2017 Fall Outlook for Central & Northern New Mexico

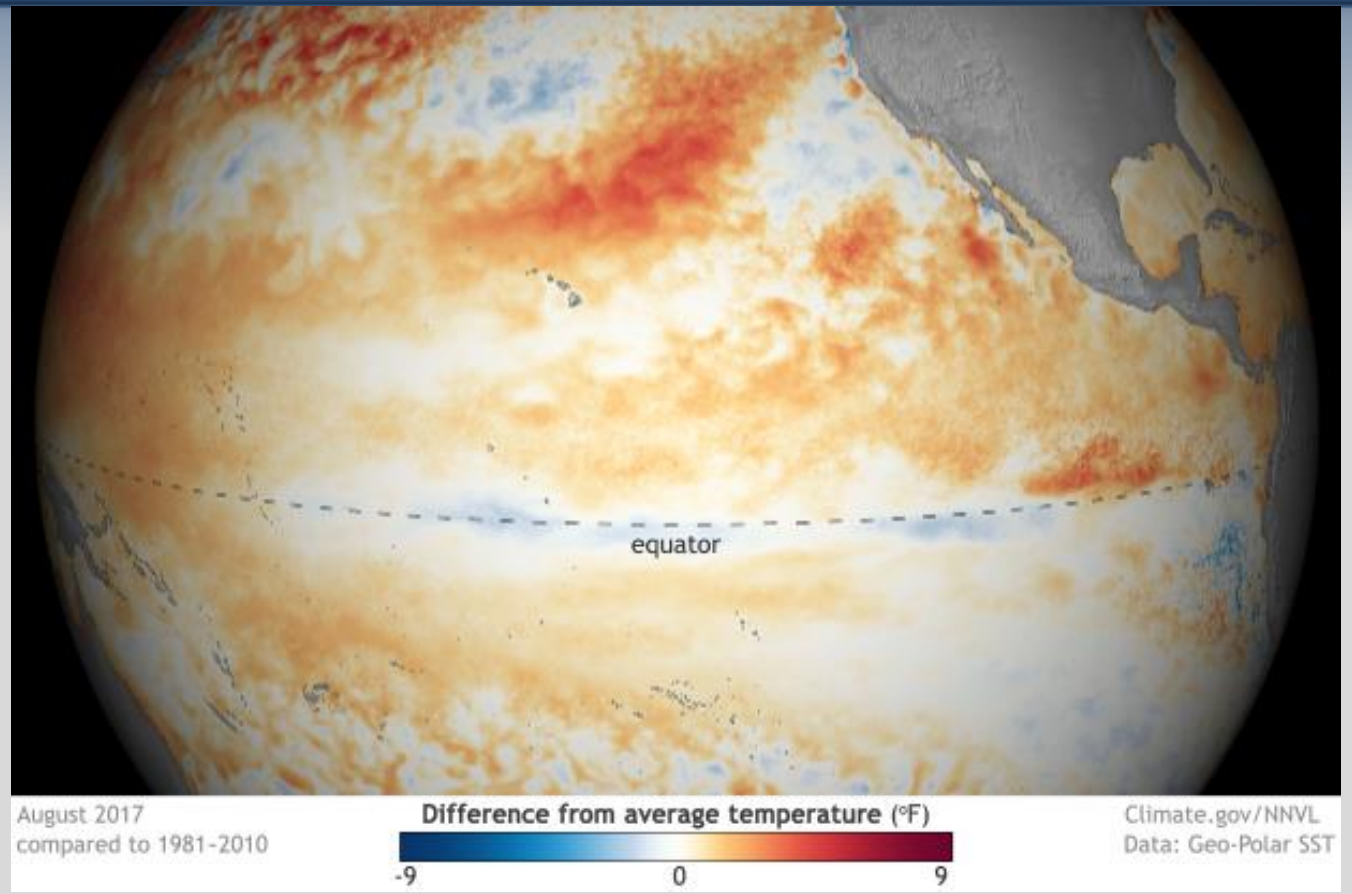
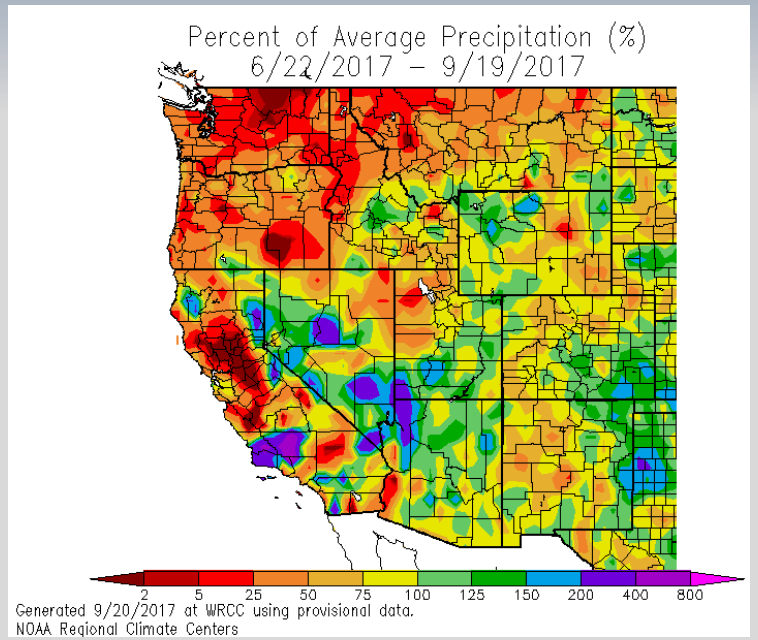
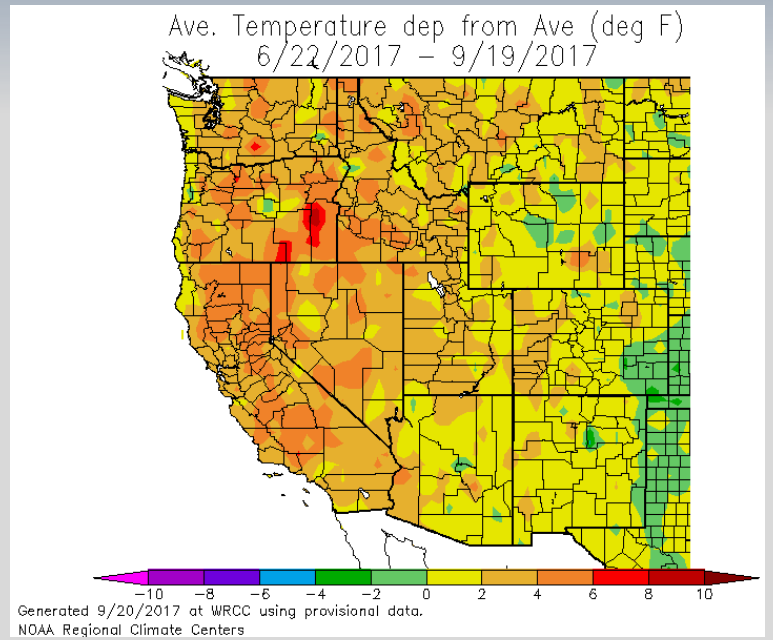
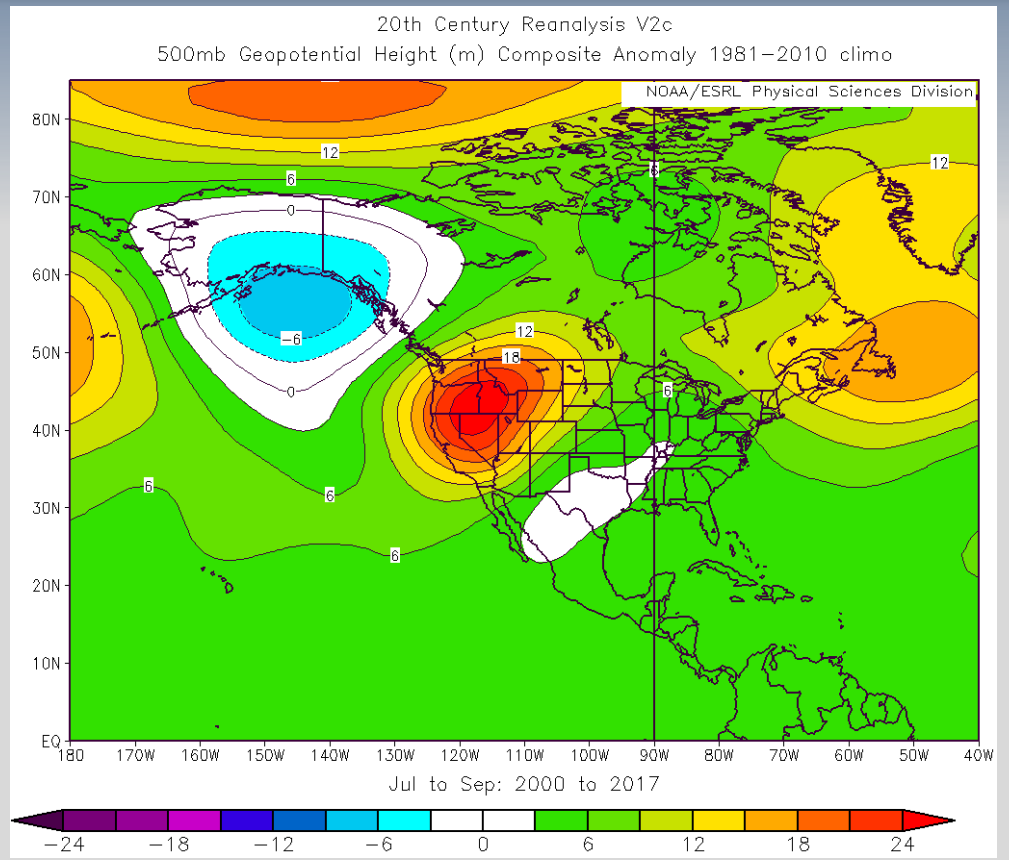


Figure 1. Colors on this image depict where and by how much monthly sea surface temperature (SST) differed from its 1981 to 2010 average. This high-resolution map is based on a dataset that combines on site measurements with near-real-time satellite observations. What does it show? Neutral conditions in the equatorial Pacific Ocean. How will below average tropical activity in the East Pacific and neutral or weak La Niña conditions impact fall weather in northern and central New Mexico?

