The California drought and what can be expected from the 2015/16 El Nino

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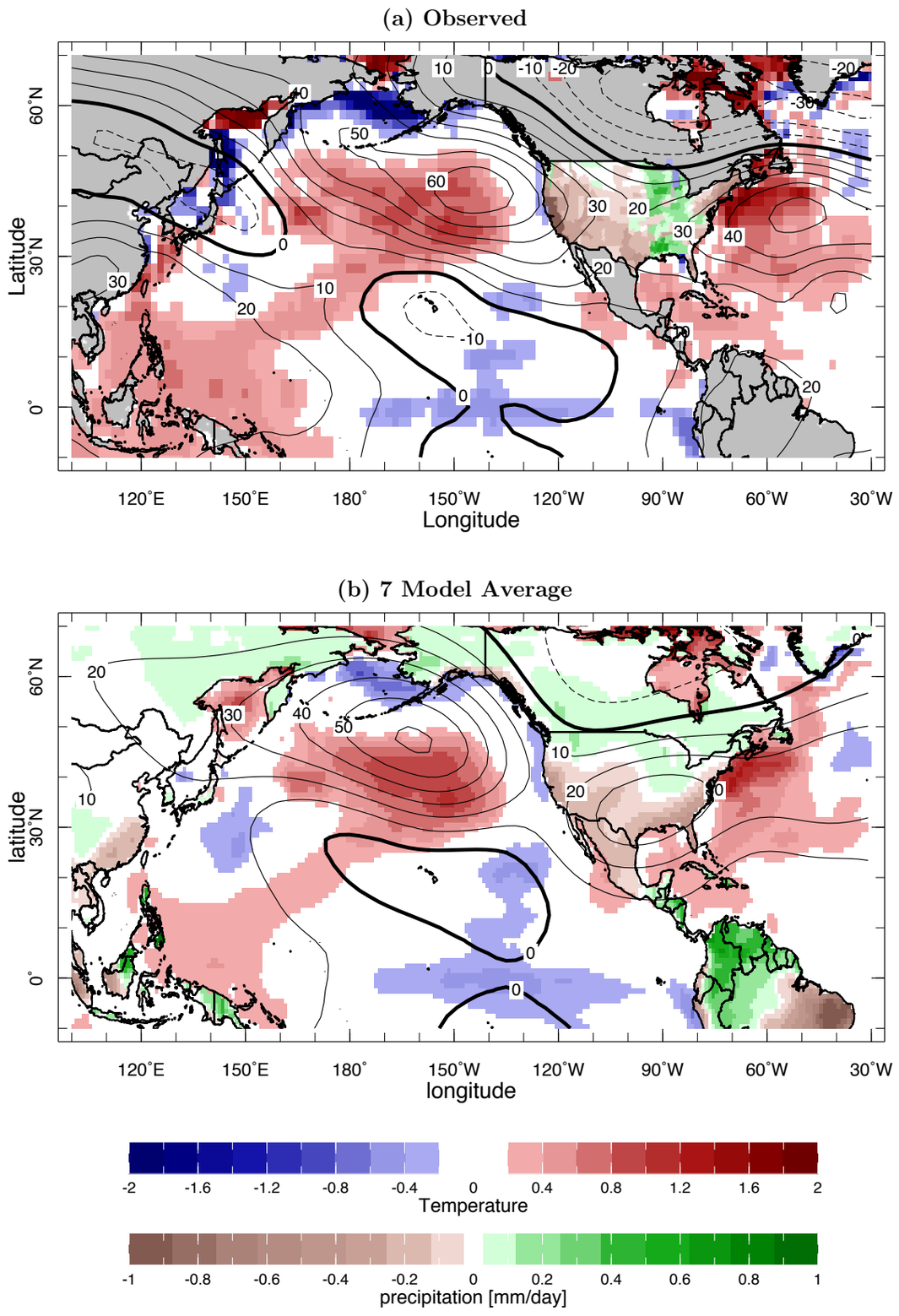
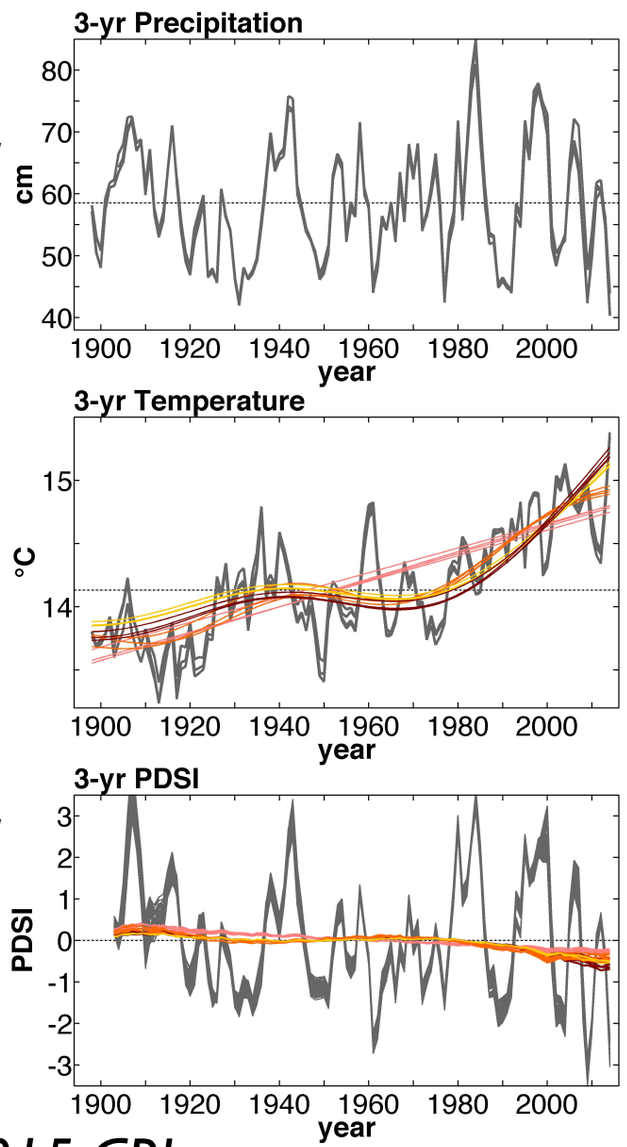
The NOAA DTF California team

