2017 Spring Outlook for Central & Northern New Mexico

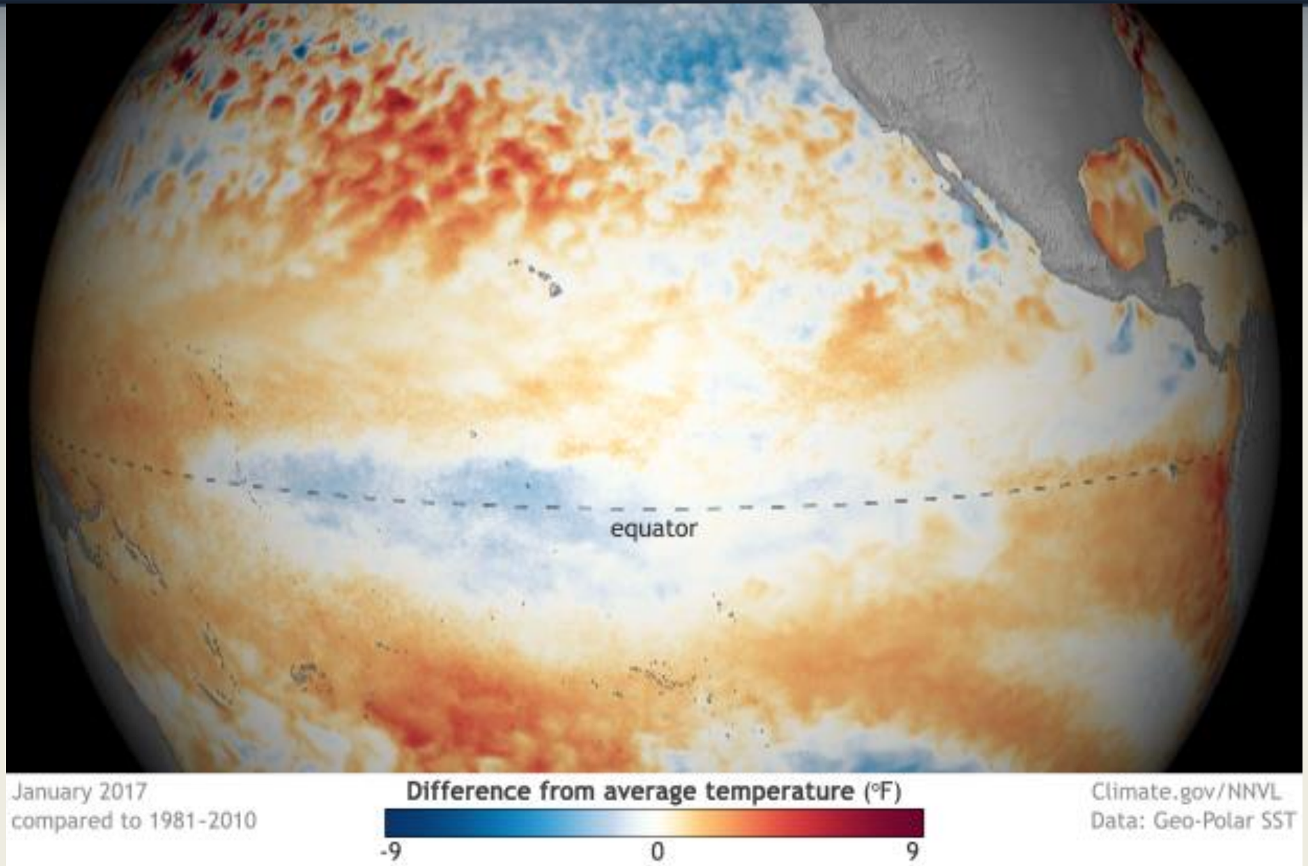


Figure 1. Colors on this map depict where and by how much monthly sea surface temperature differed from its 1981 to 2010 average. This high-resolution map is based on a dataset that combines on site measurements with near-real-time satellite observations. What does it show? La Niña has ended and the equatorial Pacific is warming up. Will the warming trend continue into meteorological spring (March, April, and May (MAM))?

Latest Sea Surface Temperature Observations & Oscillation Index Values

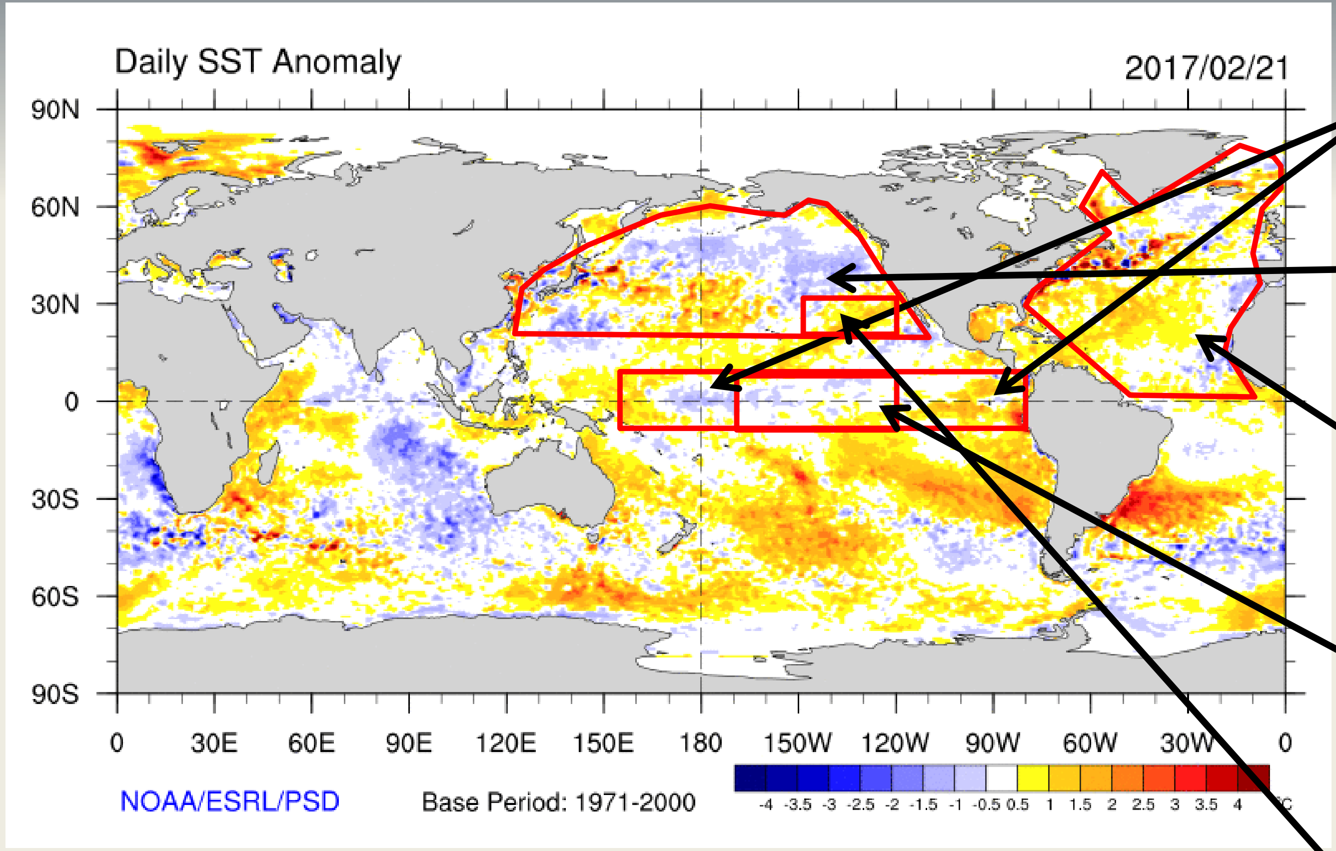
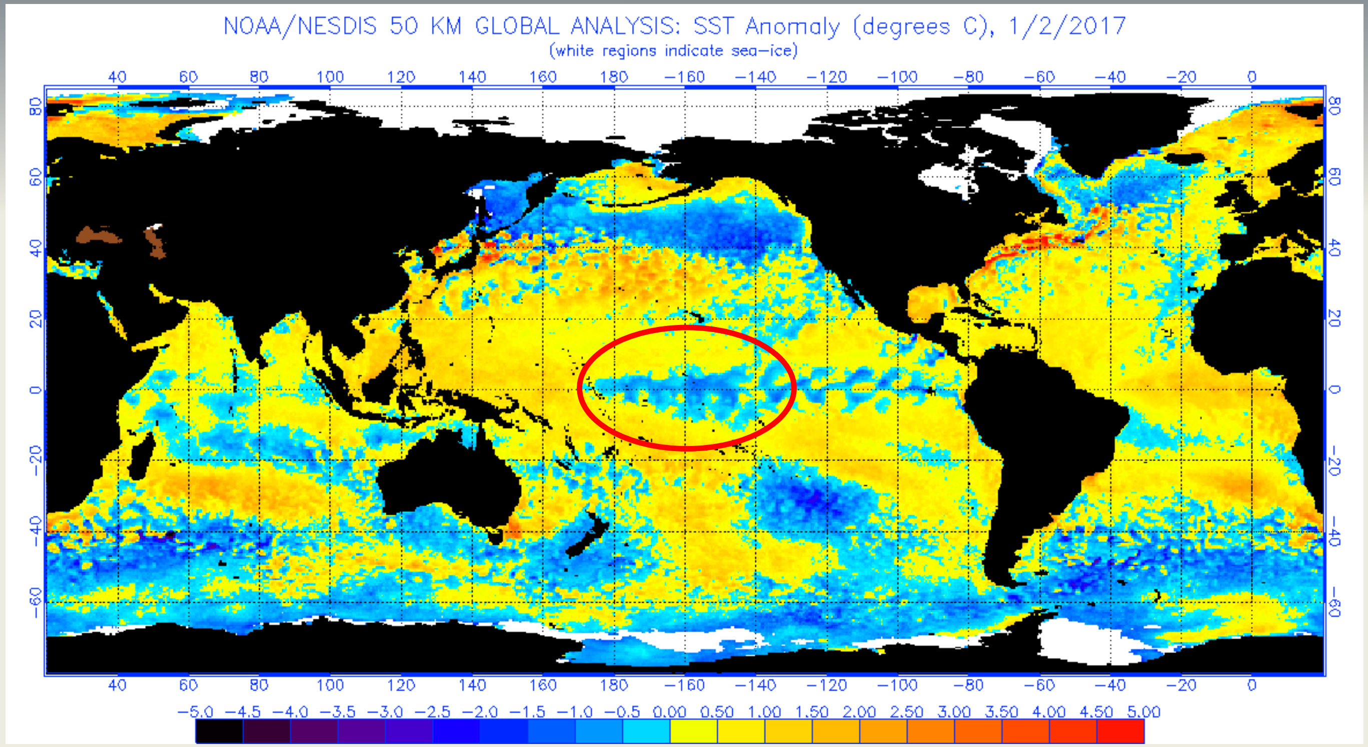


