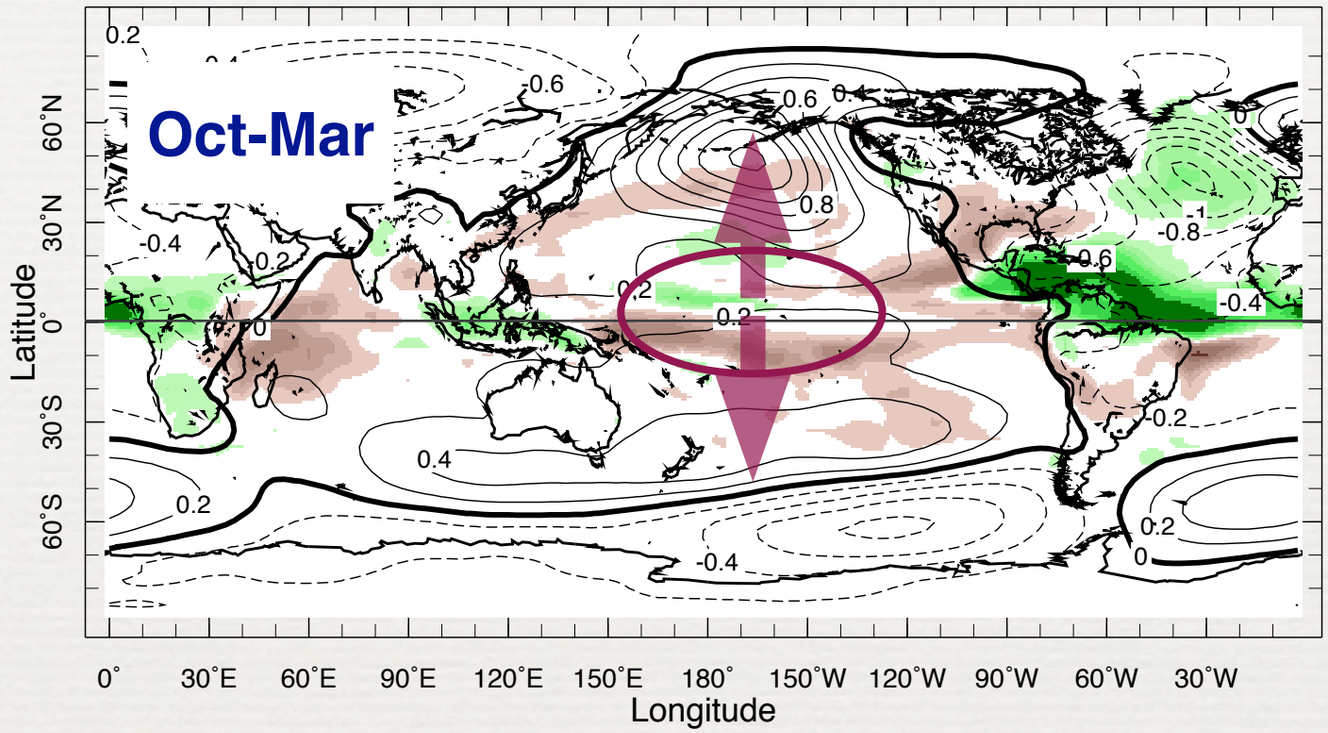


* *TNA = Atlantic 0-30°N*

- ***CLIVAR Drought Working Group (DWG), multi-model average*** of SLP and PPT response to a fixed NAtl SSTA (*below*).
- **Suppression of trop. Pac. precipitation by enhanced TNA convection**

