2017 Summer/Monsoon Outlook for Central & Northern New Mexico

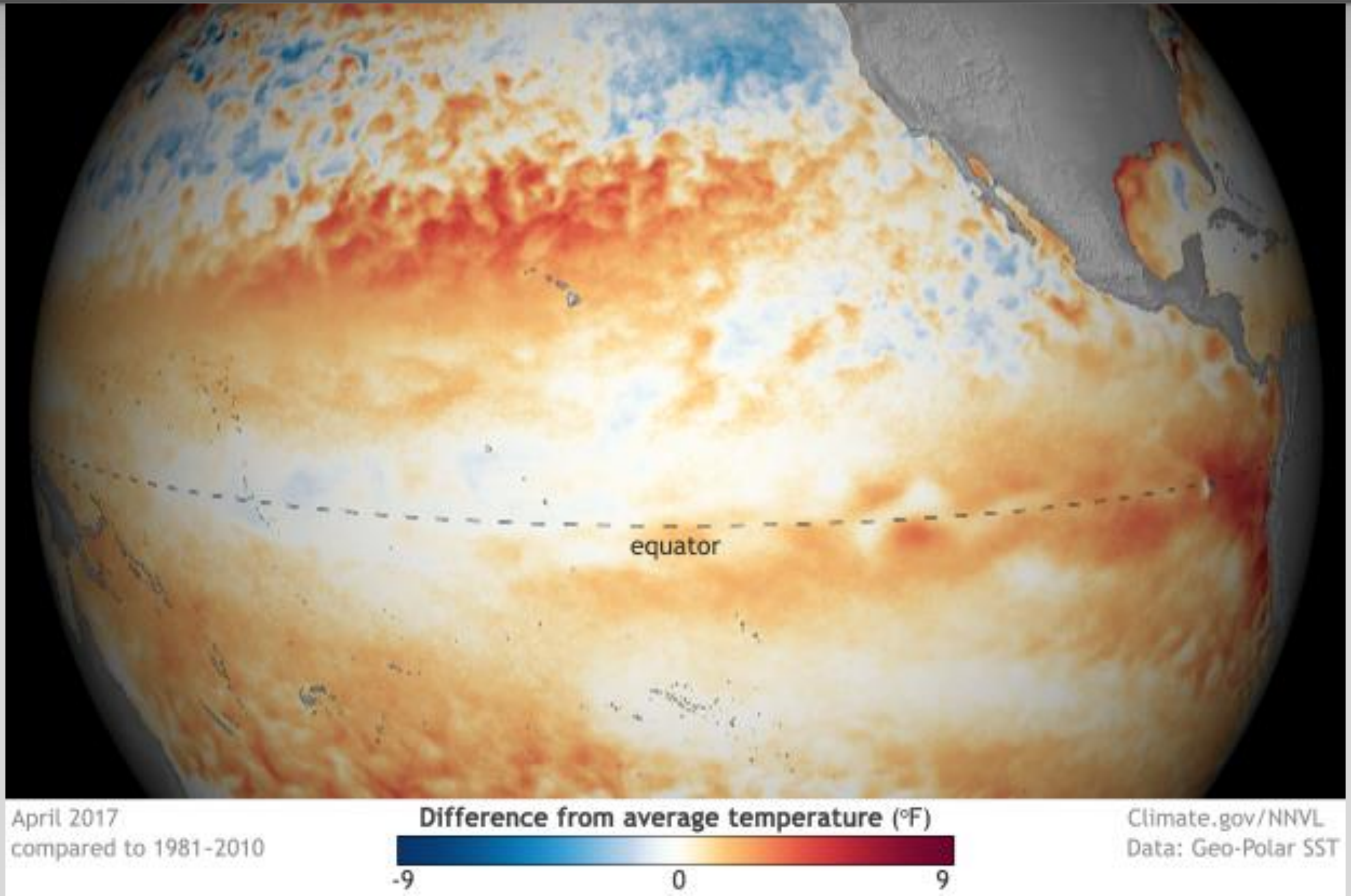


Figure 1. Colors on this map depict where and by how much monthly sea surface temperature differed from its 1981 to 2010 average. This high-resolution map is based on a dataset that combines on site measurements with near-real-time satellite observations. What does it show? La Niña has ended and the equatorial Pacific continues to slowly warm. Will the warming trend continue into summer and result in another El Nino? How will a warming equatorial Pacific impact the North American Monsoon (NAM)?

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.

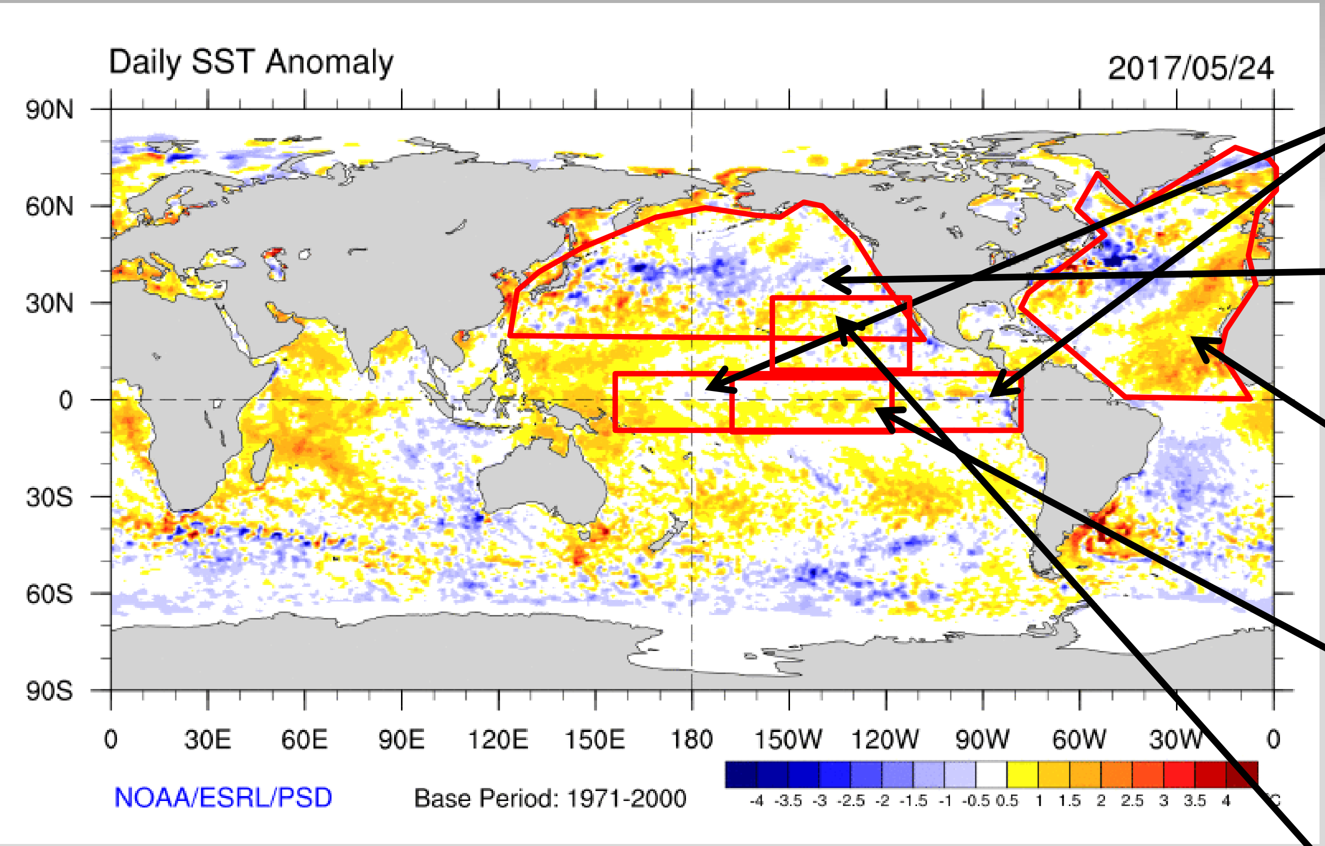
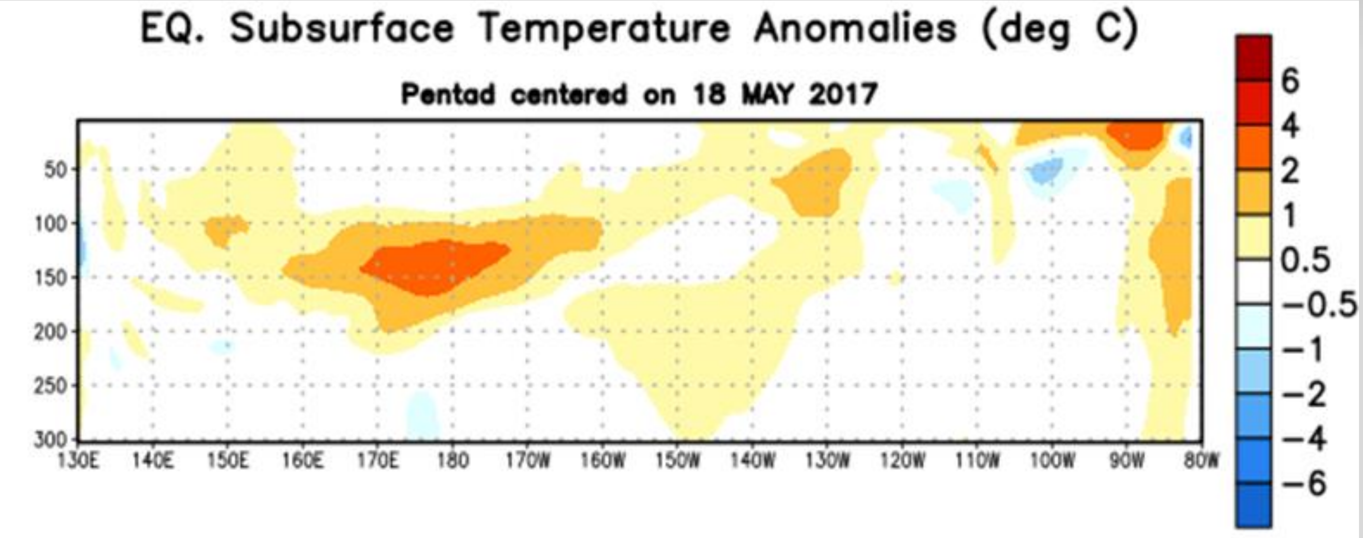