Figure 2. SST Anomalies in the Equatorial Pacific Ocean in late February 2017 showing that a weak La Niña has ended.

- Multivariate ENSO Index (MEI) for DEC-JAN 2016-17: **-0.55**
- Pacific Decadal Oscillation (PDO) for JAN 2017: +**0.77**
- Atlantic Multidecadal Oscillation (AMO) for JAN 2016: +**0.23**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for NDJ 2016-17: **-0.7**
- Pacific Prime Meridional Mode (PMM) for JAN 2017: **+1.03**

Like the Strong El Niño of 2015-16, the Weak La Niña of 2016-17 was a Modoki



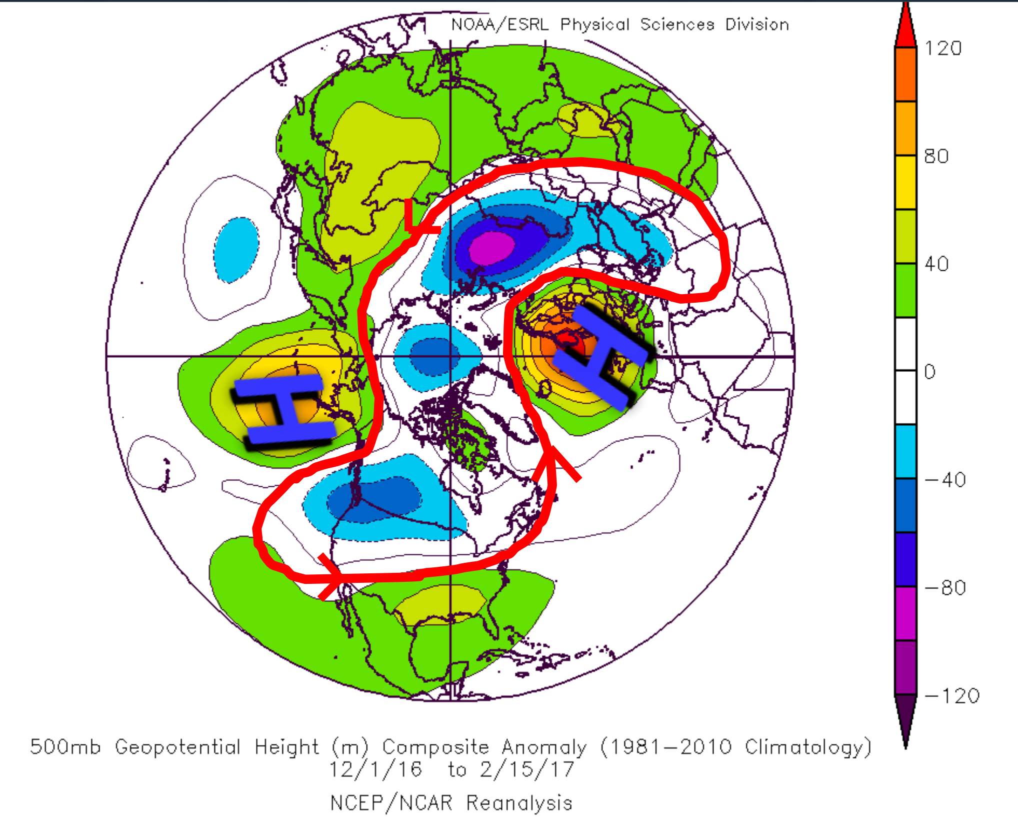


Figure 3-4. Global SSTAs (left) showing that the largest area of cooler than average waters in the equatorial Pacific was farther west than a traditional La Niña. A Modoki La Niña means that the largest area of cooler than average waters is shifted west toward the central Pacific as opposed to off the South American coast. Normally a slight shift like this does not make such a significant difference but throw in a positive PDO (which helps develop a stronger than average Aleutian Low) and a long-lived blocking ridge in the north Pacific and north Atlantic and voilá, an active storm track develops across the western U.S.

Comparing La Niña's of the Past with 2016-17

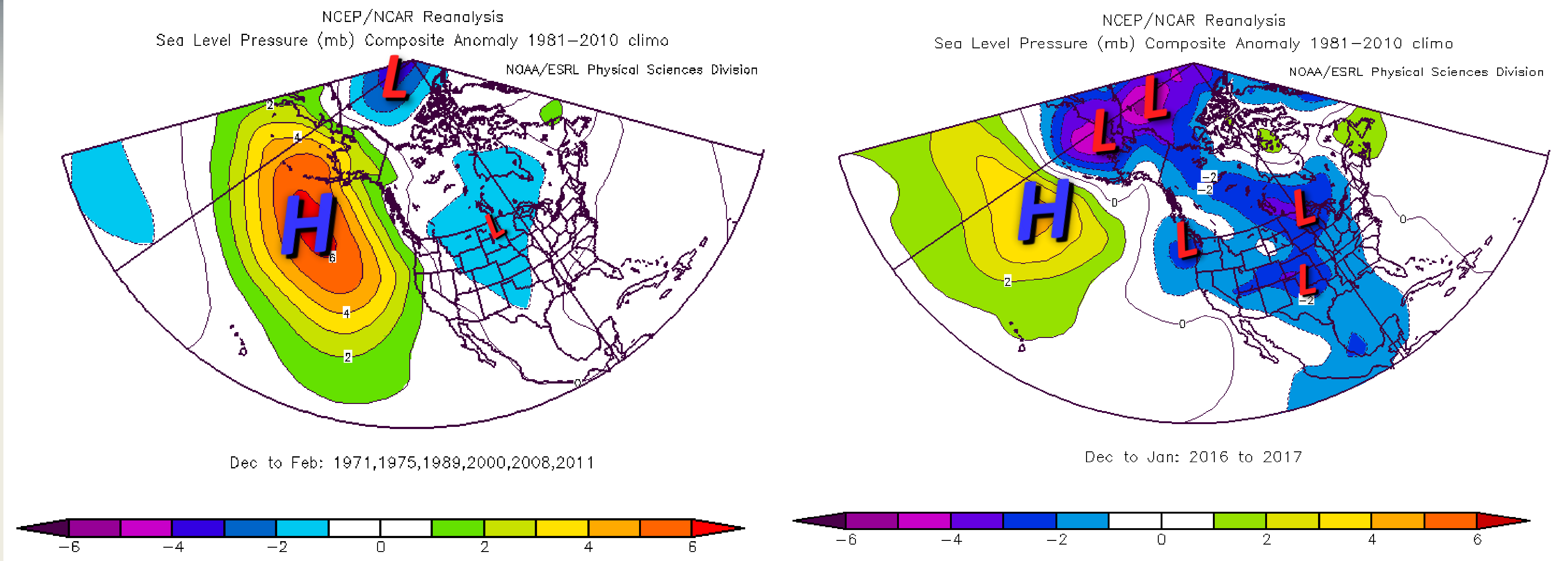


Figure 5-6. Sea Level Pressure (millibar) composite anomaly from six previous La Niña events (left) and 2016-17 (right). Note the major difference in the Aleutian Low strength in Bering Sea during this year's weak La Niña as well as the weaker surface high over the north-central Pacific compared with previous La Niña events.