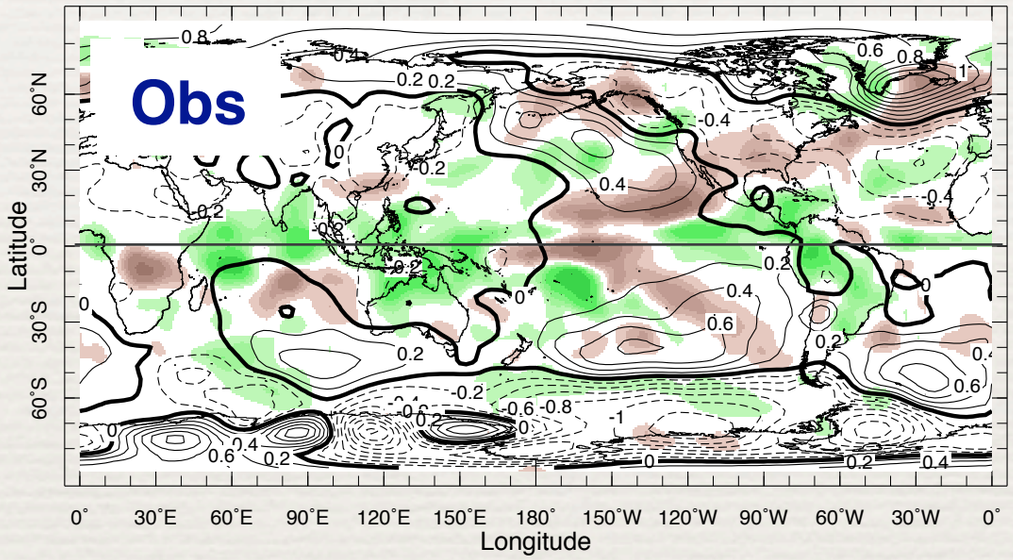


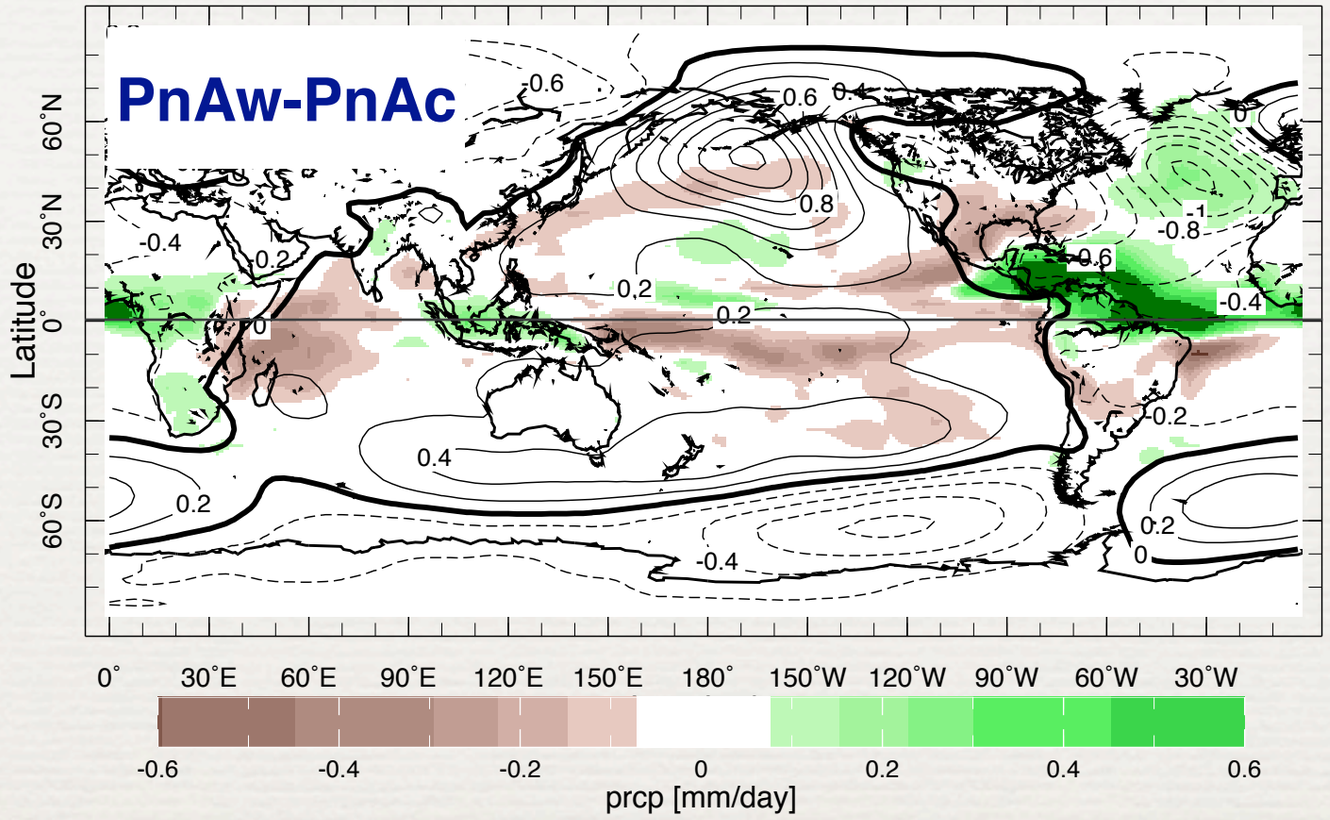
40-yr average of [Aw-Ac]/2

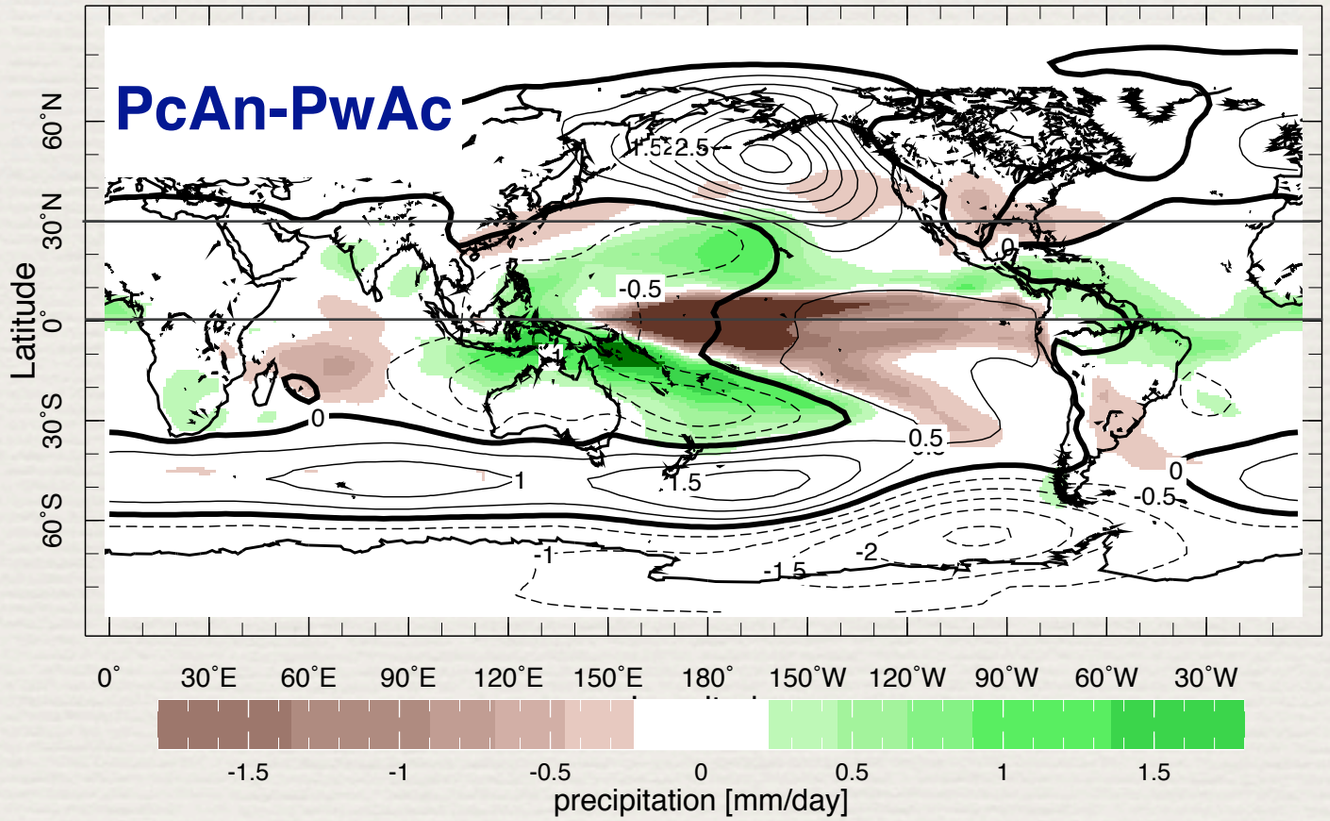


Participating models: NCAR (CAM3.5), GFDL (AM2.1), LDEO (CCM3), NCEP (GFS), NASA (NSIPP)

- CLIVAR DWG Multi-model **Oct-Mar** response to an Atlantic SSTA compared to the same season response to a Pacific (Niño) SSTA.







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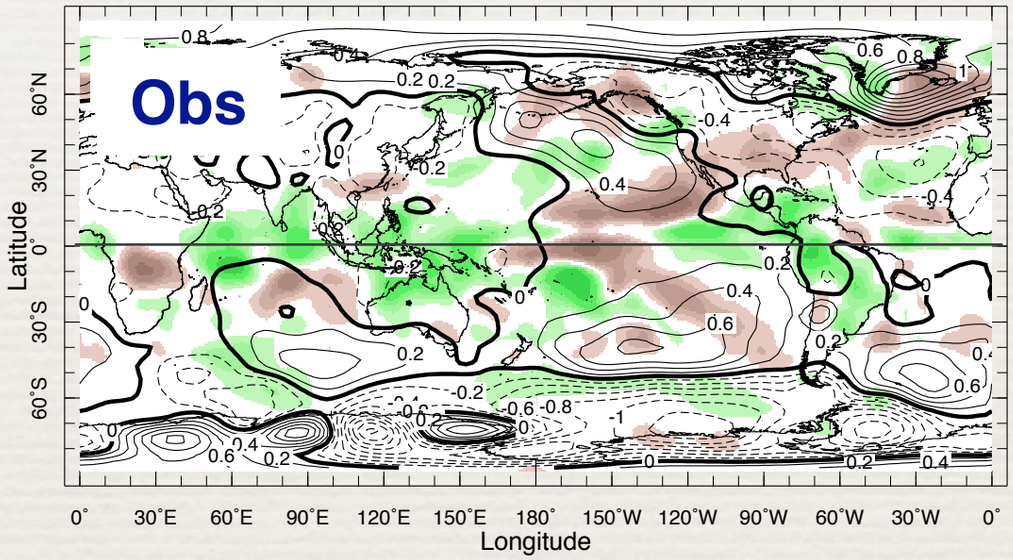