A Quick Peek Back at the 2017 North American Monsoon







Figures 2-4. Portions of eastern New Mexico were above average with regard to precipitation, in large part due to backdoor boundaries/fronts and northwest flow aloft on the southeast side of the Four Corners upper high. Temperatures throughout the majority of the state were above average during the monsoon season. Is this the new normal? Take a look at 500mb geopotential height anomalies since 2000. The “Four Corners Upper High” during the monsoon has shifted farther to the northwest. Why? In part because the Aleutian Low over this same time-frame has been stronger than average and compensating downward motion downstream is the result. The higher heights are also thought to be the result of warmer than average mid and low level temperatures (chicken and egg dilemma applies here as higher heights result in warmer temperatures and vice versa).

Latest Sea Surface Temperature Observations & Oscillation Index Values

*SSTs are what drive tropical & subtropical thunderstorms. It's these thunderstorms that drive global weather patterns/climate.

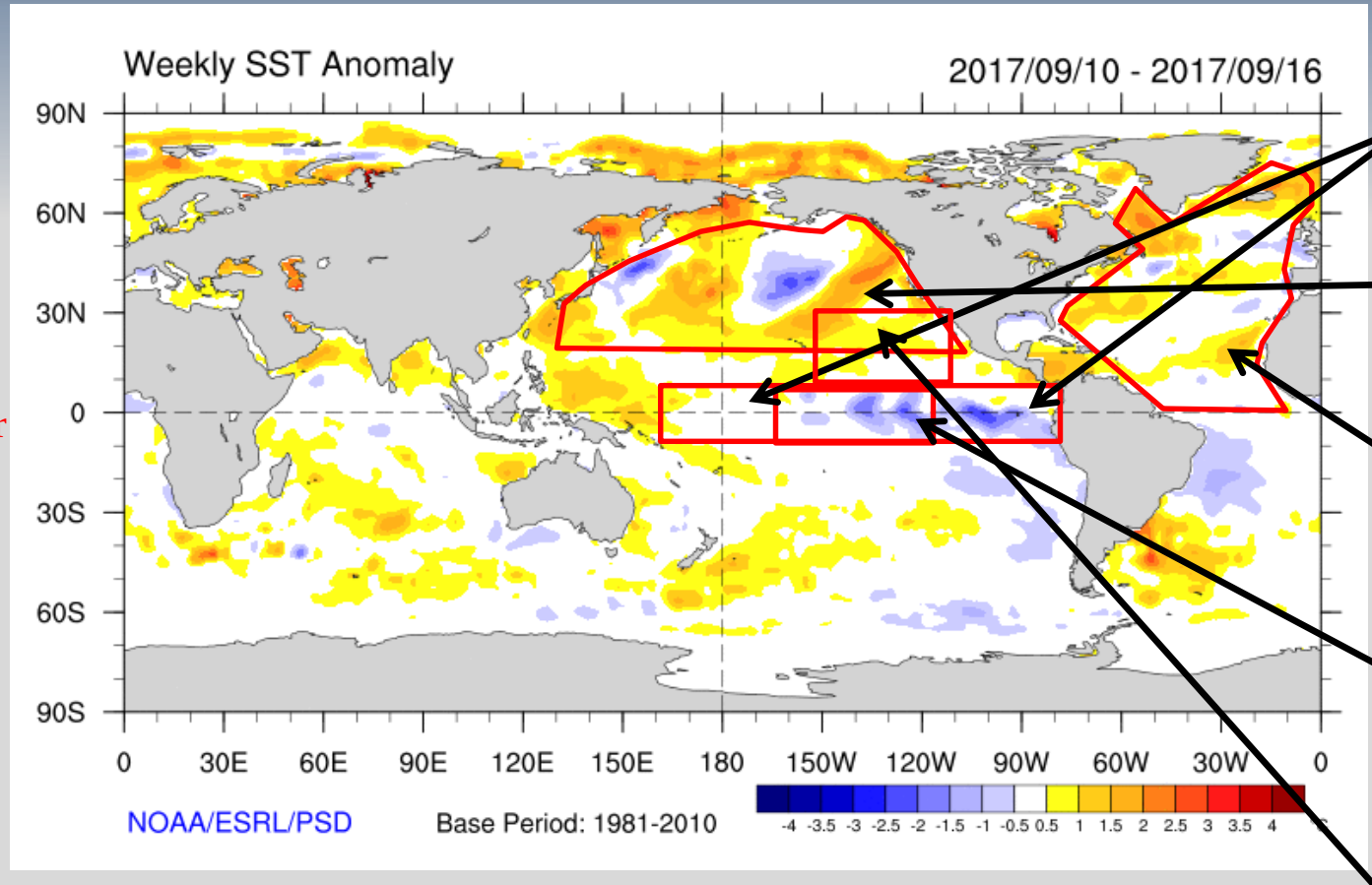
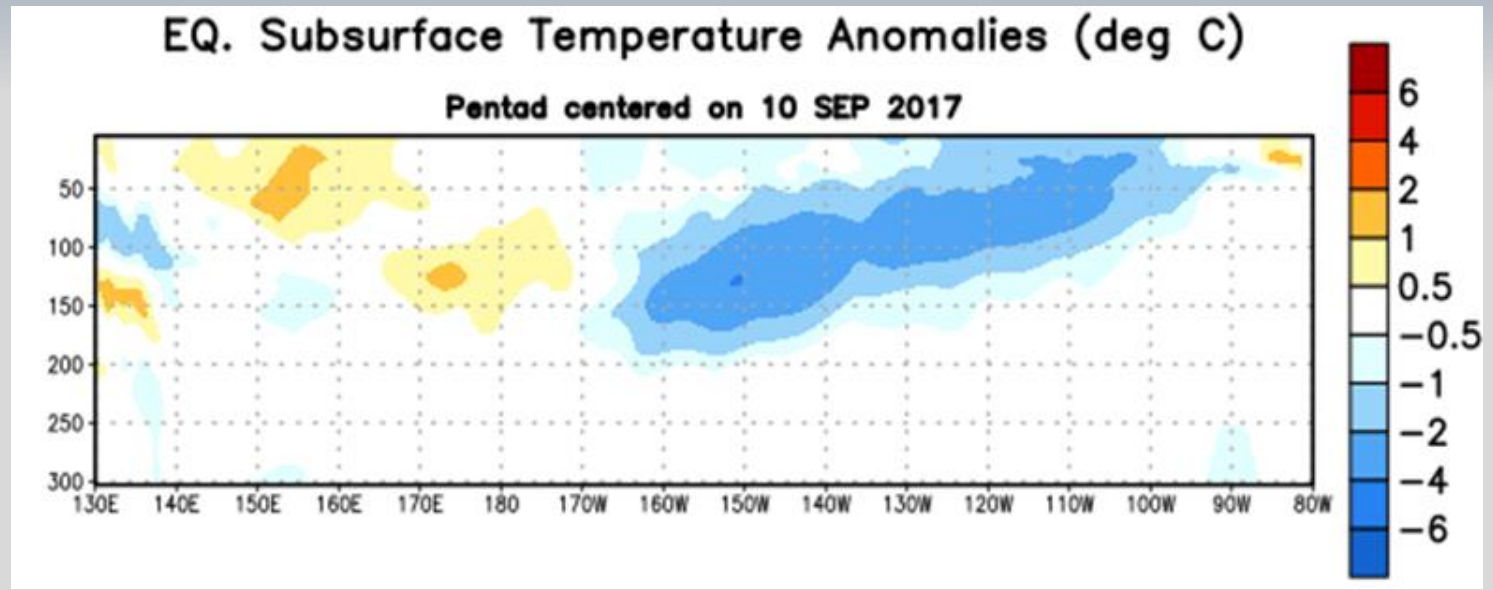


Figure 5. SST Anomalies in the Equatorial Pacific Ocean in September 2017 showing neutral conditions in the equatorial Pacific.

- Multivariate ENSO Index (MEI) for JUL-AUG 2017: +**0.03**
- Pacific Decadal Oscillation (PDO) for AUG 2017: +**0.09**
- Atlantic Multidecadal Oscillation (AMO) for AUG 2017: +**0.31**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for JJA 2017: **-0.1**
- Pacific Meridional Mode (PMM) for JUL 2017: **+1.43**

Sub-surface Temperatures



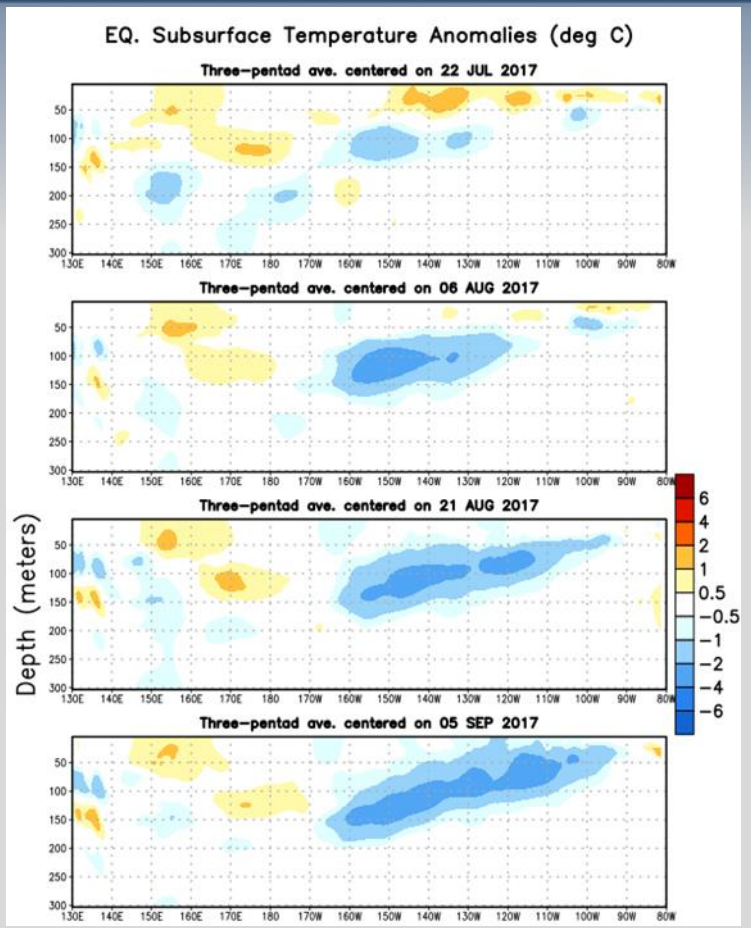


Figure 6 & 7. Subsurface temperature anomalies at the equator. Subsurface temperatures often lead the surface temperatures by several months. An increasing amount of slightly cooler than average water under the surface provides some additional confidence in the fact climate models are forecasting ENSO neutral or weak La Niña conditions.

Where Are We Now?