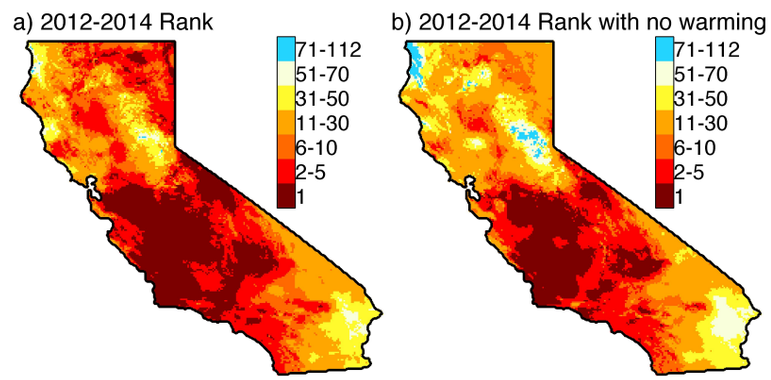
Causes of the ongoing California drought

2011-2014 Winter SSTA (ocean), Precip (land), 200 mb Height (contour)



SST-forced models (average across ensemble means from 7 models) reproduce ~1/3 of west coast ridge and precipitation drop in 2011/14. Drought forced by tropical SSTs + weather

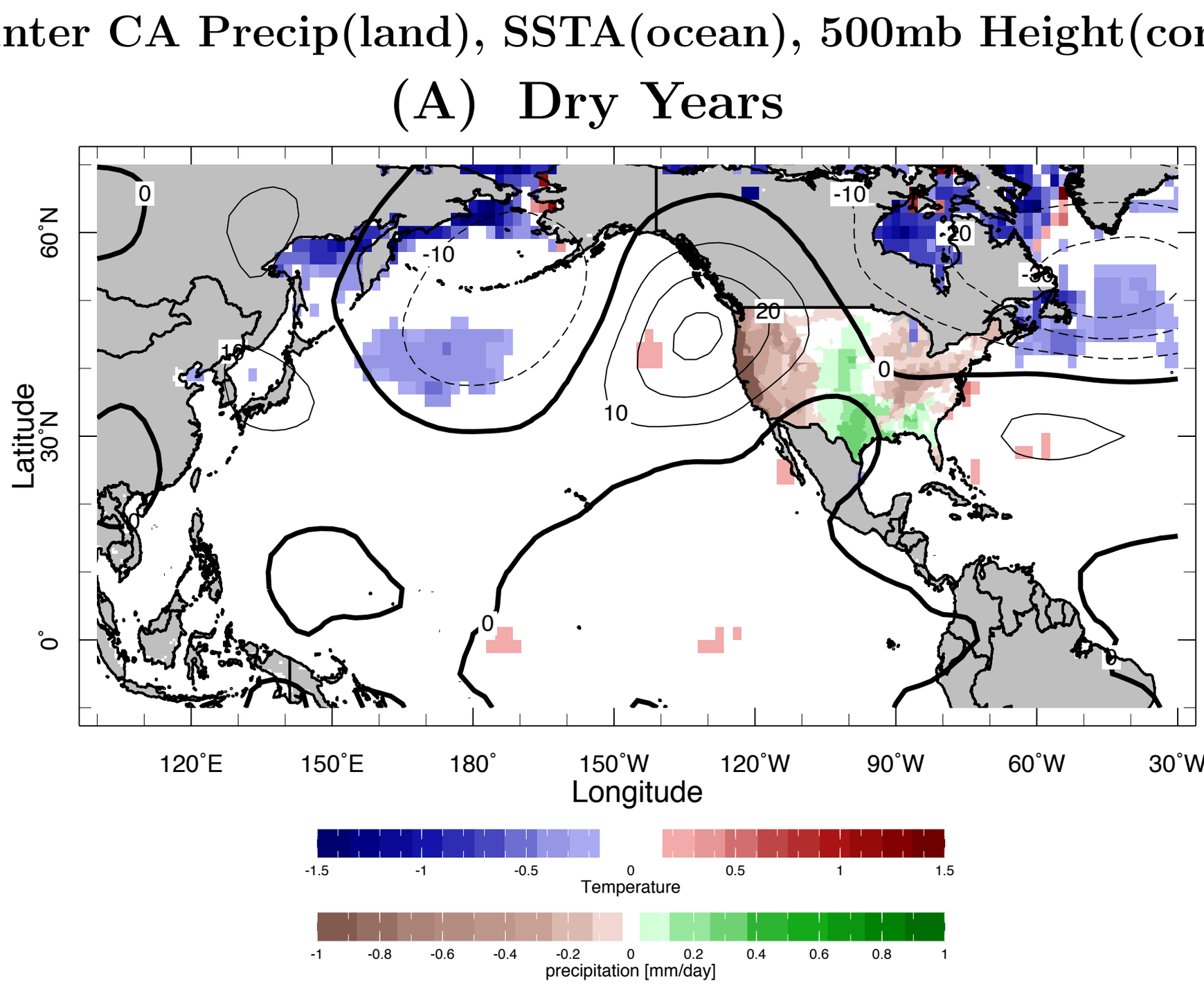




~3/4 of PDSI drop caused by *P* drop, ~1/4 by high temperature. Long term warming contributed to the high temperatures, expanding area with exceptional drought.