Where Are We Now?

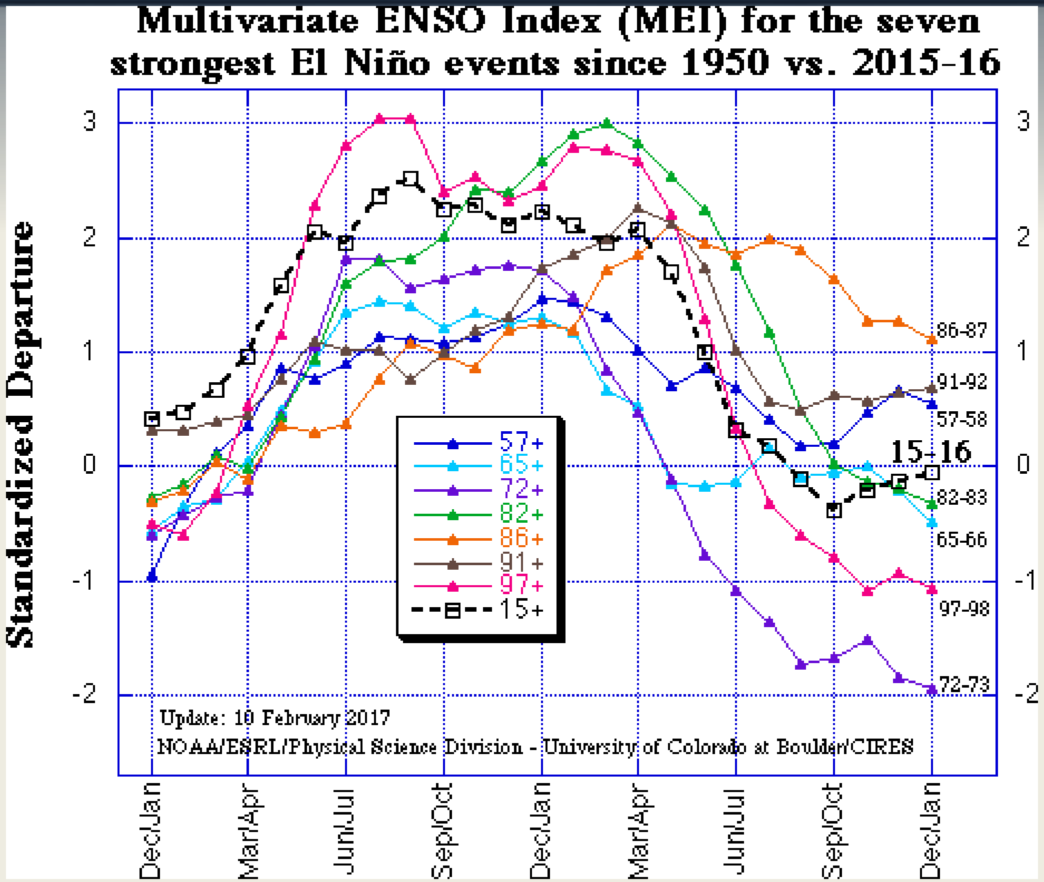
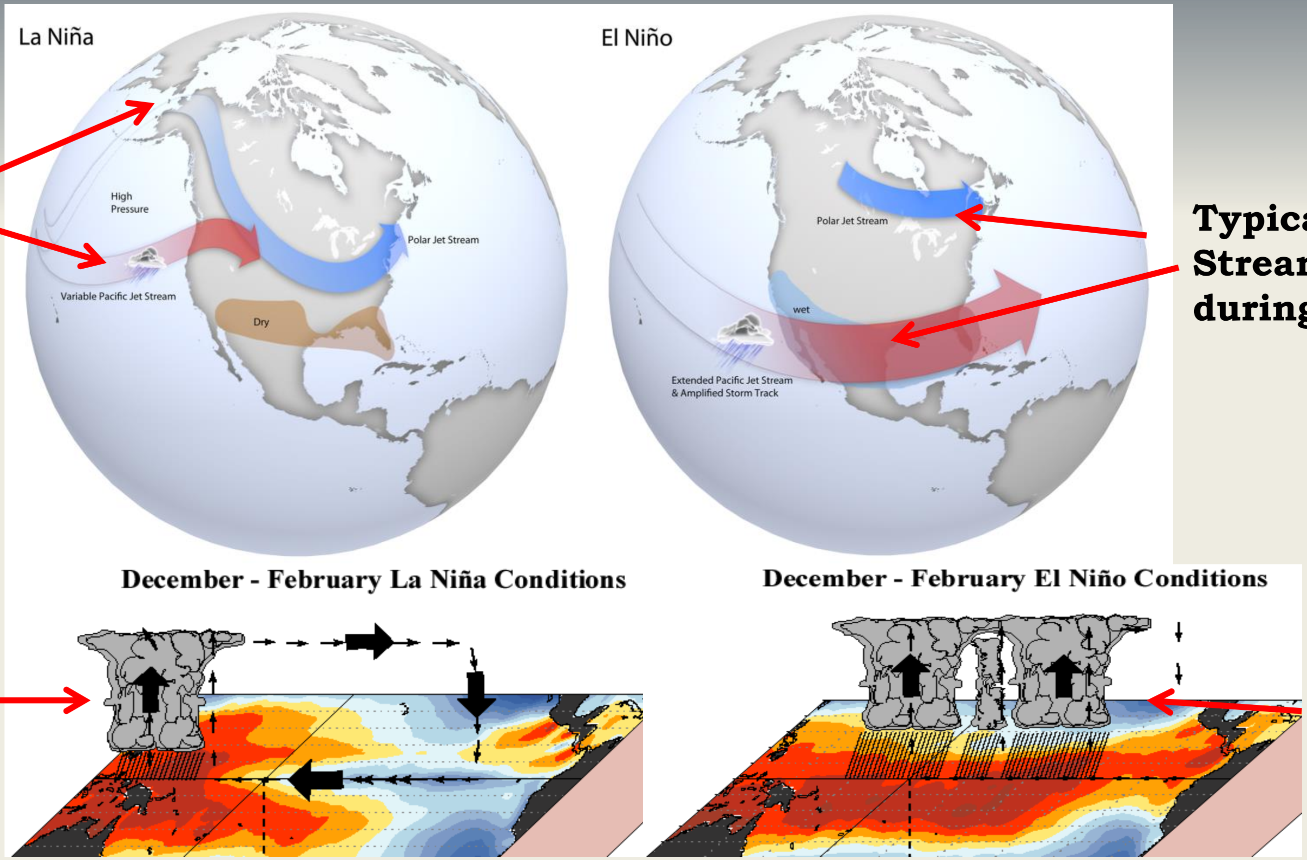


Figure 7. Seven strongest El Niño events using the Multivariate El Niño Southern Oscillation Index since 1950. 2015-16 was cooling/trending similarly to 1997-98 event but in Sept/Oct 2016, the brakes were applied.