Figure 2. SST Anomalies in the Equatorial Pacific Ocean in May 2017 showing neutral conditions in the equatorial Pacific.

- Multivariate ENSO Index (MEI) for MAR-APR 2017: +**0.77**
- Pacific Decadal Oscillation (PDO) for APR 2017: +**1.20**
- Atlantic Multidecadal Oscillation (AMO) for APR 2017: +**0.29**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for FMA 2017: **+0.1**
- Pacific Meridional Mode (PMM) for MAR 2017: **+0.22**

Sub-surface Temperatures



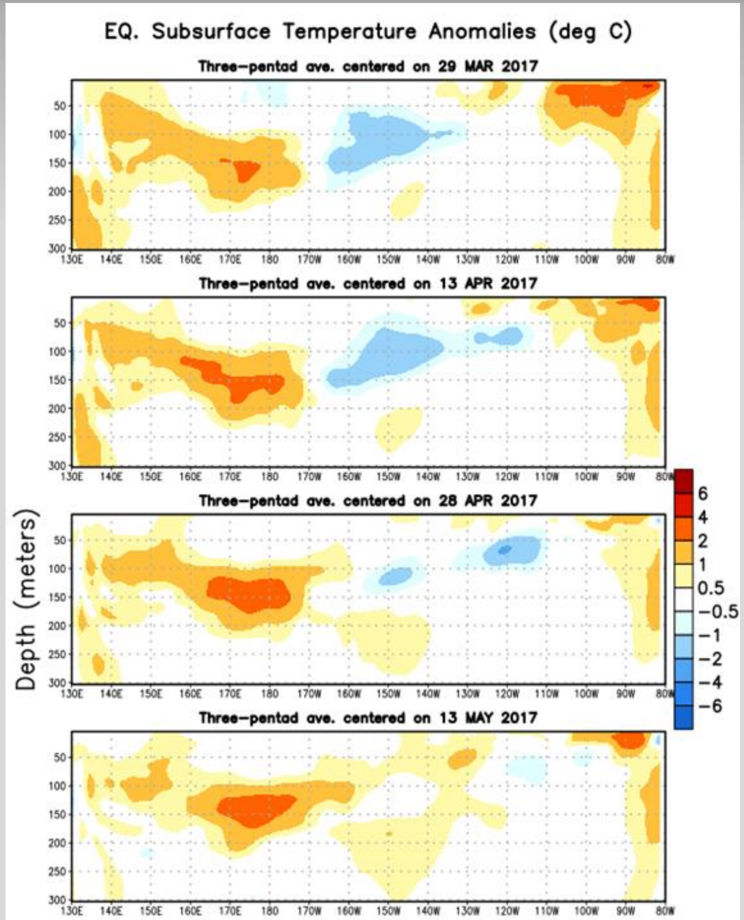


Figure 3 & 4. Subsurface temperature anomalies at the equator. Subsurface temperatures often lead the surface temperatures by several months. An increasing amount of warm water under the surface would provide some confidence to shore up the models that are forecasting El Niño. Currently, subsurface temperatures are slowly warming across the West Pacific.

Where Are We Now?

