

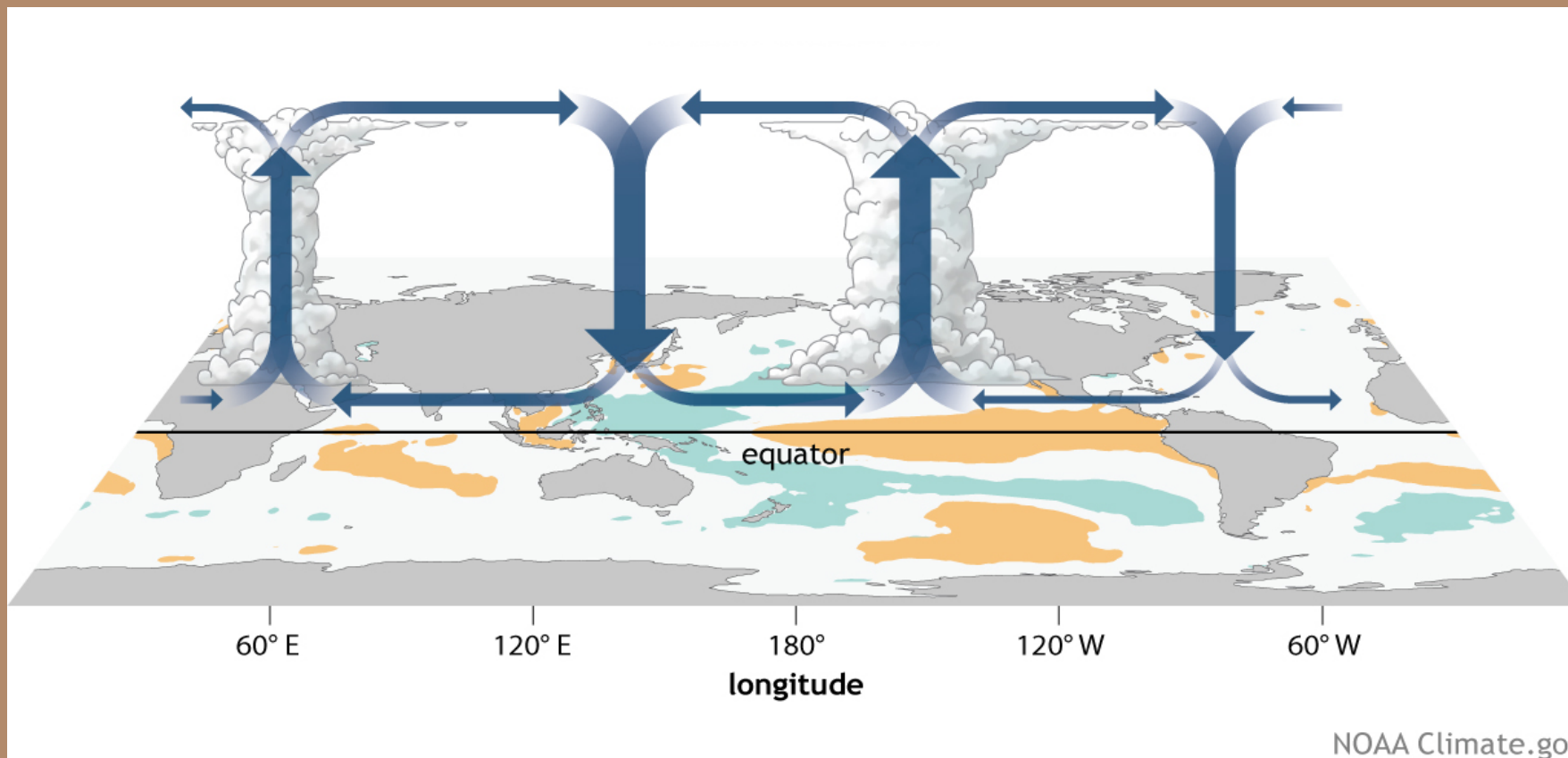
2018 Monsoon Outlook

For Central & Northern New Mexico



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NOAA Climate.gov

Figure 1. What brings about an above to well above average North American Monsoon (NAM)? Is it all thermally driven? Does low snowpack in the Southern Rockies make a difference? The answer is quite complex and not fully understood but the common denominator seems to be the Walker Circulation, a pattern in the tropical Pacific of air rising in the west and sinking in the east with westward moving air at the surface. Anomalous ocean warming in the central and eastern Pacific (orange) help to shift the rising branch of the Walker Circulation westward to near 180°, while the compensating (or associated) sinking branches shift to just west of the Maritime continent and far southeastern North America. NOAA Climate.gov drawing by Fiona Martin.

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North American Monsoon (NAM) – What is it?



The North American Monsoon (NAM), like its much stronger cousin the Asian or Indian Monsoon, is the result of the polar jet stream and sub-tropical upper-level highs migrating northward during the warm season. The **word “monsoon”** comes from the **Arabic word** mausim, meaning season. Essentially, it describes a seasonal wind shift over a region that is usually accompanied by an increase in moisture and precipitation, accounting for nearly half of annual precipitation for much of New Mexico. Source regions for the moisture include, the Gulf of Mexico, Gulf of California and the eastern Pacific Ocean. Monsoon onset dates in the U.S. Southwest typically begin in mid to late June in northwest Mexico (Sonora, Chihuahua, Sinaloa, and Durango) and early July in New Mexico and Arizona.