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



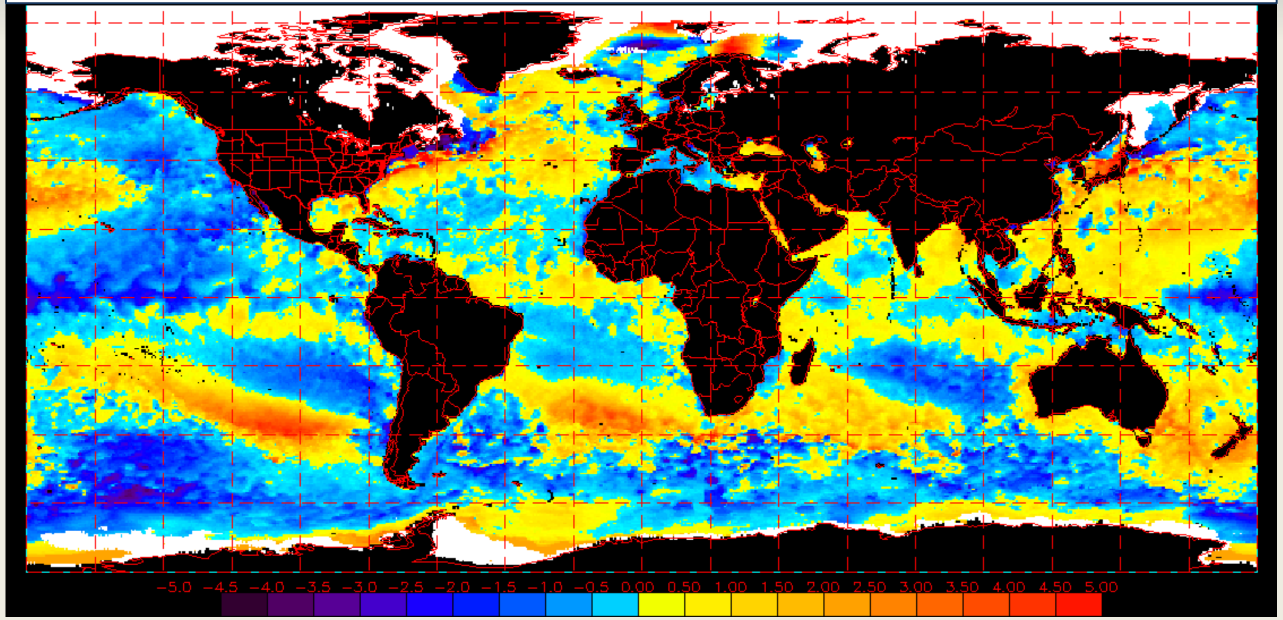
Typical Tropical circulations during La Niña (Walker Circulation)

Typical Tropical circulations during El Niño (Walker Circulation)

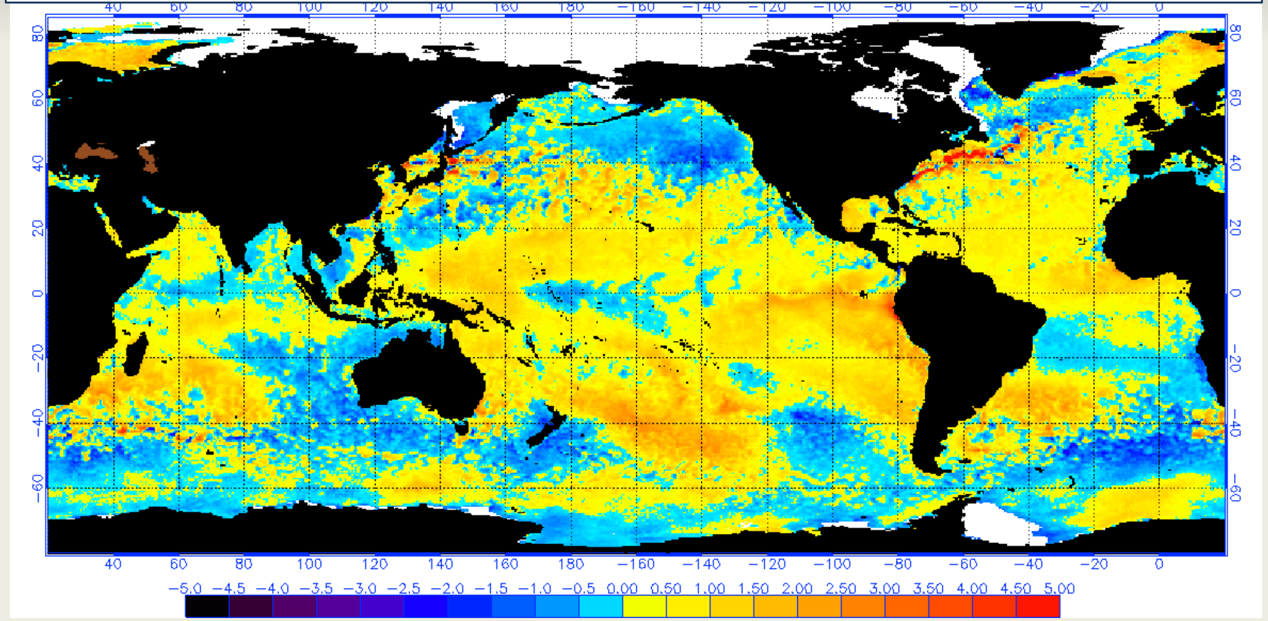
Figure 8. Warmer than average SSTs support stronger than average SST gradients across the Pacific Ocean and the resulting deep tropical and subtropical convection farther east than average. This deep convection allows the jet stream to penetrate farther east and southward into the far eastern Pacific Ocean and western United States. The jet stream is the result of large temperature differences between tropical and subtropical convection and much colder air aloft toward the poles. In other words, more deep convection farther east in the Pacific Ocean Basin typically equates to greater chances that the jet stream/storm track will move over New Mexico. Is the atmosphere's response to this changing

Comparing early February 1998 Global SSTAs to early February 2017

Global SSTA's 2/20/1999



Global SSTA's 2/20/2017



Figures 9-10. SSTAs from February1999, and current conditions. Note the stark differences between SSTA in the Pacific in 1999 compared with 2017. SSTA patterns in the world's oceans during early 2017 are unlike past weak La Niña or 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 and temperature during the past several years. Also note the map projection difference.

Pacific Meridional Mode (PMM)

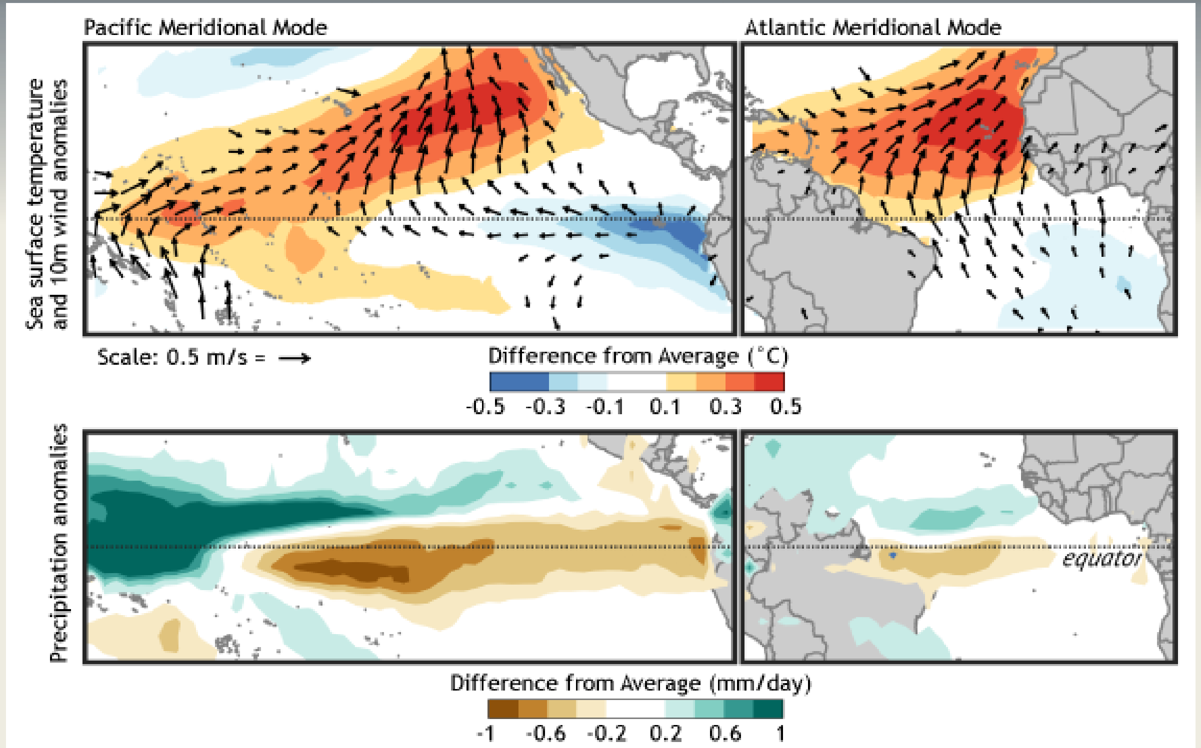


Figure 11. Tropical patterns associated with the positive state of the Pacific (left) and Atlantic (right) Meridional Modes (MM). The top panels show SST anomalies (shading) and near-surface wind anomalies (vectors), and the bottom panels show precipitation changes. Red (green) shading indicates above-average 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. The majority of El Niño events over the past four decades are preceded by an MM (Chiang and Vimont 2004, Chang et al., 2007).