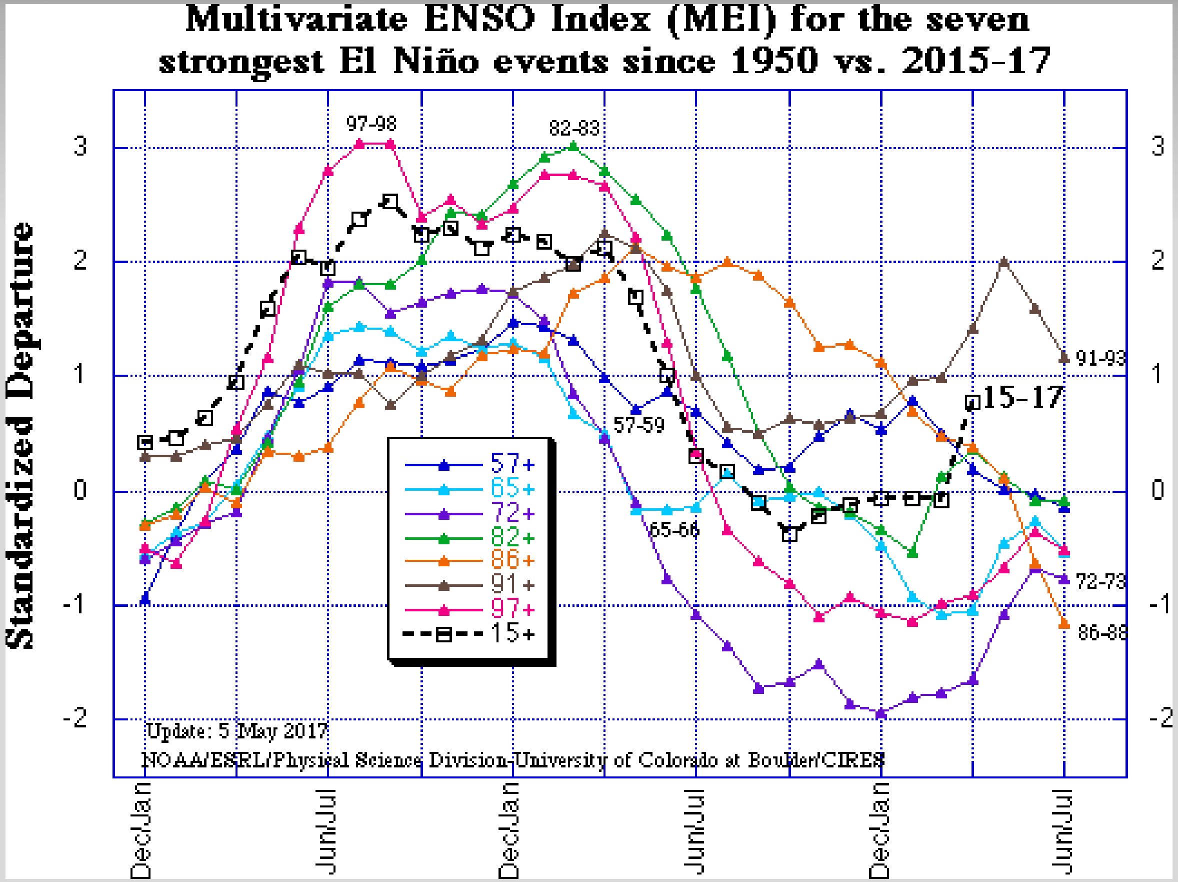
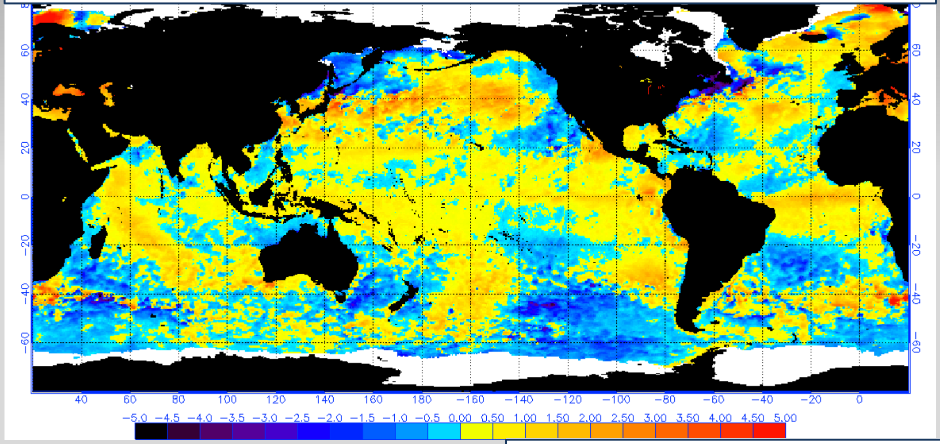


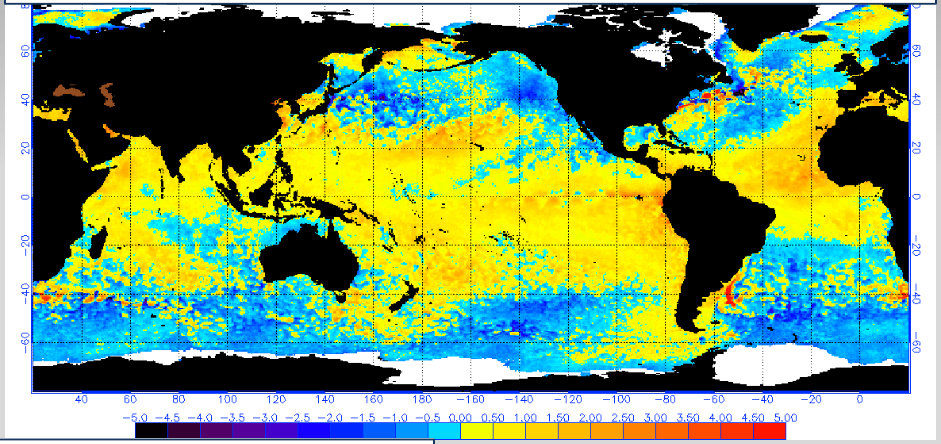
Figure 5. Seven strongest El Niño events using the Multivariate El Niño Southern Oscillation Index since 1950. 2015-16 was cooling/trending similarly to 1997-98 event but in Sept/Oct 2016, the brakes were applied. 2017 is looking similar to 1991-93.

Comparing May 2009 Global SSTAs to Current Conditions

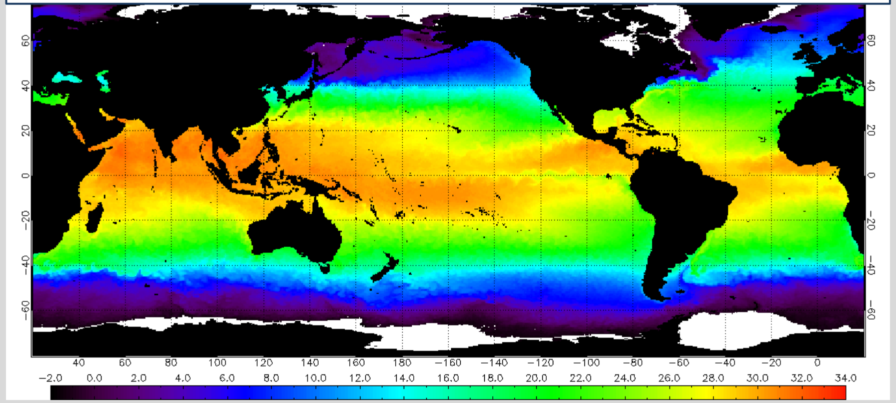
Global SST Anomalies 5/21/2009



Global SST Anomalies 5/18/2017



Global Observed SSTs 5/18/2017



Figures 6-8. SST Anomalies from May, 21 2009, and current conditions. Note the differences between SSTAs in the Pacific in 2009 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. <u>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</u>.

Pacific Meridional Mode (PMM)

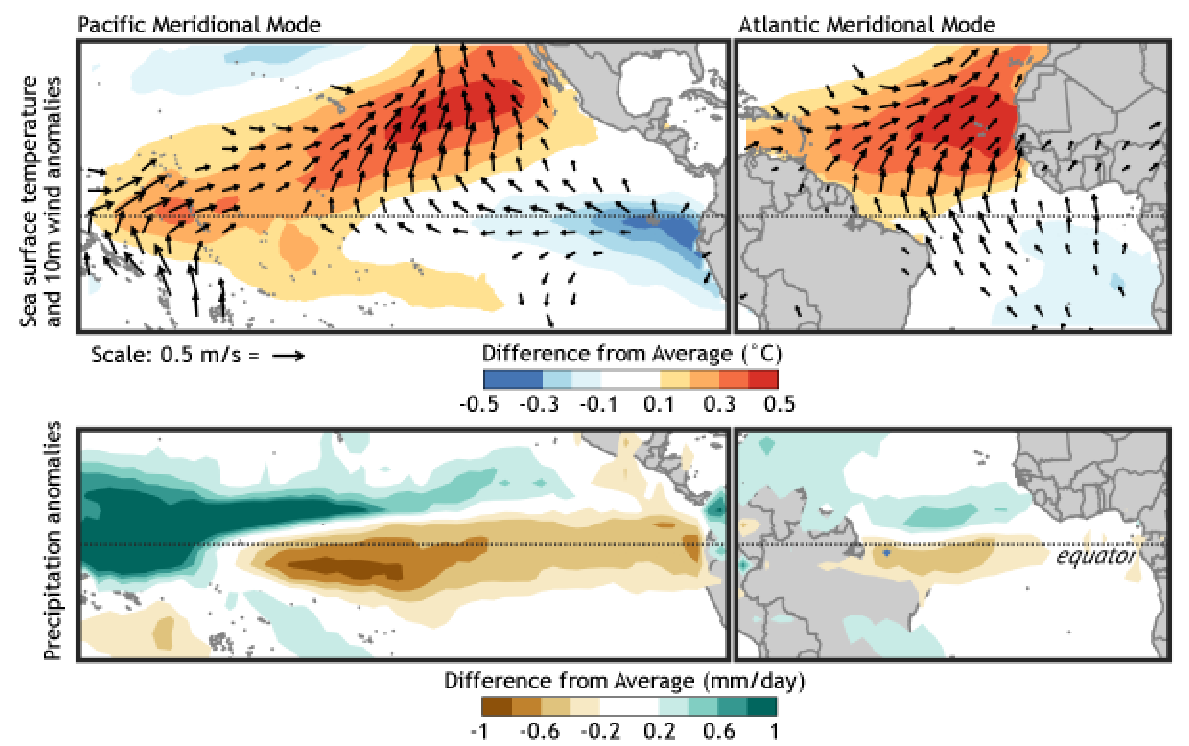


Figure 9. Tropical patterns associated with the positive state of the Pacific (left) and Atlantic (right) Meridional Modes (MM). The top panels show SST anomalies (shading) and near-surface wind anomalies (vectors), and the bottom panels show precipitation changes vs. average. Red (green) shading indicates 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