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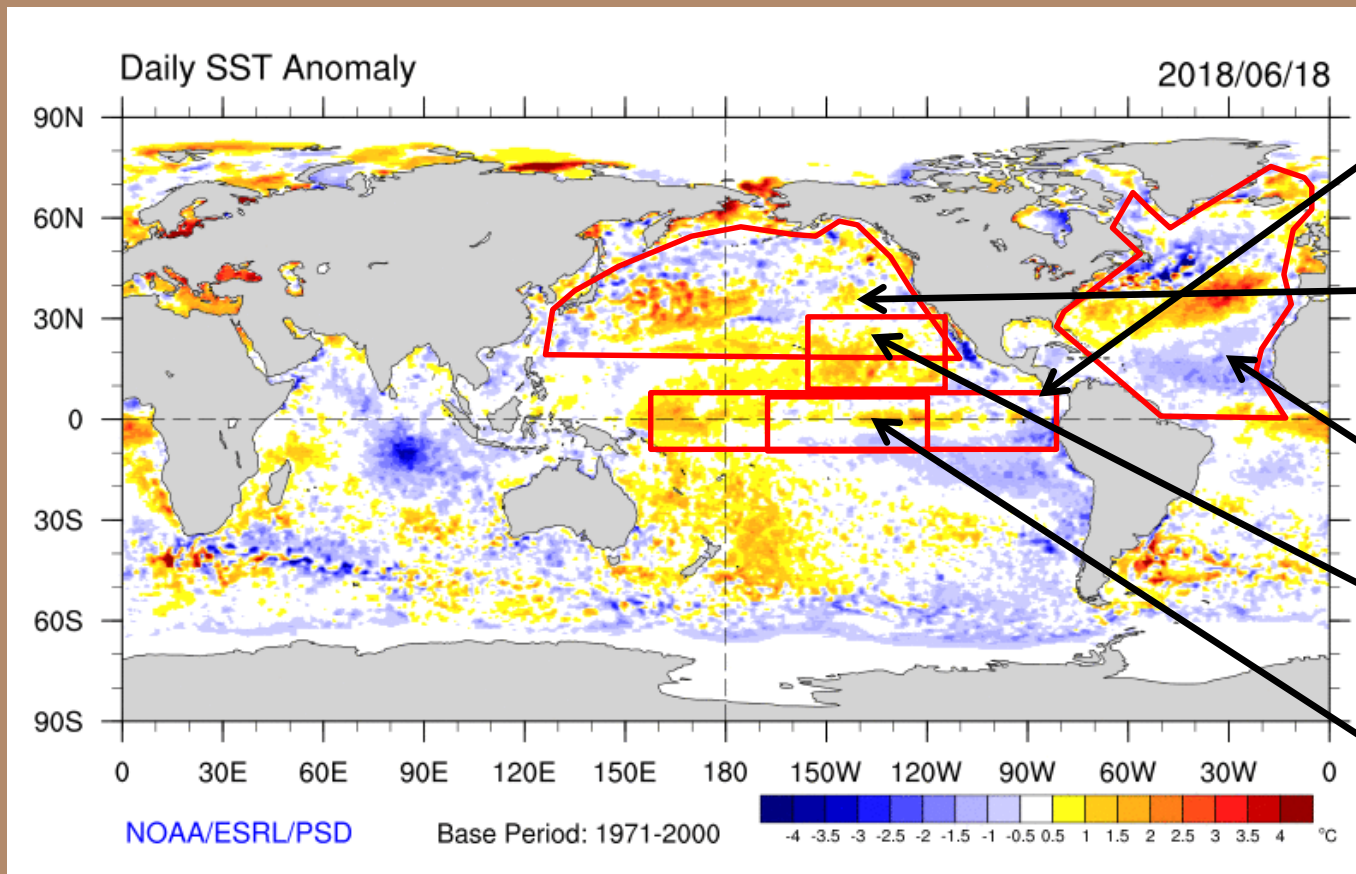
Current Sea Surface Temperatures (SSTs)



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*SSTs are what drive tropical & sub-tropical thunderstorms. It's these thunderstorms that drive global weather & climate.



- Multivariate ENSO Index (MEI) for APR-MAY 2018: **+0.47**
- Pacific Decadal Oscillation (PDO) for MAY 2018: **+0.11**
- Atlantic Multidecadal Oscillation (AMO) for APR 2018: **+0.06**
- Pacific Meridional Mode (PMM) for MAY 2018: **+5.21**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for MAM 2018: **-0.4**

Figure 2. SST Anomalies in the Equatorial Pacific Ocean in mid June 2018 showing neutral conditions in the equatorial Pacific.

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Sub-surface Temperatures



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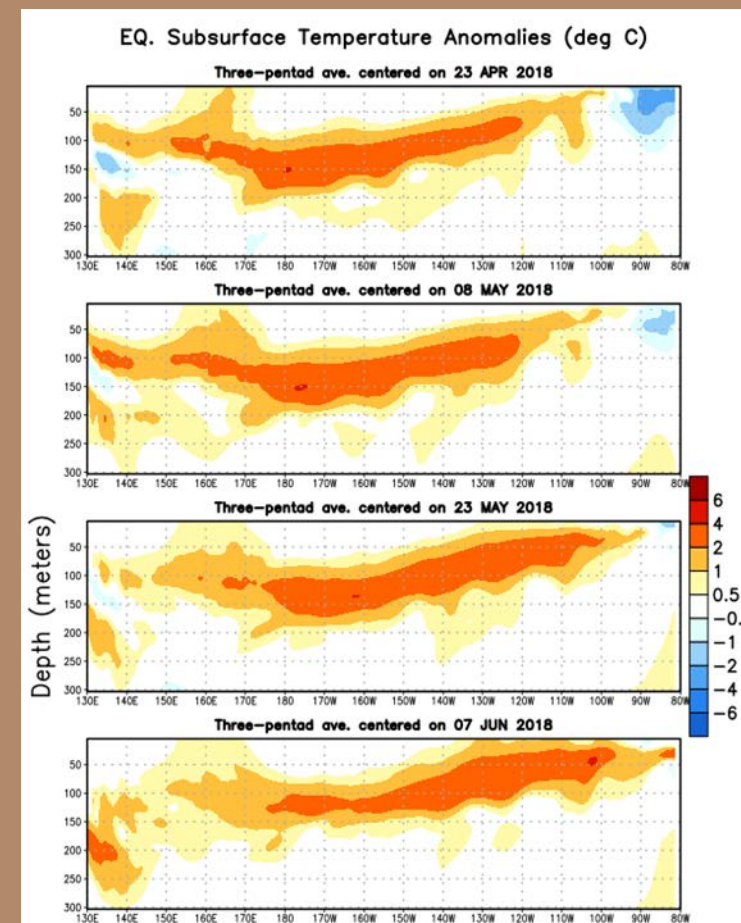
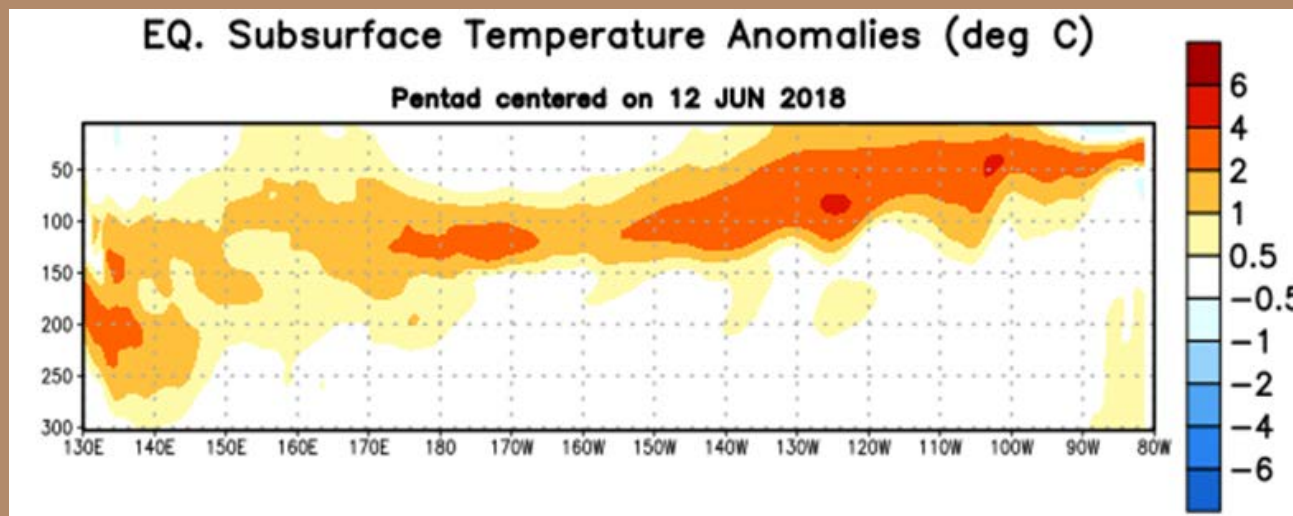


Figure 3 & 4. Sub-surface temperature anomalies at the equator. Sub-surface temperatures often lead the surface temperatures by several months. An increasing amount of warm water under the surface provides confidence in climate models that are forecasting neutral to El Niño conditions by late summer/early fall. Sub-surface temperatures continue to warm across the central and eastern Pacific Ocean.

