2016-17 Winter Outlook for Central & Northern New Mexico

Updated 11/20/16.

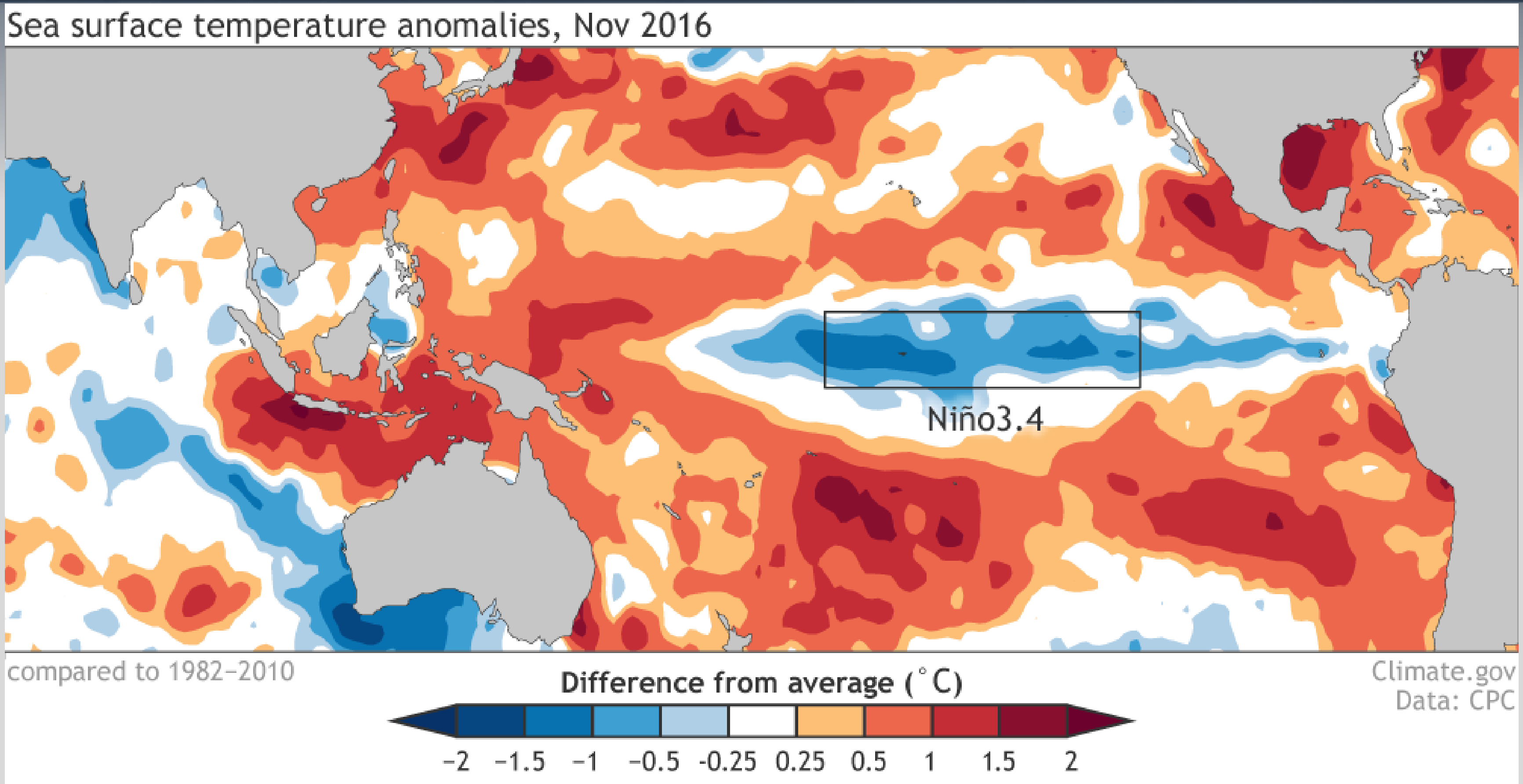


Figure 1. Sea Surface Temperature Anomalies (SSTAs) in the Pacific Ocean from the first two weeks in November, 2016. Orange/red color depicts above average temperatures and blue depicts below average temperatures. A weak La Niña is now underway.

Cooling of Sea Surface Temperatures (SSTs) in the eastern equatorial Pacific slowed significantly in late summer and early fall. How will neutral (near average) or a weak La Niña (cooler than average) sea surface temperatures (SSTs) influence meteorological winter (December, January & February) precipitation and temperature in central and northern New Mexico?

Latest Sea Surface Temperature Observations & Oscillation Index Values

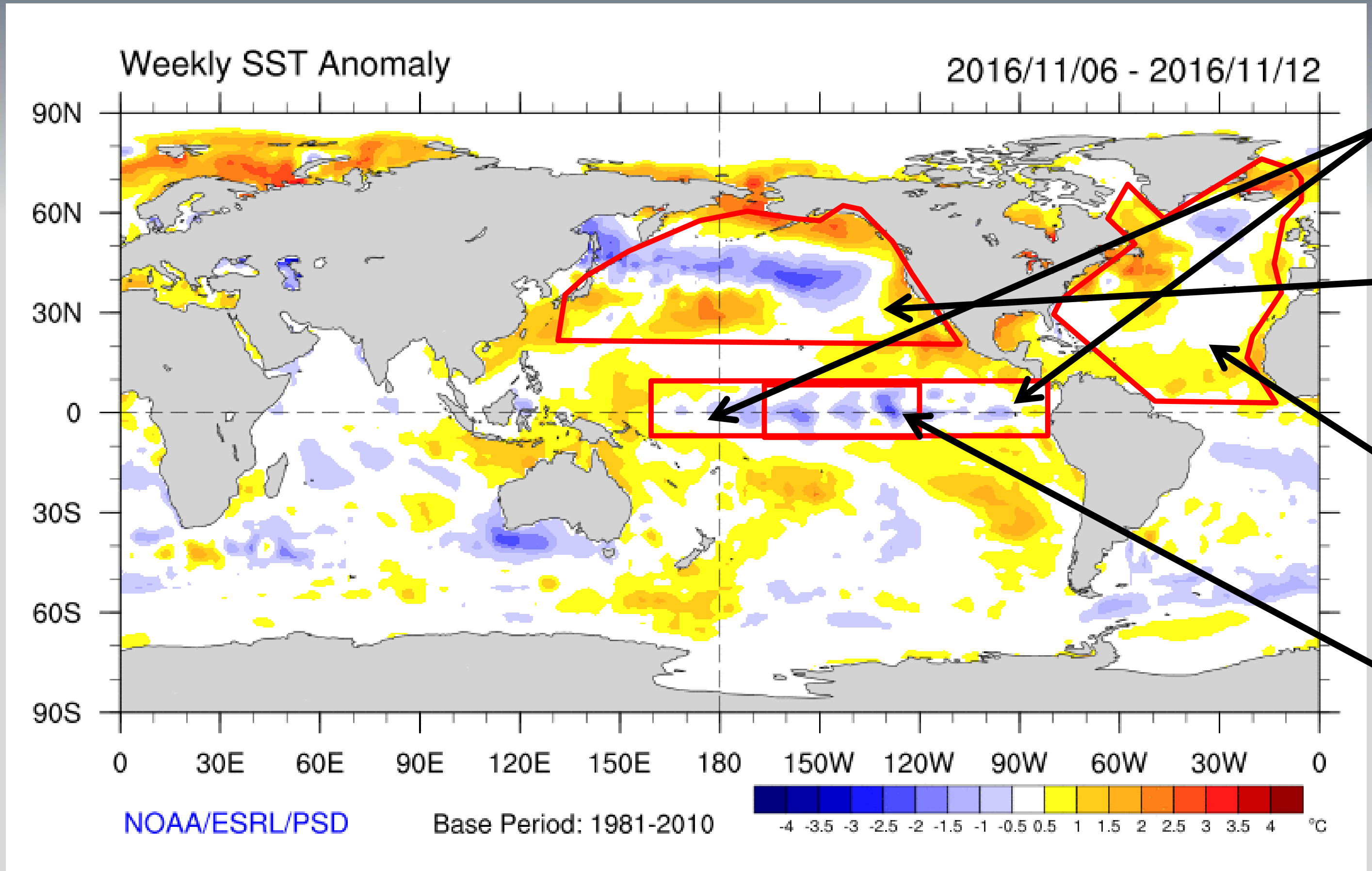


Figure 2. Latest Weekly global SST anomalies showing cooler than average temperatures in the eastern equatorial Pacific Ocean.