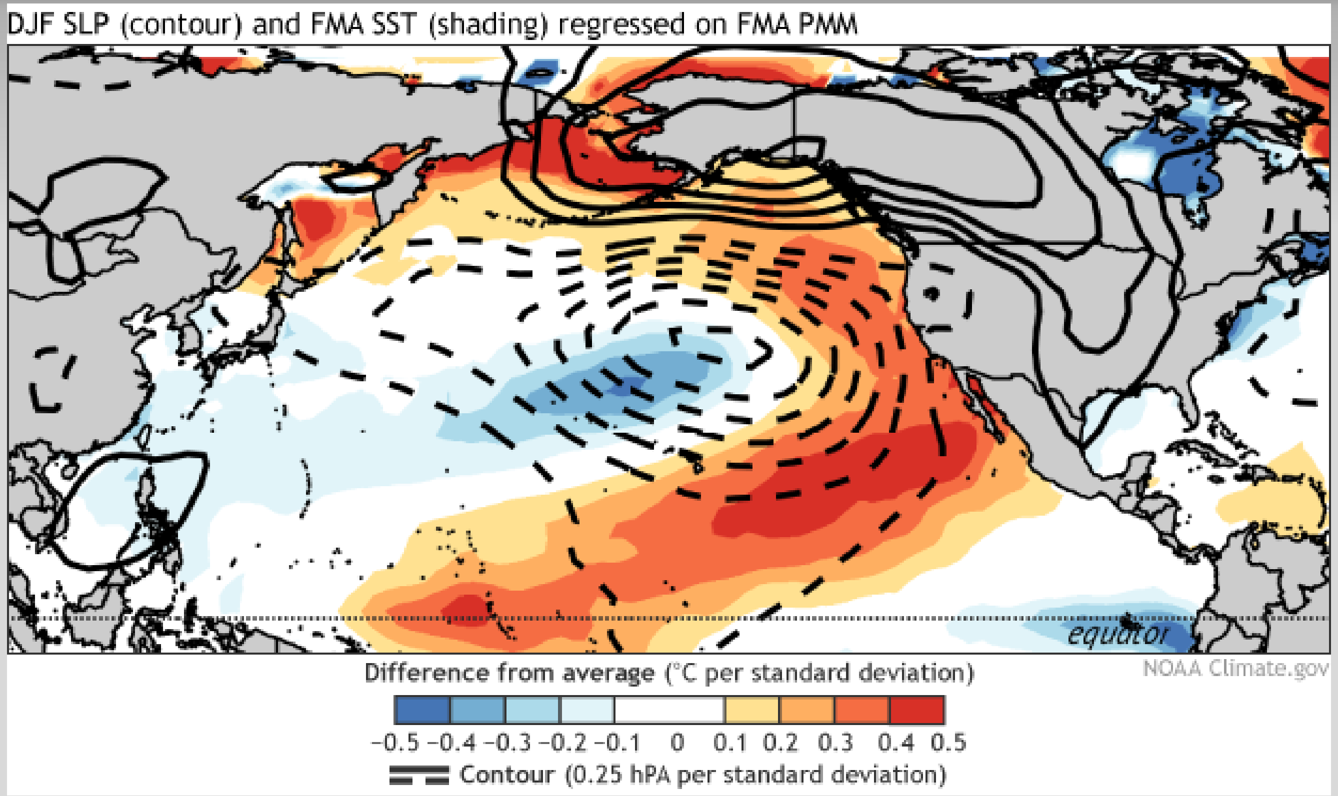


Figure 10. Early spring (February-April) sea surface temperature and winter (December-February) atmospheric circulation anomalies related to the positive state of the PMM during early spring. Dashed black contours reflect lower-than-average sea level pressure and solid black contours indicate higher-than-average 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

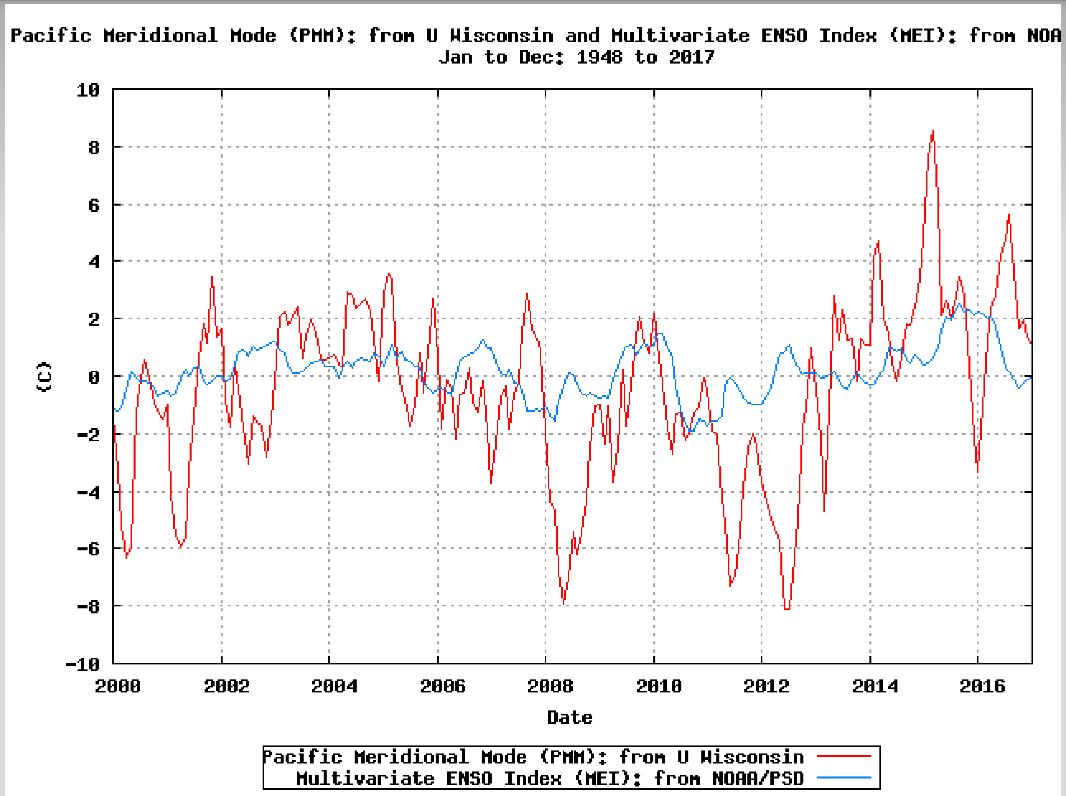
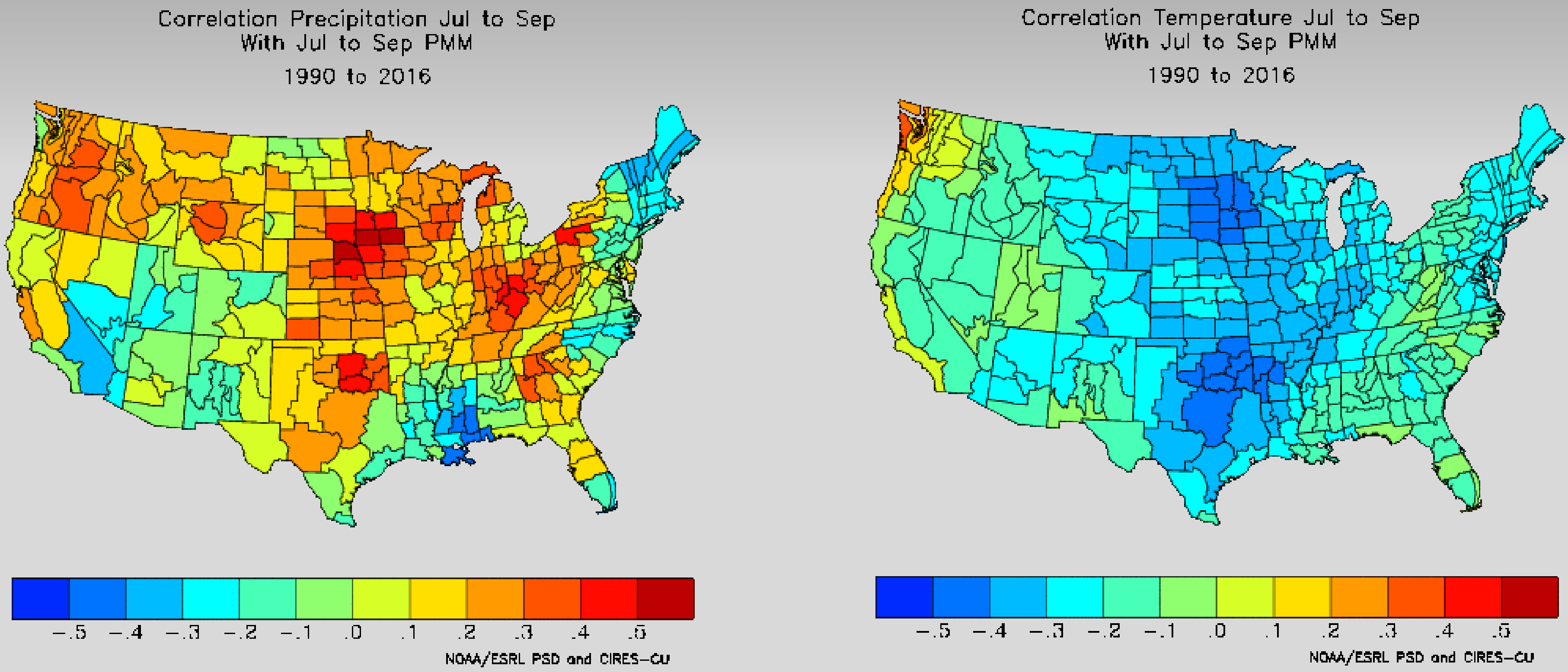