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Multivariate El Niño Index (MEI) - Analog Years



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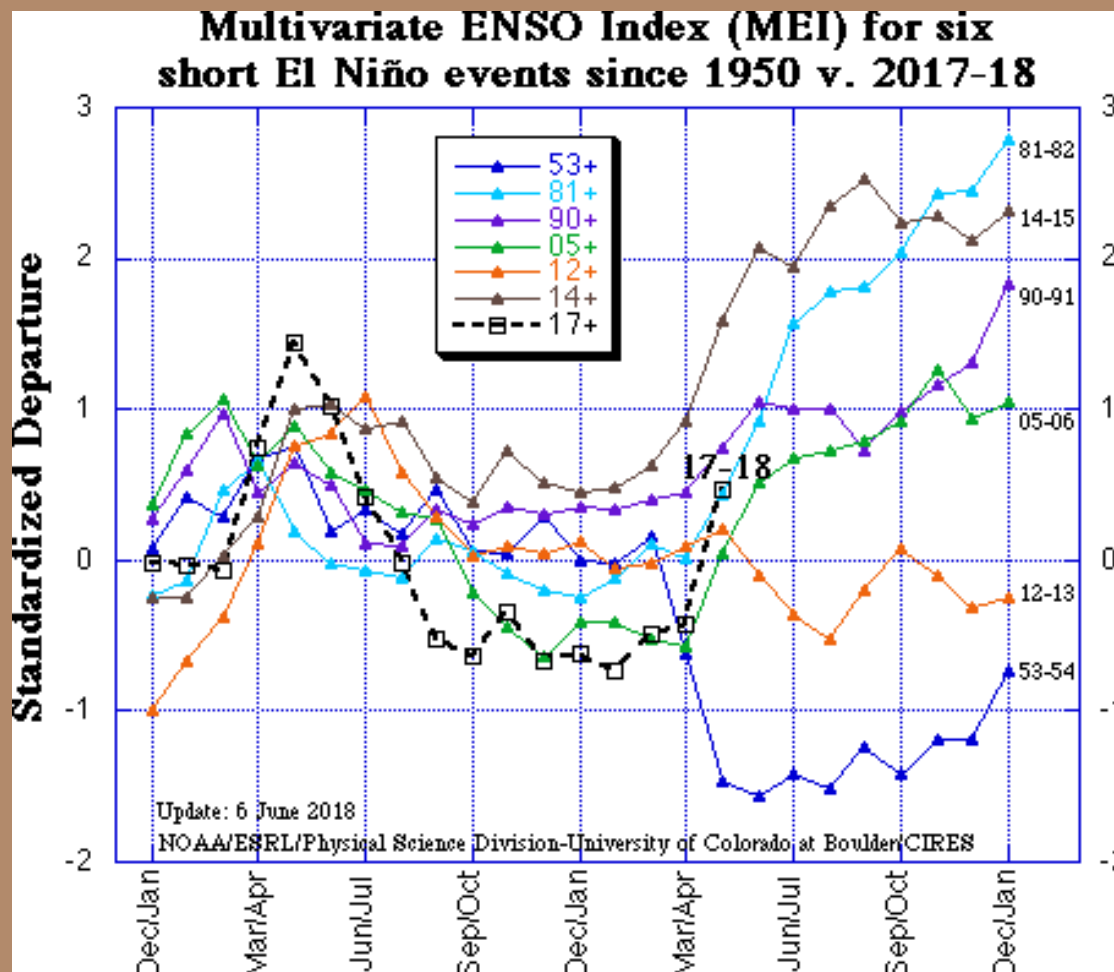


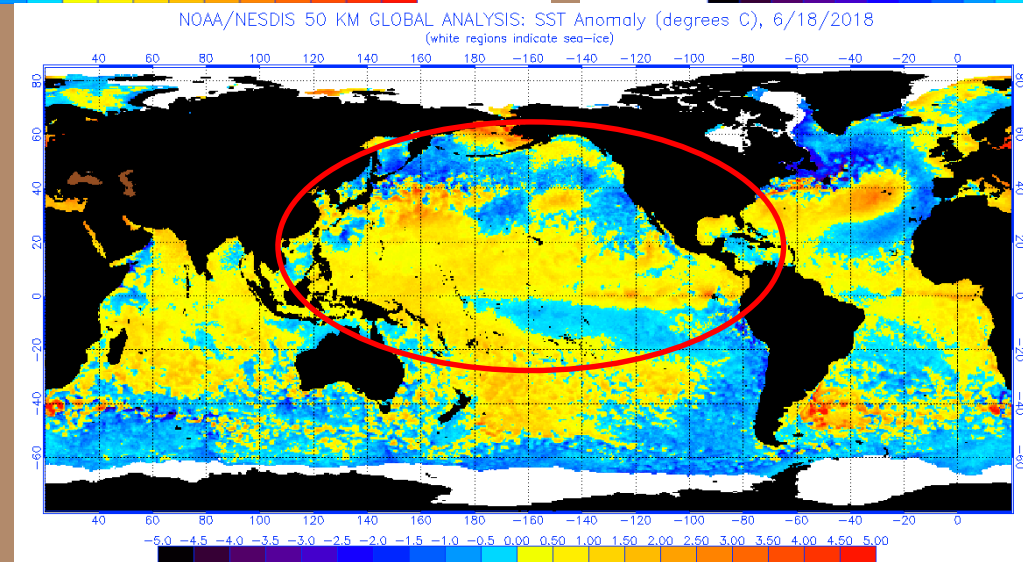
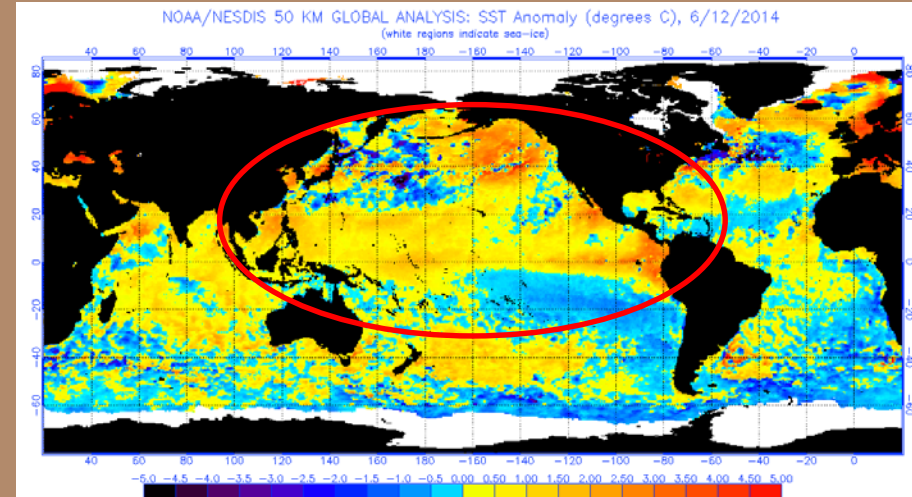
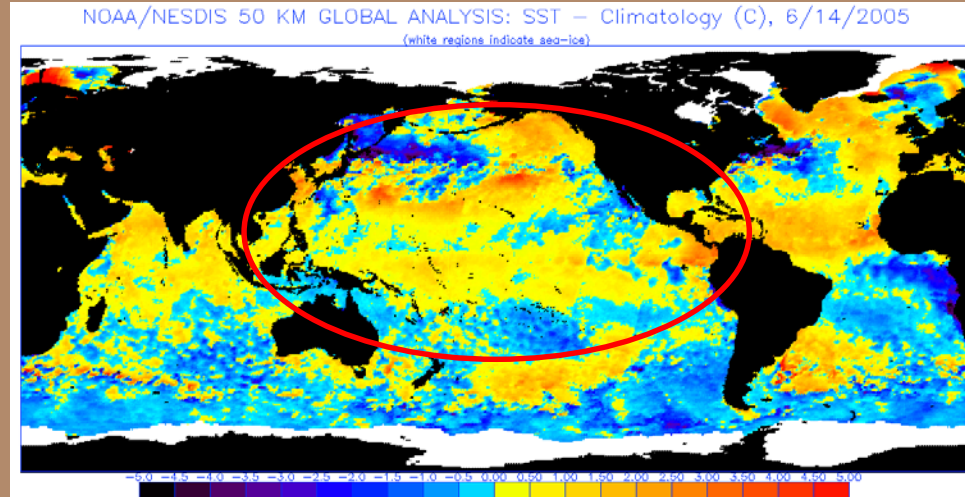
Figure 5. Six strongest El Niño events using the Multivariate El Niño Southern Oscillation Index (MEI) since 1950. 2005-06 was warming/trending similarly to 2017-18 event but in Sept/Oct 2005, the brakes were applied. 2017-18 is trending similar to 1982-83 & 2014-15.