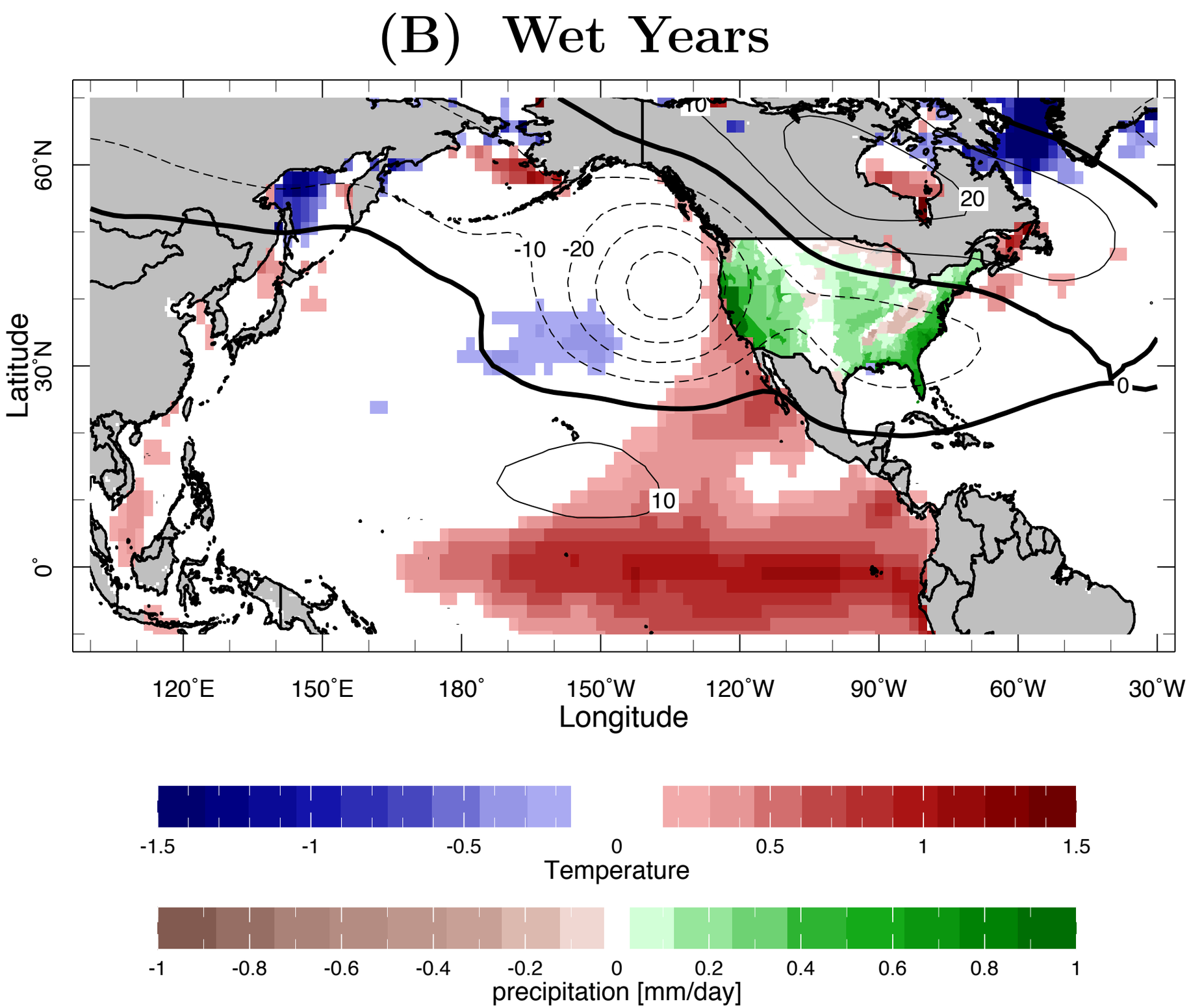
Seager et al. 2015 J. Climate, Williams et al. 2015 GRL

No surprise SST-forced models do not fully capture CA *P* variability

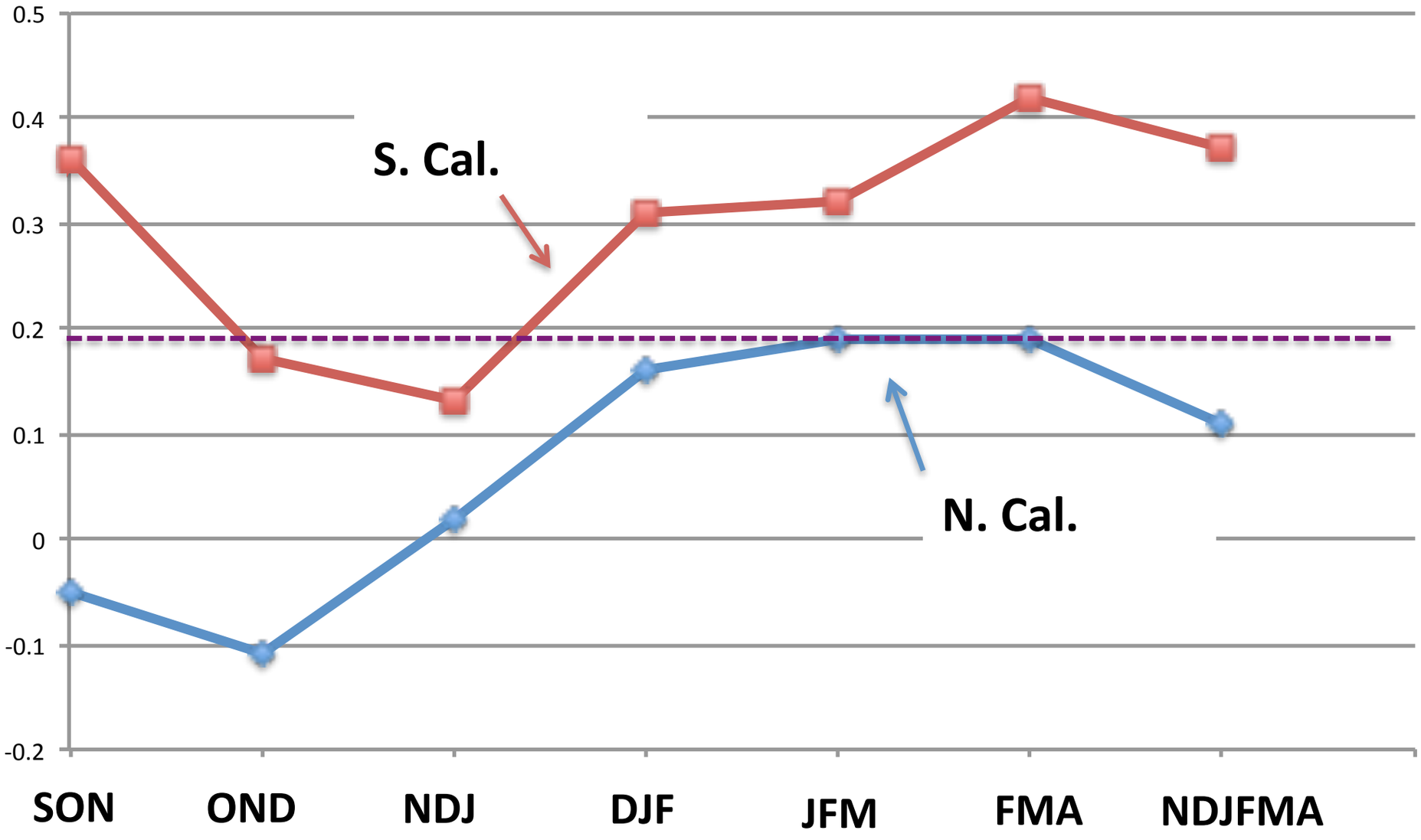


A composite of observed CA dry winters shows the off-coast ridge but no impressive sea surface temperature anomalies