- Multivariate ENSO Index (MEI) for SEP-OCT 2016: -**0.38**
- Pacific Decadal Oscillation (PDO) for OCT 2016: +**0.56**
- Atlantic Multidecadal Oscillation (AMO) for OCT 2016: +**0.39**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for ASO 2016: -**0.7**

Fall and Winter Seasons Following Strong El Niño events since 1950

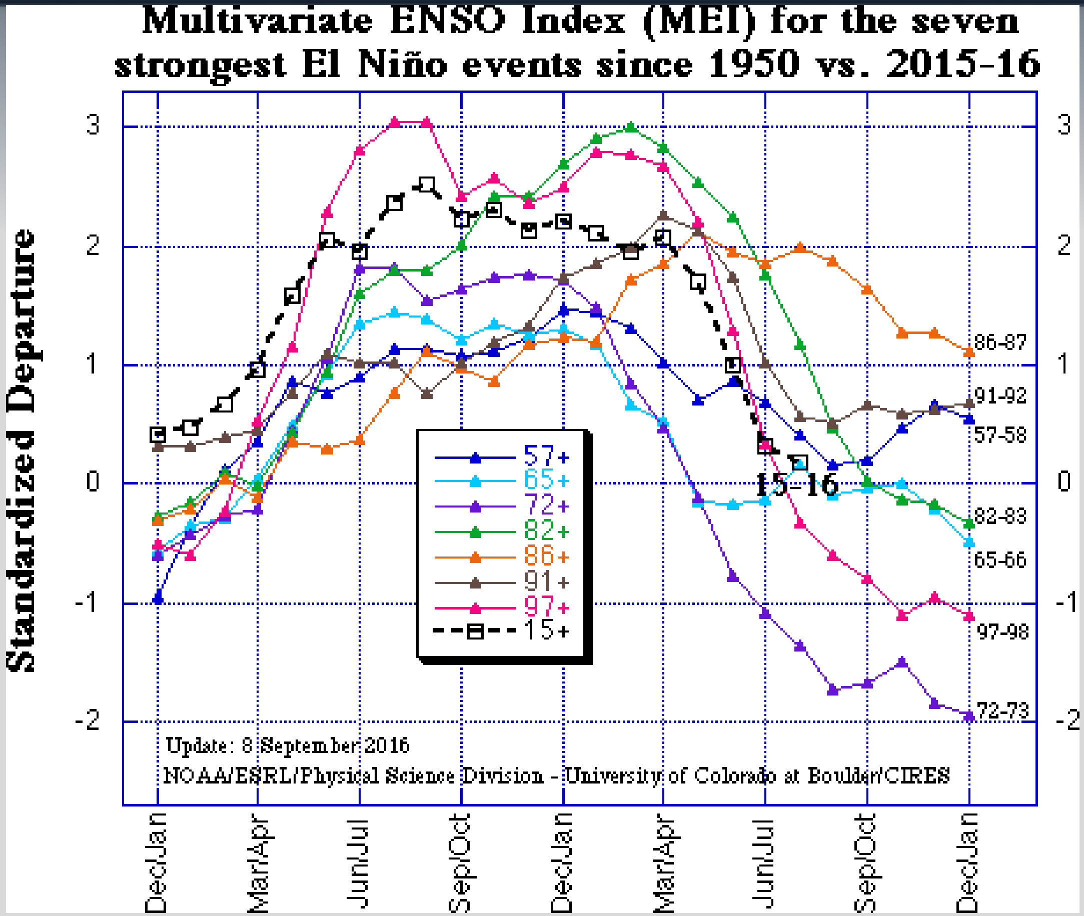
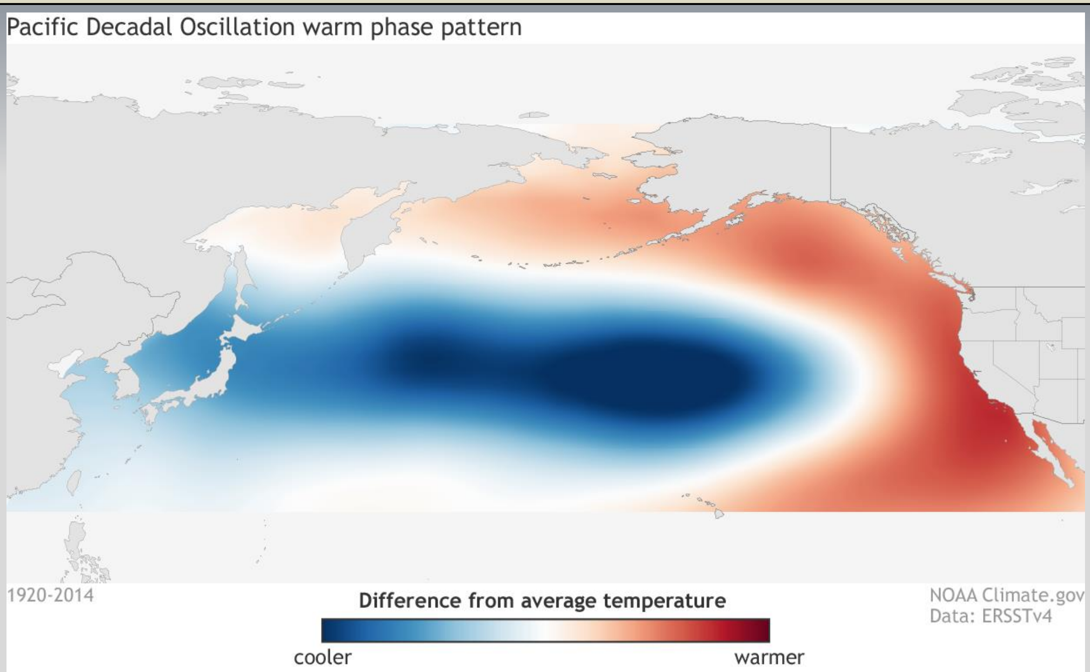


Figure 3. Seven strongest El Niño events using the Multivariate El Niño Southern Oscillation Index since 1950. 1958-59, 1966-67, 1983-84, 1992-93, 1998-99 as well as 1969-70 (a moderate El Niño with similar MEI and PDO values the current state) were chosen as analog years to 2016-17 based on MEI and Pacific Decadal Oscillation (PDO) values following El Niño events.

The Pacific Decadal Oscillation (PDO)

A key factor during a positive PDO is increased low and mid level moisture availability in far northeast Pacific/Gulf of CA.



PDO Aug, Sep, Oct 2016	PDO Jul, Aug, Sep 1998	PDO Jul, Aug, Sep 1983	PDO Jul, Aug, Sep 1969	PDO Jul, Aug, Sep 1966	PDO Jul, Aug, Sep 1958
0.52, 0.45, 0.56	-0.04, -0.22, -1.21	3.51, 1.85, 0.91	2.35, 2.69, 1.56	0.26, -0.35, -0.33	0.89, 1.06, 0.29

Figure 4. Typical Sea Surface Temperature Anomaly (SSTA) patterns and wind stress or the amount of wind force on the water surface (arrows) in the North Pacific Ocean during a positive Pacific Decadal Oscillation phase (PDO). As with ENSO, the PDO correlates well with winter precipitation in the southwest United States.