Figure 11. Time series of ENSO (blue) and PMM (red) since 2000. The PMM links the mid-latitude atmospheric circulation to the equator, and the initiation and development of ENSO. Recent research has pointed out that this sequence of events tends to have a strong connection with the development of ENSO 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 12 & 13. 1990-2016 JAS correlations of precipitation (left) and temperature (right) with PMM. When the PMM index is positive, as it is now, parts of New Mexico stands a slightly better-than-average shot at above average precipitation in JAS, particularly across the northern mountains and eastern plains. With regard to temperature, chances are better than average in JAS that most of the state stands to be warmer than average (negative correlation), particularly across western and northern NM.

Madden-Julian Oscillation (MJO)

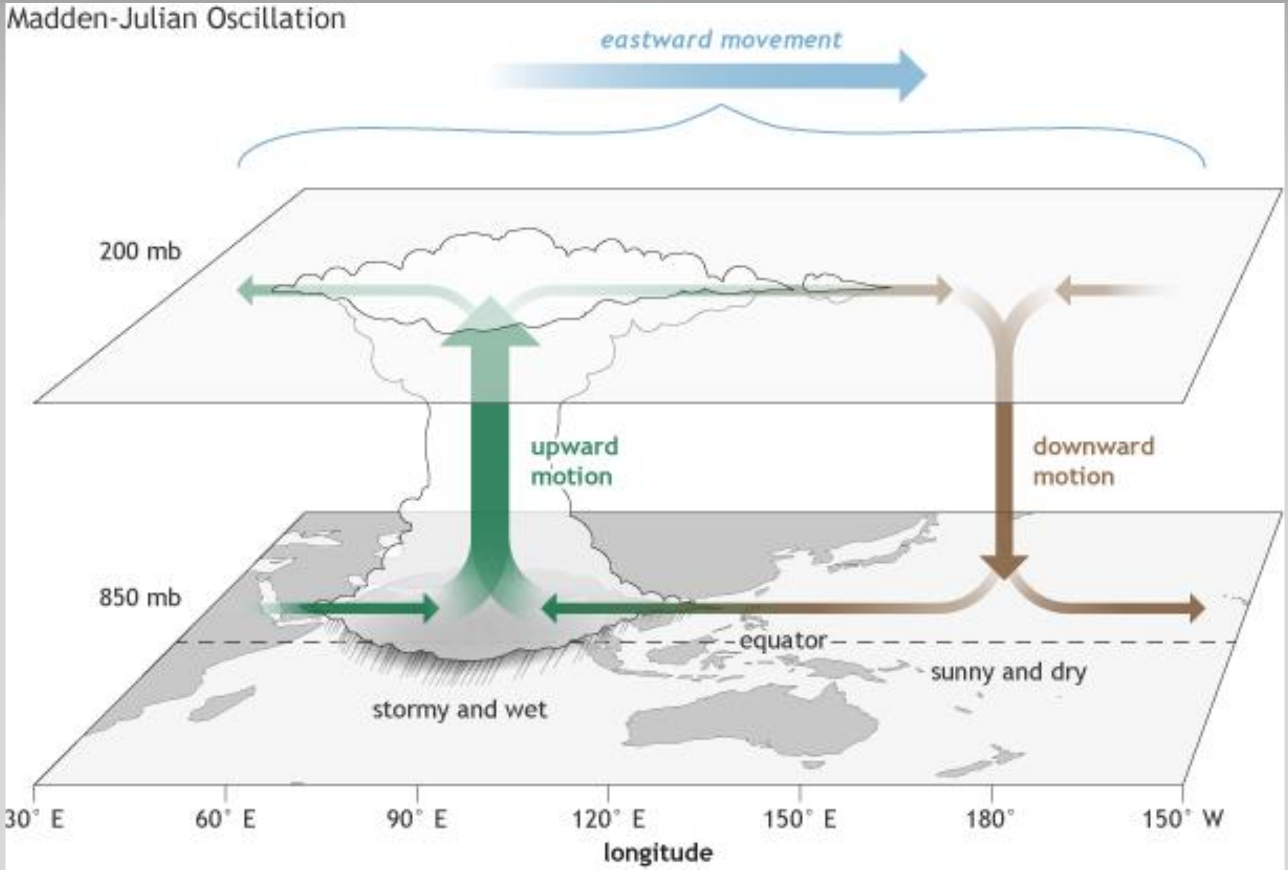


Figure 14. The MJO is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the 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 September.

Why the MJO is So Important?