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Analog Years – 2005-06 & 2014-15



Figures 6-8. SST Anomalies from the two most recent analog years June, 14 2005, June 12, 2014, and current conditions. Warmer-than-average waters (orange) tend to evaporate more water and warm the air above, creating more rising motion and clouds/thunderstorms compared to average.

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Madden-Julian Oscillation (MJO)

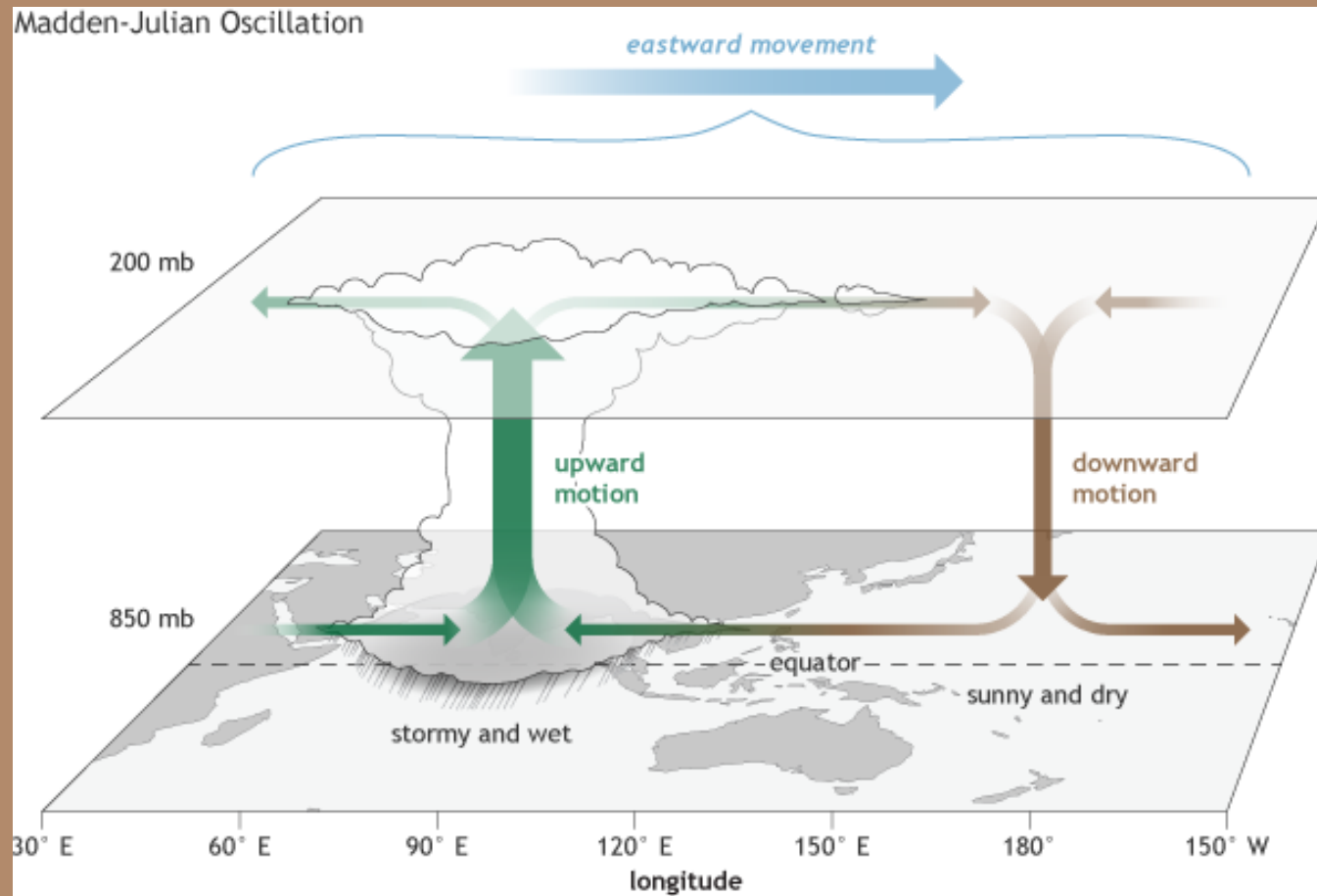


Figure 9. The MJO is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the rising 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.

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Pacific Meridional Mode (PMM)