North Pacific Index (NPI) & the Aleutian Low

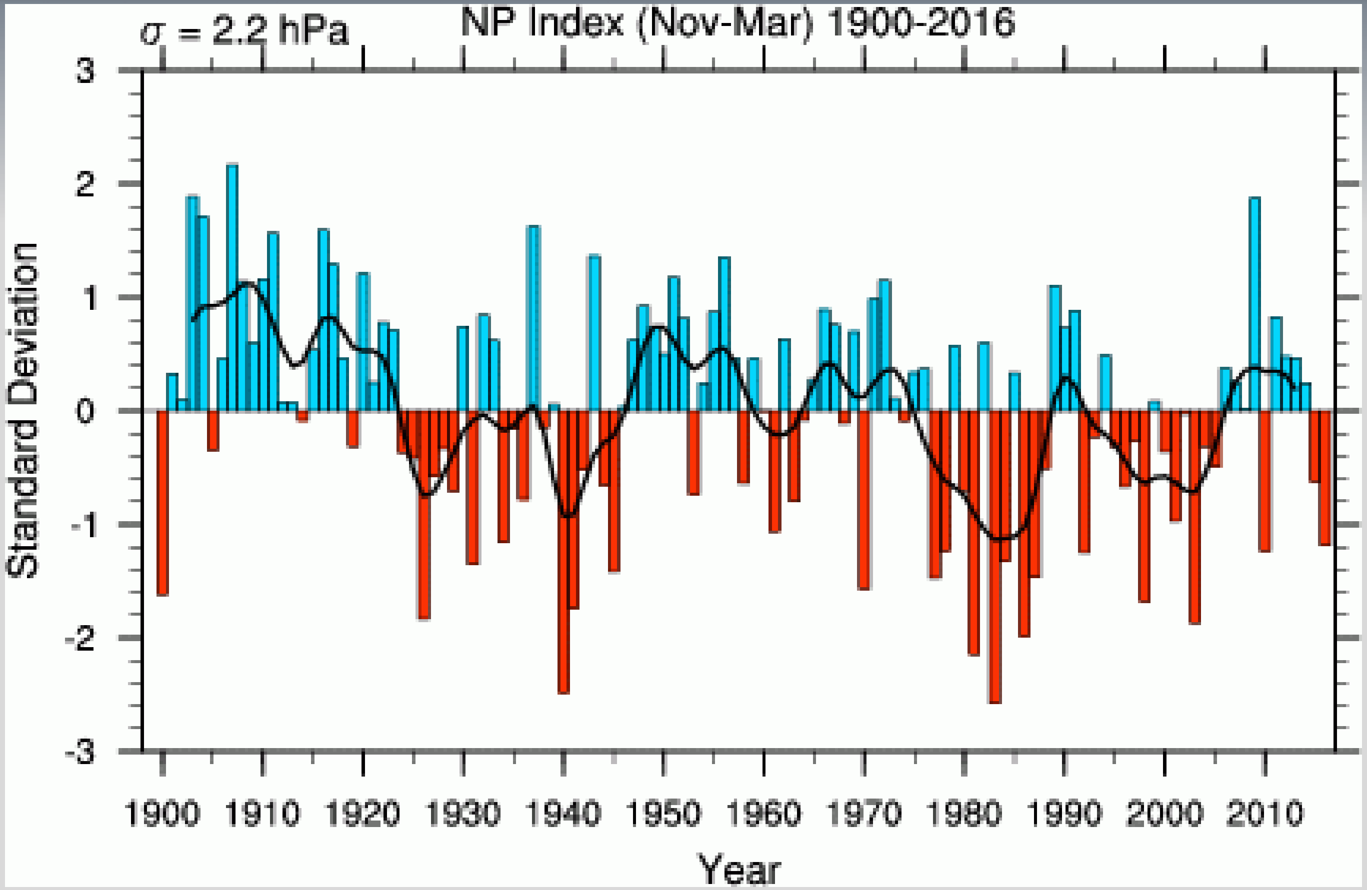
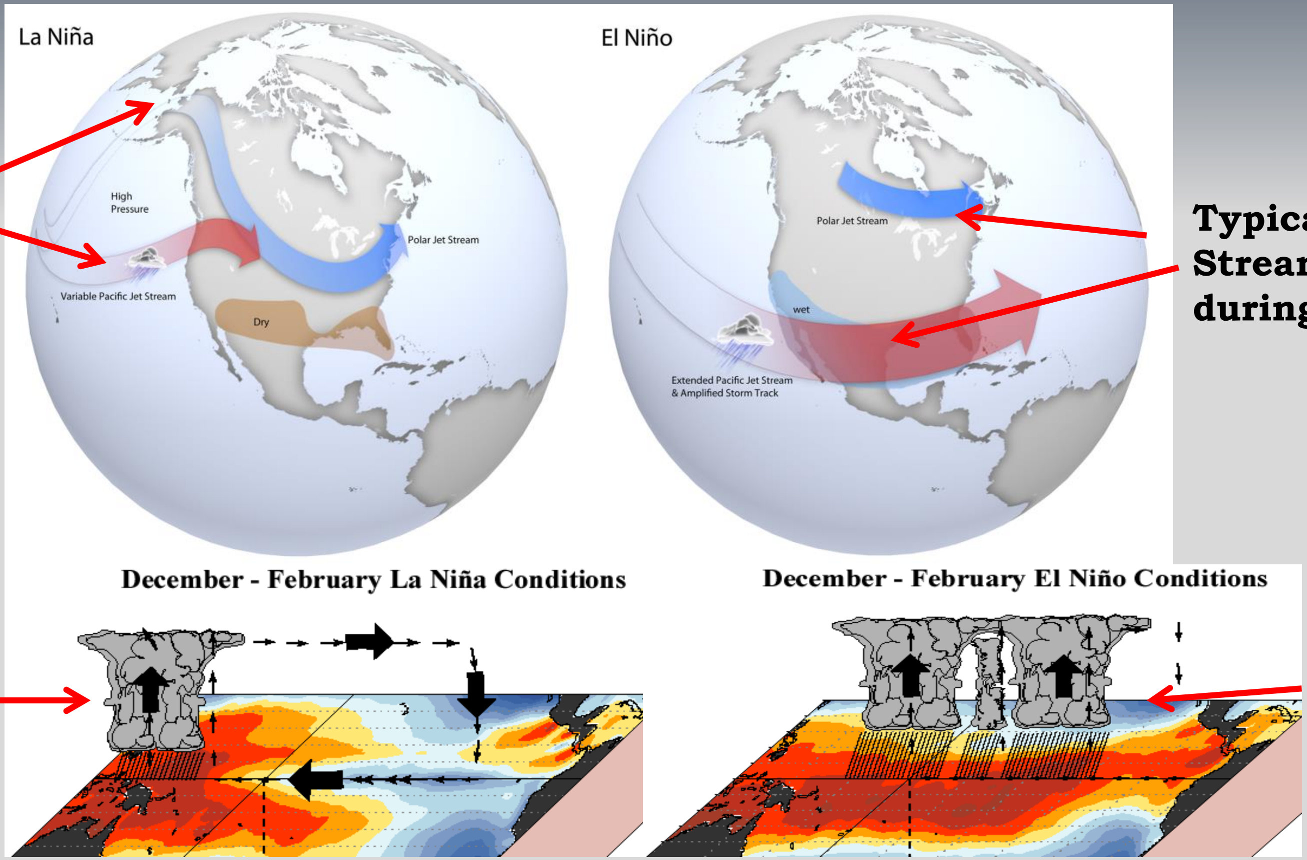


Figure 5. The North Pacific Index (NP index or NPI) is the area-weighted sea level pressure over the region 30°N-65°N, 160°E-140°W. The NP index is defined to measure interannual to decadal variations in the atmospheric circulation. The dominant atmosphere-ocean relation in the North Pacific is one where atmospheric changes lead changes in sea surface temperatures by one to two months. A negative NP Index (Nov-Mar) is associated with a positive PDO, a stronger than average Aleutian low, and a storm track farther south than average.

So What if SSTs in the Eastern Pacific Ocean Are Warmer or Cooler Than Average?

Typical Jet Stream Pattern during La Niña

Typical Jet Stream Pattern during El Niño



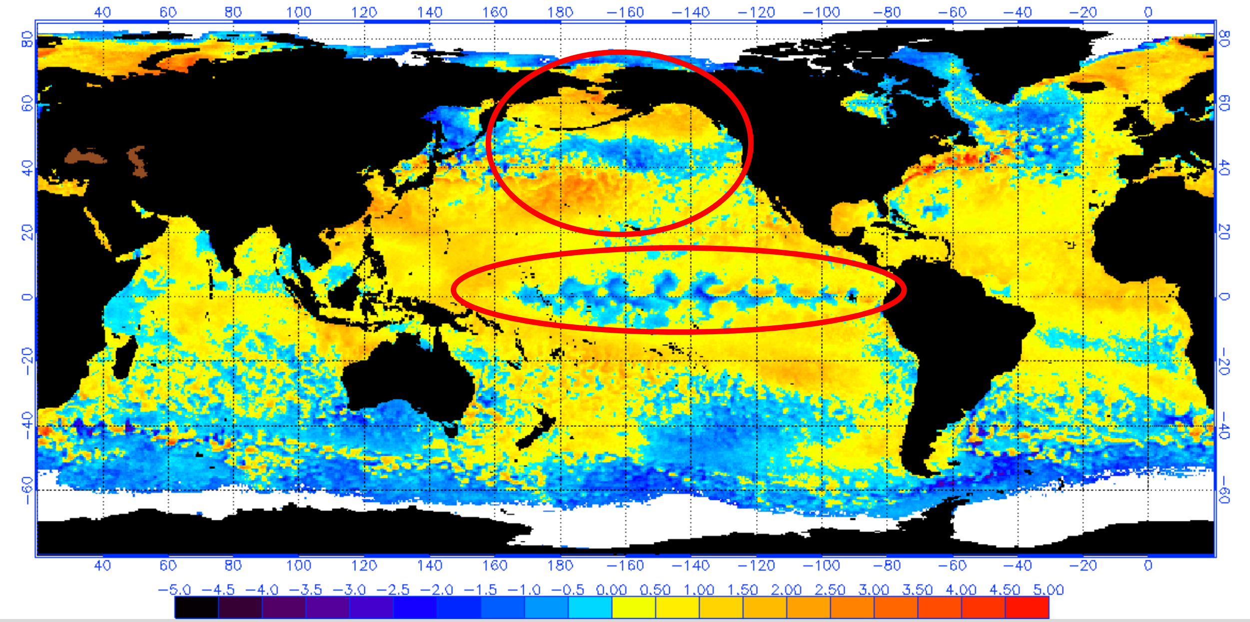
Typical Tropical circulations during La Niña