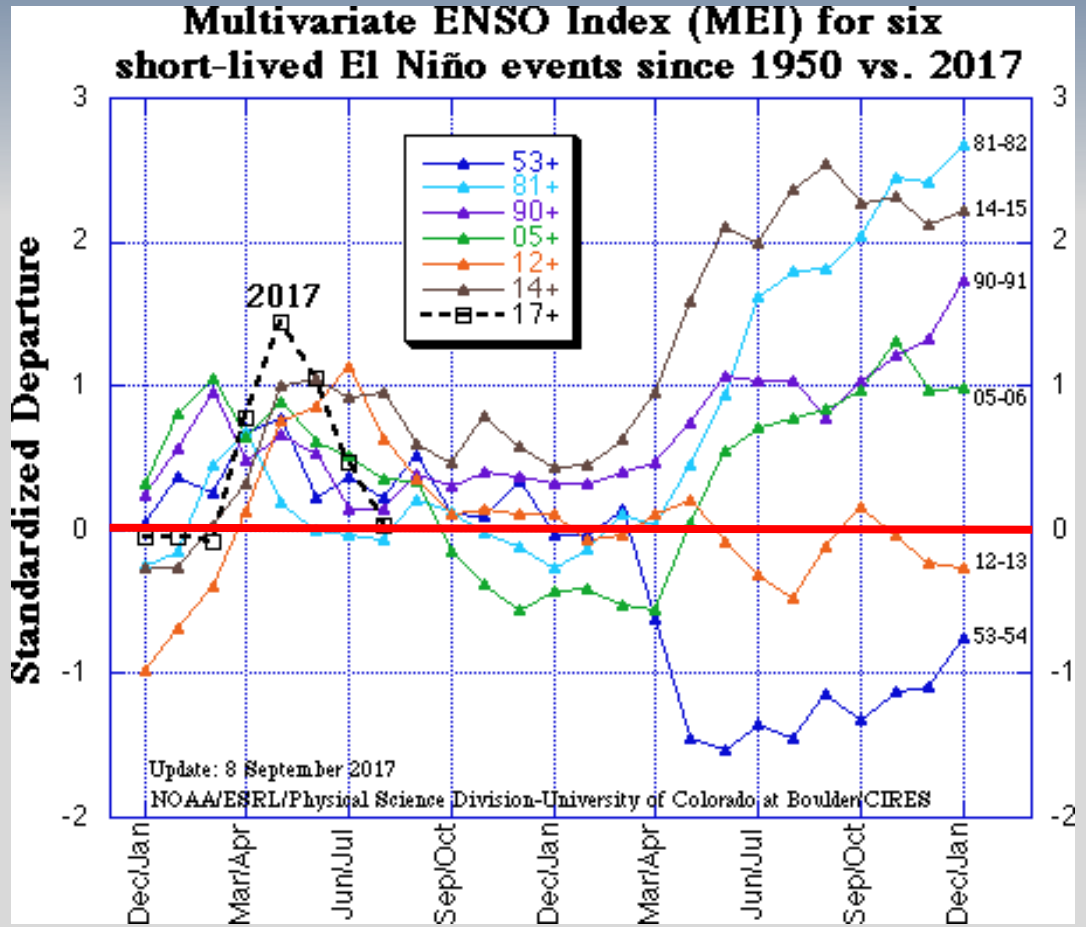
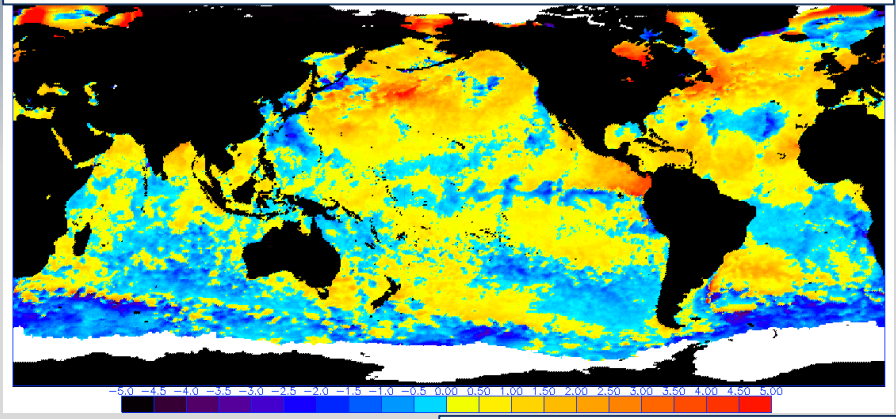


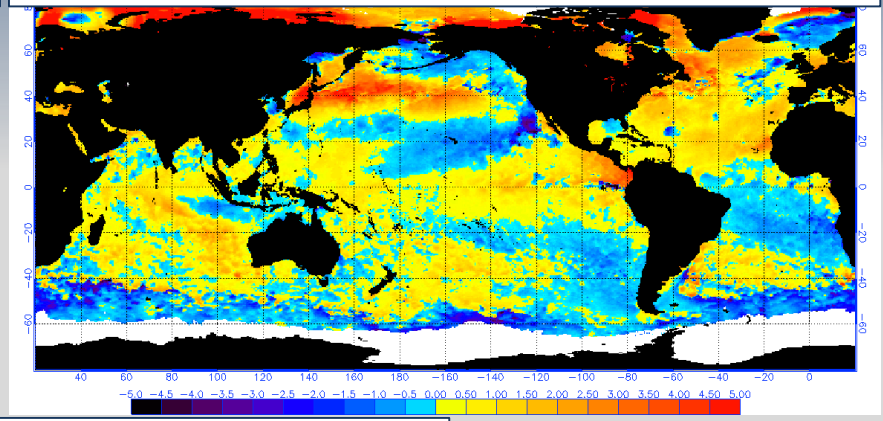
Figure 8. Six short-lived El Niño events using the Multivariate El Niño Southern Oscillation Index since 1950. Most of these years stayed ENSO-neutral, but two became weak La Niña events a few months later:1984-85 &1995-96.

Comparing September 2005 & 2012 Global SSTAs to Current Conditions

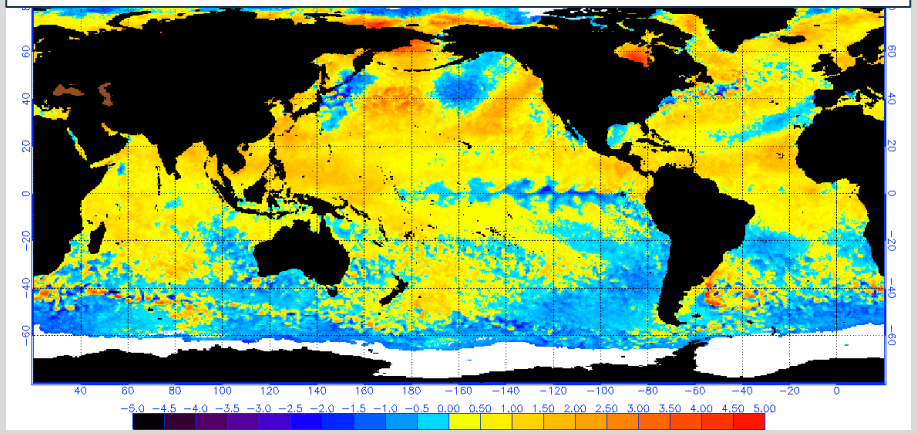
Global SST Anomalies 9/9/2005



Global SST Anomalies 9/10/2012



Global SST Anomalies 9/11/2017



Figures 9-11. SST Anomalies from September, 9 2005, September 10, 2012, and recent conditions. Note the differences between SSTAs in the Pacific in both years compared with 2017. SST gradient patterns (bottom image) in the world's oceans during early 2017 are unlike past neutral years so analog years were not used in this outlook. This outlook will focus on climate variability and climate model forecasts which have been better predictors of seasonal precipitation & temperature during the past several years.

Pacific Meridional Mode (PMM)

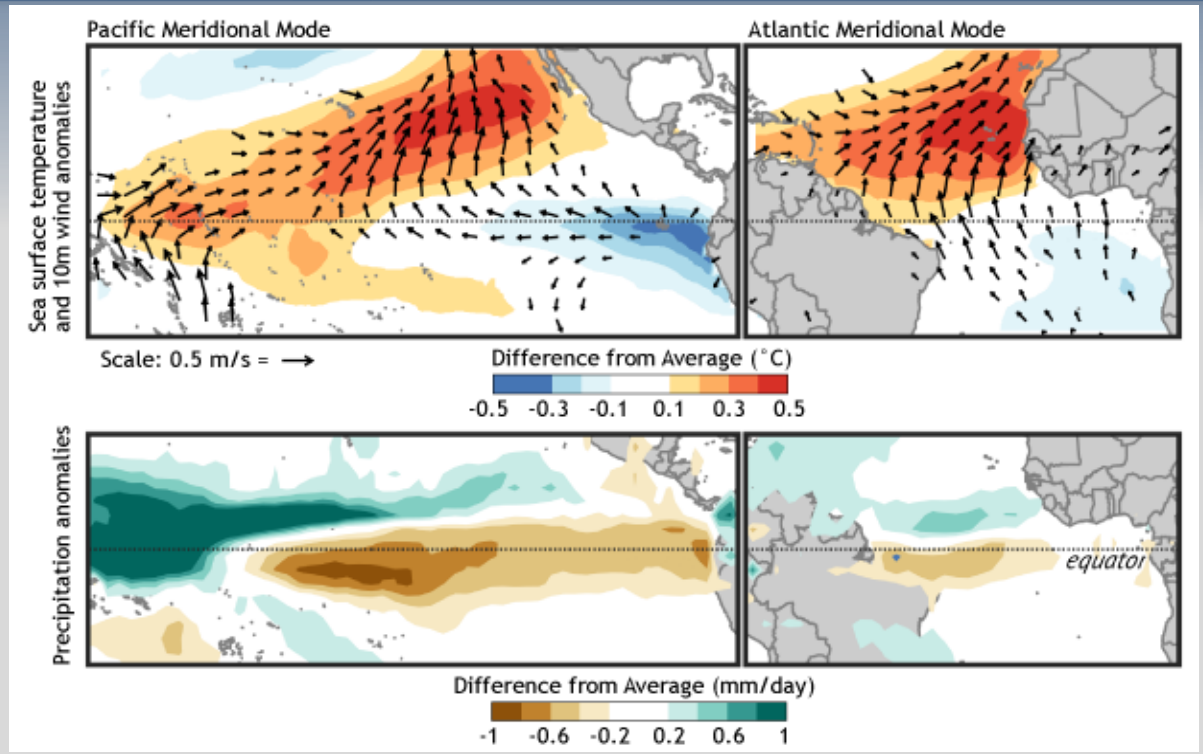


Figure 12. Tropical patterns associated with the positive state of the Pacific (left) and Atlantic (right) Meridional Modes (MM). The top panels show SST anomalies (shading) and near-surface wind anomalies (vectors), and the bottom panels show precipitation changes vs. average. Red (green) shading indicates above-average SST (precipitation) and blue (brown) shading indicates below-average SST (precipitation). MMs are defined by a distinctive sea-surface warming and southwesterly wind anomaly in the vicinity of the Intertropical Convergence Zone (ITCZ) during boreal spring. In other words, a positive PMM leads to stronger low level moisture advection northeastward toward the southwest U.S. during the North American Monsoon. Additionally, the majority of El Niño events over the past four decades are preceded by a positive PMM (Chiang and Vimont 2004, Chang et al., 2007).