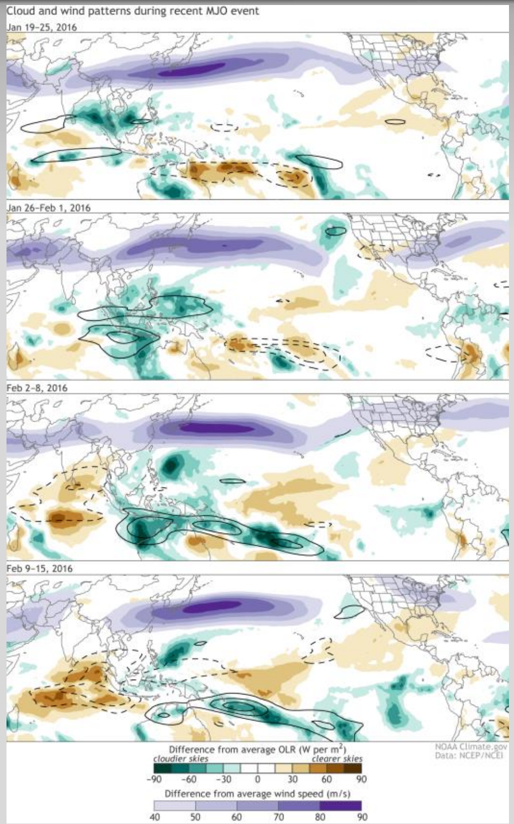
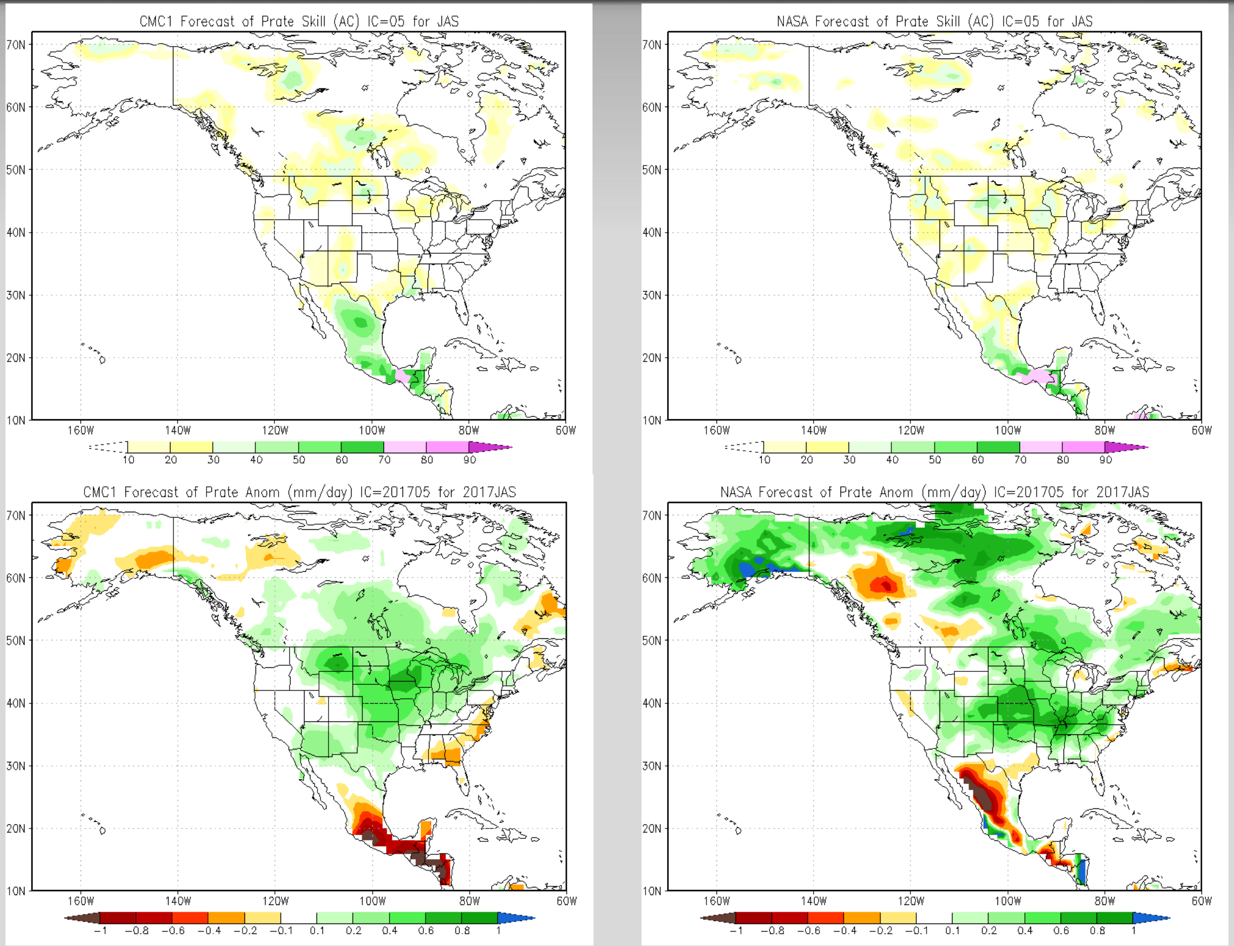


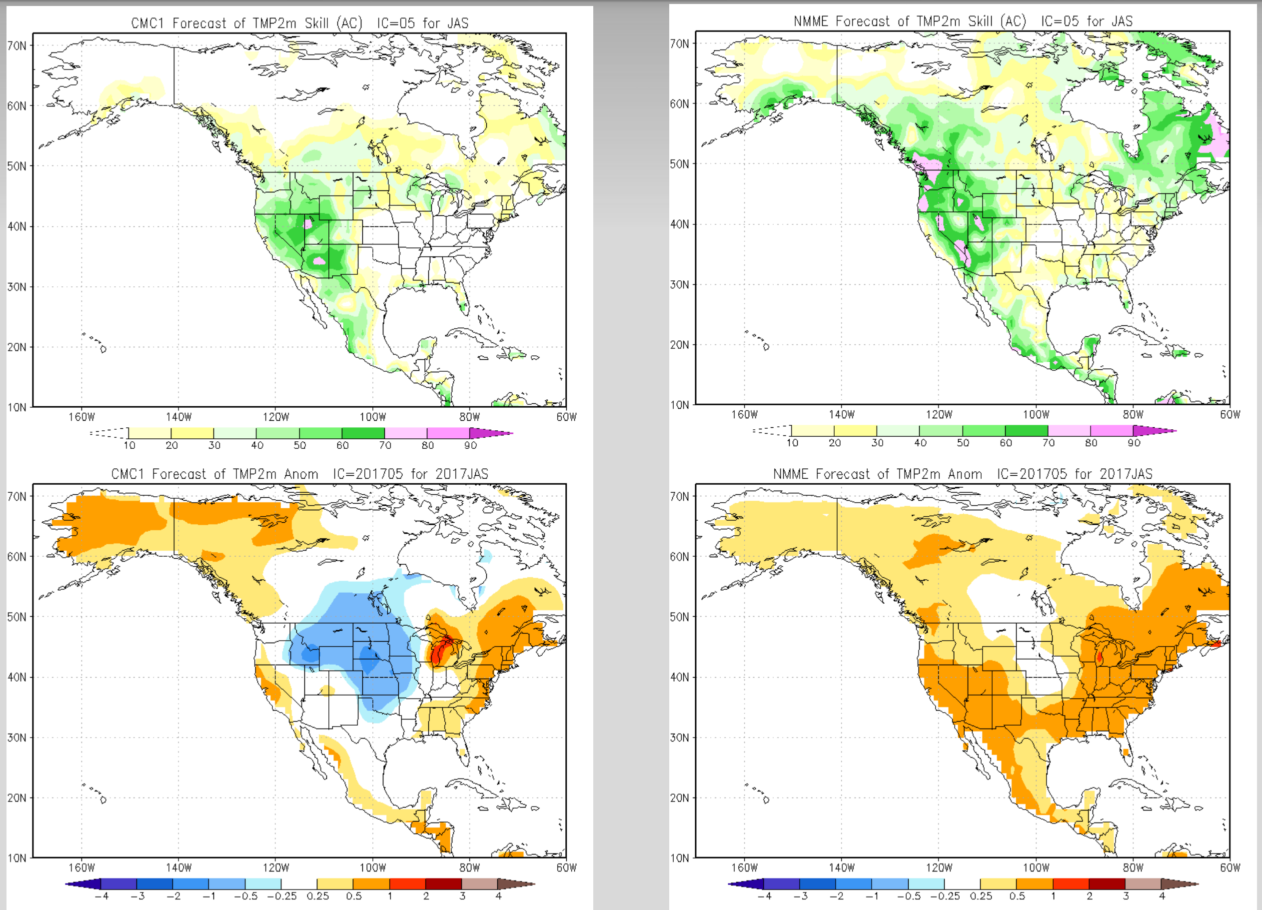
Figure 15. Clouds and wind patterns for the MJO event that occurred from late-January to mid-February 2016. Black contours highlight the OLR (outgoing longwave radiation, or heat energy) signals directly associated with the MJO. The MJO also affects the jet stream over the United States. When the MJO 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 return to the Maritime Continent during early June. During the **North American Monsoon**, the MJO can result in a strengthening in the sub-tropical jet stream, allowing upper level troughs to interact with the monsoon moisture plume, increasing convective activity across the southwestern U.S.