In contrast, observed wet California winters tend to be caused by El Nino events



Seasonal Dependence of California Precip and El Niño Correlation

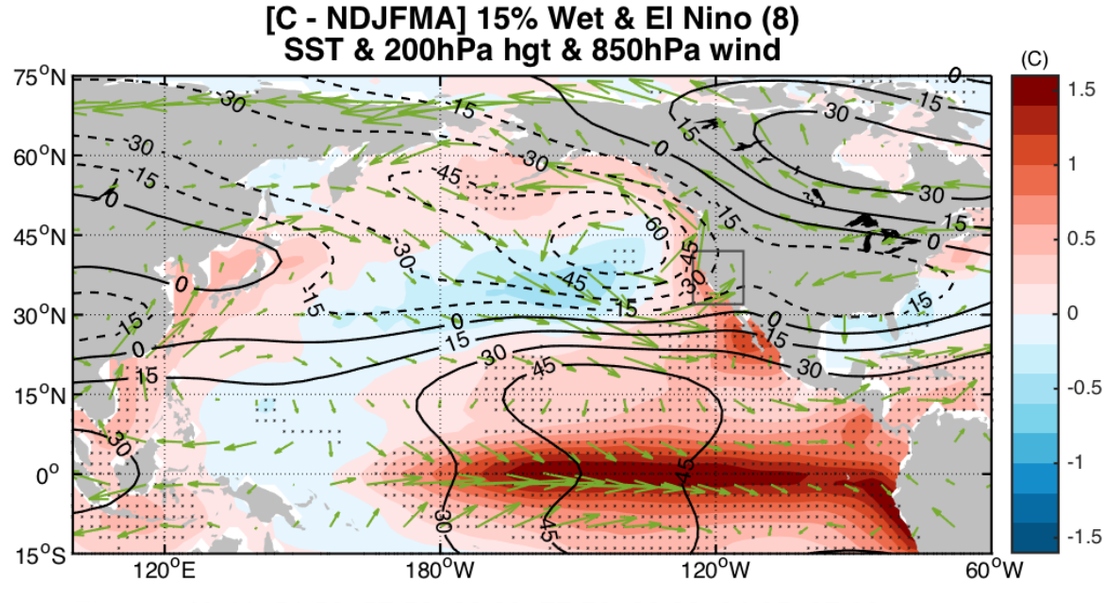


strengthens as winter progresses and stronger in SoCal than NoCal

Composite for top 15% wet vs. non-wet California seasons (NDJFMA) that are also El Niño

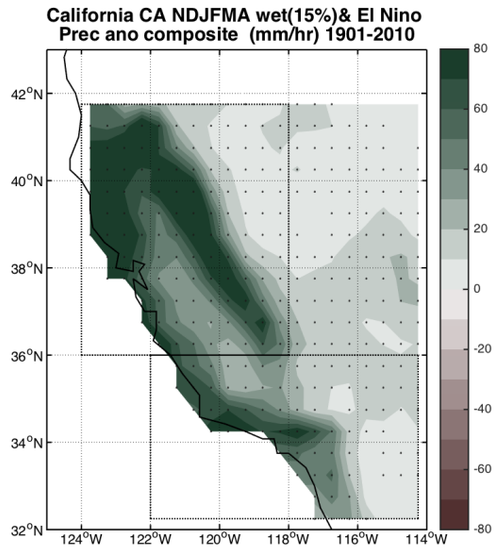
Strong El Niños more reliably cause wet California than weaker El Niños

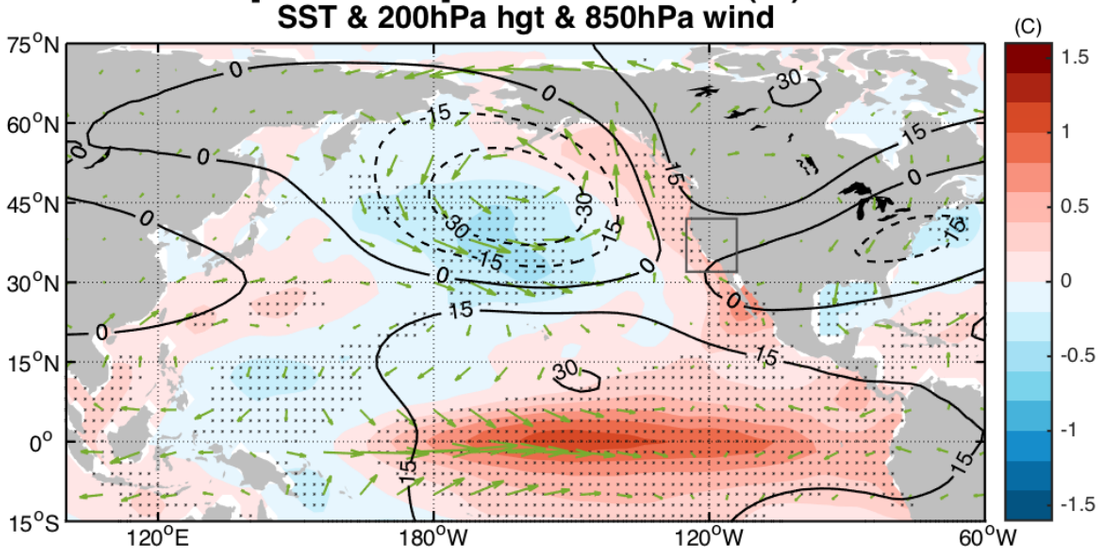
SST (shading), 200hPa Hgt (black contours), and 850 hPa Wind



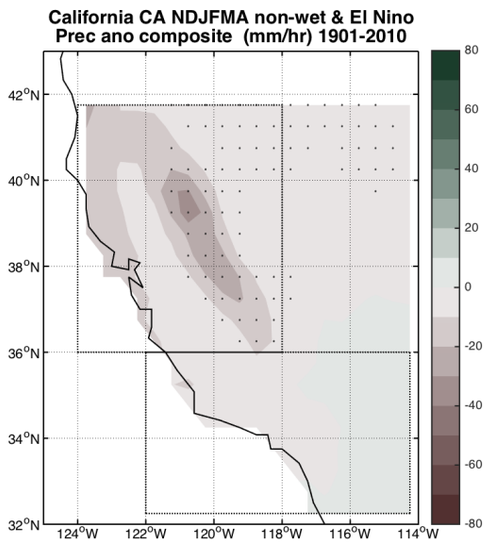
El Nino: 40/41, 51/52, 57/58, 68/69, 77/78, 82/83, 94/95, 97/98

Precipitation





El Nino: 02/03, 04/05, 05/06, 11/12, 14/15, 18/19, 23/24, 25/26, 29/30, 30/31, 39/40, 41/42, 53/54, 58/59, 63/64, 65/66, 69/70, 72/73, 76/77, 86/87, 87/88, 91/92, 02/03, 04/05, 06/07



Wet California during El Niño more favored:

1) during strong events

2) during late rather than early winter

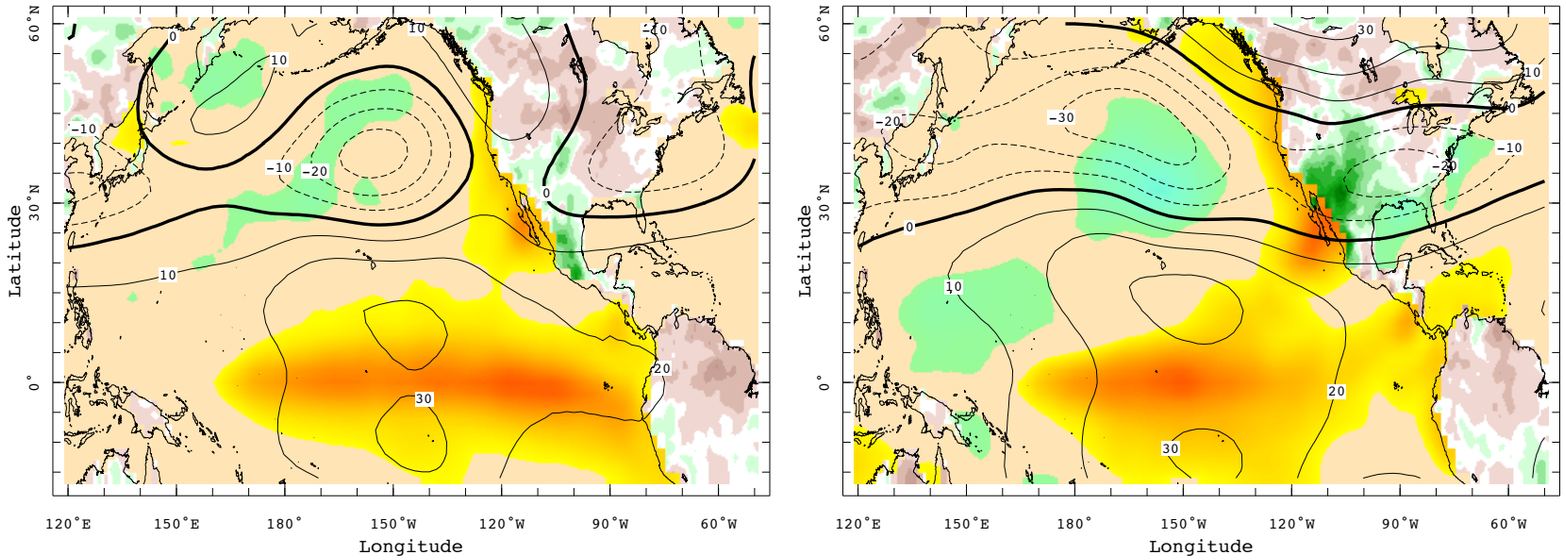
3) in the south than the north

N. America Composite Anomalies

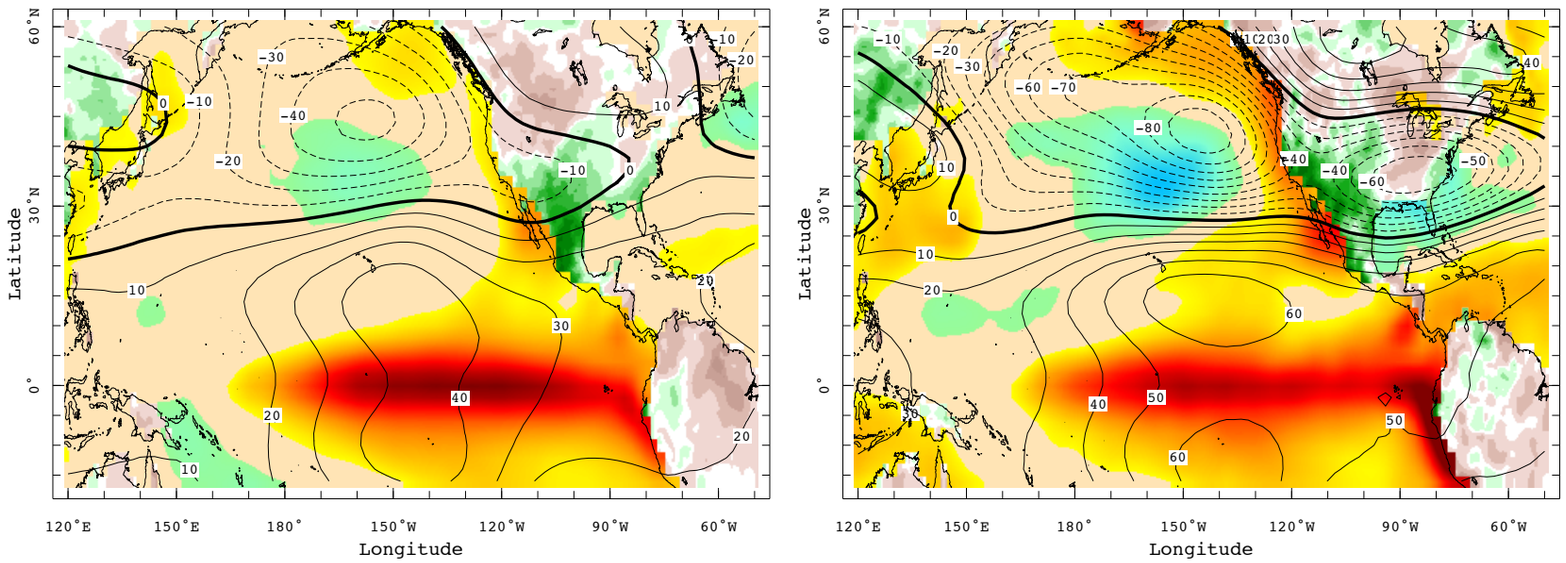
Precipitation Percent of Climatology (land), SSTA (ocean), 200 mb Height (contour)