PMM Continued

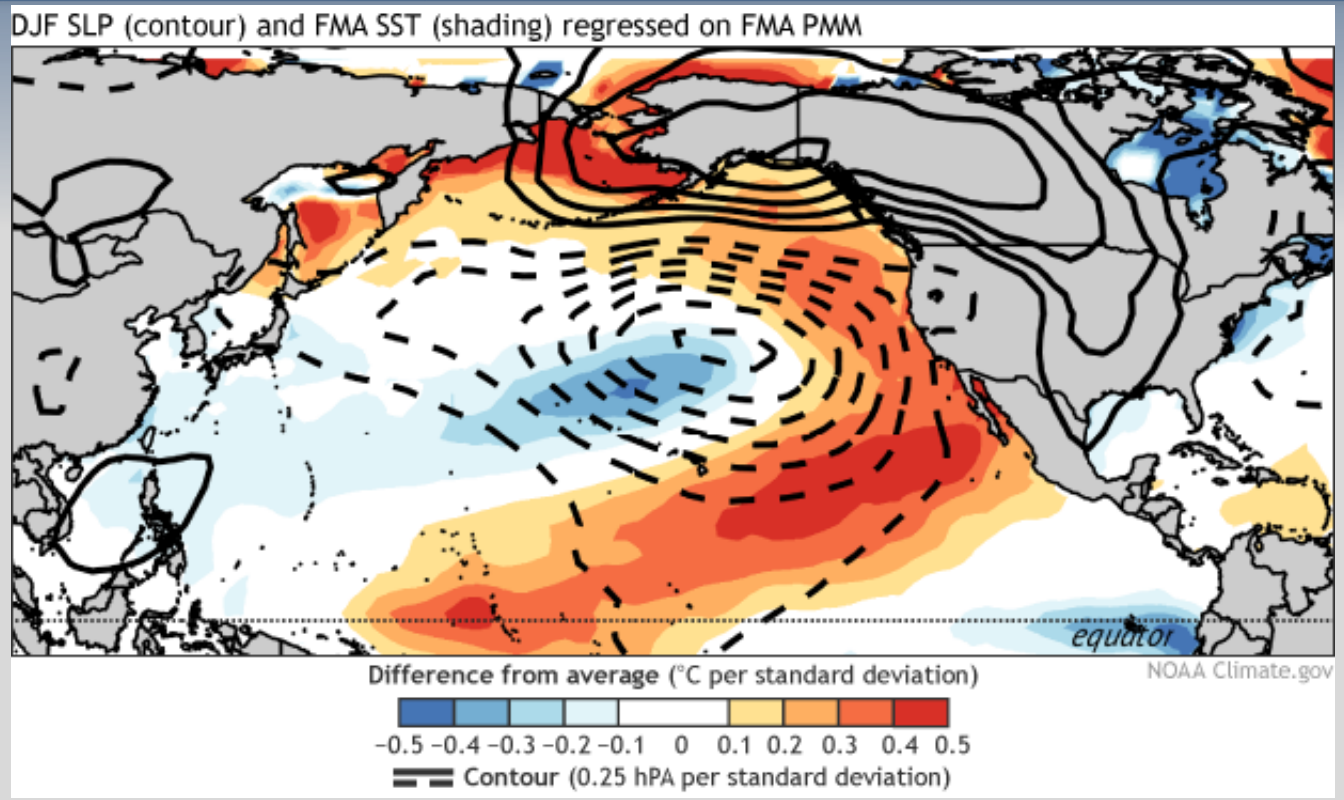


Figure 13. Early spring (February-April) sea surface temperature and winter (December-February) atmospheric circulation anomalies related to the positive state of the PMM during early spring. Dashed black contours reflect lower-than-average sea level pressure and solid black contours indicate higher-than-average sea level pressure. Anomalous low-level winds flow counter-clockwise approximately paralleling the dashed contours, while flowing clockwise nearly paralleling the solid contours. Red shading indicates above-average SSTs and blue shading reflects below-average SSTs.

PMM Timeseries vs. ENSO

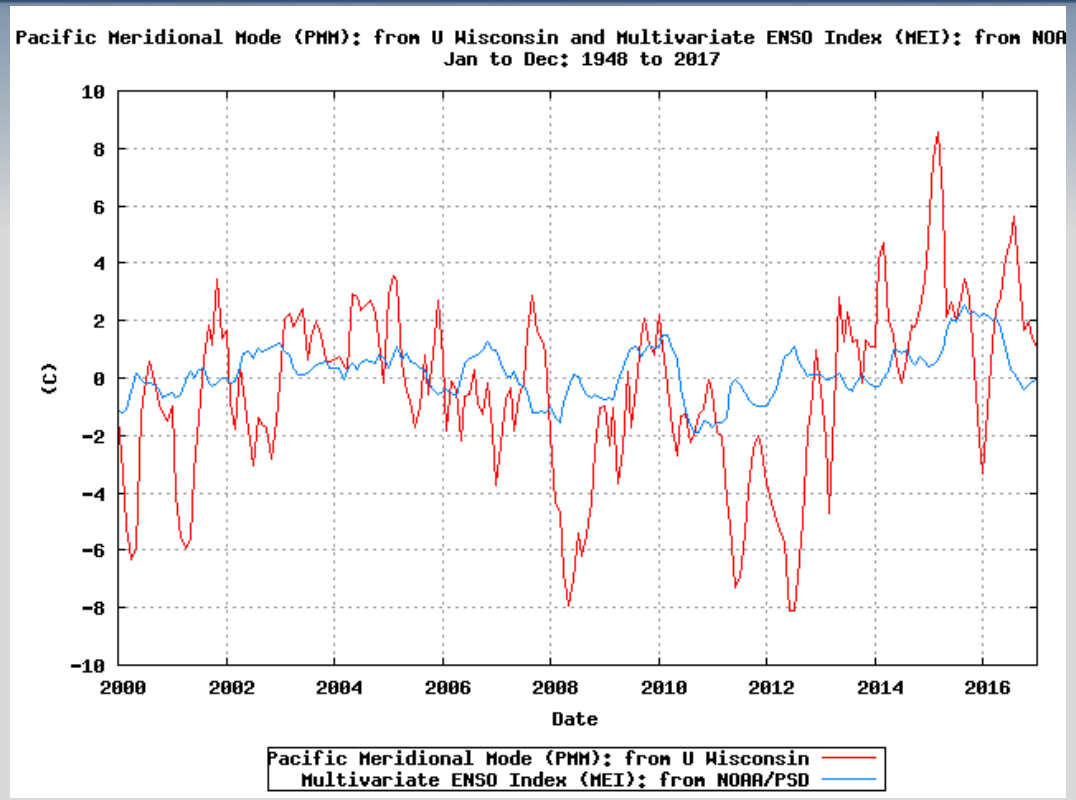
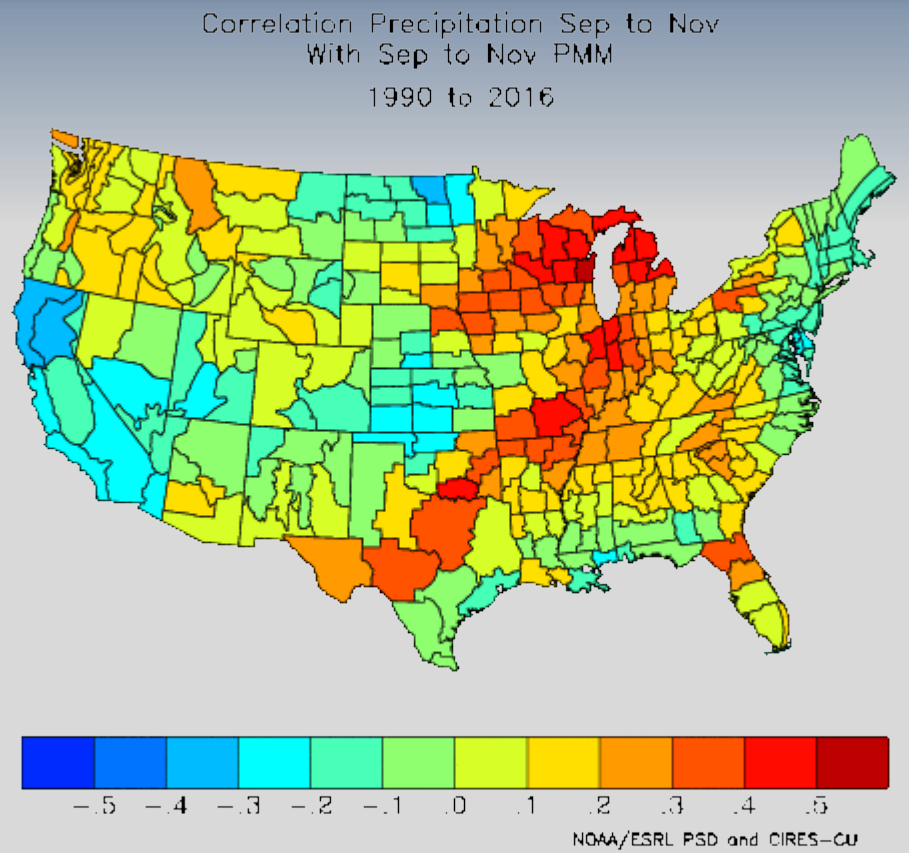
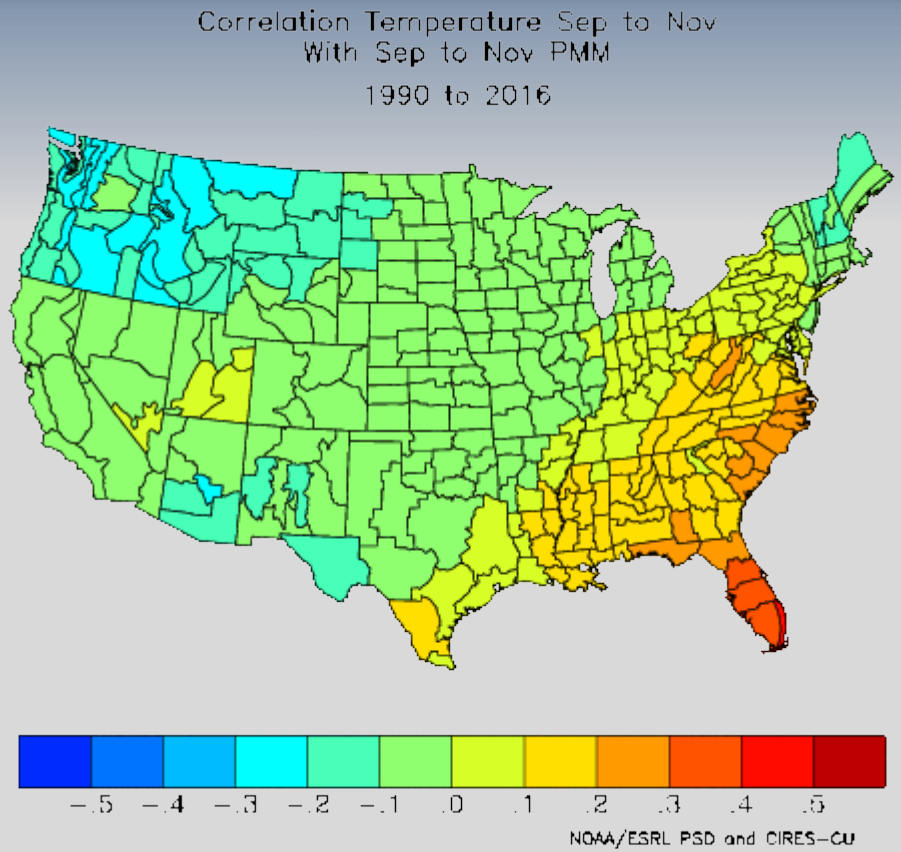