Typical Tropical circulations during El Niño

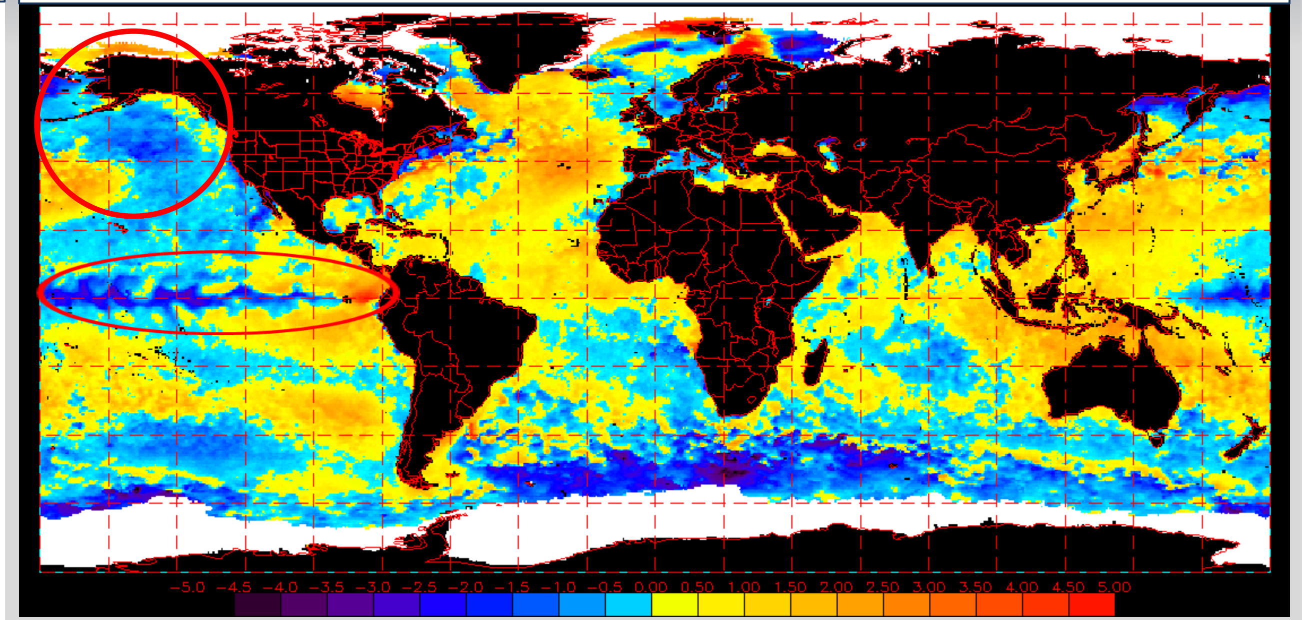
Figure 6. Warmer SSTs support deep tropical and subtropical convection farther east than average. This deep convection draws the jet stream farther south into the far eastern Pacific Ocean and southwestern United States during El Niño. The opposite is true during La Niña and the polar jet stream generally remains north of New Mexico.

Comparing Late October 1998 Global SSTAs to Late October 2016

Global SSTA's 10/27/2016



Global SSTA's 10/31/1998



Figures 7 & 8. SSTAs from the most recent analog year, 1998, and current conditions. Note the differences between the northeast Pacific and North Atlantic SSTA distribution. Also note the different map projections. In late October 1998, the eastern equatorial Pacific was cooler than 2016 and the northeast Pacific was cooler than average (negative PDO).

DJF Precipitation – Analog Years vs. 30-yr Average

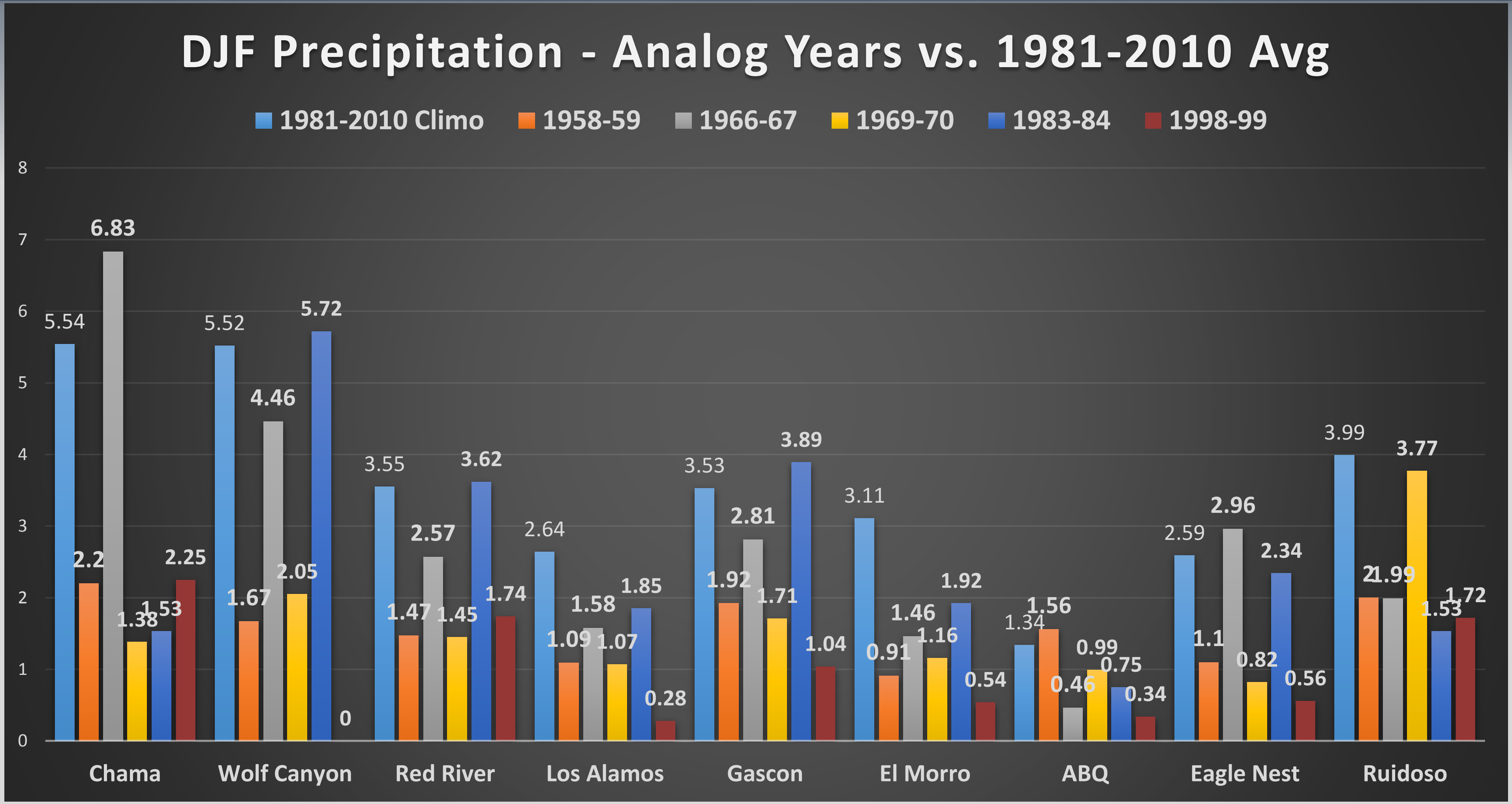


Figure 9. DJF precipitation from selected sites comparing the DJF following five strong El Niño events to the 1981-2010 climatological average. Most sites reported near to below average precipitation.