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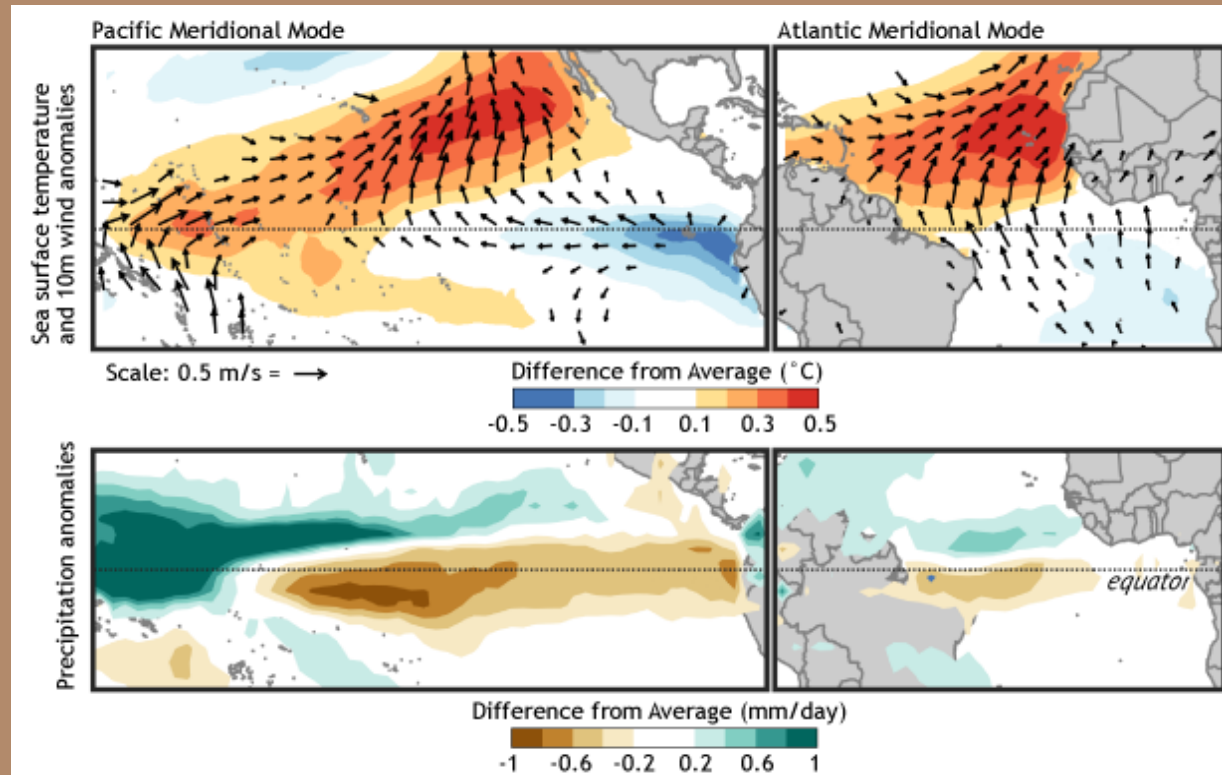


Figure 10. Tropical patterns associated with the positive state of the Pacific (left) and Atlantic (right) Meridional Modes (MM). The top panels show SST anomalies (shading) and near-surface wind anomalies (arrows), and the bottom panels show precipitation changes vs. average. Red (green) shading indicates 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).

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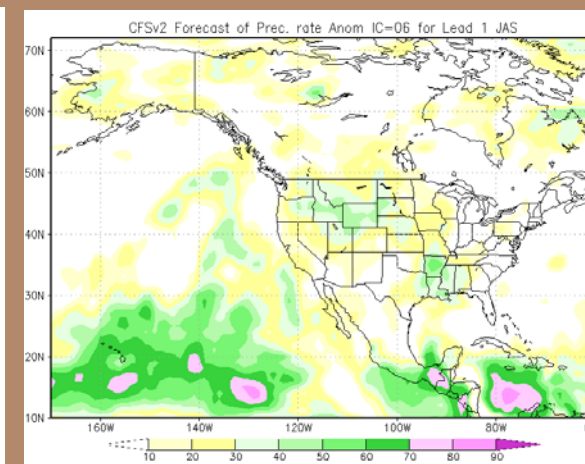
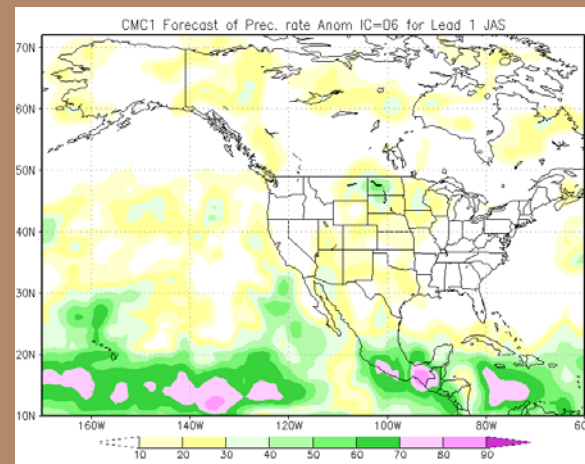
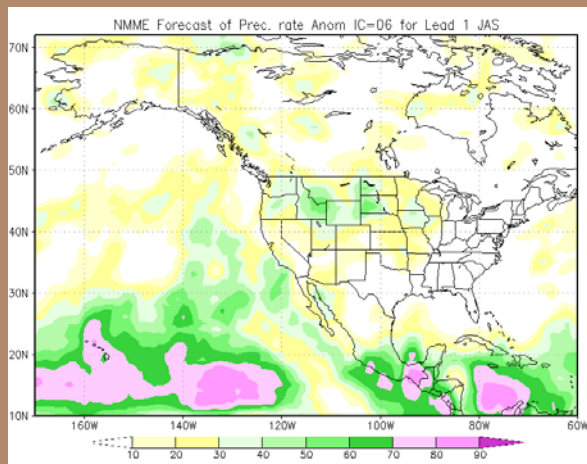
Precipitation Forecasts for July, August & September (JAS)



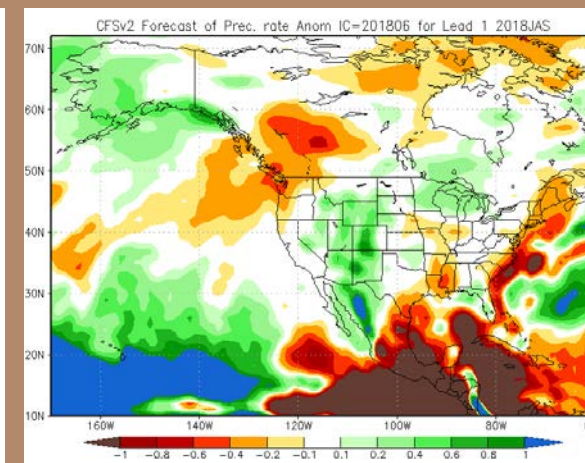
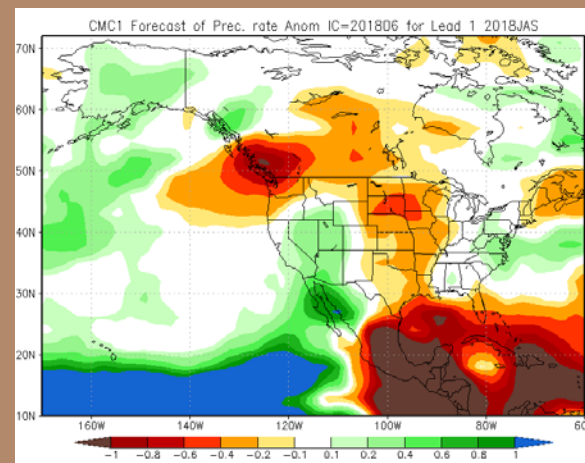
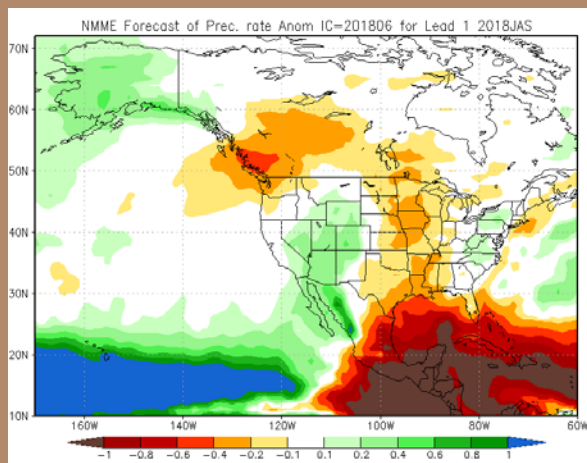
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Skill



Precipitation rate anomaly forecast



Figures 11-16. Climate model precipitation rate anomaly plots from the three climate models which have the highest skill percentages (top images), the North American Multi-Model Ensemble (NMME), Canadian Meteorology Center (CMCI) and the Coupled Forecast System (CFSv2) models. All three model forecasts (bottom images) are forecasting near to above average precipitation for July, August, and September (JAS) precipitation in New Mexico.