Figure 14. Time series of ENSO (blue) and PMM (red) since 2000. The PMM links the mid-latitude atmospheric circulation to the equator, and the initiation and development of ENSO. Recent research has pointed out that this sequence of events tends to have a strong connection with the development of ENSO events that are stronger in the central Pacific (i.e., Modoki). Improving climate model skills in simulating and predicting the MM may lead to improved skill in forecasting ENSO, and ultimately eliminate the spring predictability barrier (Latif et al., 1998).

Correlation of Precipitation and Temperature with PMM





Figures 15 & 16. 1990-2016 SON correlations of precipitation (left) and temperature (right) with PMM. When the PMM index is positive, as it is now, parts of New Mexico stand a slightly better-than-average chance (negative correlation with precipitation) of near or slightly below average precipitation. With regard to temperature, chances are better than average in SON that most of the state stands to be warmer than average (negative correlation with temperature).

Madden-Julian Oscillation (MJO)

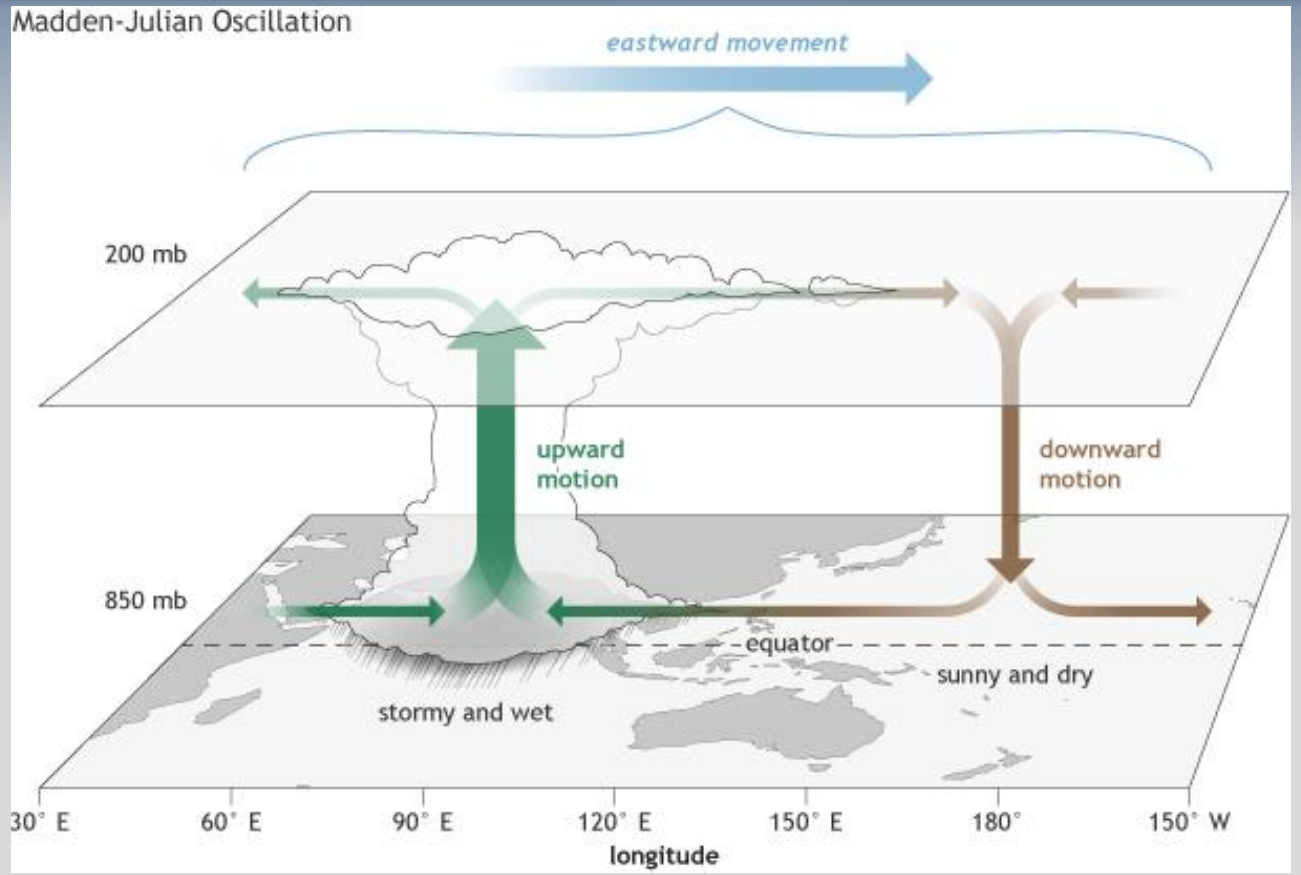


Figure 17. The MJO is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the rising air in the stormy area causes surface winds to blow toward the active area. The MJO can play a role in New Mexico's weather at any time of year but it tends to have its greatest impacts during the fall. Vast majority of forecast models for the latter half of September, however, keep this year's MJO influence tied mainly to the Indian Ocean, Maritime Continent, and West Pacific.

Why the MJO is So Important?

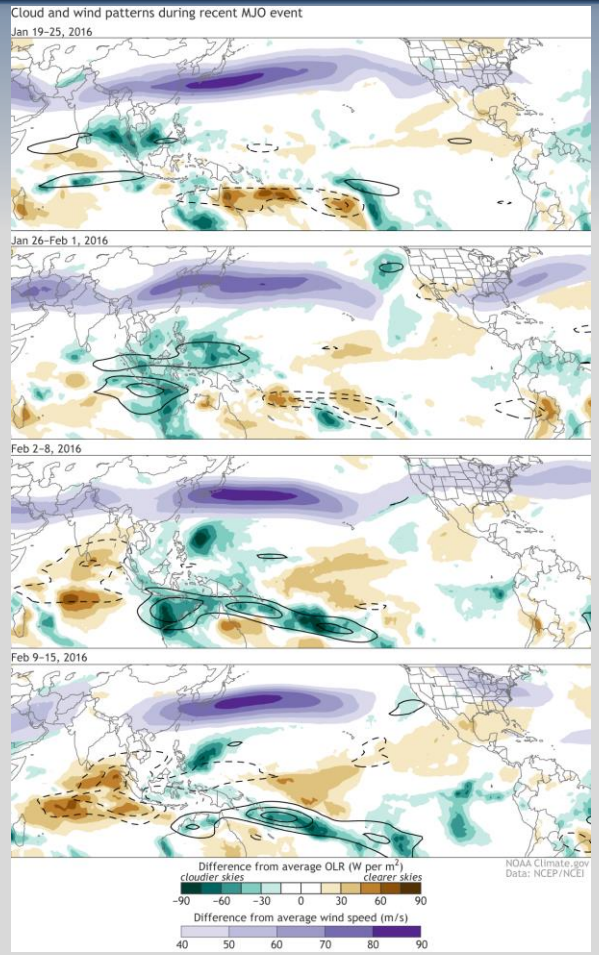


Figure 18. Clouds and wind patterns for the MJO event that occurred from late-January to mid-February 2016. Black contours highlight the OLR (outgoing longwave radiation, or heat energy) signals directly associated with the MJO. The MJO also affects the jet stream over the United States. When the MJO is over the Maritime Continent (Indonesia, Philippines and Papua New Guiana), the jet typically bends northward over the western part of the country and southward to east. That configuration leads to unseasonably warm temperatures in in the west and cool temperatures in the east during the cool season. As the MJO moves eastward into the Pacific, the Pacific jet weakens and the pattern over the U. S. flips. The MJO is expected to remain near the Maritime Continent and Western Pacific Ocean during early October 2017.