DJF Snowfall – Analog Years vs. 30-yr Average

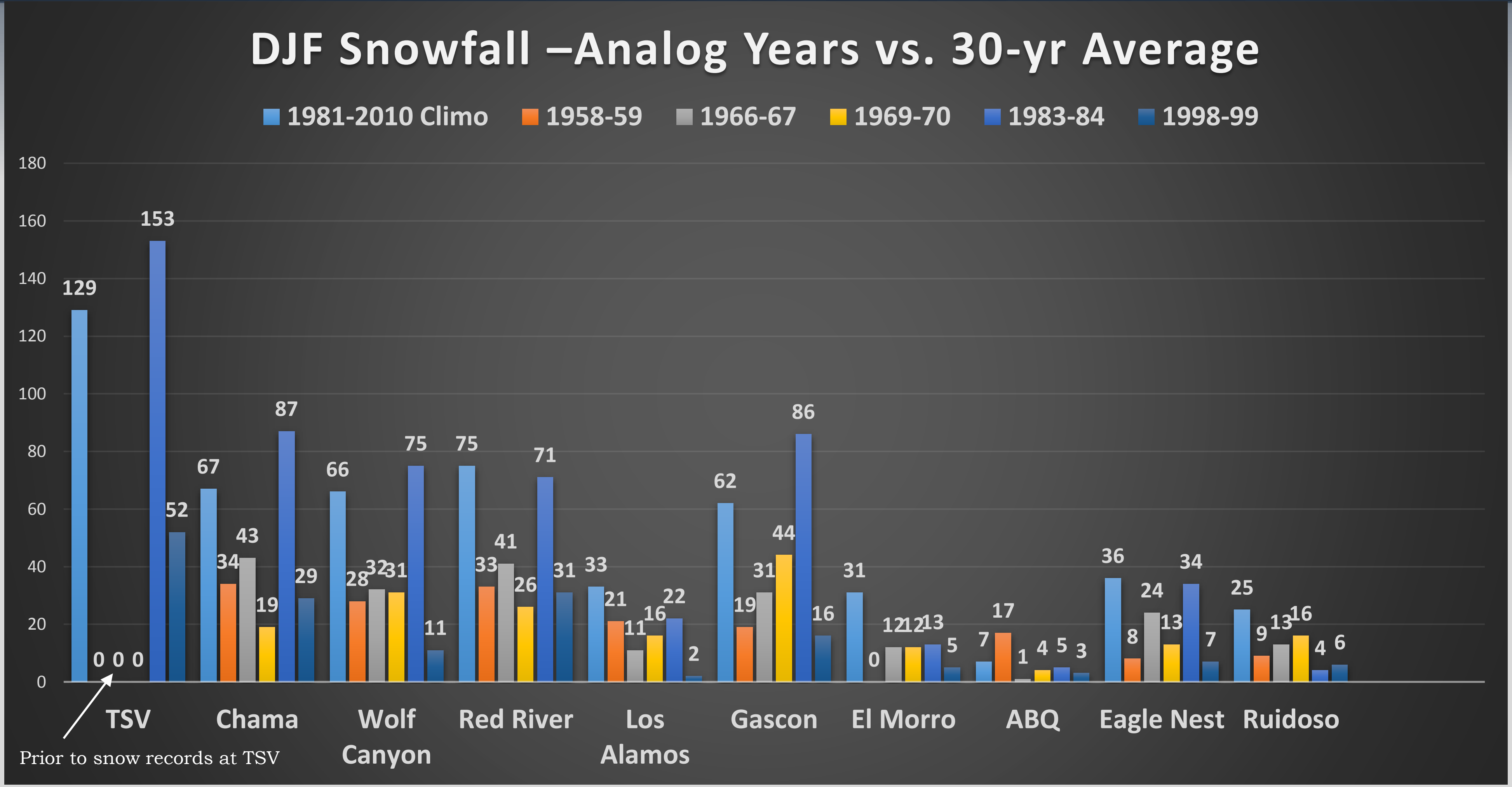
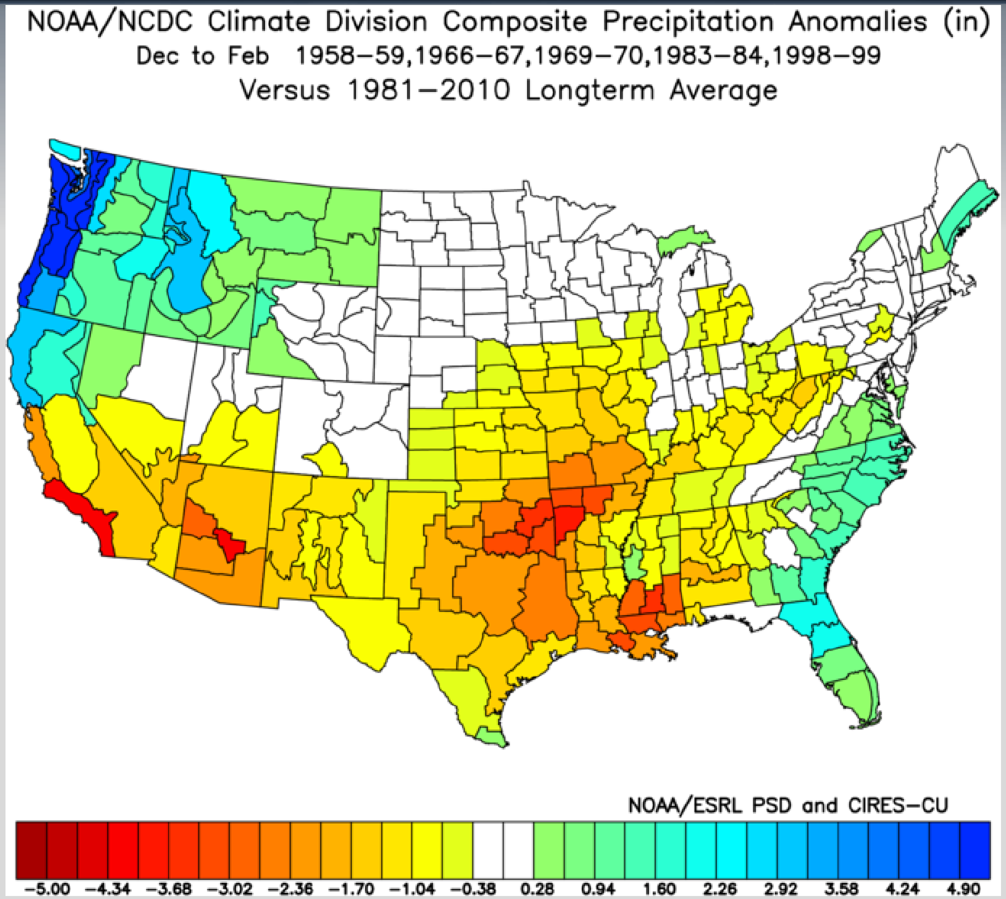
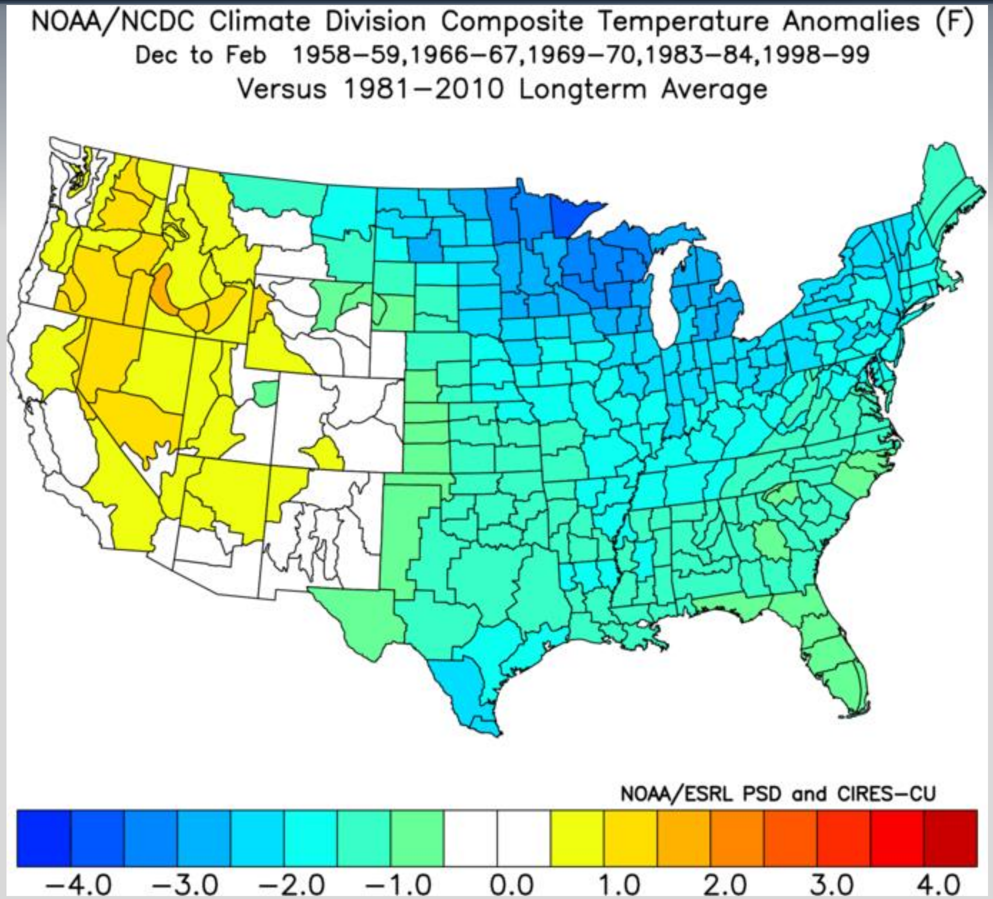


Figure 10. DJF snowfall from selected sites comparing the DJF following five strong El Niño events with 1981-2010 climatological averages. Most sites received, generally speaking, near to below average snowfall.

Precipitation and Temperature Anomalies Analog Years vs. Average





Figures 11 & 12 . DJF Precipitation and Temperature anomaly plots for CPC's climate divisions comparing four analog seasons (1958-59, 1966-67, 1969-70, 1983-84, & 1998-99) with 30-year climatological averages. All of the eight climate divisions in the state were slightly below to below average for precipitation while the northwest plateau division was slightly above average with regard to temperature.