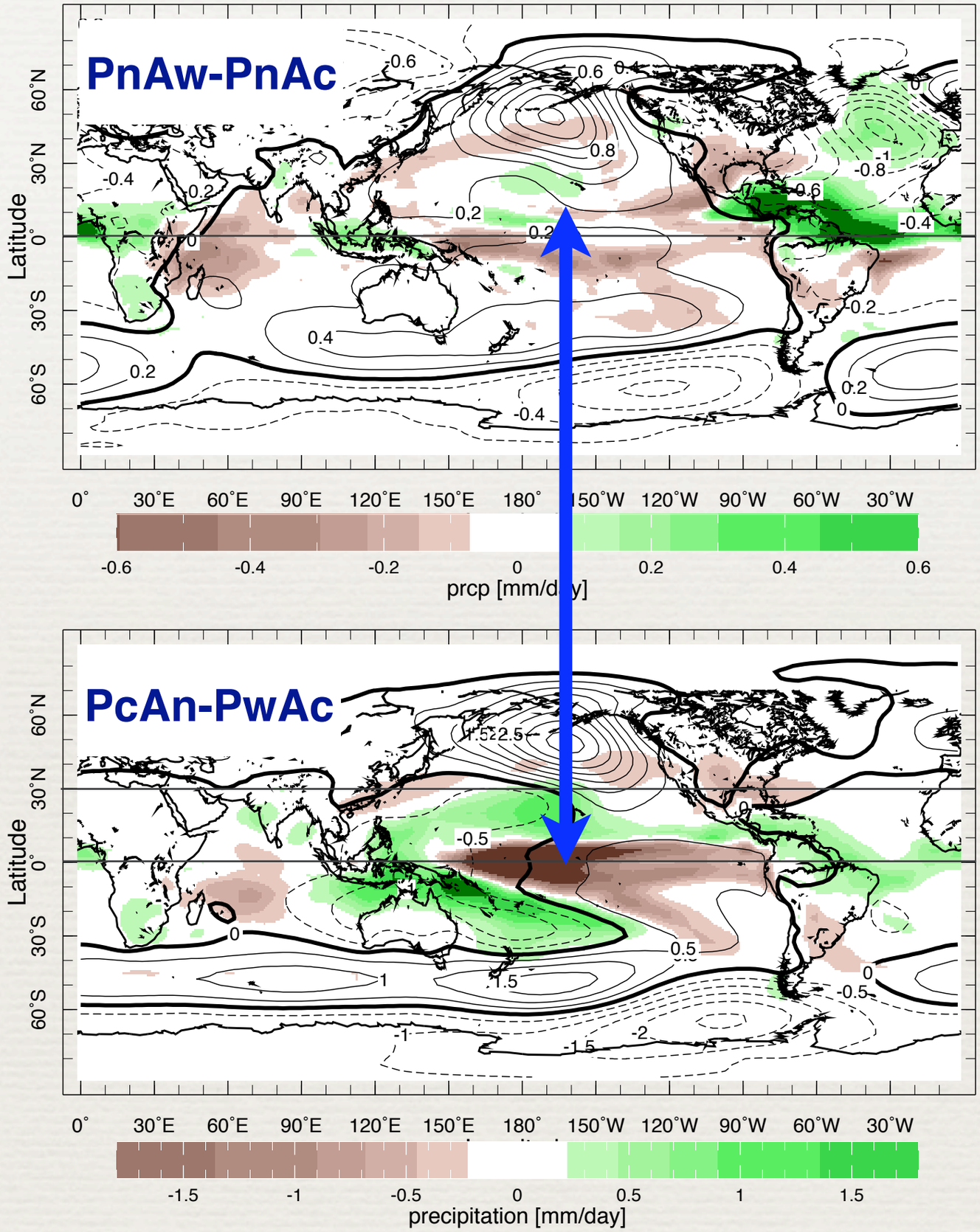

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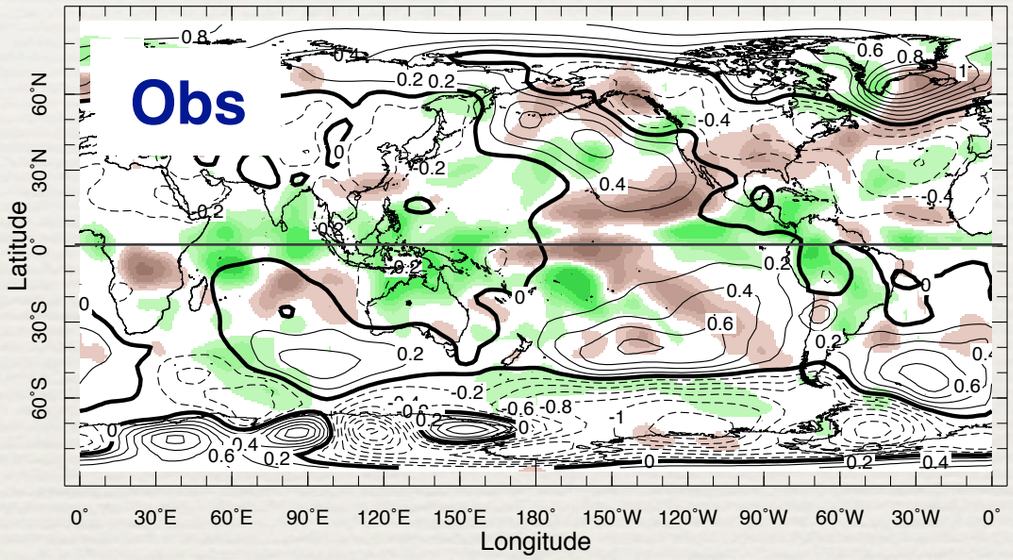