The Aleutian Low

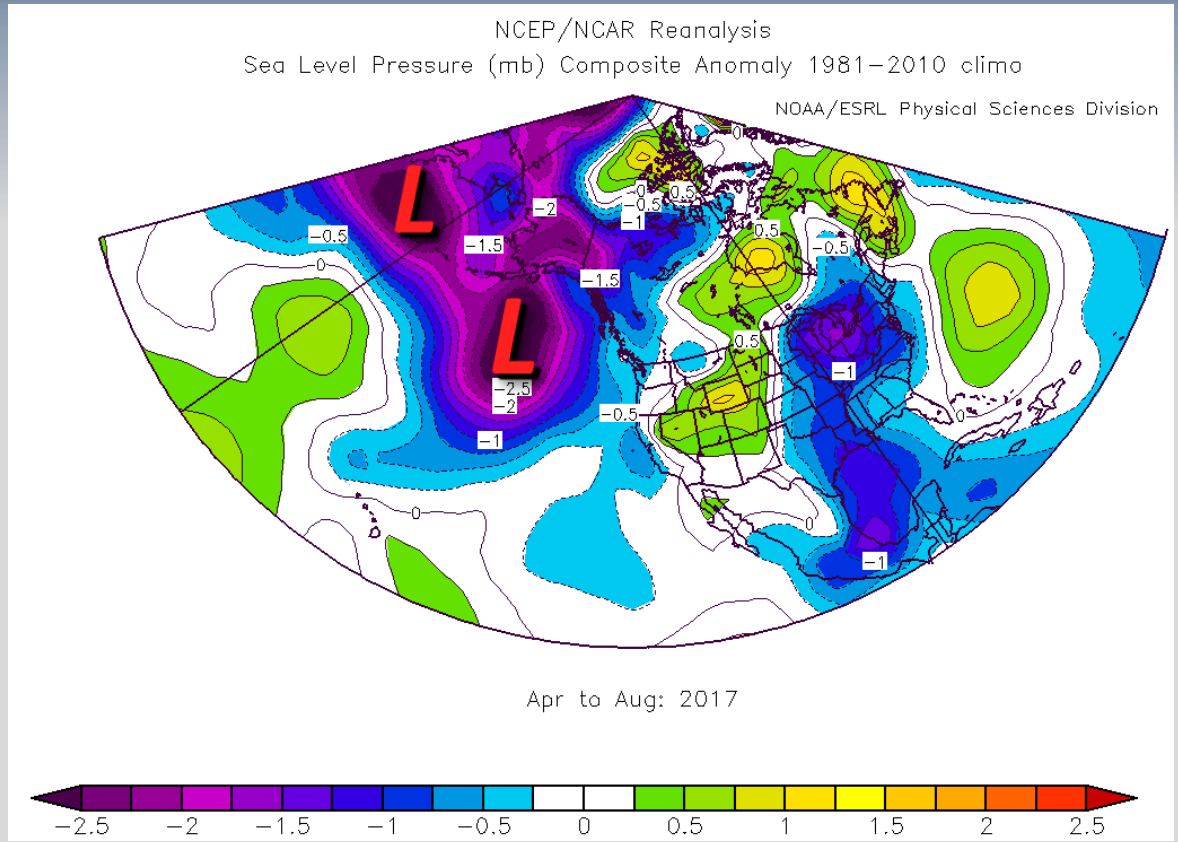
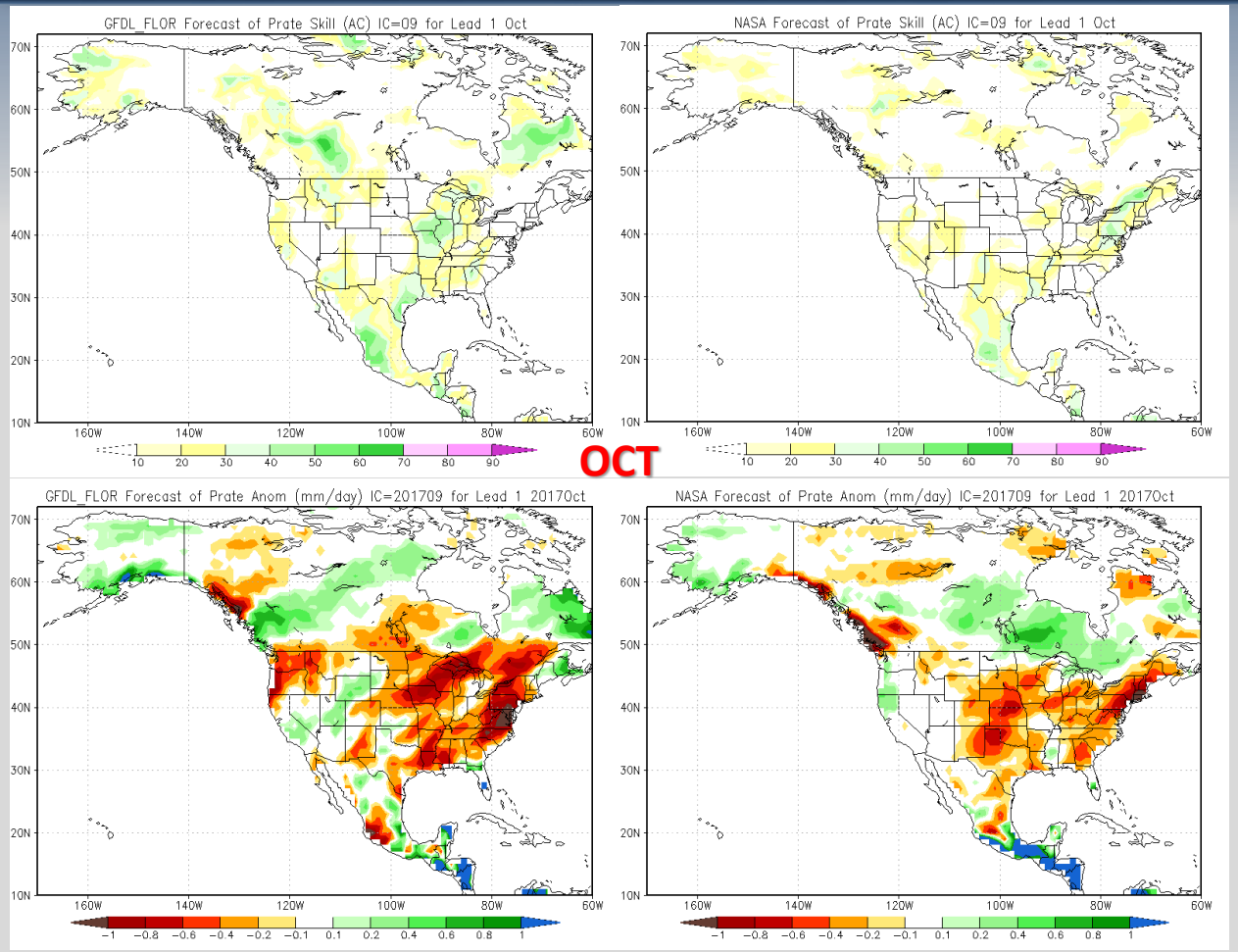
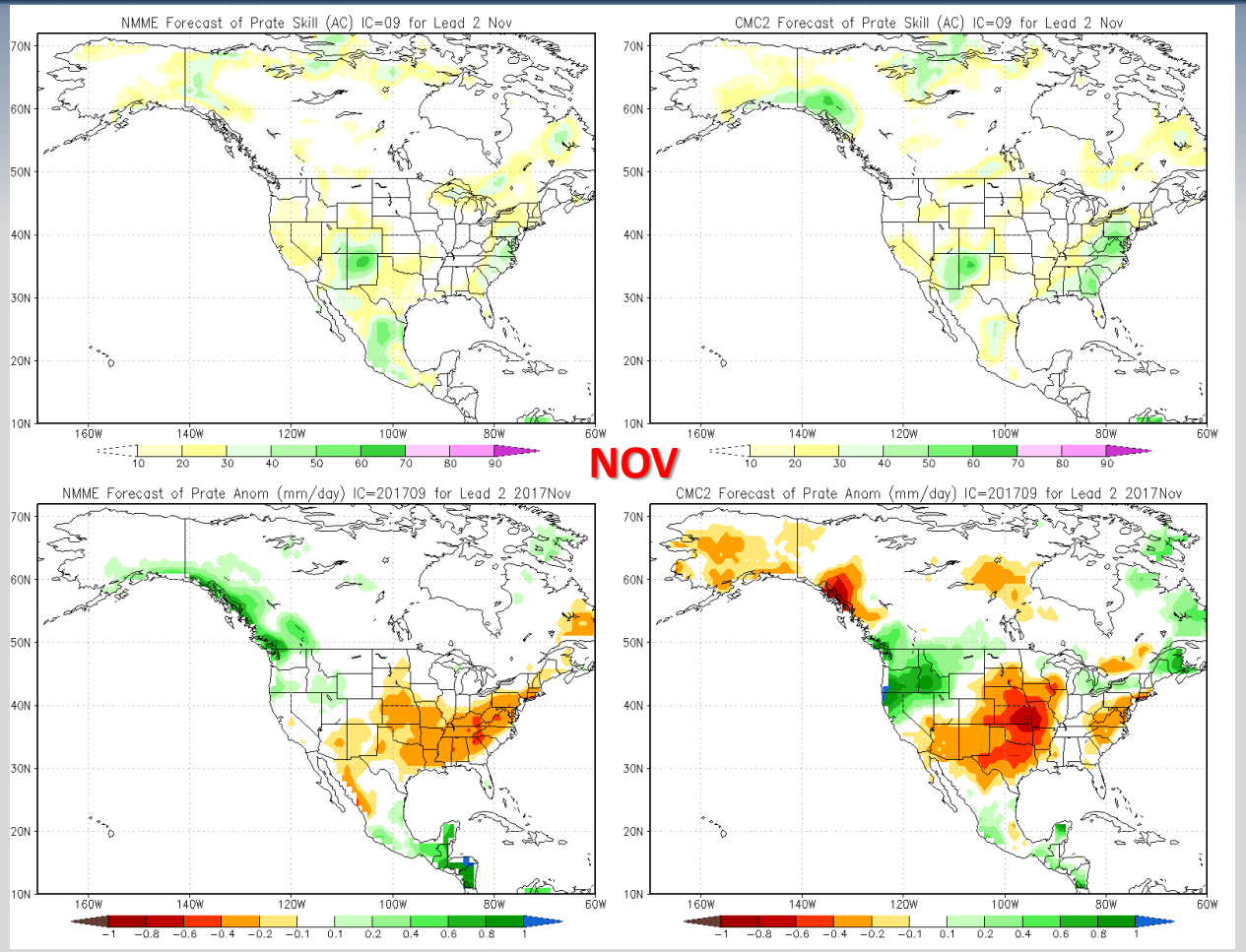


Figure 19. The Aleutian Low is a climatic feature centered near the Aleutian Islands on charts of mean sea level pressure (MSLP). It represents one of the main "centers of action" in the atmospheric circulation of the Northern Hemisphere. The Aleutian Low is most intense (lowest pressure) during winter and nearly disappears in summer (S.N. Rodionov et. al 2007). The Aleutian Low remains displaced farther east and has been stronger than average since spring 2017, behaving as though the tropical Pacific was warmer than average or in an El Niño state. This is thought to be due to an above average amount of deep convection over/near the Maritime Continent and West Pacific. Typically, a stronger than average Aleutian Low in winter, leads to more frequent upper level troughs for the PACNW and Northern/Central Rockies.