JAS Climate Model Forecasts
Precipitation



Figures 16-19. Climate model precipitation rate anomaly plots from the two climate models which have the highest skill percentages (top two images), the Canadian Meteorology Center (CMC1) and the National Aeronautics and Space Administration (NASA) models. Both model forecasts (bottom two images) are slightly above average for July, August, and September precipitation. The above average precipitation rate forecast pattern suggest more frequent than average upper level troughs moving through the Northern Plains and Midwest which would point toward above average backdoor front frequency for New Mexico.

JAS Climate Model Forecasts
Temperature



Figures 20-23. Climate model temperature anomaly plots from the two climate models which have the highest skill percentages (top two images), the Canadian Meteorology Center (CMC1) and the North American Multi-Model Ensemble (NMME) models. Both model forecasts (bottom two images) indicate near to slightly above average temperatures. The temperature forecast pattern suggests more frequent than average upper level troughs moving south and southeast through the Northern Plains and Midwest which would point toward above average backdoor front frequency for New Mexico. Keep in mind the NMME output is from a group of model runs while the CMC1 is a single run/solution. Typically, single model runs will show greater precipitation and temperature extremes.

ENSO Predictions

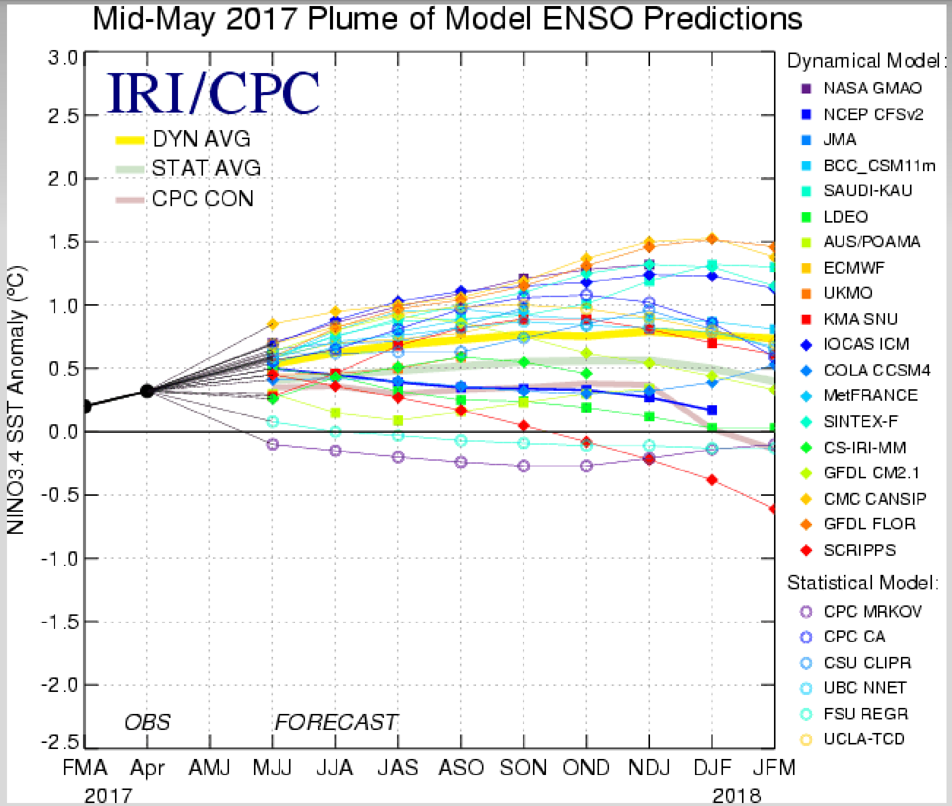
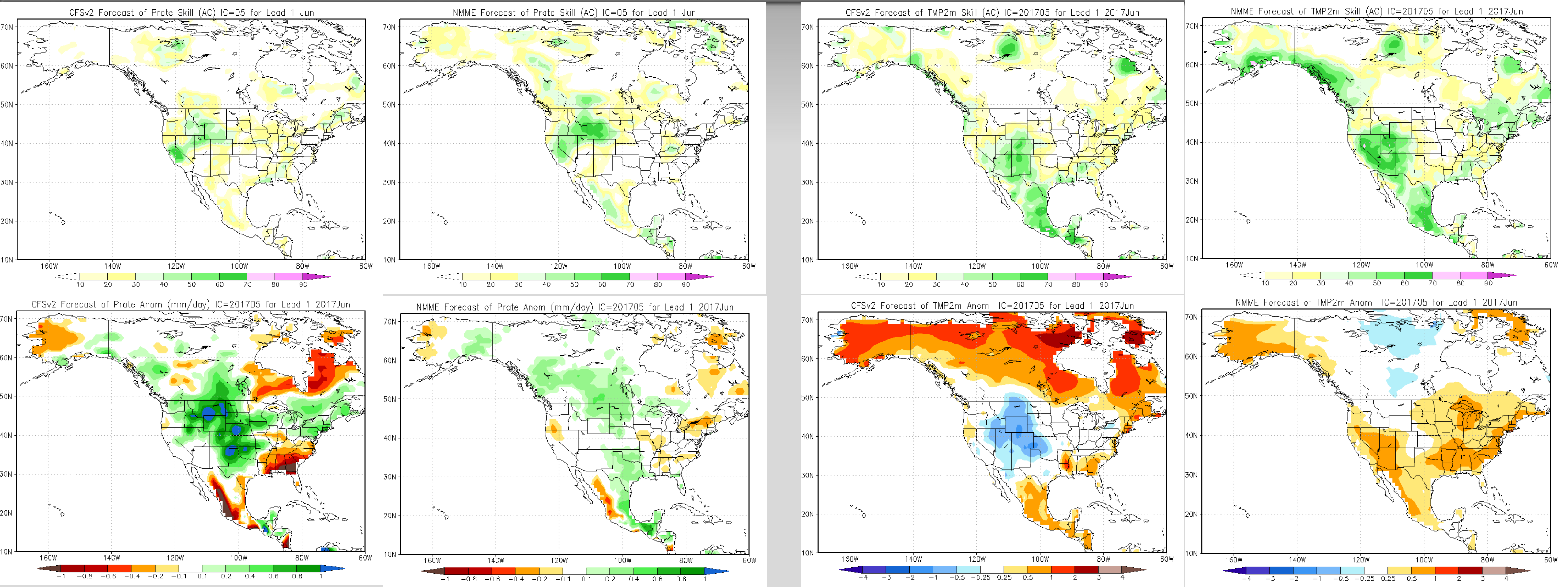