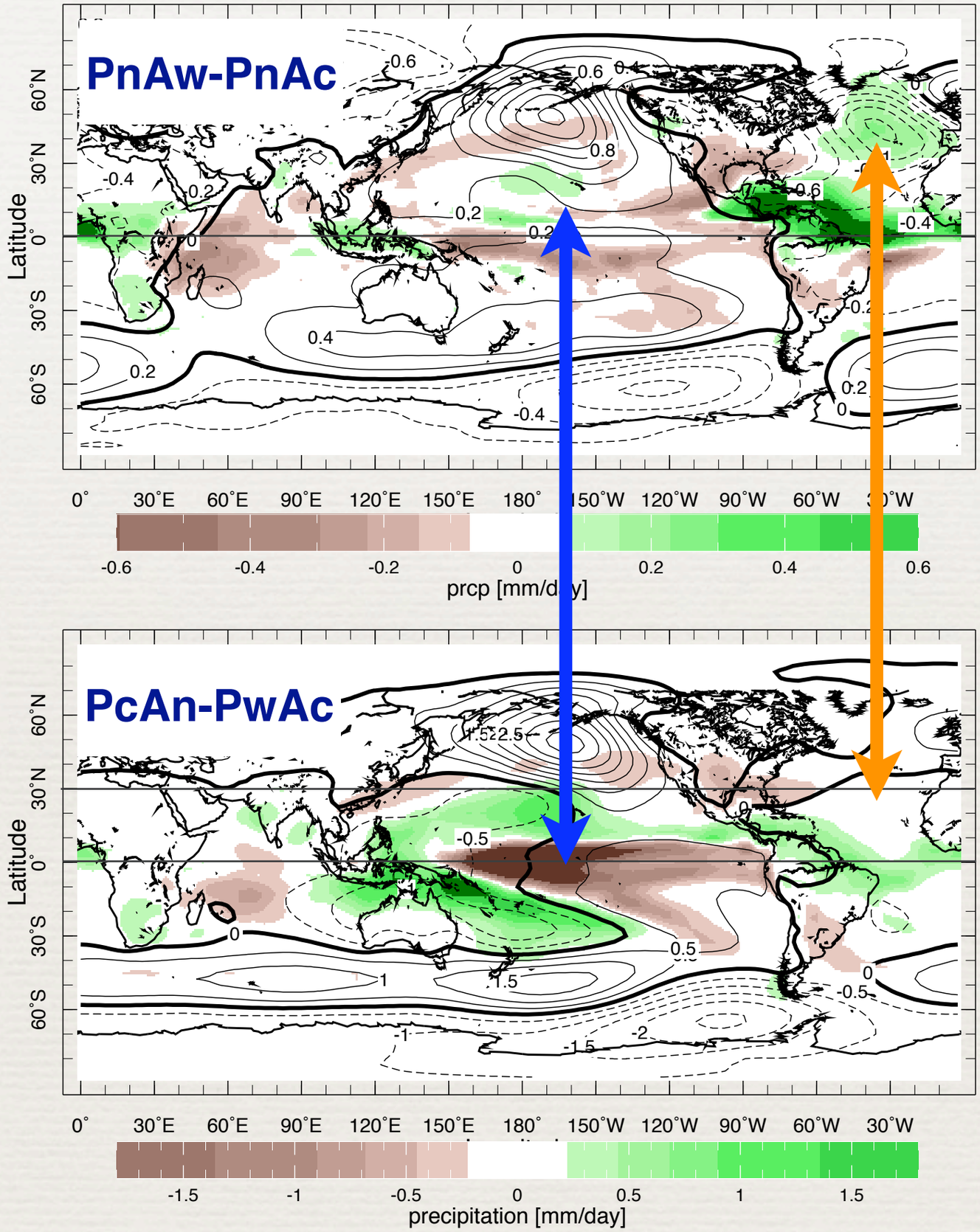
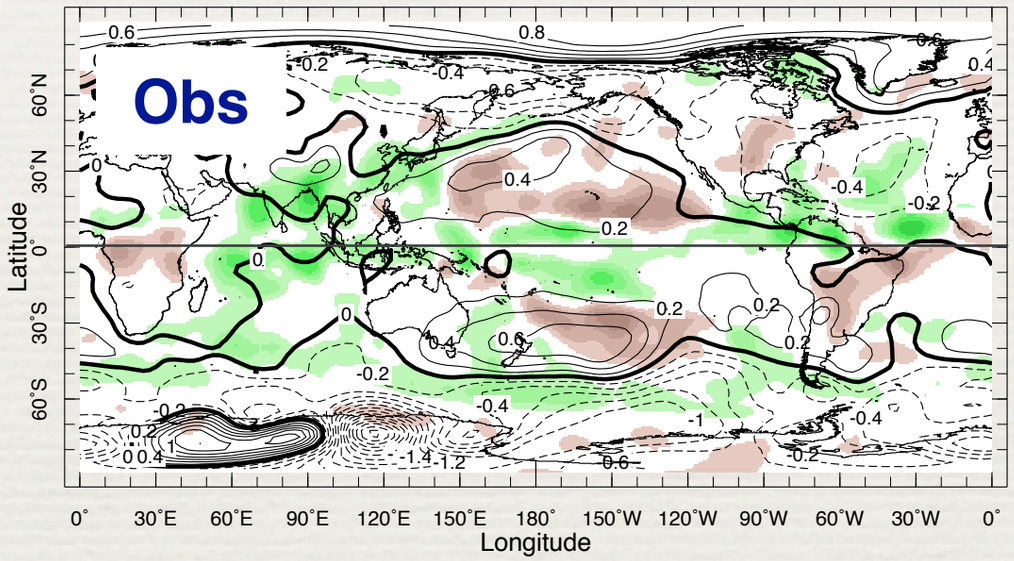
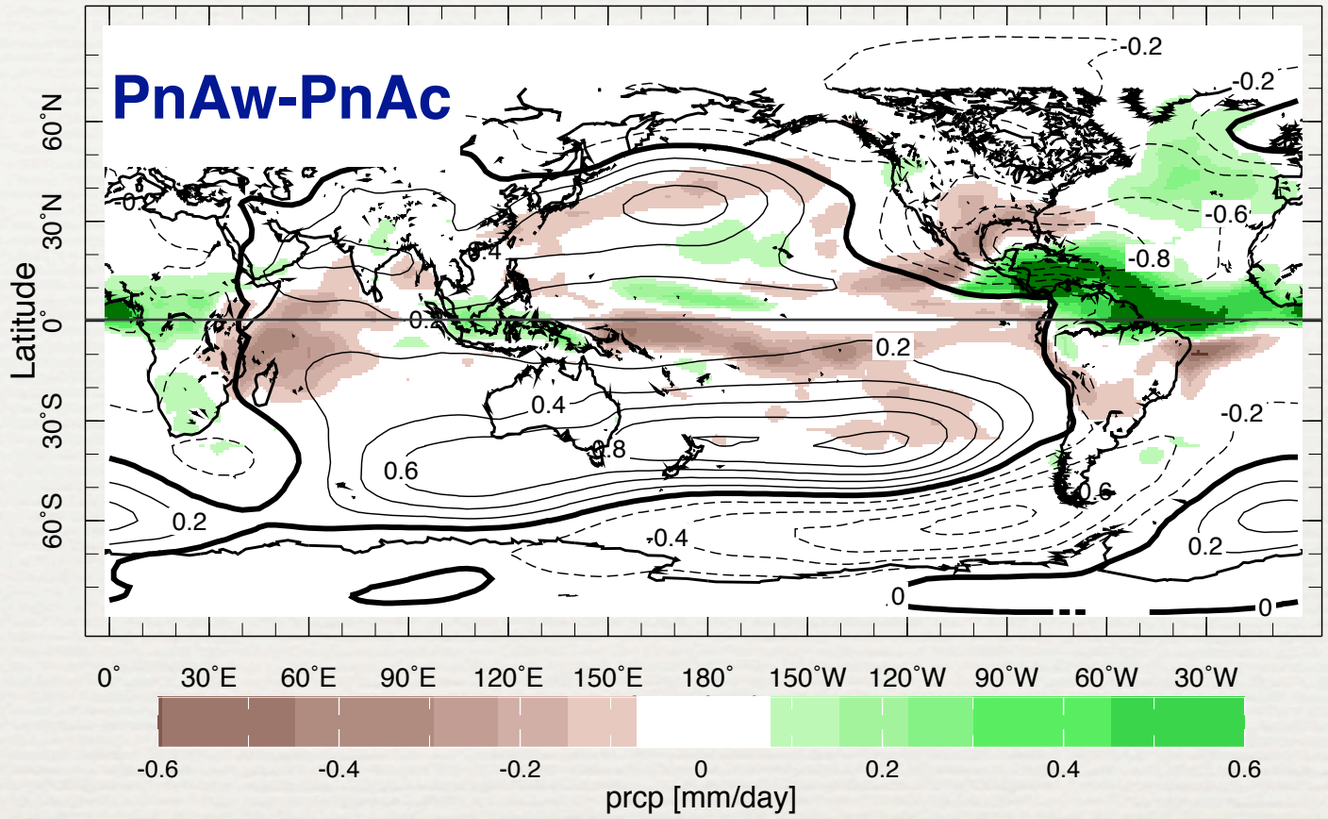
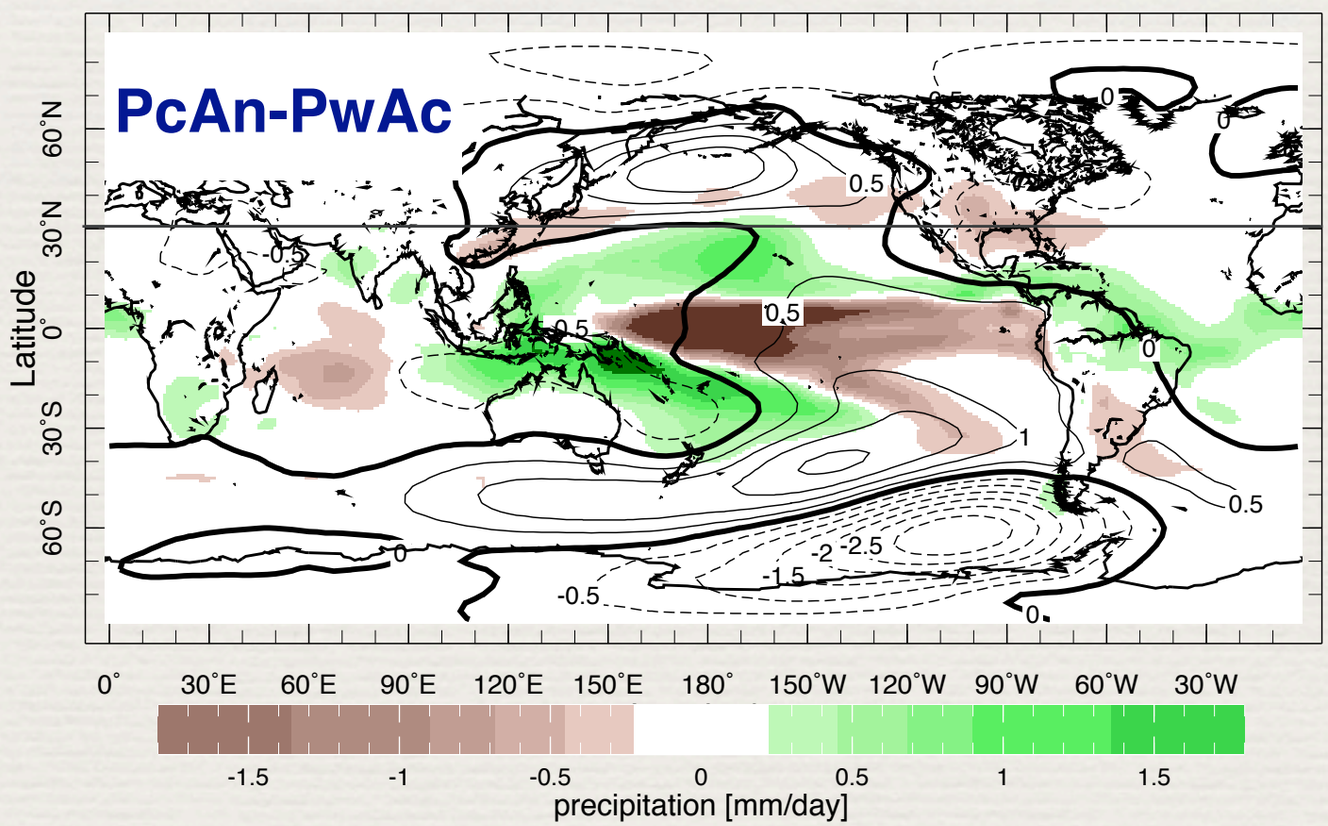