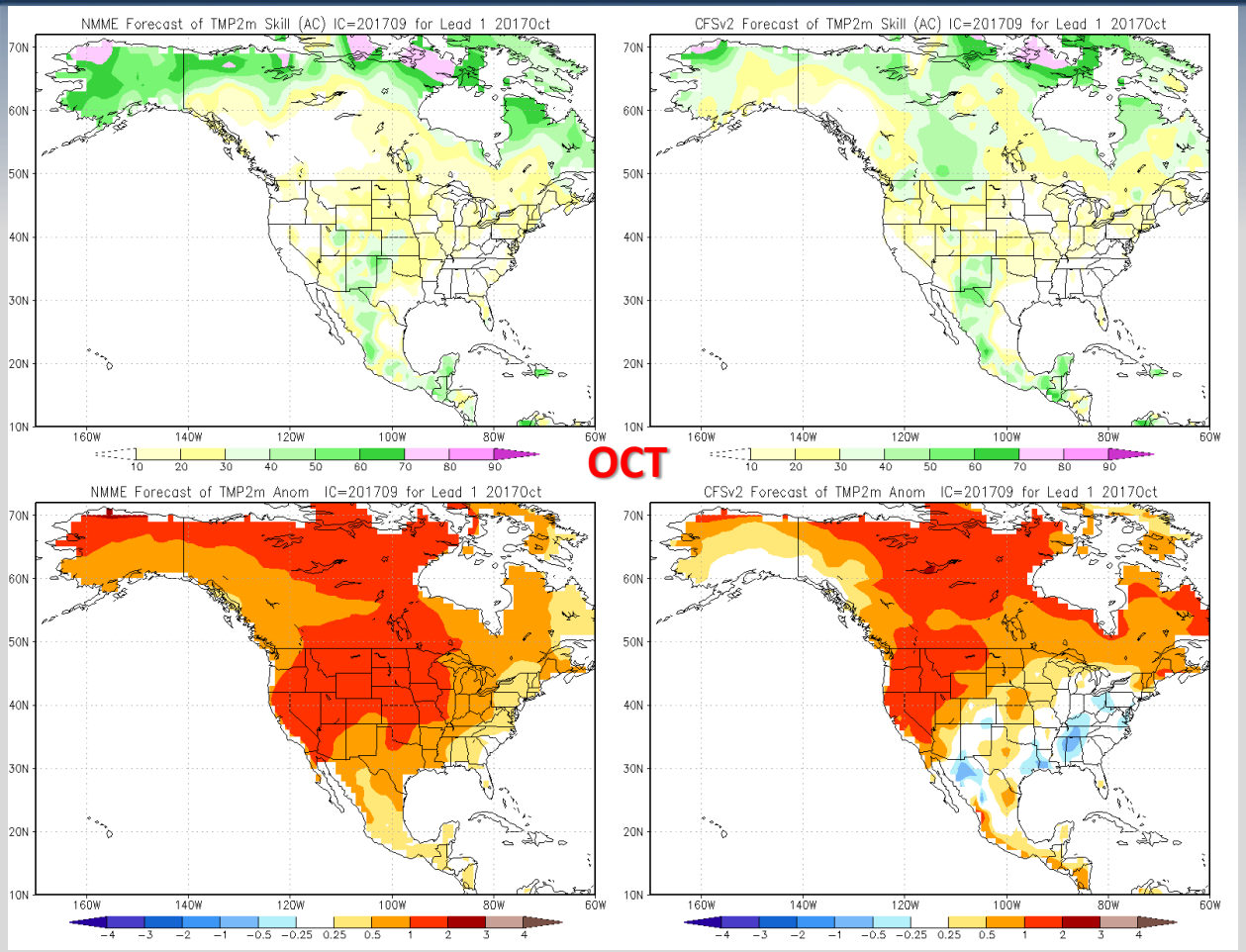
Oct-Nov Climate Model Forecasts
Precipitation

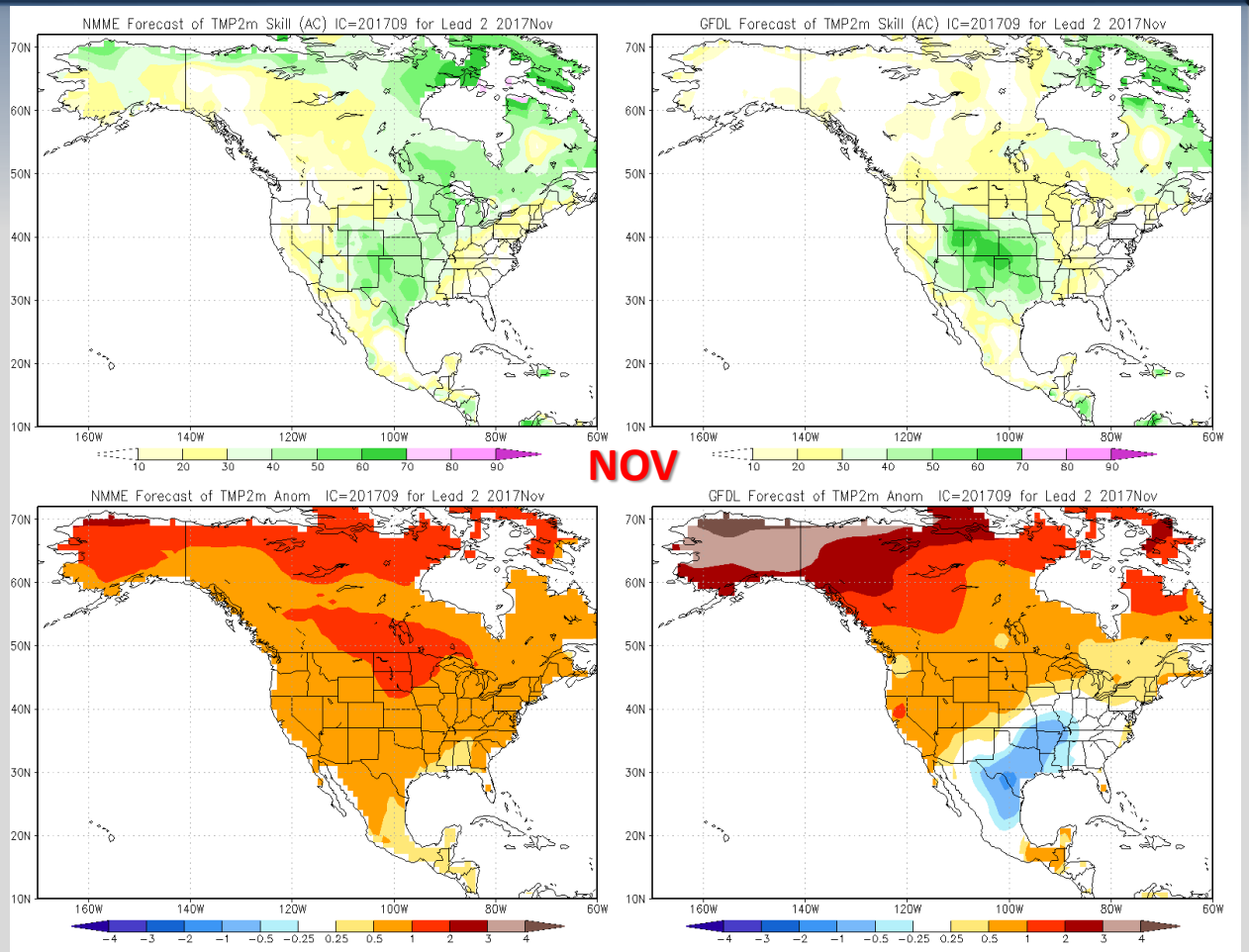




Figures 20-27. Top two climate model precipitation rate skill percentages (top row) for October and November 2017. Model forecasts (bottom row) are slightly below average with precipitation, primarily for the southeast half of NM in October. Model forecasts for November are not much different, ranging from slightly below to below average with regard to precipitation.

Oct-Nov Climate Model Forecasts
Temperature





Figures 27-34. Climate model temperature anomaly plots from the two climate models which have the highest skill percentages for October and November (top four images). Model forecasts (bottom four images) indicate near to slightly above average temperatures. The temperature trend during autumn in New Mexico since around 1982 has been steadily increasing.