Latest Climate Model Forecasts

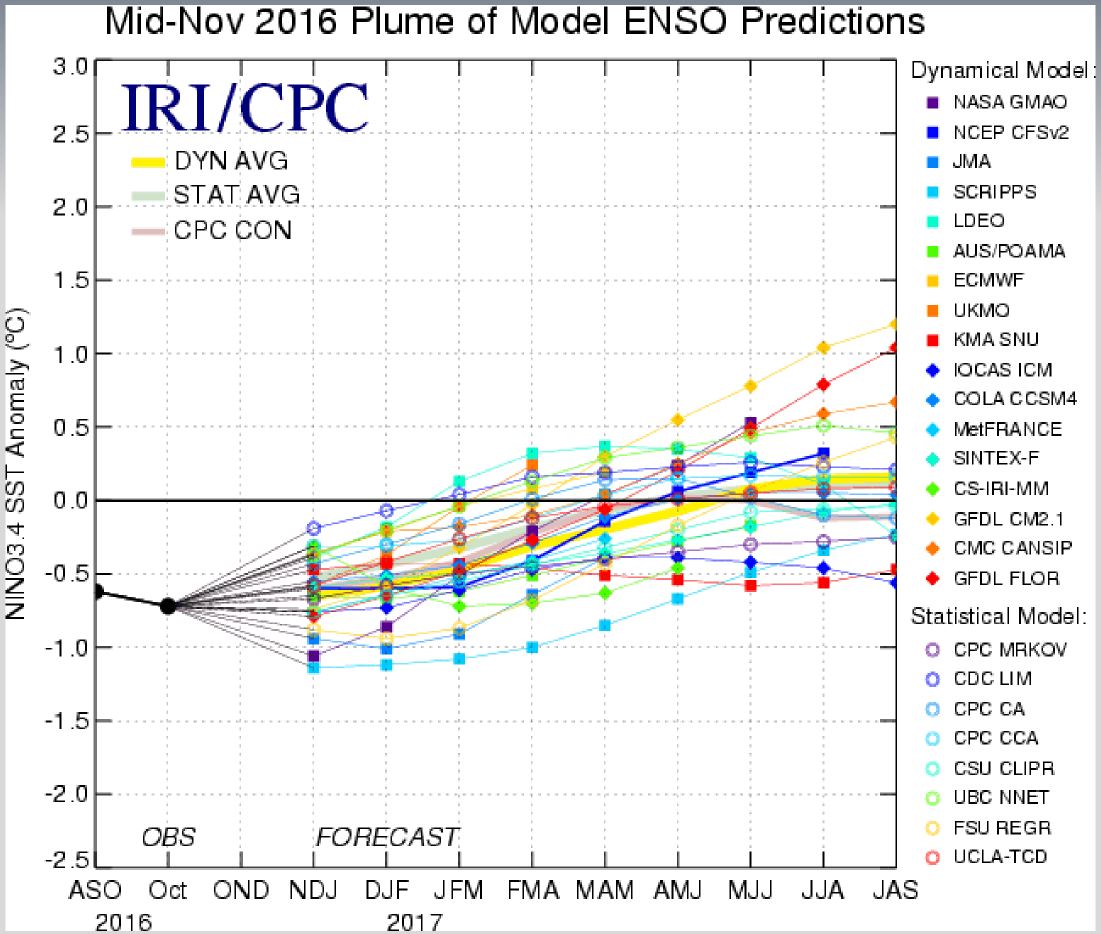
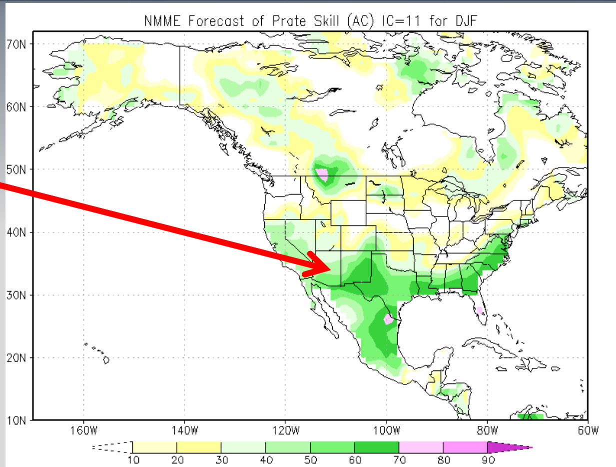
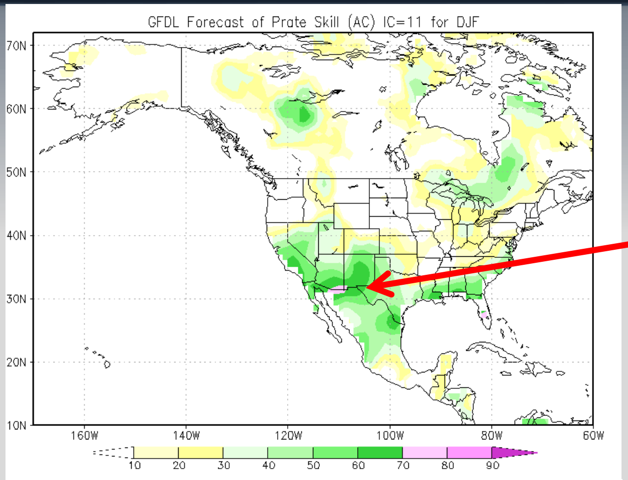


Figure 13. Most multi-model averages forecast a weak La Niña (~ -0.5°C) or neutral conditions during the Northern Hemisphere winter (DJF) 2016-17.

Numerical Climate Prediction Model Precipitation for DJF

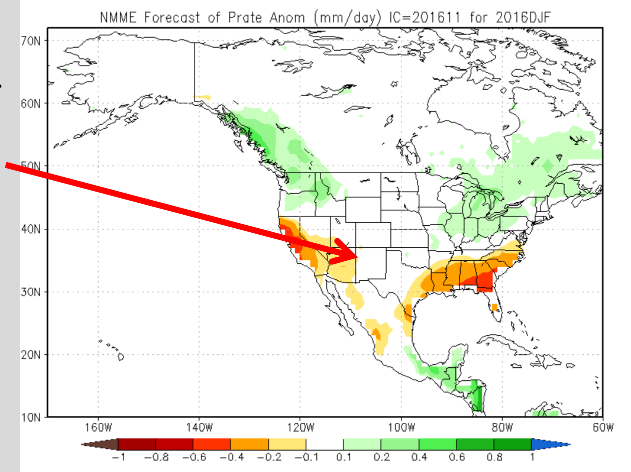
Highest model skill in DJF across southeast NM.

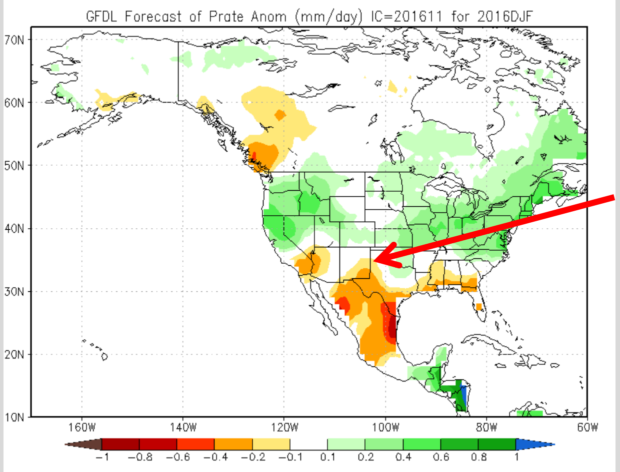




Highest model skill in DJF across central NM.

White equates to near average precipitation rates.