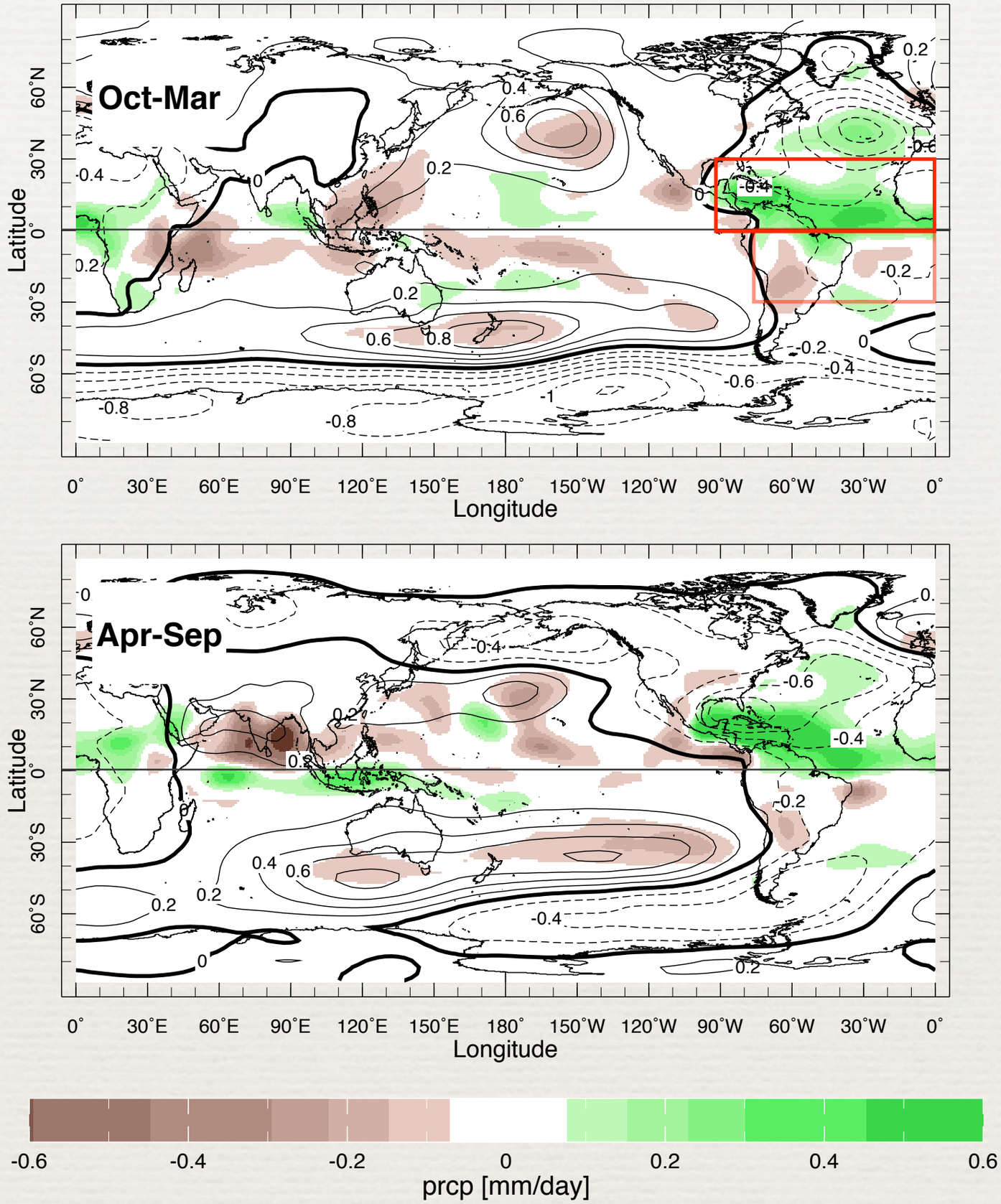
CLIVAR DWG Multi-model **Apr-Sep** response to an Atlantic SSTA compared to the same season response to a Pacific (Niño) SSTA.