PMM cont'd

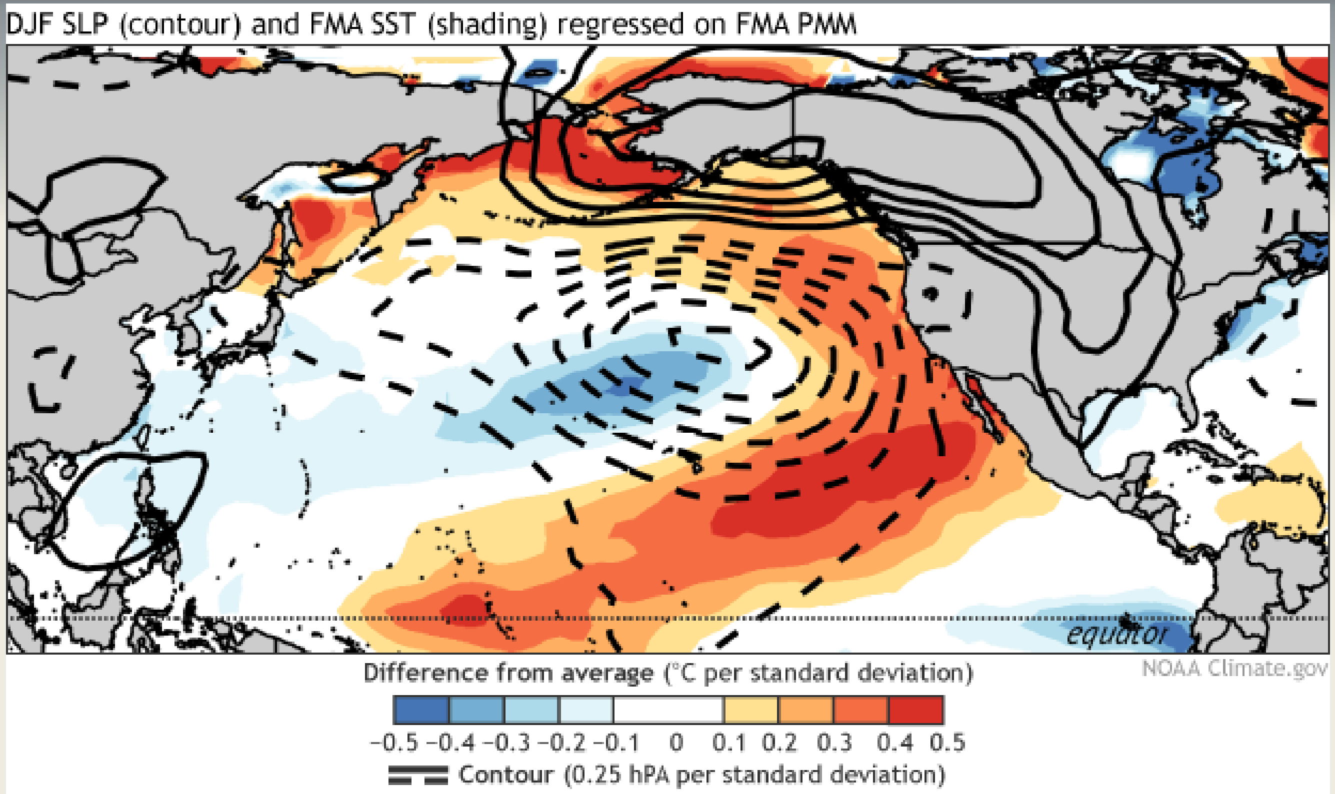


Figure 12. Early spring (February-April) sea surface temperature and winter (December-February) atmospheric circulation anomalies related to the positive state of the PMM during early spring. Dashed black contours reflect lower-than-average sea level pressure and solid black contours indicate higher-than-average 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.

Pacific PMM Timeseries

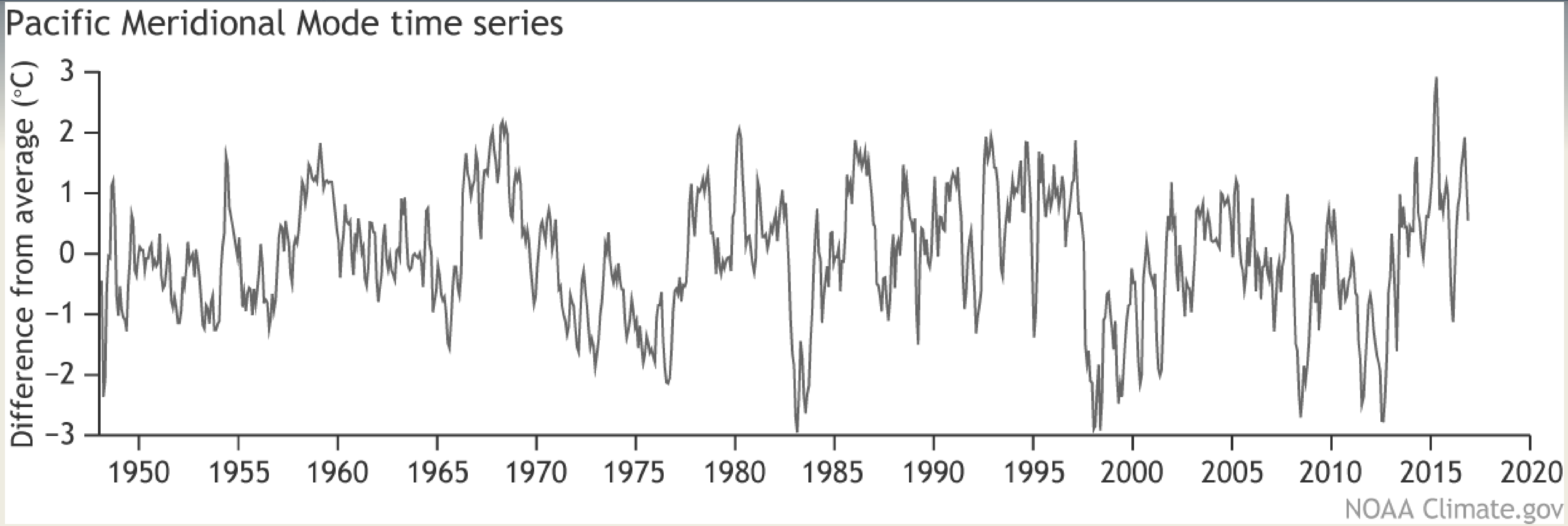
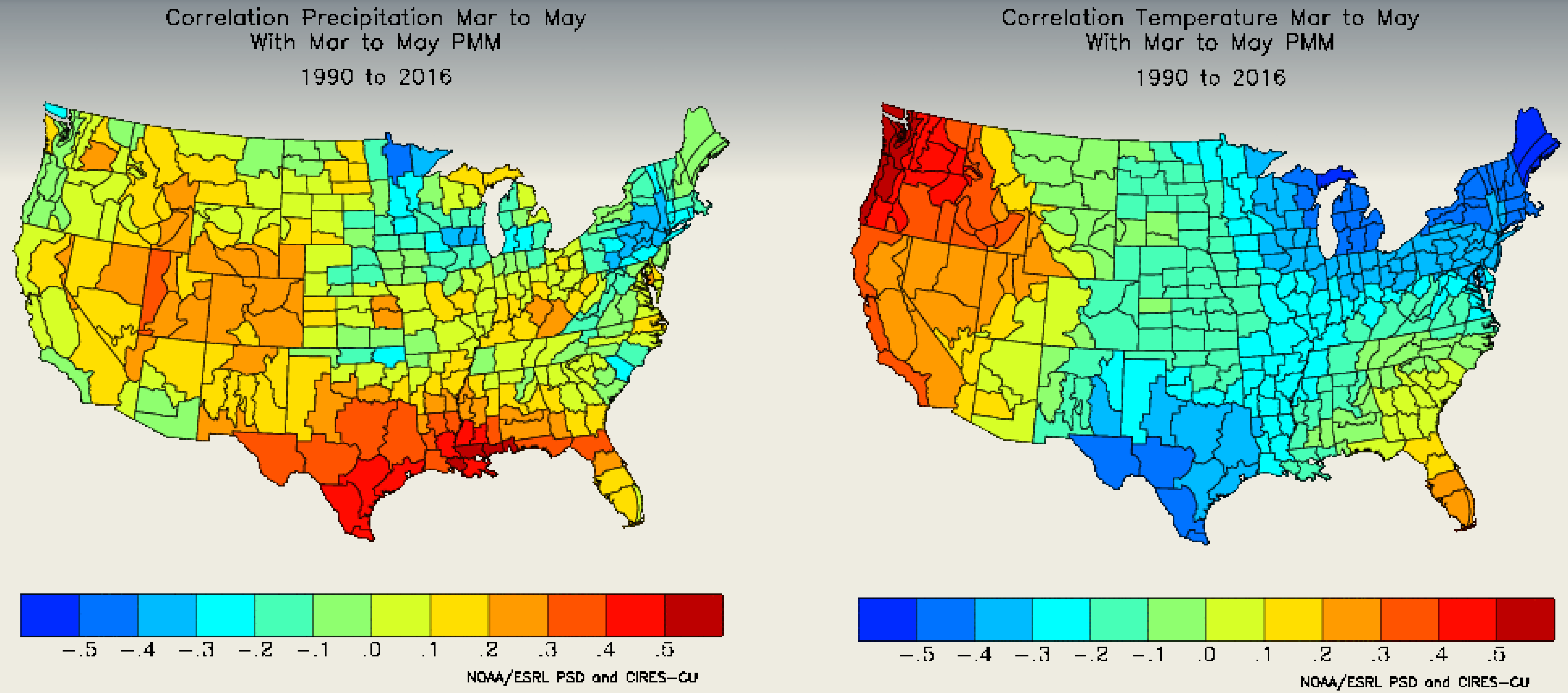