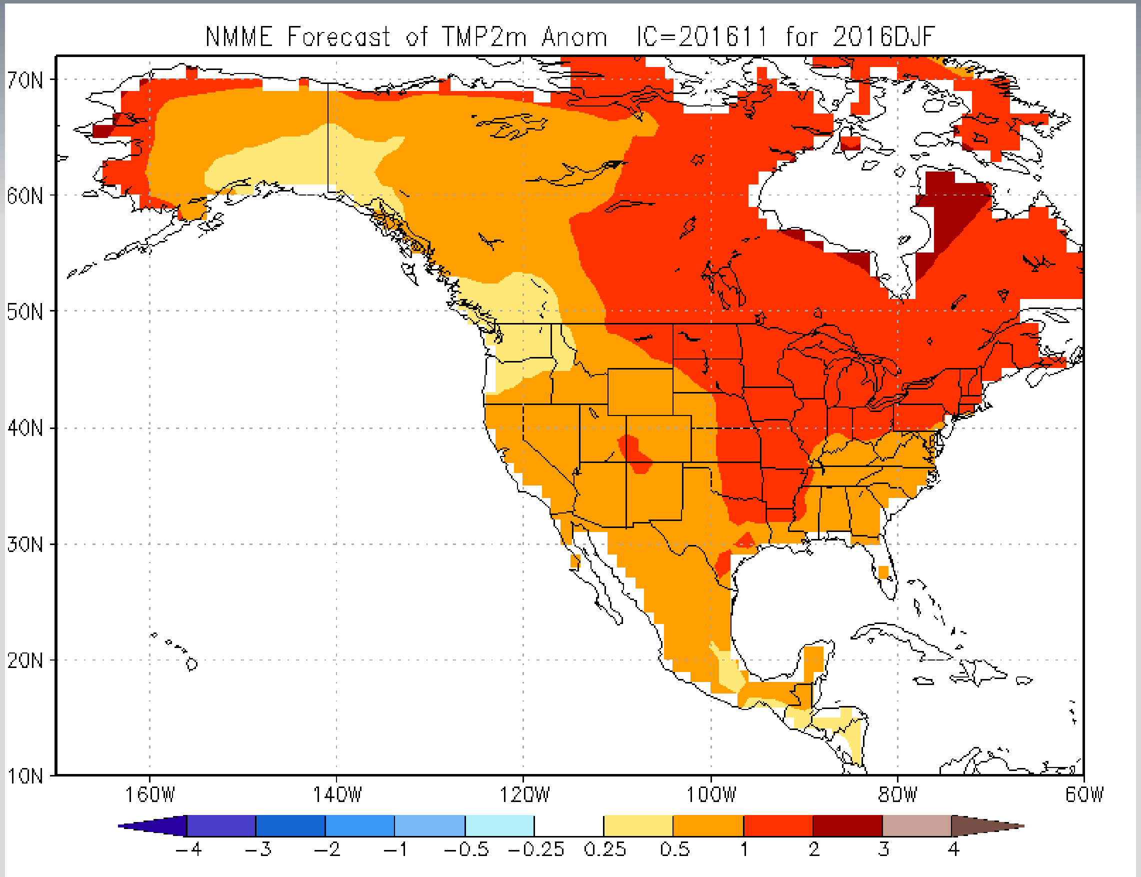


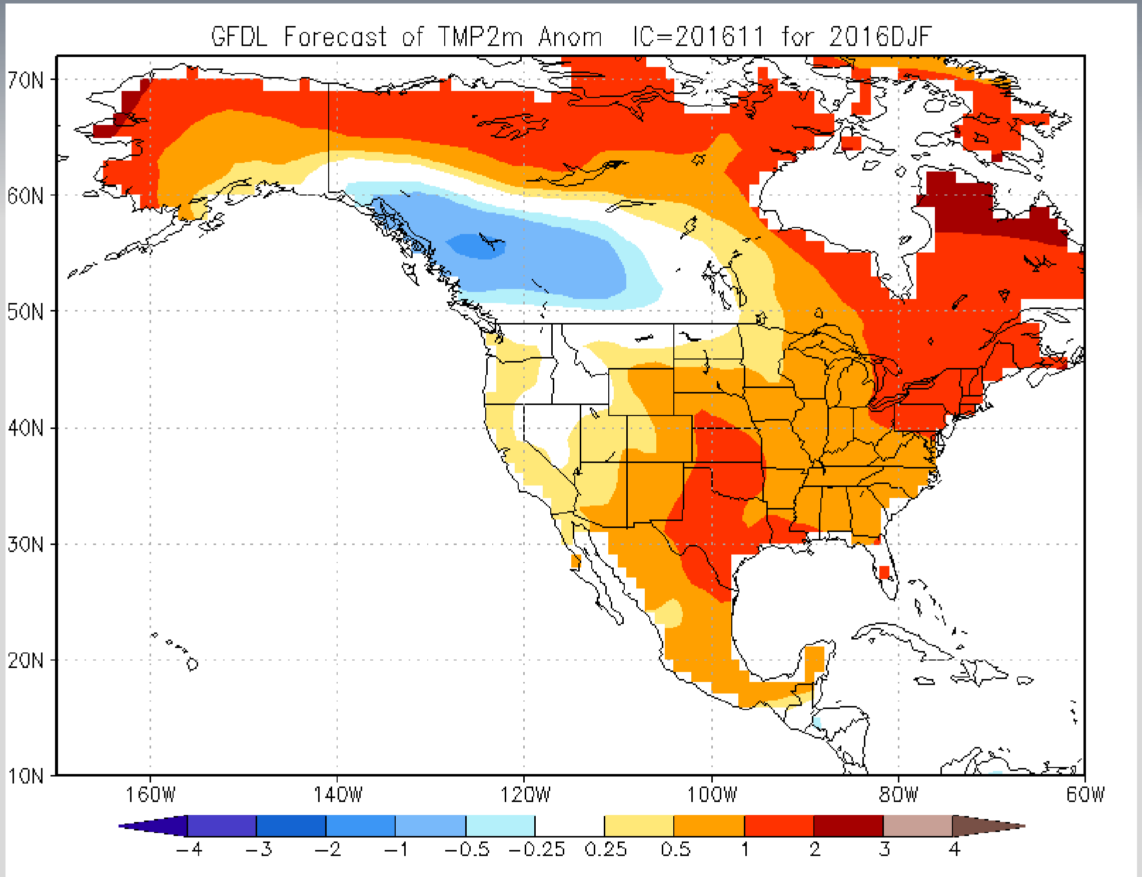


Light orange equates to slightly below average precipitation rates.

Figures 14-17. Model precipitation rate anomaly plots from the two climate models which have the highest skill percentages (top two images), the North American Multi-Model Ensemble (NMME) and the Geophysical Fluid Dynamics Laboratory (GFDL) Climate 2.1 model. Both model forecasts range from slightly below (GFDL) to below average precipitation rates (NMME) during DJF 2016-17 across New Mexico.

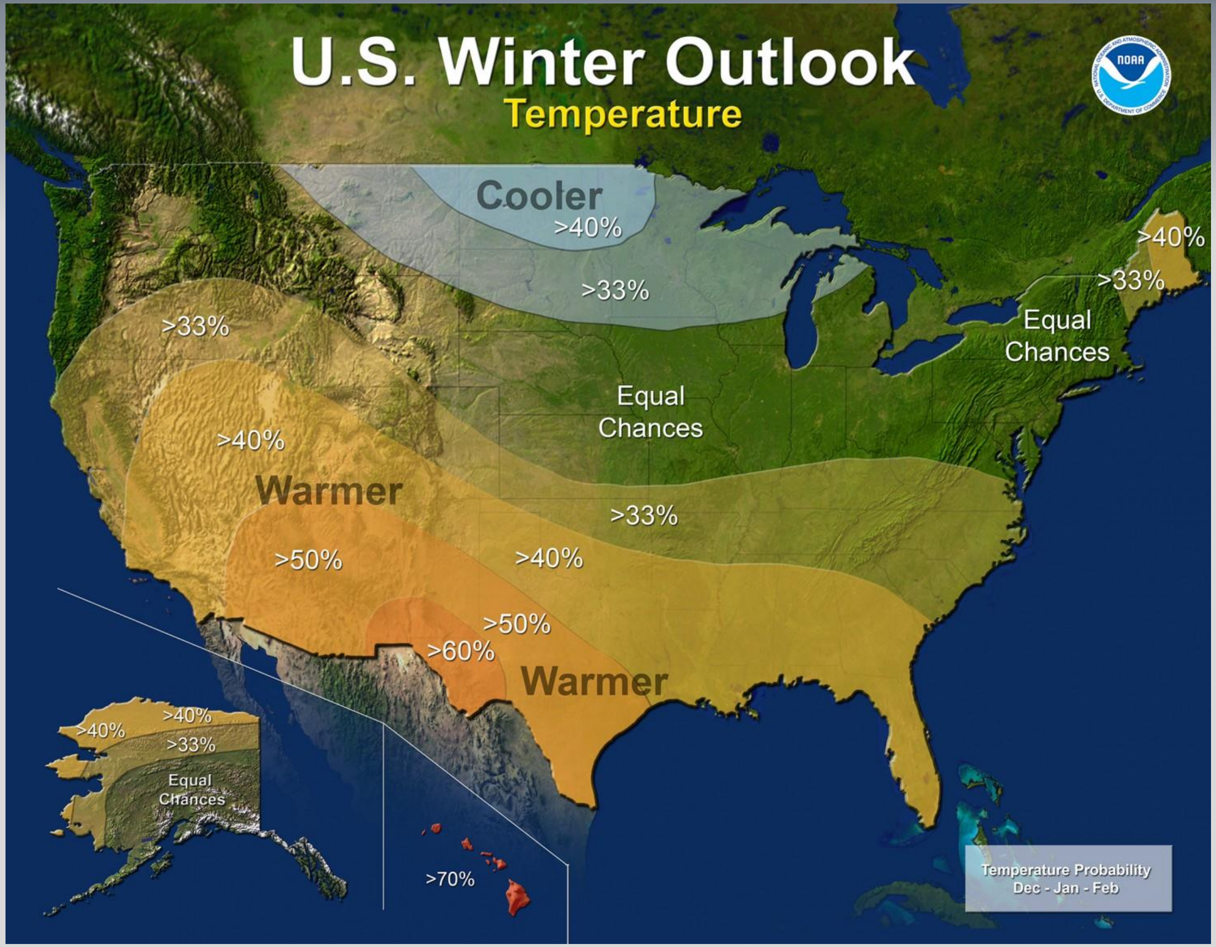
Numerical Climate Prediction Model Temperatures for DJF