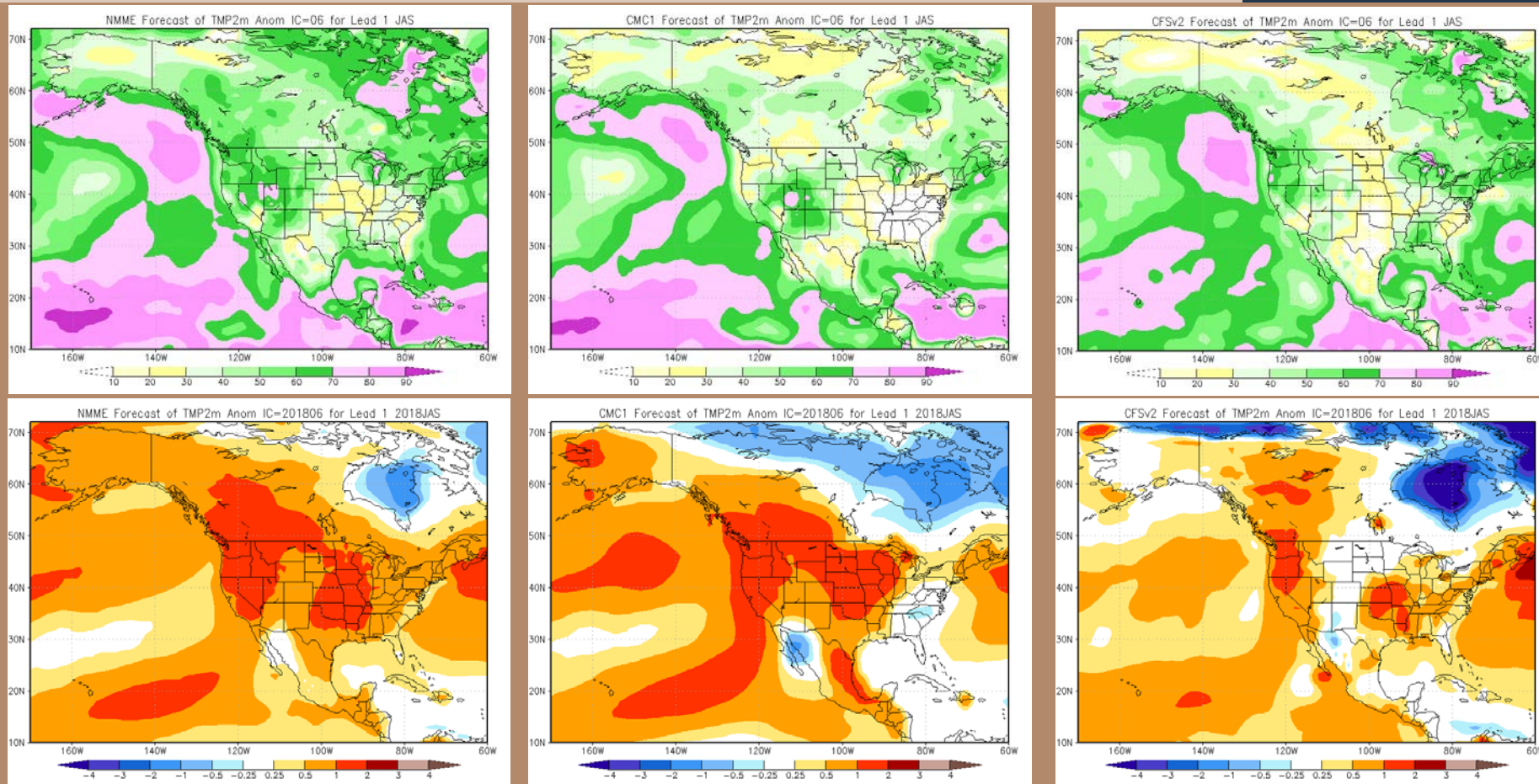
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Temperature



Figures 17-22. Climate model temperature anomaly plots from the three climate models which have the highest skill percentages (top images), the North American Multi-Model Ensemble (NMME), Canadian Meteorology Center (CMCI) and the Coupled Forecast System (CFSv2) models. Model forecasts (bottom images) indicate near to slightly above average temperatures in JAS. Keep in mind the NMME output is from a group/ensemble of model runs while the CMCI and CFSv2 are single runs. Typically, single model runs will show greater precipitation and temperature extremes.

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Early Onset?