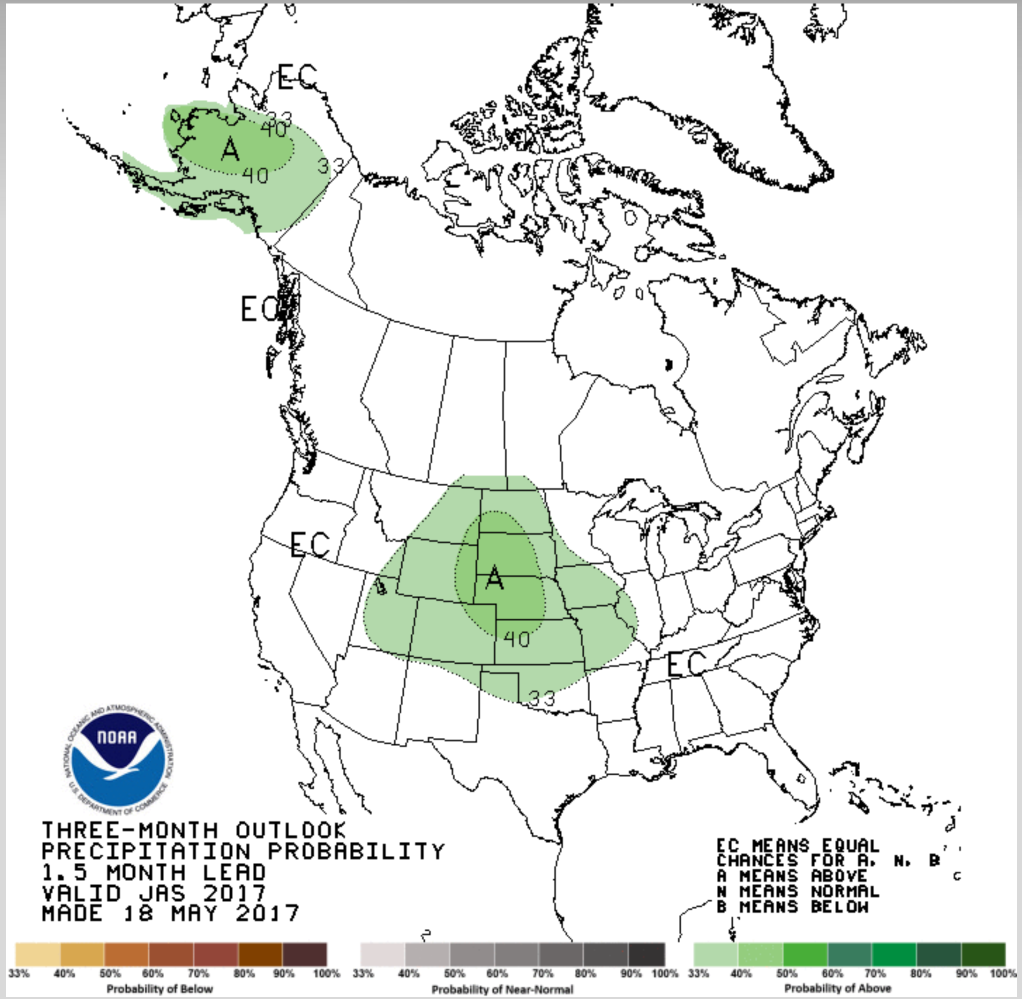
Figure 24. The latest climate models are not as excited about an El Niño as they once were. Most of the models in the set of dynamical and statistical model predictions issued during early May 2017 predicts ENSO-neutral to weak El Niño conditions during the May-July period, but with increasing chances for El Niño during late summer and fall. In the most recent week, the SST anomaly in the Nino3.4 region was 0.5 C, at a borderline El Niño level, and 0.32 C for the month of April, which is ENSO-neutral. The atmospheric variables continue to reflect mainly neutral patterns, except that conditions in the eastern tropical Pacific have been more El Niño-like. For northern summer and fall 2017, more than half of the dynamical models favor an El Niño, while only about half of the statistical models do.

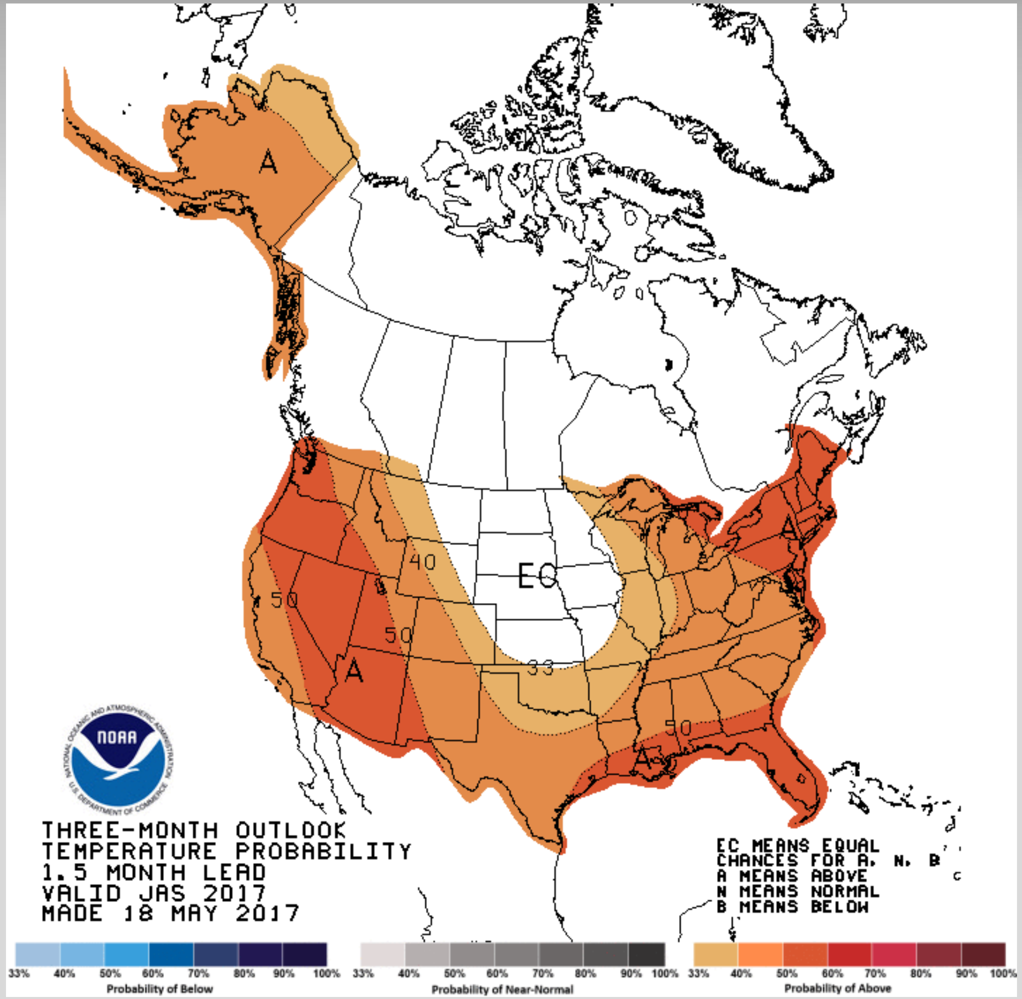
How about June?



Figures 25-32. The climate orphaned month of June looks more interesting than usual. The most highly skilled climate models suggest, as they do for JAS, that the weather pattern for the Northern Rockies, Northern Plains and Midwest will likely be more active than average. If so, then more frequent than average backdoor fronts will likely drop into New Mexico from the northeast. The so called “reverse” monsoon (by definition there can be no such thing) fueled by backdoor fronts/boundaries could end up driving an active June, especially across eastern New Mexico.

Climate Prediction Center's (CPC) JAS Outlook





Figures 33 & 34. CPC agrees with the climate model consensus of more frequent than average upper level troughs passing through portions of the Northern Rockies as well as the Northern and Central Plains during JAS.

Summary

- Slightly positive 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 July, August and September 2017 will most likely range from near to slightly above 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 JAS 2017 will most likely be near to slightly 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.

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

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