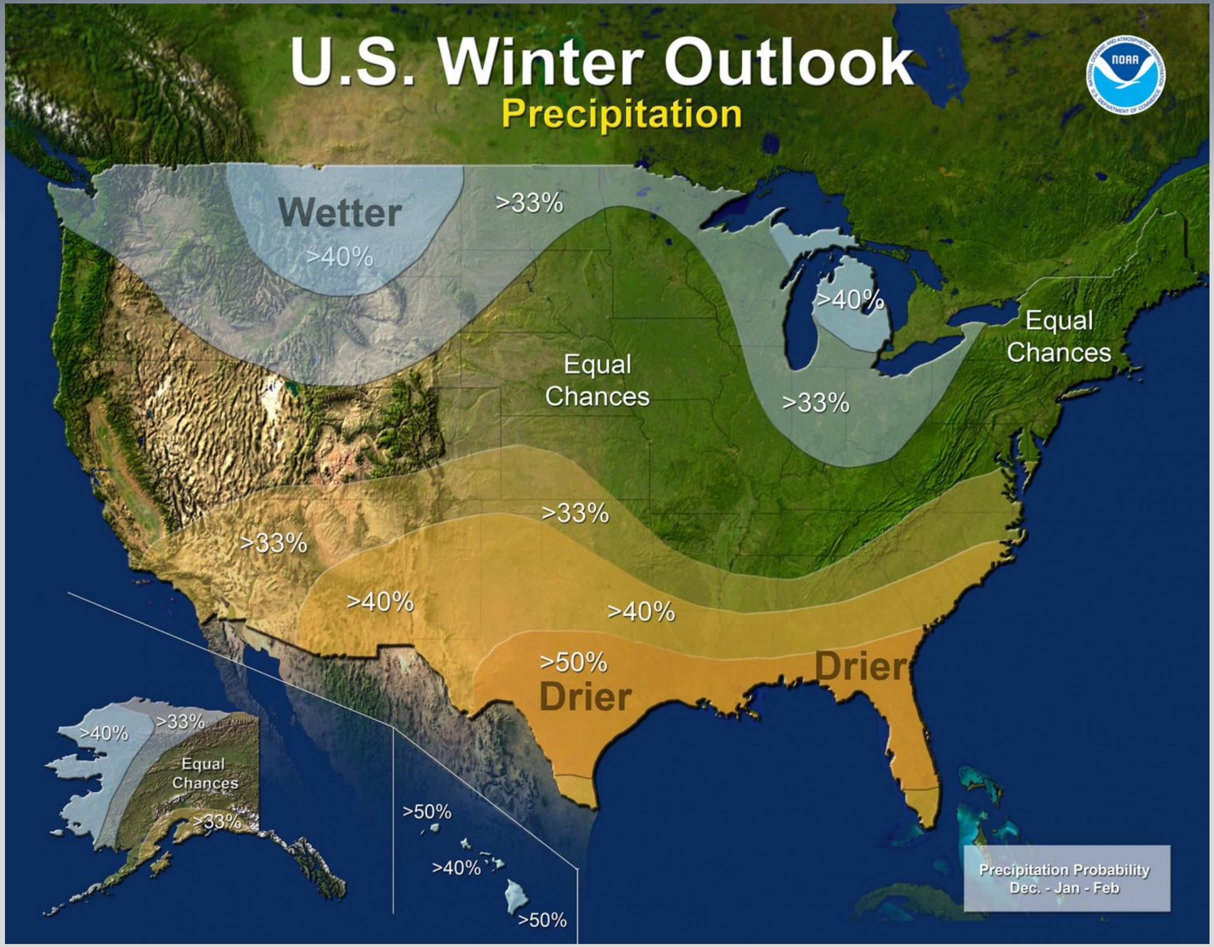




Figures 18-19. Two meter (6.5 feet above ground level) temperature anomaly forecasts from the two climate models which have the highest forecast skill percentages, the North American Multi-Model Ensemble (NMME) and the Geophysical Fluid Dynamics Laboratory (GFDL) Climate 2.1 model. Both models forecast above average temperatures during DJF 2016-17 across New Mexico and much of the western U.S.

Climate Prediction Center's Official 2016-17 Winter Outlook





Figures 20-21. CPC's DJF 2016-17 precipitation and temperature forecasts favoring below average precipitation and above average temperatures.

What Did the Strong El Niño of 2015-2016 Remind Us About?

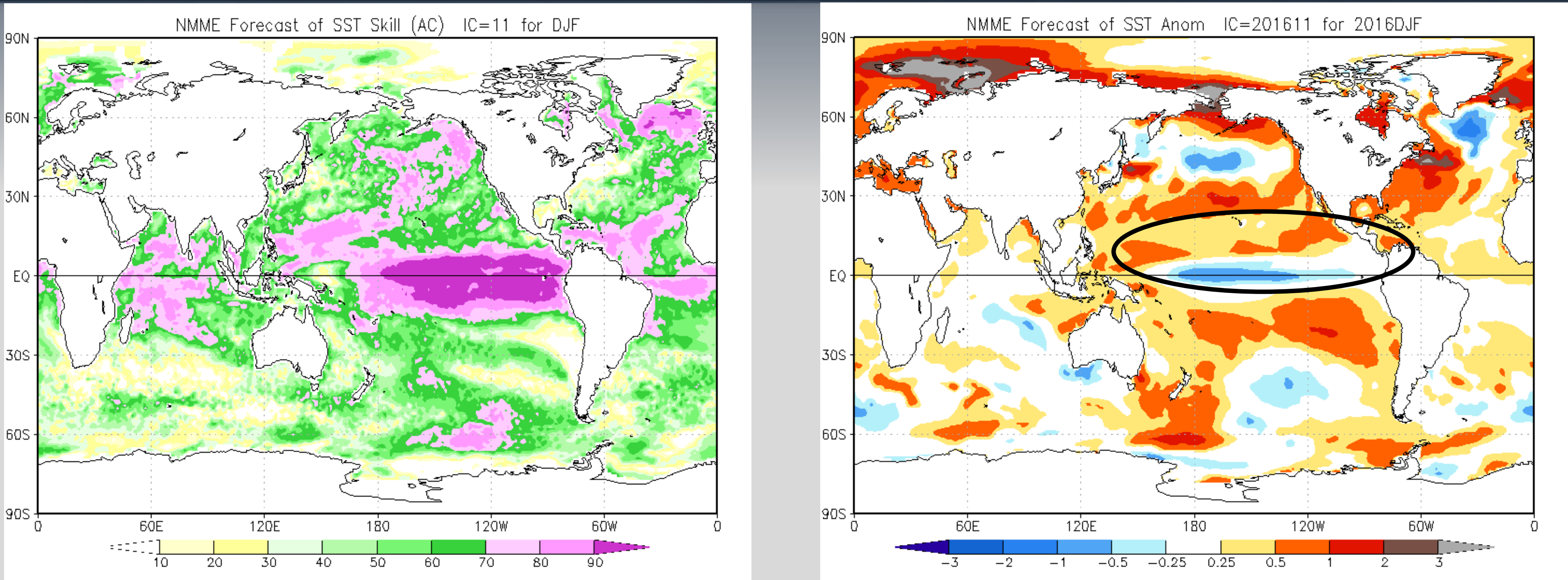


Figure 22-23. NMME SST skill score and SSTA forecast for DJF. Note the SSTA gradient around 5°N latitude. One of the main takeaways from the 2015-16 El Niño was that SST gradients (differences) are what drove anomalous convection in the tropics. Where these gradients set up determine how the upper level pattern (jet stream) behaves across the eastern Pacific Ocean and western U.S. The NMME shows excellent skill in predicting SSTs across the equatorial Pacific and if current observations (Fig. 2) and the NMME forecast for DJF are correct, anomalous convection may end up being more prevalent across the eastern equatorial Pacific than climate models are suggesting. This convection could act to draw the jet stream farther south across the southwest U.S. on occasion during DJF.

Summary

- Precipitation (both rain and snow) in previous Winter (DJF) seasons during the waning year of a strong/extreme El Niño events since 1950 ranged from near to below the 1981-2010 climatological averages at sites throughout northern and central New Mexico. Past precipitation data also suggests that the northern third of New Mexico stands the best chance of being near average during neutral or weak La Niña events.

- Precipitation data from the five most analogous years to 2016 (1958-59, 1966-67, 1969-70, 1983-84, and 1998-99) combined with forecasts from the most highly skilled climate forecast models indicate that precipitation in central and northern New Mexico during December, January and February (DJF) 2016-17 will most likely range from slightly below to near average 1981-2010 climatological averages.

- Snowfall data from the five previous strong to extreme El Niño events combined with climate model forecasts suggest that snowfall will range from slightly below to near average amounts in DJF 2016-17.

- Each neutral state to weak La Niña episode is different. The two closest analog years following a strong El Niño when considering the MEI alone, 1958-59 and 1969-70, precipitation/snowfall was below average at nearly all sites. Current observations and model forecasts suggest that if a weak La Niña does develop, it will be short lived (Figure 12).

Outlook Information

- **Outlook provided by National Weather Service Forecast Office Albuquerque, NM.**

- **For further information contact Andrew Church: andrew.church@noaa.gov (505) 244-9150**