ENSO SST Predictions

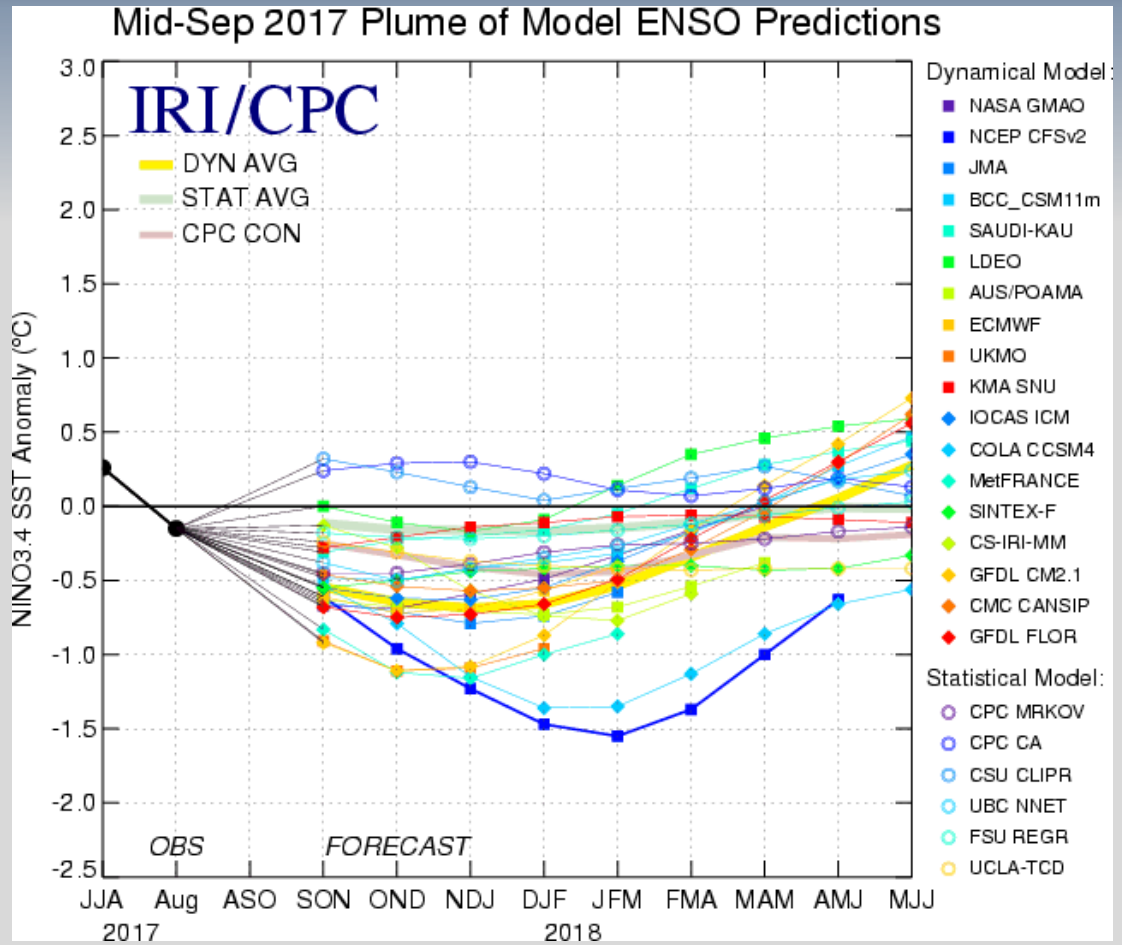
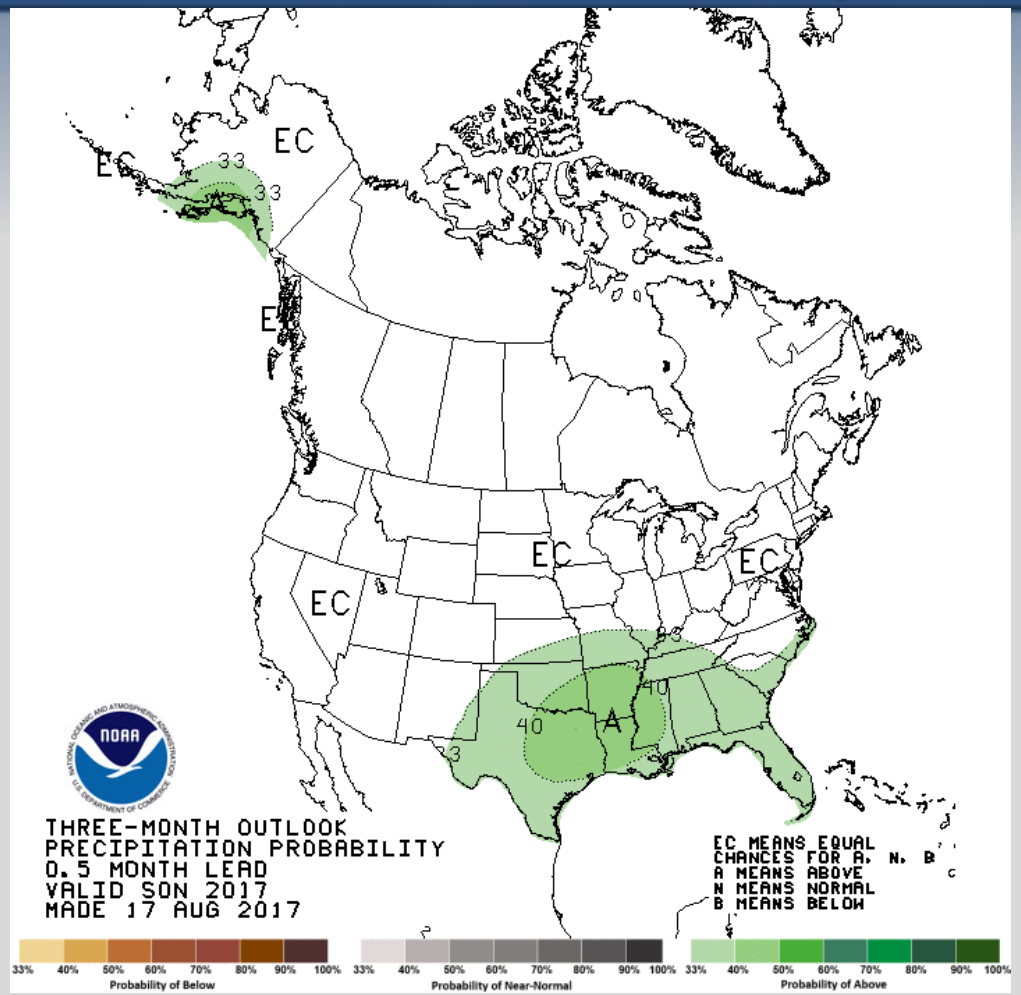
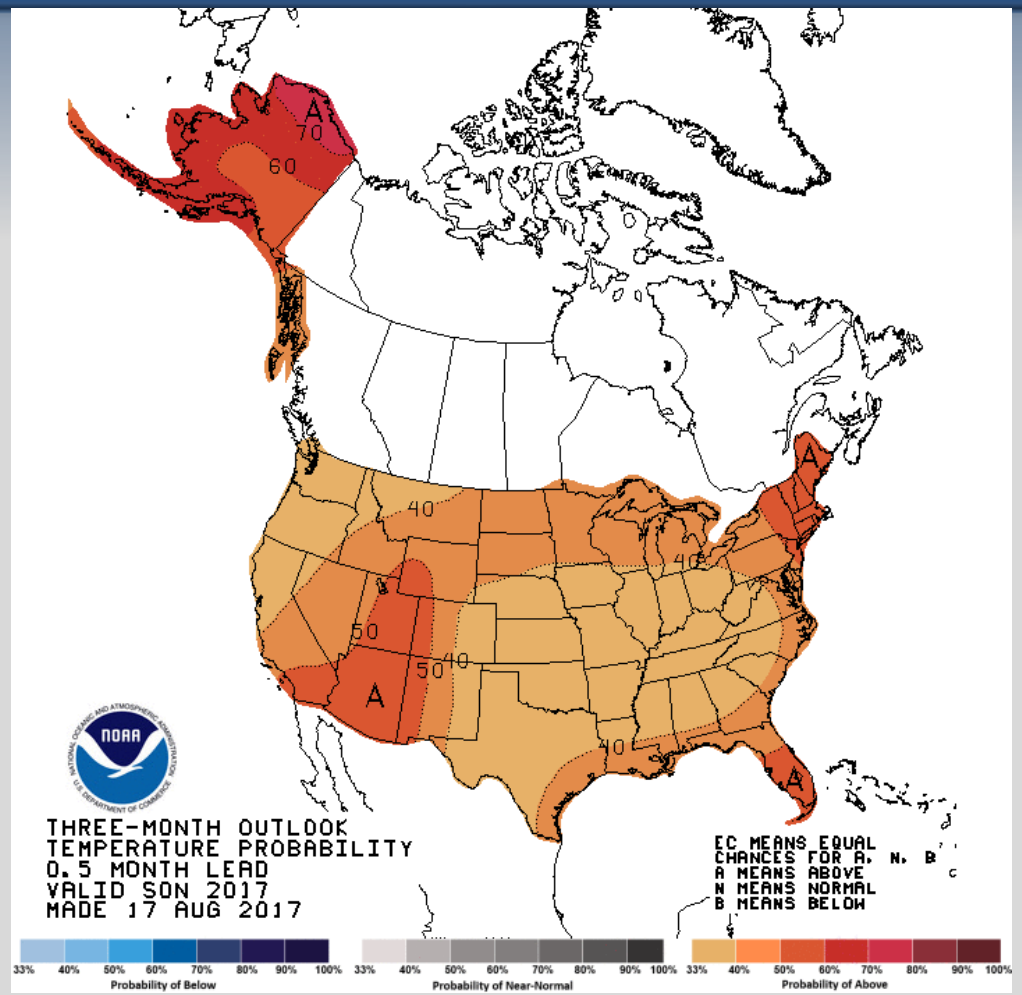


Figure 35. Climate model runs over the summer have changed their tune. Most models remain in neutral territory but many have trended into weak La Niña territory for fall 2017. This has prompted the Climate Prediction Center to issue a La Niña watch for the upcoming fall and winter. Current atmospheric variables in the equatorial Pacific Ocean continue to reflect a neutral pattern.

Climate Prediction Center's (CPC) SON/Fall Outlook

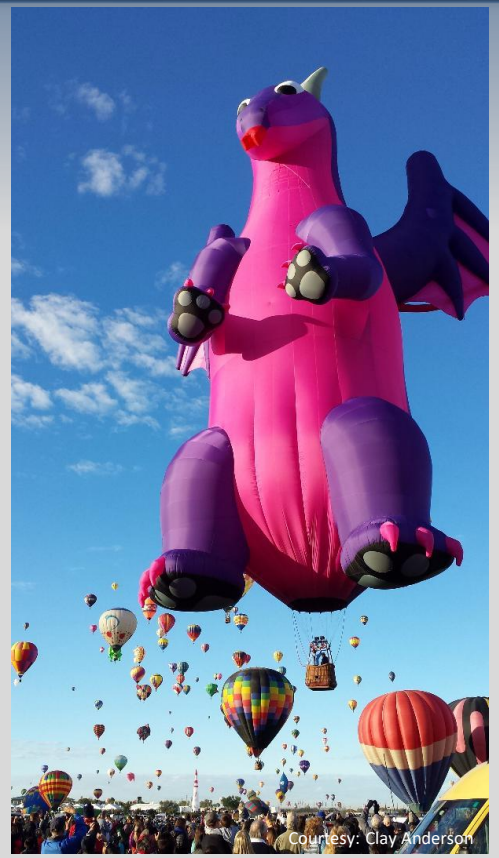




Figures 36 & 37. CPC agrees with the climate model consensus of above average temperatures. This outlook included the month of September and with an active Tropical Atlantic, the precipitation forecast was above average along and near the Gulf Coast.

How About Wind During the First Two Weeks of OCT?


Courtesy: Bennie Boss


Courtesy: Clay Anderson


Courtesy: Clay Anderson


Courtesy: Clay Anderson


Courtesy: Clay Anderson

Unfortunately, a stronger than average Aleutian Low generally means that Pacific storm systems will be more frequent than average across the western U.S. during October. This could result in above average wind speeds for much of the state during the second week of October.

Summary

- Slightly negative correlations with the Pacific Meridional Mode (PMM) and precipitation combined with forecasts from the most highly skilled climate forecast models indicate that precipitation in central and northern New Mexico during October and November 2017 will most likely range from **slightly below to below 1981-2010 climatological averages**.
- Negative correlations with PMM and temperature combined with recent temperature trends and climate model forecasts indicate that temperatures in central and northern New Mexico during October and November 2017 will most likely range from **slightly above to above average**.

Outlook Information

References

- Chiang, J. C. H., D. J. Vimont, 2004: Analogous Pacific and Atlantic Meridional Modes of Tropical Atmosphere–Ocean Variability. *J. Climate*, **17**, 4143-4158.

- Chang, P., L. Zhang, R. Saravanan, D. J. Vimont, J. C. H. Chiang, L. Ji, H. Seidel, M. K. Tippett, 2007: Pacific meridional mode and El Niño—Southern Oscillation. Geophysical Research Letters. Vol. 34, Issue 16.

- Rodionov, S.N., Overland, J.E., Bond, N.A., 2007. The Aleutian Low, storm tracks, and winter climate variability in the Bering Sea. Deep-Sea Research II 54 (2007) 2560–2577.

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

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