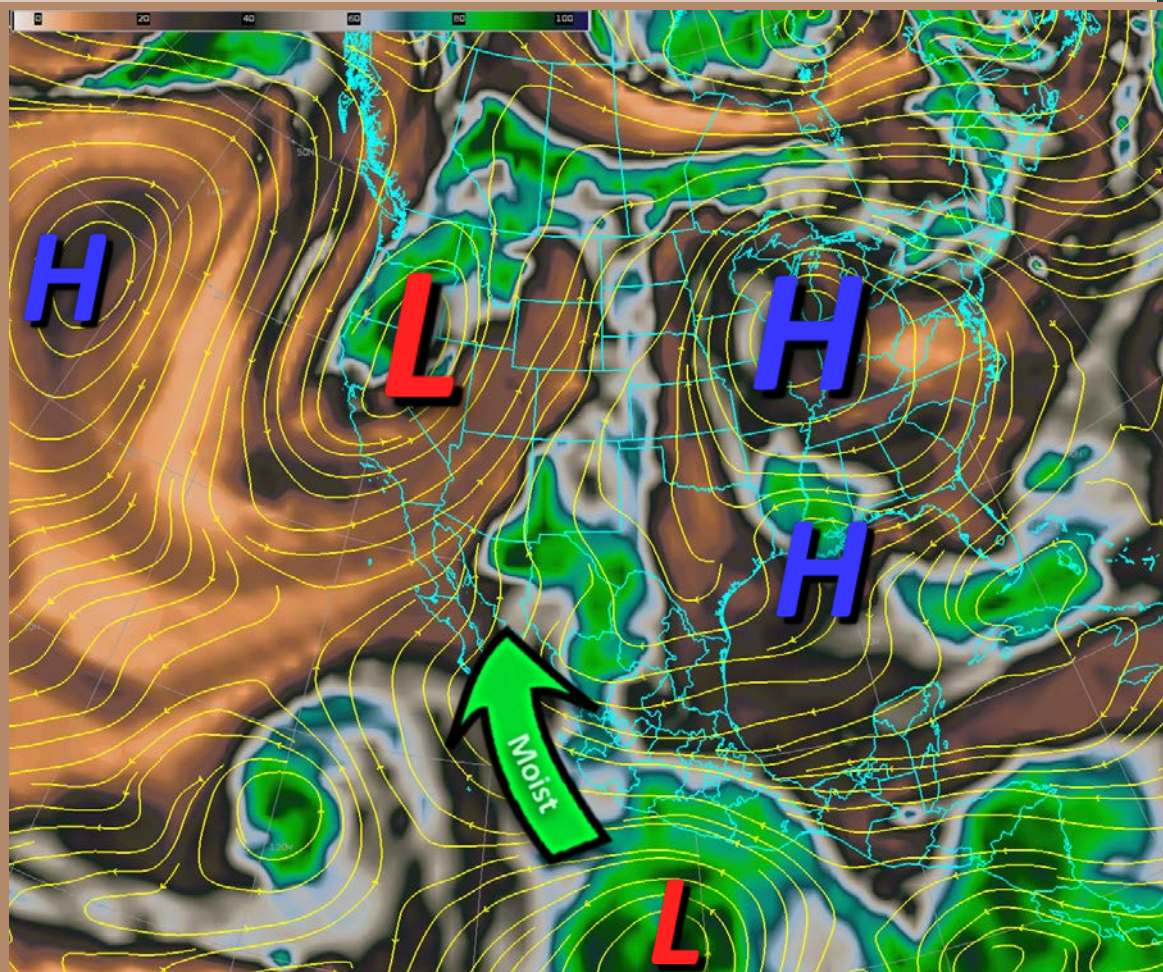


Figure 23. Forecast of streamlines and relative humidity at 500 mb (around 18,000 ft MSL) for Saturday June 30, 2018. Latest numerical weather prediction models are indicating a slightly early monsoon onset late next week. Arguably, southerly flow aloft and the remnants of Tropical Storm Bud was the start to the NAM but the upper-level westerlies quickly returned to the state. The “real” onset appears to be what’s coming late next week.

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ENSO Predictions



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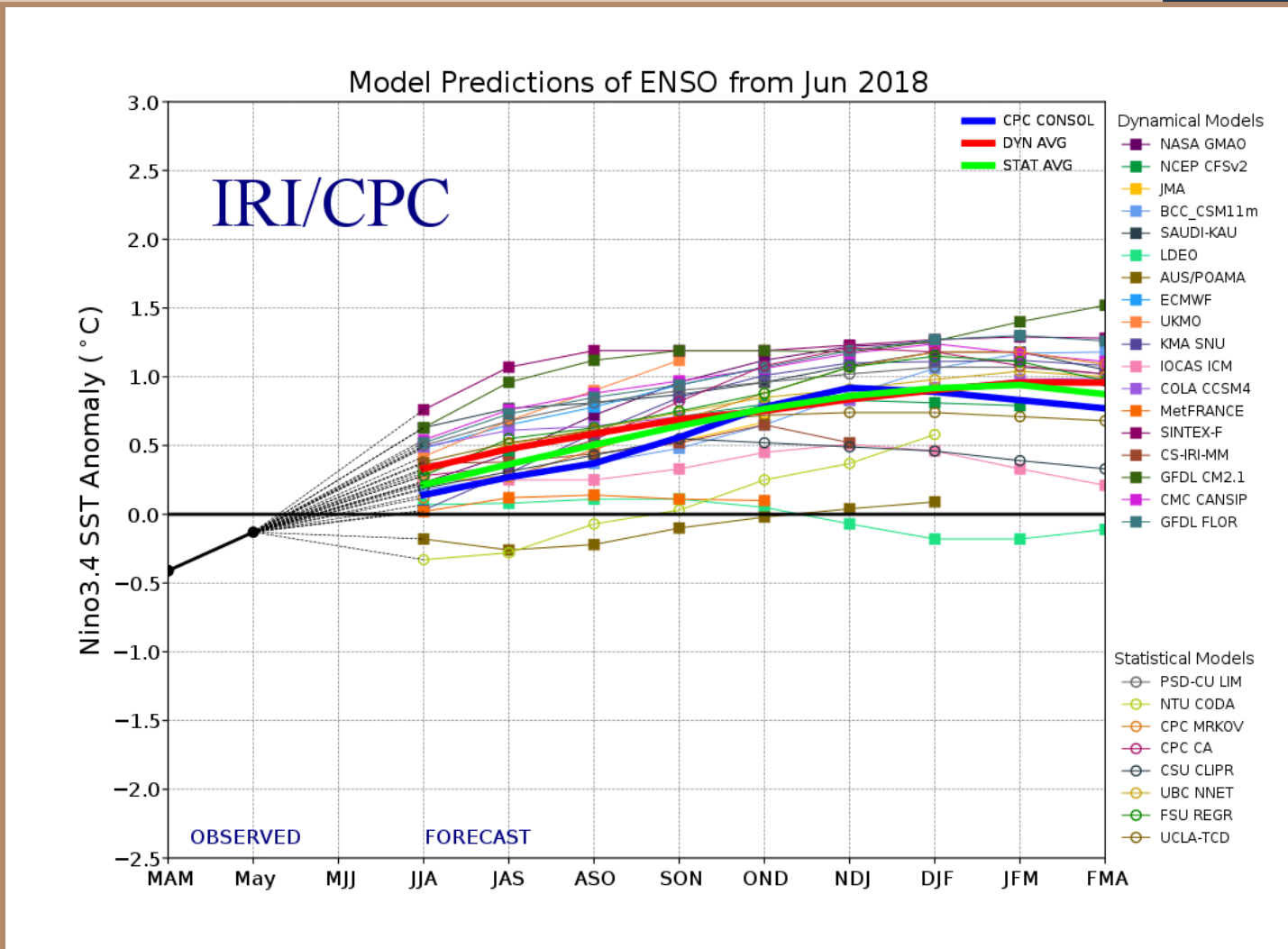


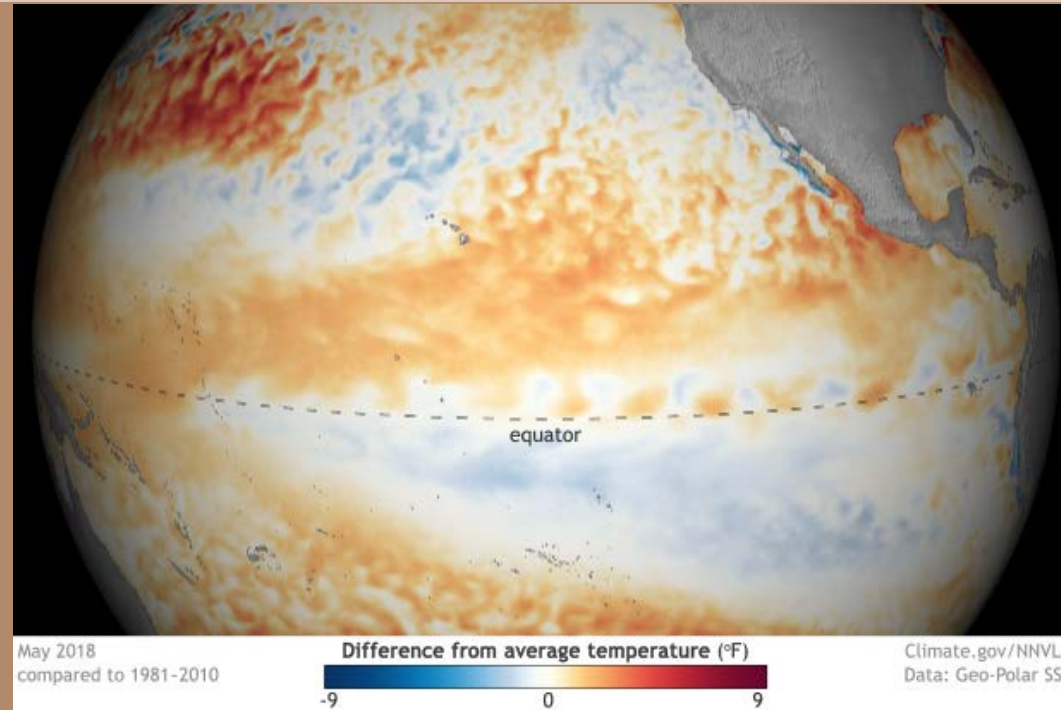
Figure 24. The vast majority of climate models predict ENSO-neutral conditions through summer 2018, with an increased chance of El Niño by fall/winter 2018.