Figure 13. Time series of the PMM since 1945. The PMM links the mid-latitude atmospheric circulation to the equator, and the initiation and development of ENSO. Recent research has pointed out that this sequence of events tends to have a strong connection with the development of ENSO events that are 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 14-15. 1990-2016 MAM correlations of precipitation (left) and temperature (right) with PMM. When the PMM index is positive, as it is now, most of New Mexico stands a better-than-average shot at above average precipitation in MAM, particularly across the northern mountains and far southwest parts of the state. With regard to temperature, chances are better than average in MAM that most of the state stands to be cooler than average, particularly across the eastern plains.

NMME Spring SST Forecast

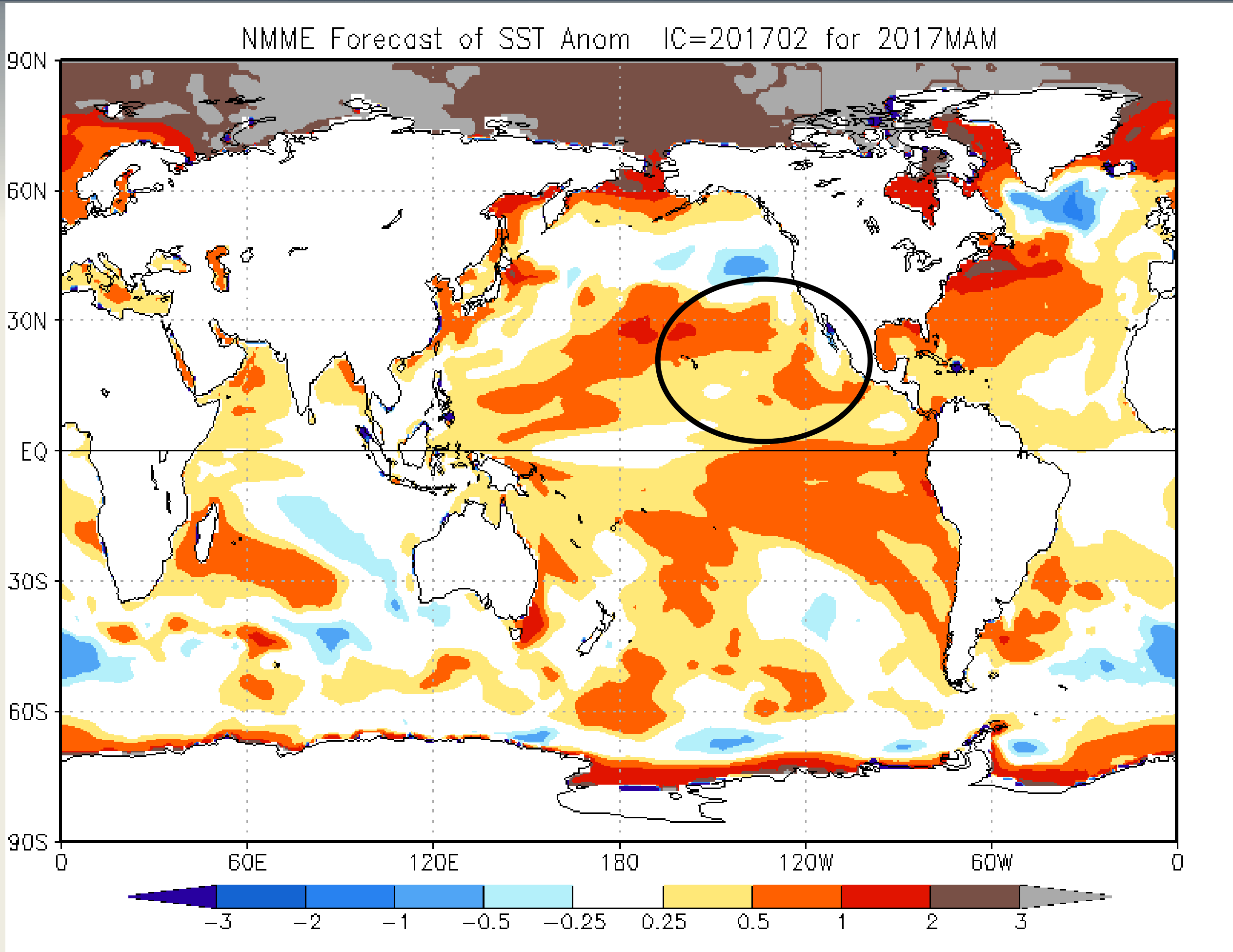


Figure 16. NMME SST forecast for MAM 2017. PMM is forecast to remain positive as the equatorial Pacific warms up.

Madden-Julian Oscillation (MJO)