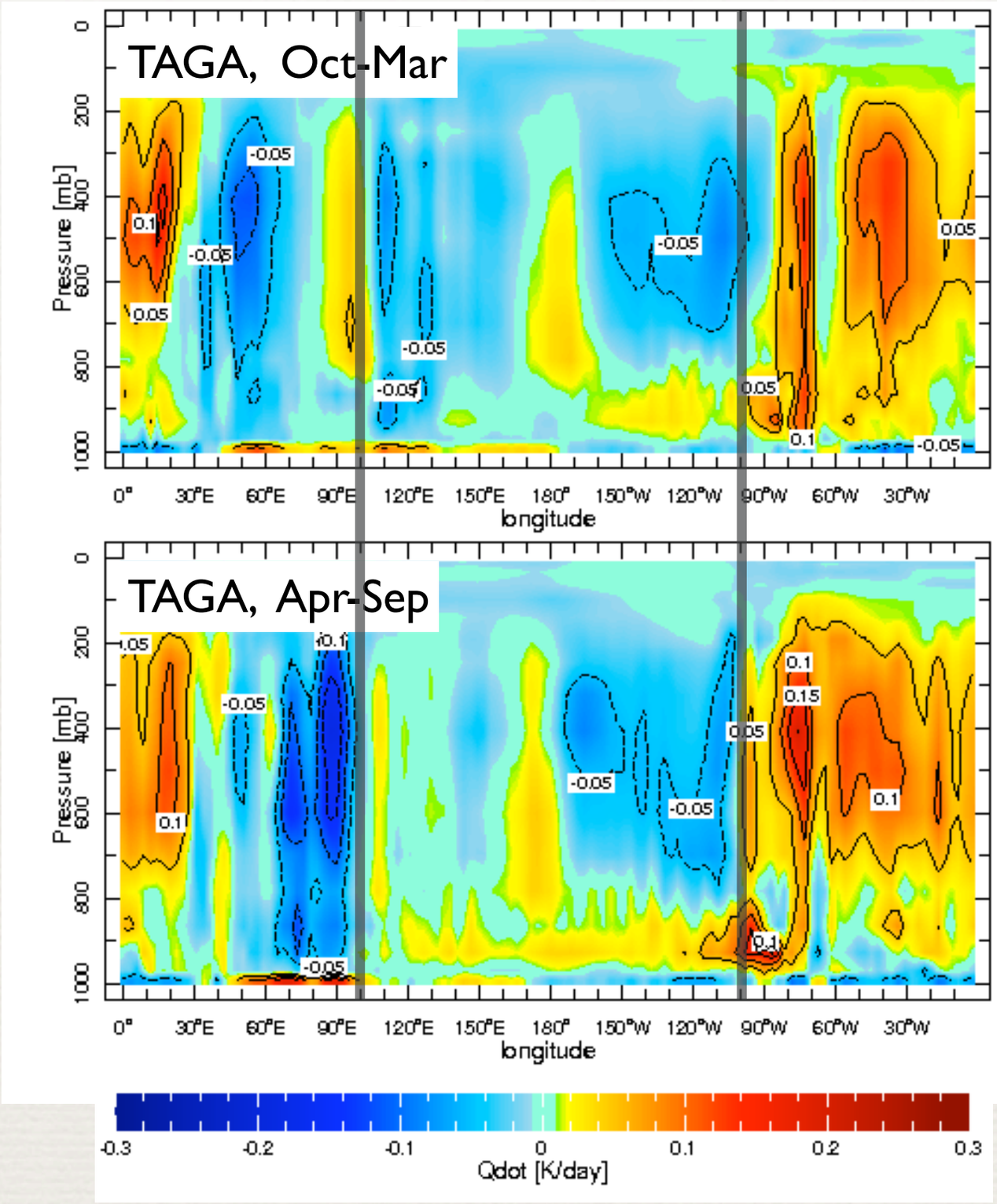




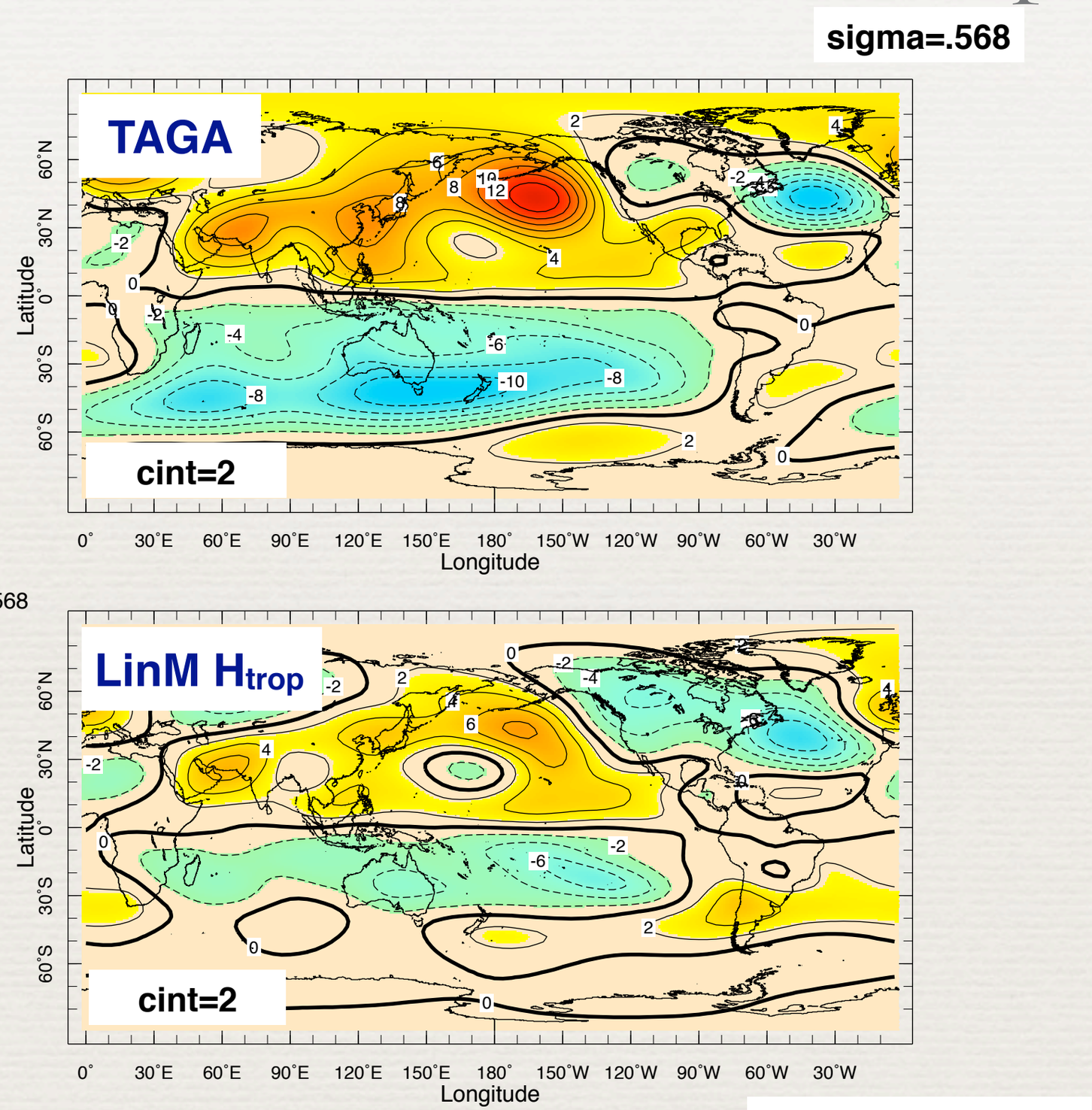
- Regression of SLP and PPT on TNA SST in a TAGA integration of the CCM3 (1980-2007).
- In TAGA, SSTAs are prescribed to vary realistically, month-by-month, between 30°S and 30°N in the Atlantic only. Elsewhere, SST is climatology.



- We force a linear GCM with heating derived from the TAGA model regression on TNA SST (*on the right*)
- The three-dimensional, TAGA heating anomaly is prescribed between 30° north and south of the equator.
- We run separate experiments for “winter” and “summer” prescribing the entire tropical patterns, Atlantic only (100°W-0°), and Pacific only (110°E-100°W).