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El Niño Watch is in Effect



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- Watch:** Issued when conditions are favorable for the development of El Niño or La Niña conditions within the next six months.
- Advisory:** Issued when El Niño or La Niña conditions are observed and expected to continue.
- Final advisory:** Issued after El Niño or La Niña conditions have ended.
- Not Active:** ENSO Alert System is not active. Neither El Niño nor La Niña are observed or expected in coming 6 months.

Figure 25. May 2018 sea surface temperature departure from the 1981-2010 average. Graphic by climate.gov; data from [NOAA's Environmental Visualization Lab](#). ENSO-neutral conditions are favored through Northern Hemisphere summer 2018, with the chance for El Niño rising to 50% during fall, and ~65% by winter 2018-19.

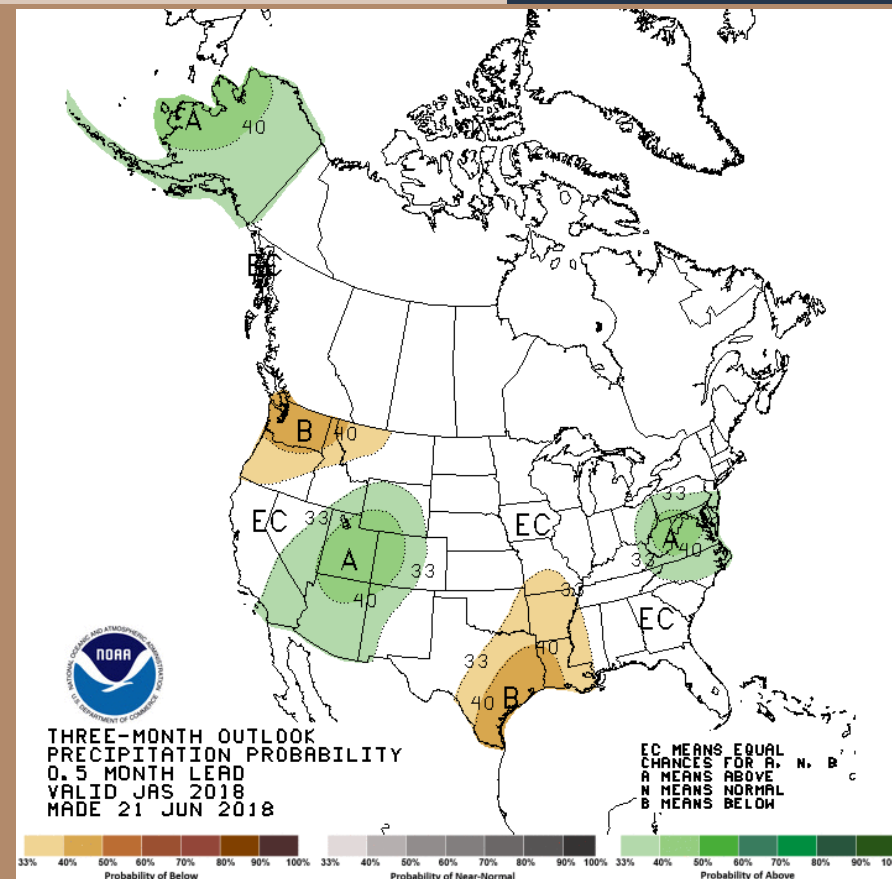
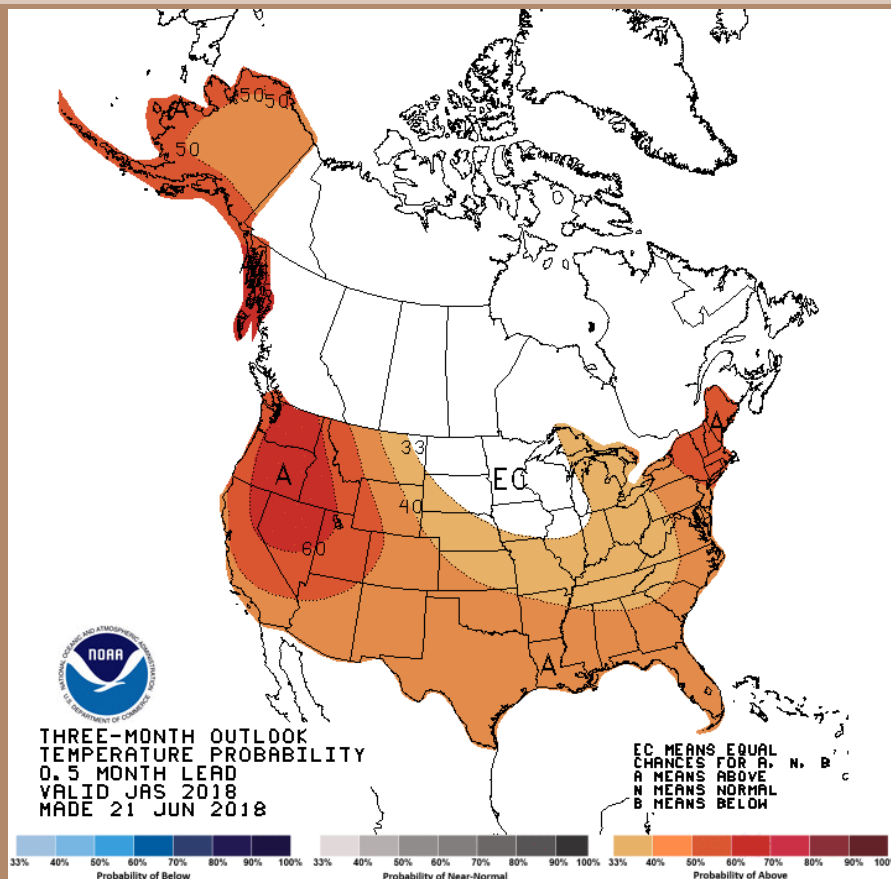
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Figures 26 & 27. CPC agrees with the climate model consensus of near to above average chances for above average precipitation, especially for western New Mexico. Generally speaking, above average thunderstorm activity would lead to high temperatures near to slightly below average with low temperatures near to above average given higher dew point temperatures and increased cloud cover. It's worth noting that below average summer temperatures in New Mexico are a rare occurrence these days. Since 2000, only four July through September periods have experienced slightly below average temperatures with the 13 remaining years above to well above the average statewide mean of 83.7°F.

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Summary

- Forecasts from the most highly skilled climate forecast models indicate that precipitation in central and northern New Mexico during July, August and September 2018 will most likely range from near to above 1981-2010 climatological averages.
- Climate model forecasts along with recent temperature trends indicate that temperatures in central and northern New Mexico during JAS 2018 will most likely range from near to slightly above average.



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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