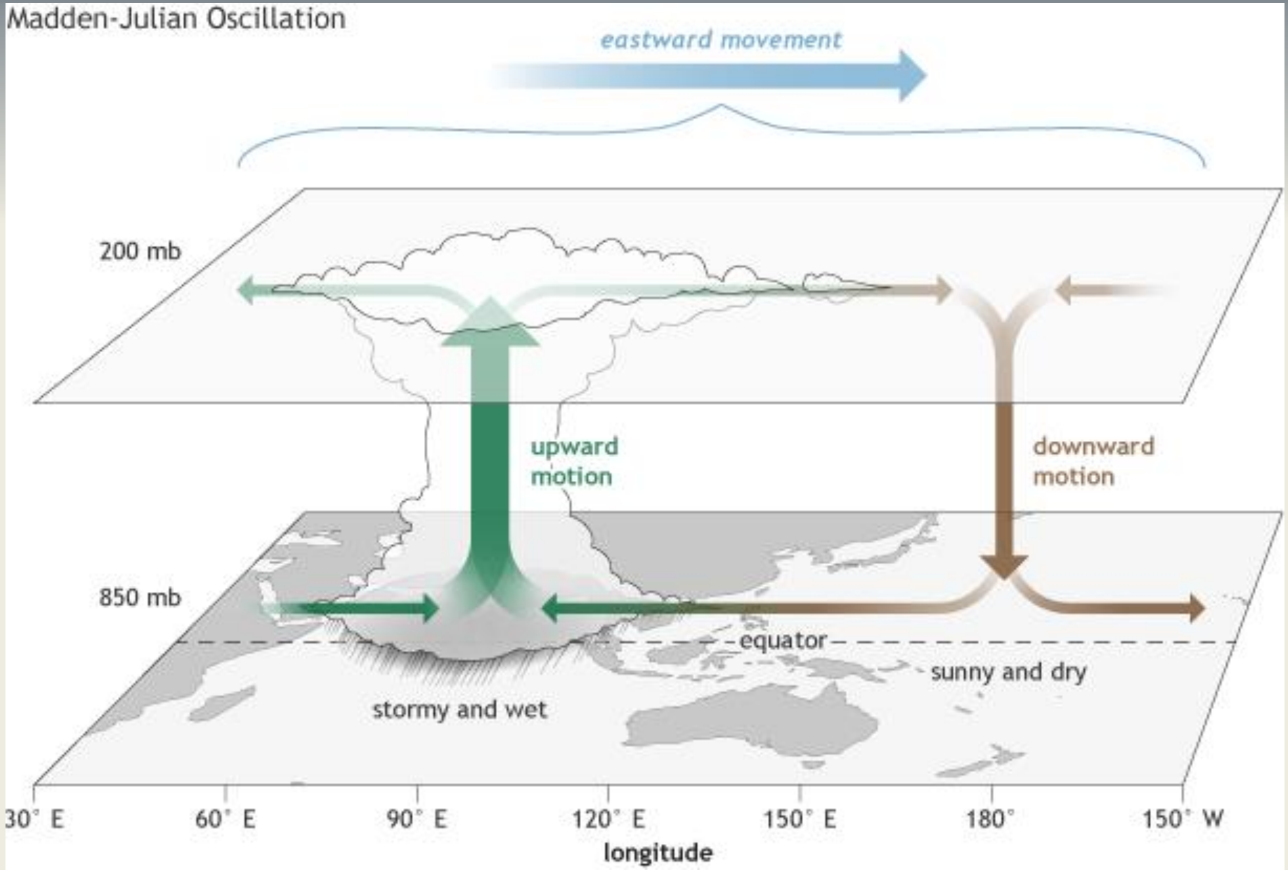


Figure 17. The MJO is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the rising air in the stormy area causes surface winds to blow toward the active area.

Why the MJO is So Important

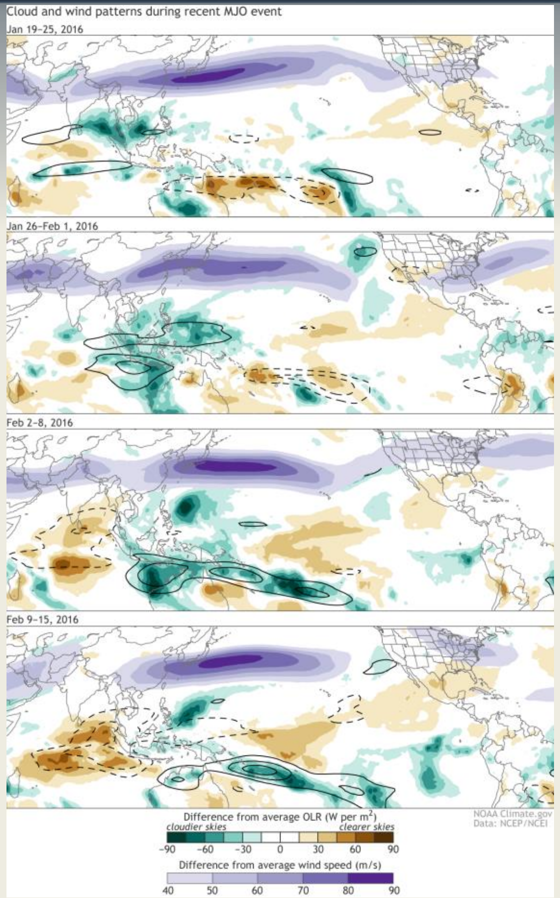
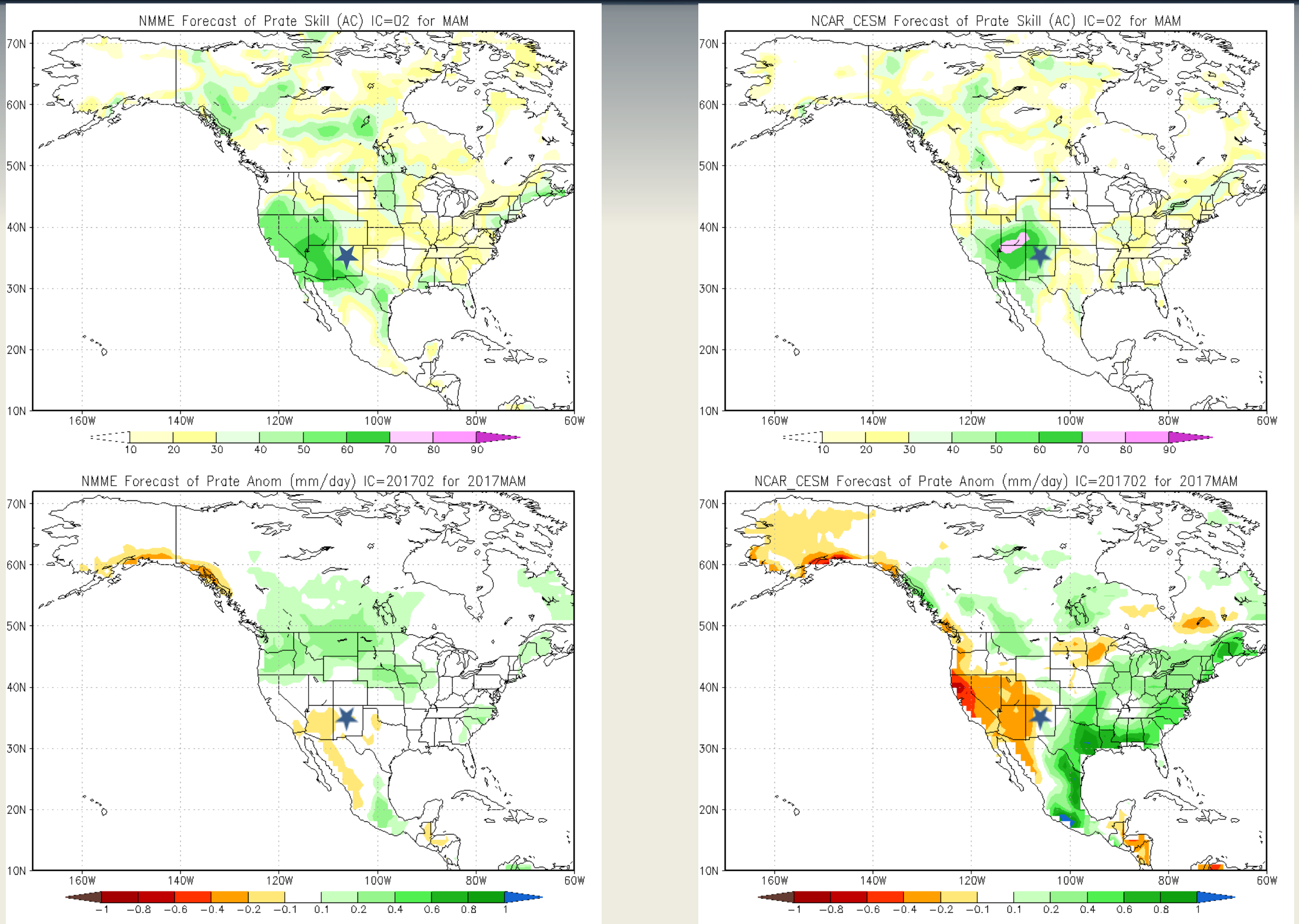