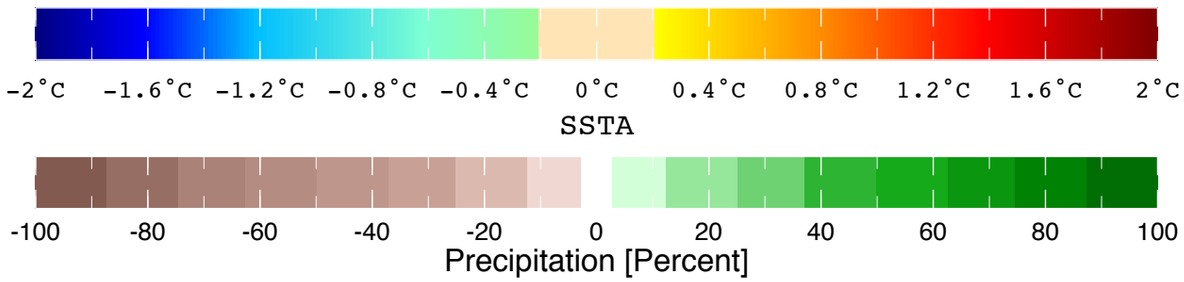
NDJ **FMA**

Weak El Niño: 0.5°C < NINO3.4 < 1.0°C



Moderate to Strong El Niño: 1.0°C < NINO3.4





GOGA N. America Composite Anomalies

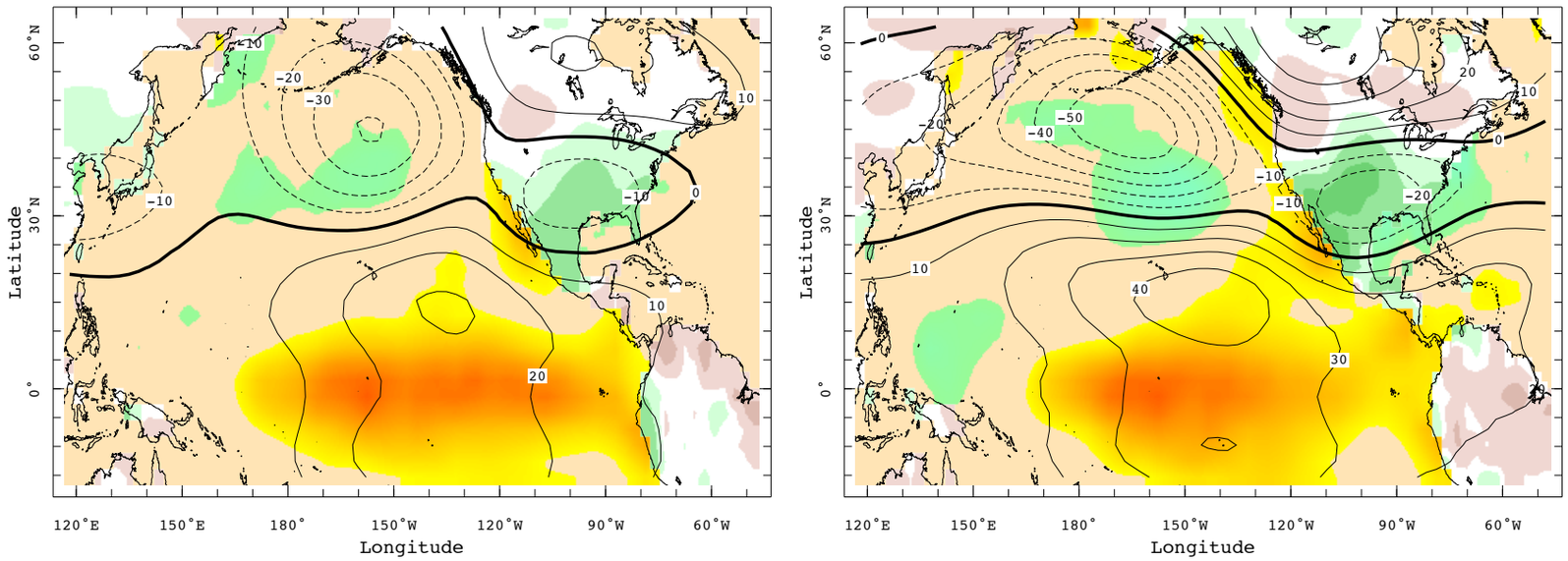
Precipitation Percent of Climatology (land), SSTA (ocean), 200 mb Height (contour)

The ENSO- California P connection simulated well in 16-member CCM3 ensemble.

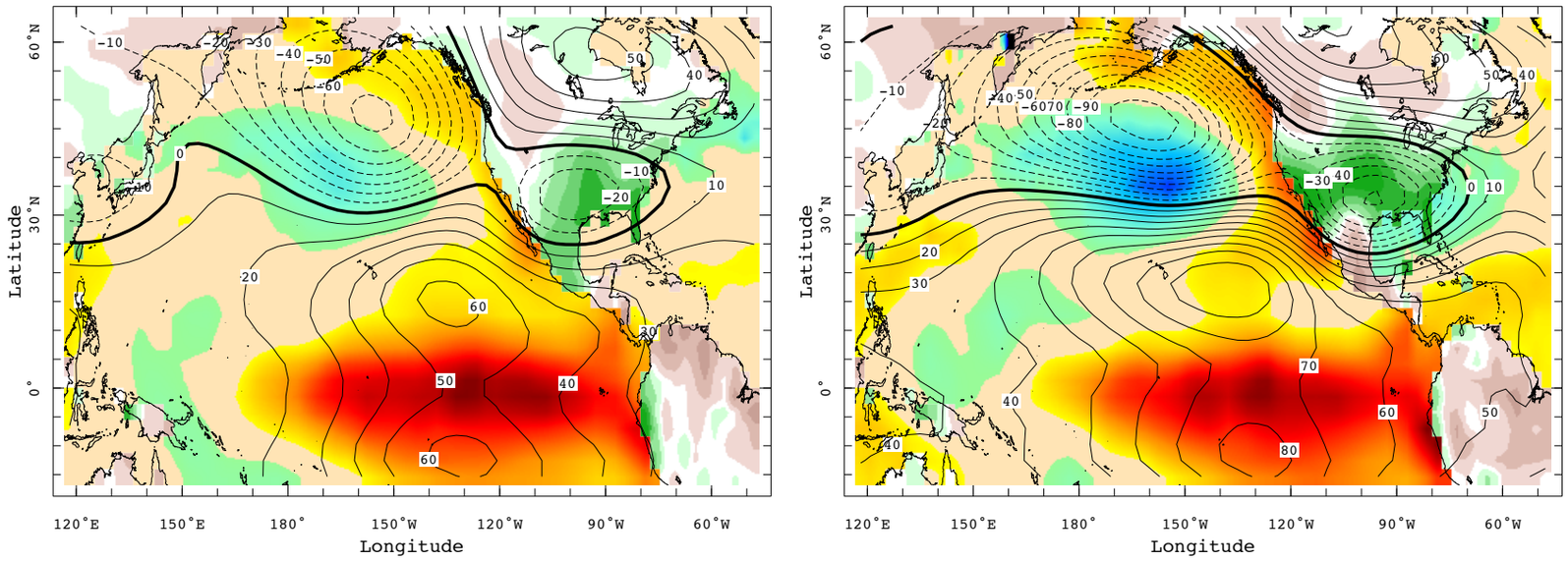
ENSO teleconnections strengthen from early to late winter even as tropical SST anomalies weaken. Why?