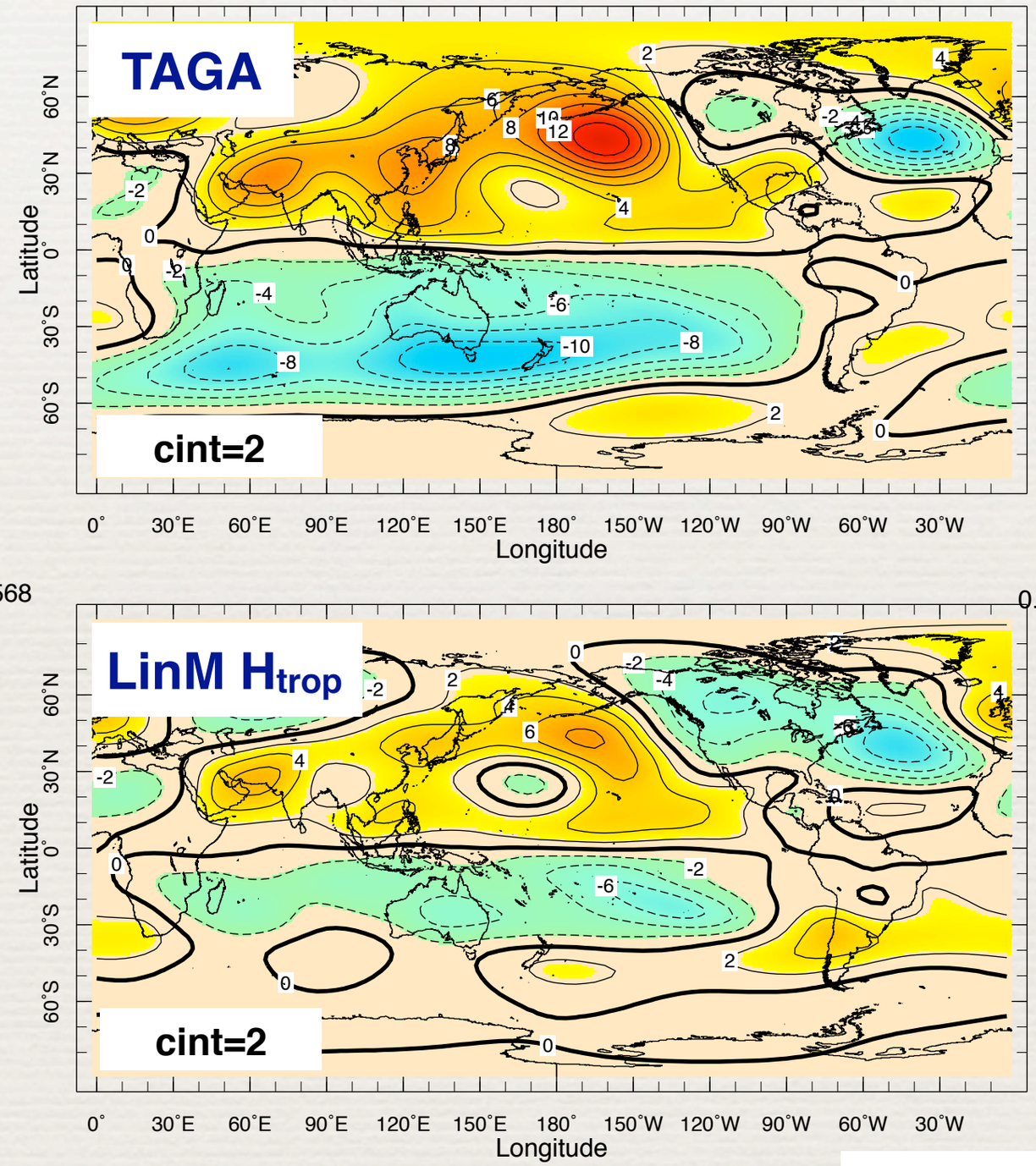


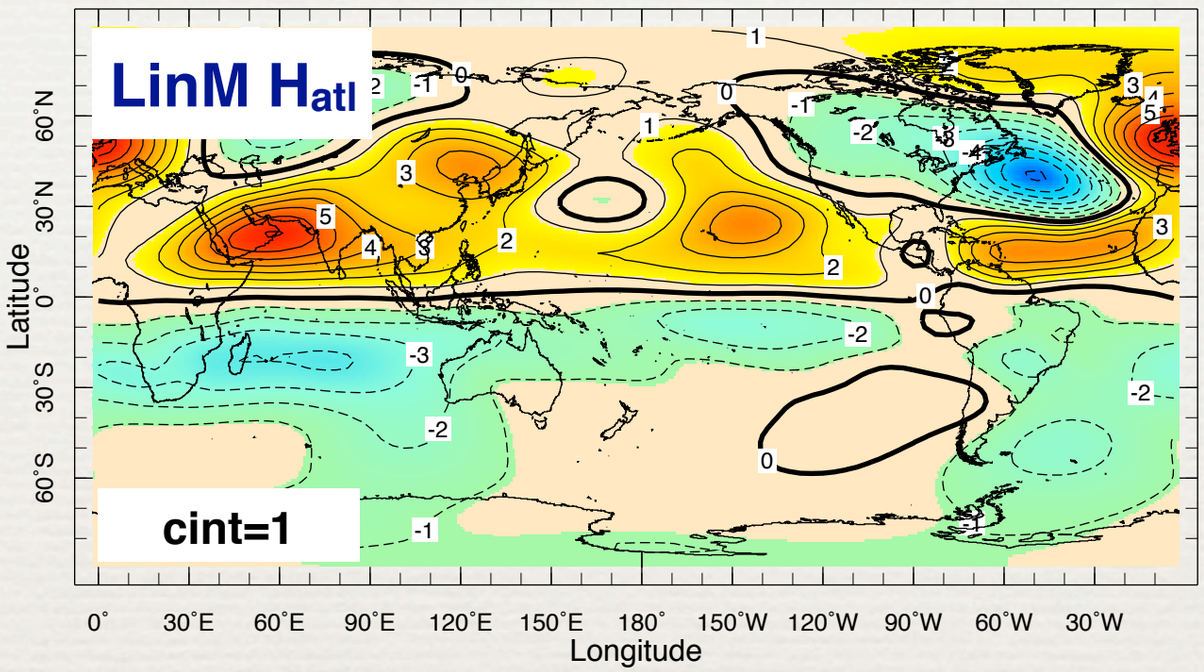
Streamfunction response: Winter



Streamfunction response: Winter

sigma=.568



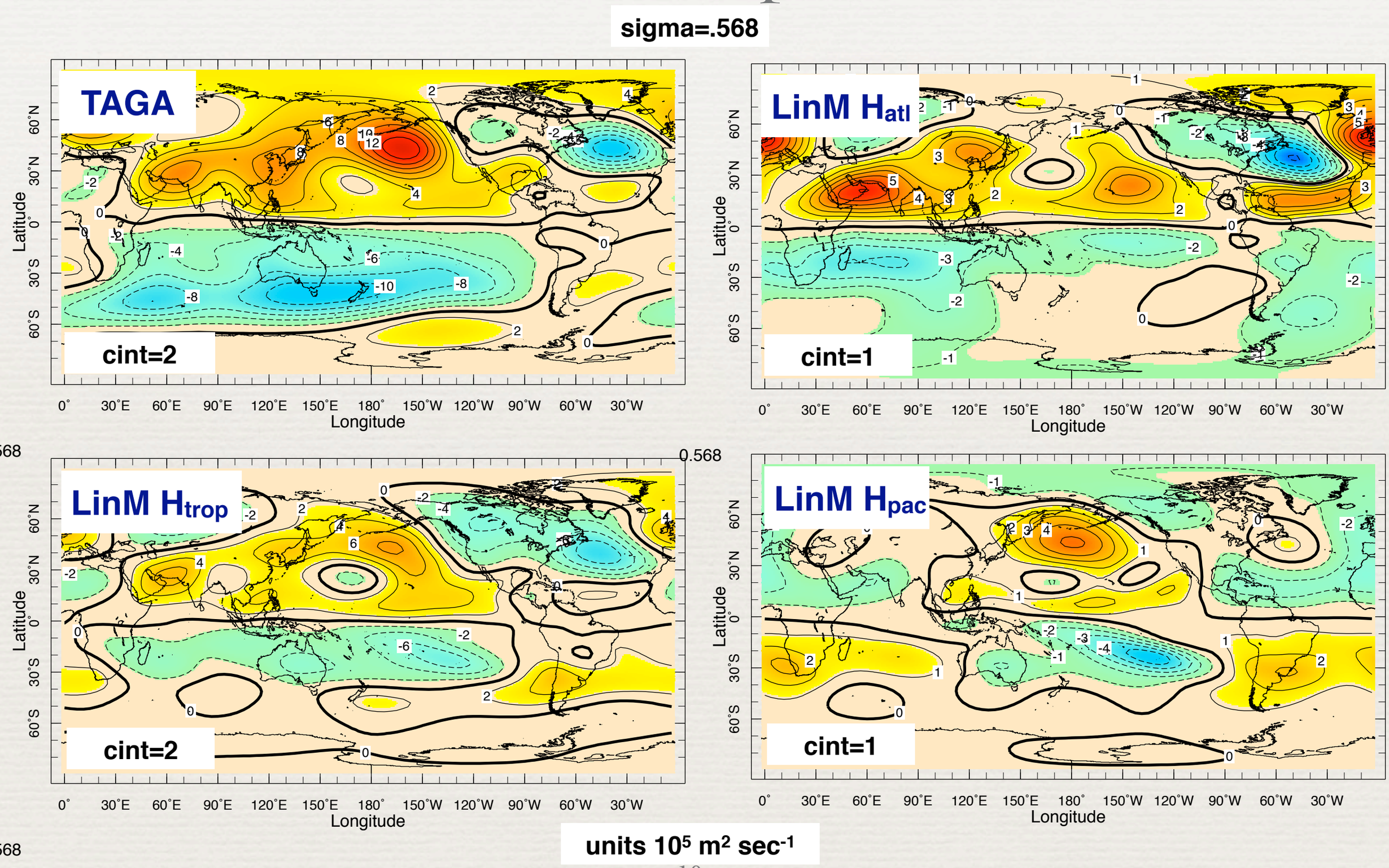


0.568 0.568

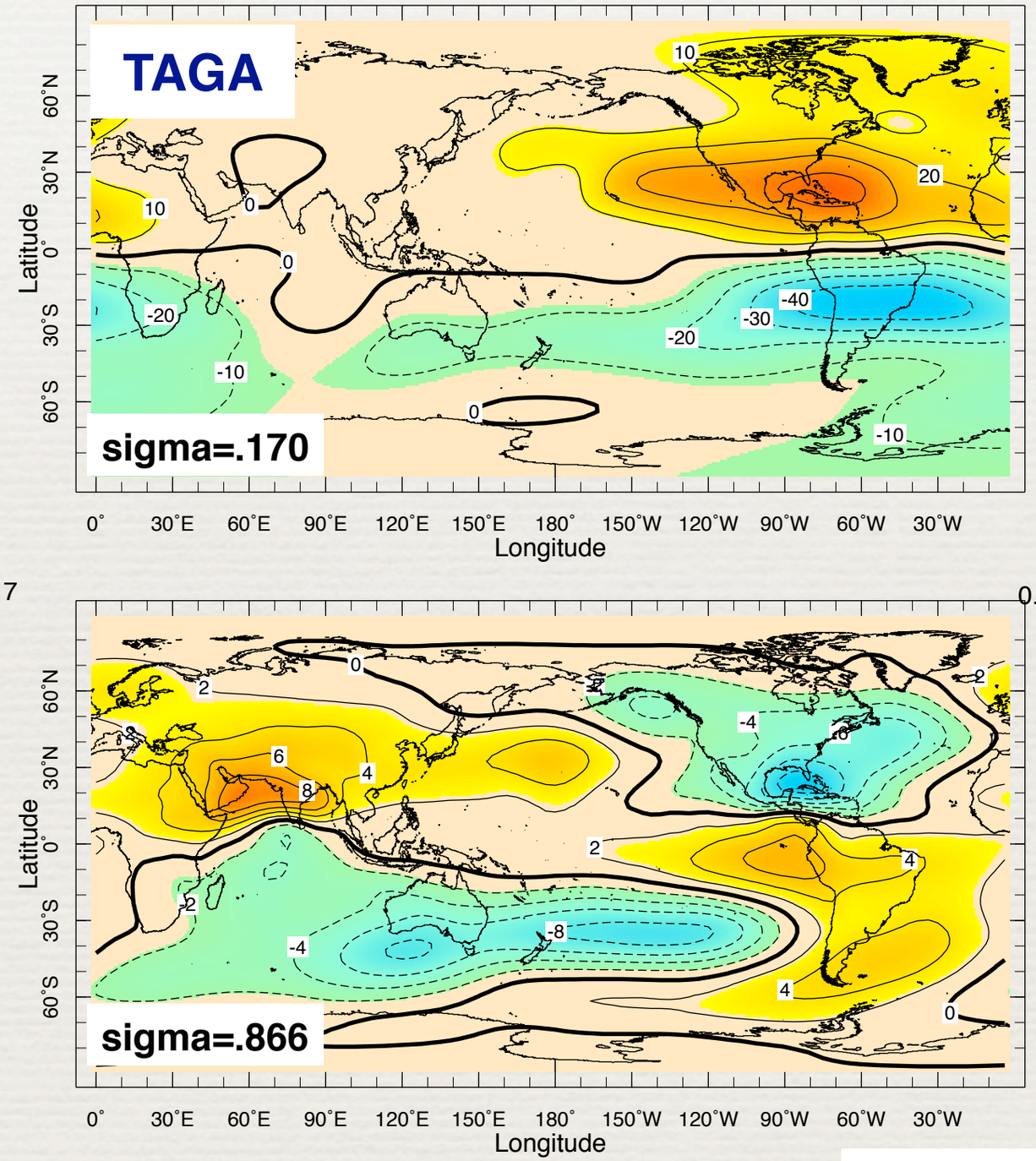
0.568

units 10^5 m^2 sec^{-1}

Streamfunction response: Winter



Streamfunction response: Summer



units 10^5 m^2 sec^{-1}

Summary

- Interannual, cold-season TNA SST variability exerts a mild influence North American precipitation compared to ENSO. The influence is more comparable in the warm season.
- TNA SST work, in part, through perturbing tropical Pacific precipitation, which explains the similarity in the land precip response as well as the global circulation response.
- This raises interesting prospects for the role of "global interactions" in long term (decadal and multi-decadal) variability.
- But is this realistic?
  - Models with prescribed SSTAs tend to exaggerate precip response over the oceans (where SSTA is forced by the atmosphere)
  - The experiments shown were forced AGCM runs (no AO coupling)
  -

Global SST anomaly 1932-39