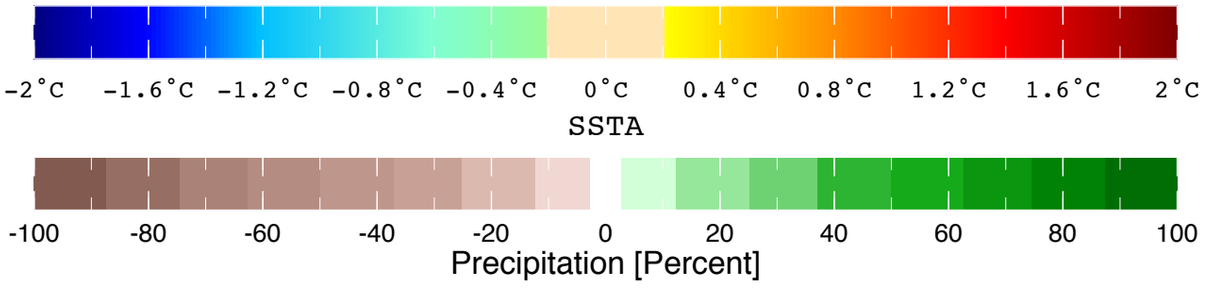
NDJ | **FMA**

Weak El Niño: 0.5°C < NINO3.4 < 1.0°C



Strong El Niño: 1.0°C < NINO3.4

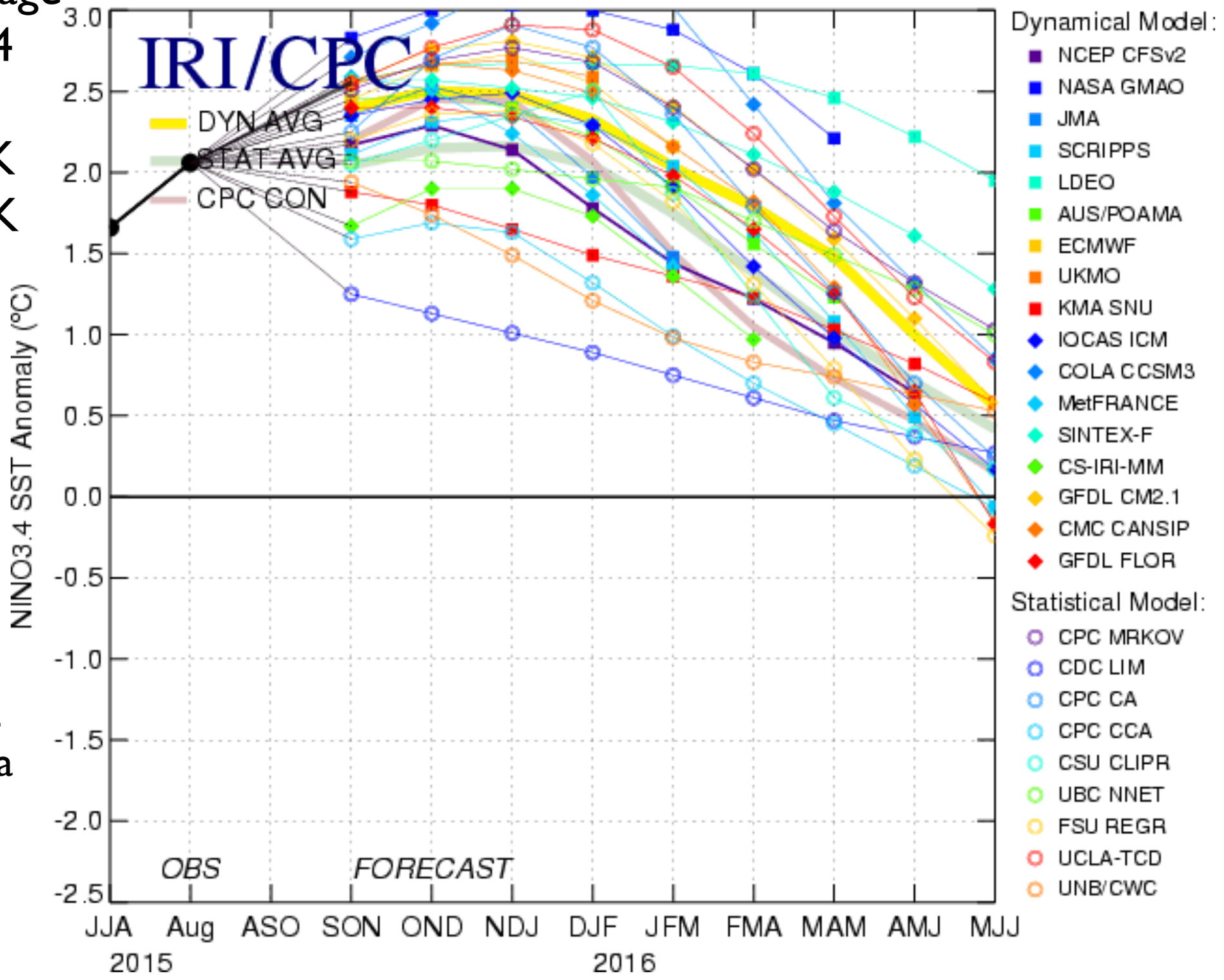




Dynamical model average NINO3.4

NDJ 2.5K
FMA 1.8K

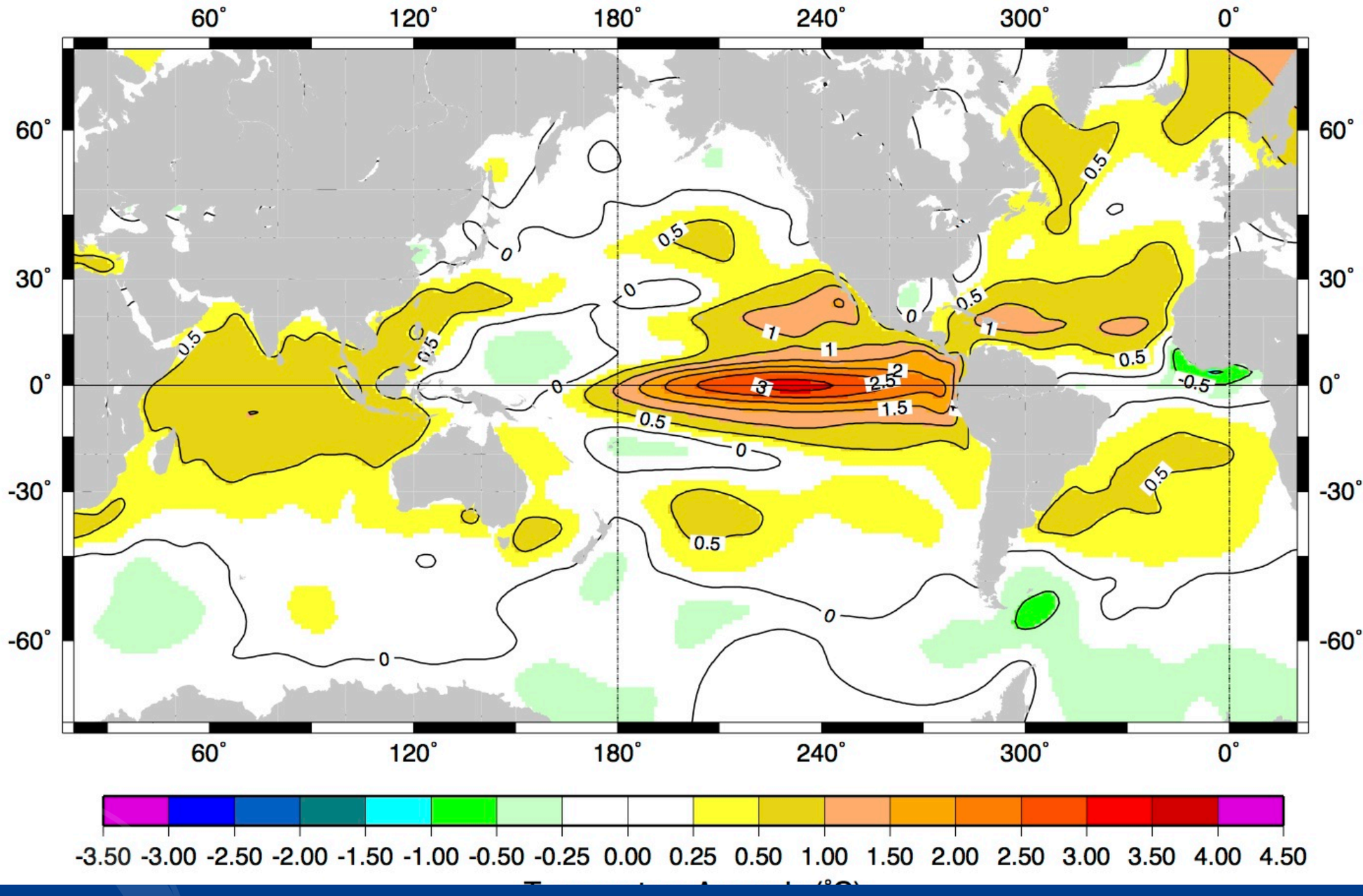
If FMA forecast correct it would be a seasonal record



Global Blend SST Anomalies

(Tropical Forecast: Mean)

Forecast from SEP-2015 - Season JFM-2016



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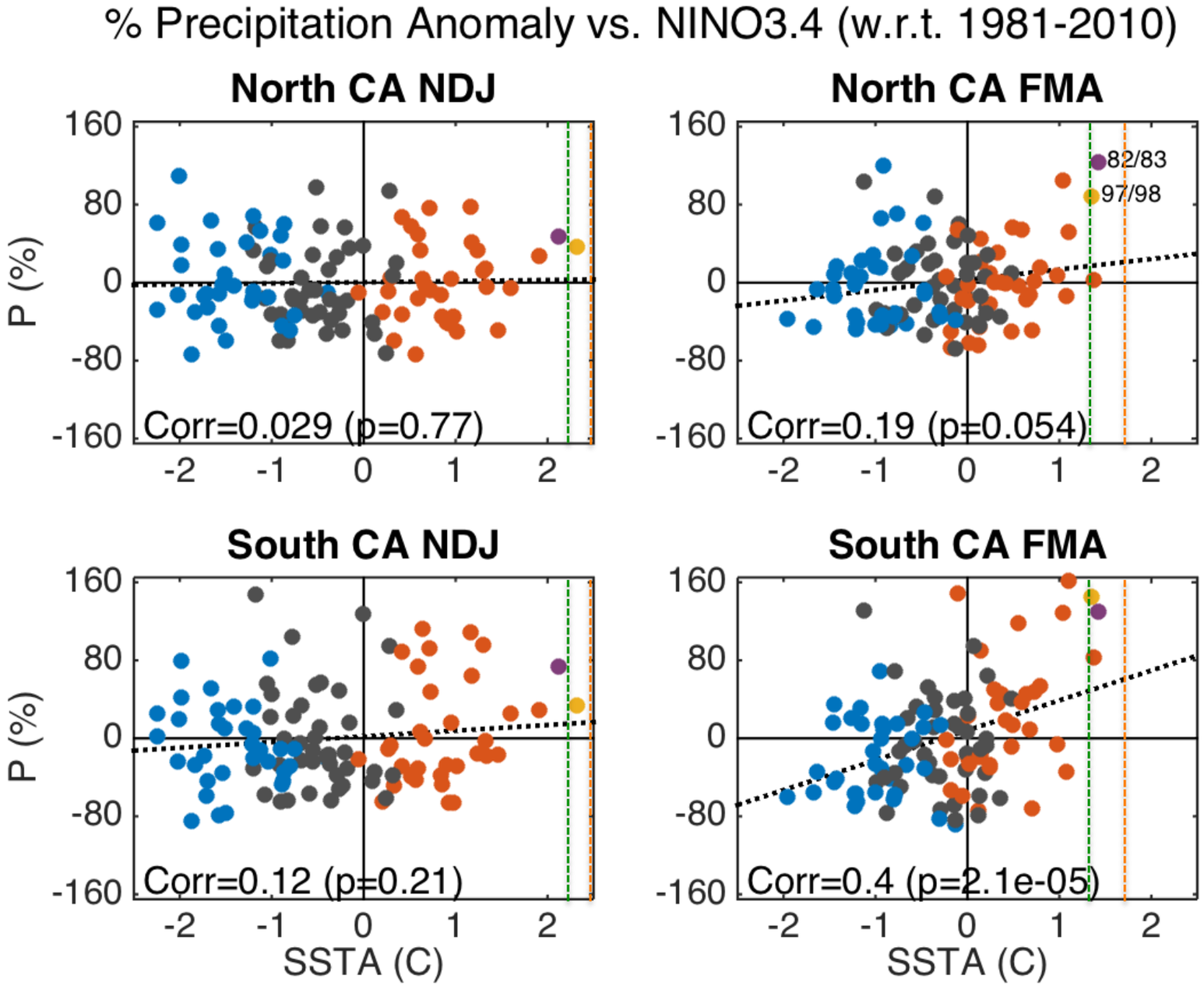
Removal of the 4 years statewide accumulated precipitation deficit requires a record rainfall anomaly in 2015/16



Forecast NINO3.4 for 15/16 based on IRI/CPC dynamical (orange lines) and statistical (green lines) models

	Climatology for NDJFMA (mm)	Sum of P anomalies[1] from 11/2011~04/2015[2] (mm)	Percentage (column 3/column 2 *100%)
Northern	504.83	-745.35	**-147.64%**
Southern	198.90	-388.35	**-195.25%**

Conclusions

California is undergoing a 5 year roller coaster ride of SST driving of winter precipitation

Four winters of drought have left precipitation deficits about 150% (north) and 200% (south) of the climatological normal

Strong El Niños tend to make CA wet but more so in the south than the north and in the late winter than the early winter

Forecasts are for a strong El Niño persisting through to the late winter

A wet winter is likely but record wet needed to erase the accumulated precipitation deficit

(Soil moisture, reservoir storage may need less precipitation to return to "normal"