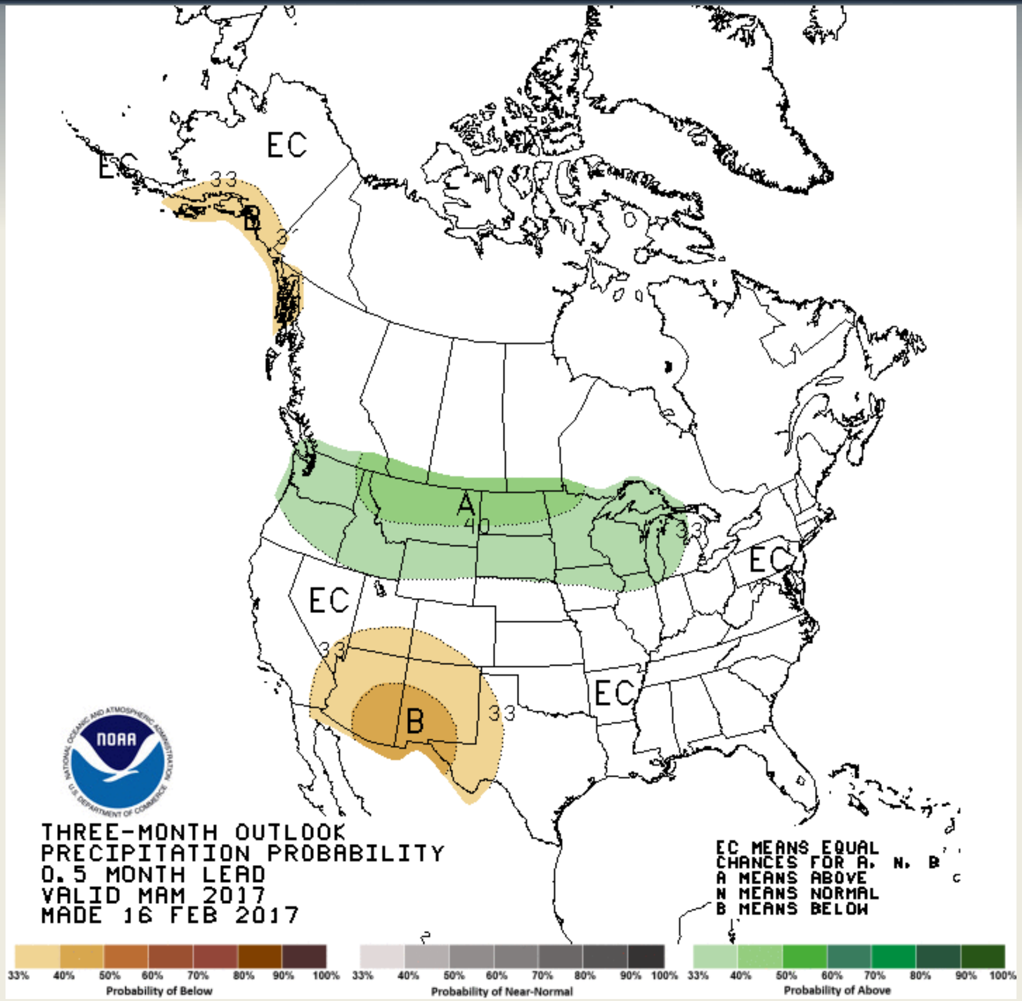
Figure 18. Clouds and wind patterns for the MJO event that occurred from late-January to mid-February 2017. Black contours highlight the OLR (outgoing longwave radiation, or heat energy) signals directly associated with the MJO. The MJO also affects the jet stream over the United States. When the MJO is over the Maritime Continent, 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. 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 and the West Pacific during the latter half of March 2017.

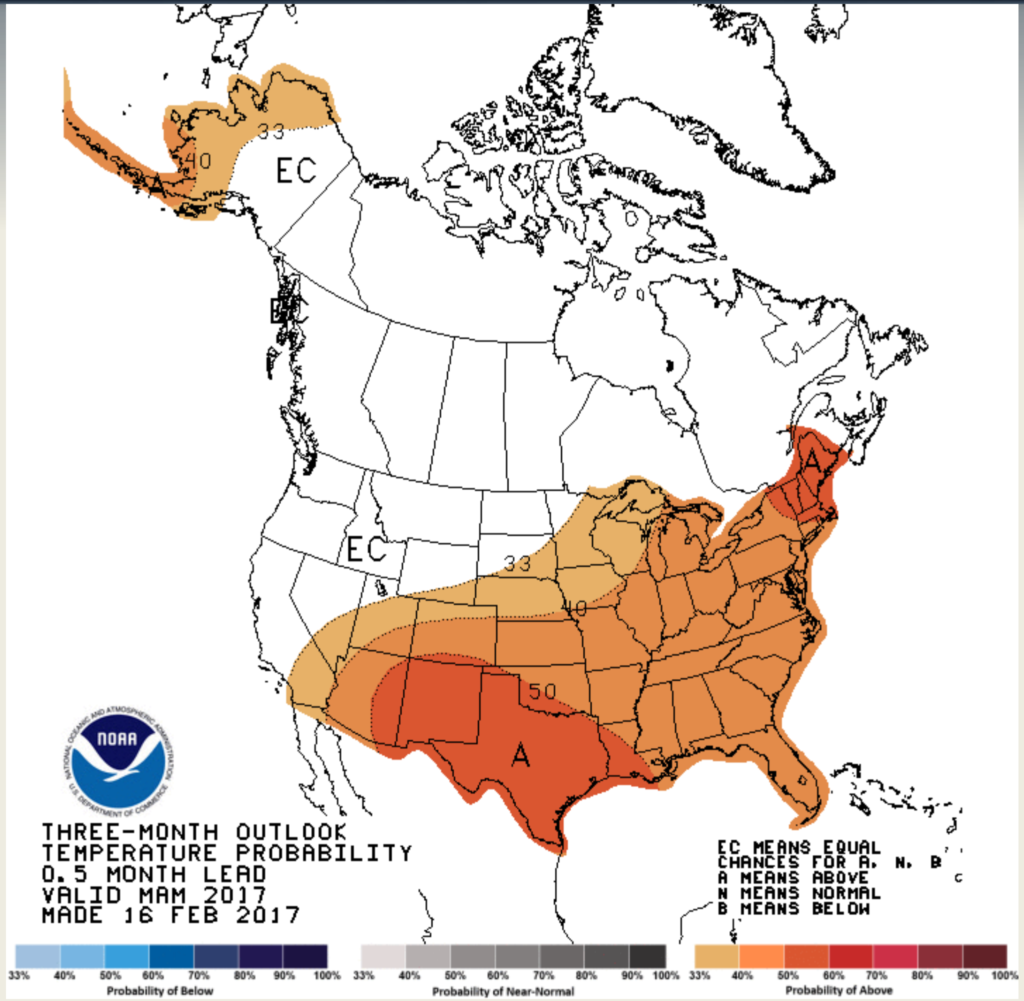
MAM Climate Models



Figures 19-22. Climate 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 NCAR CESM models. Both model forecasts are near average for MAM with the NCAR model below average across far western NM.

Climate Prediction Center's Official MAM Outlook





Figures 23-24. CPC's MAM 2017 precipitation and temperature forecasts favoring below average precipitation and greater than average chances for temperatures to be above average across New Mexico.

How About Wind?

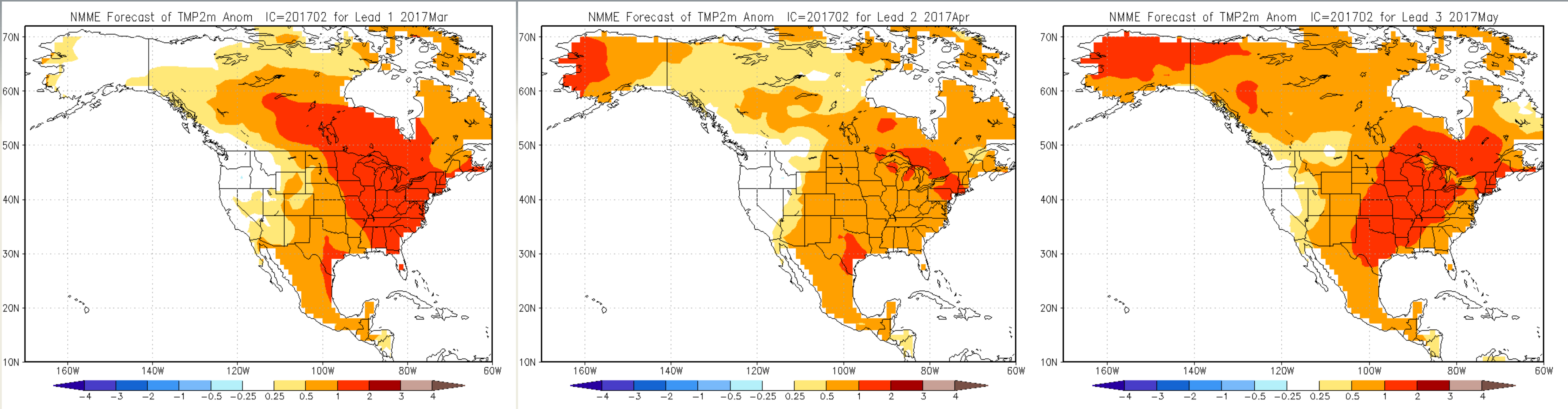


Figure 25-27. Monthly temperature forecast anomalies from the NMME in MAM. With analog seasons becoming less applicable, spring wind forecasts are challenging. Temperature anomaly forecasts from the NMME give some insight to what this global model ensemble is forecasting during MAM. It's apparent from this model that the active pattern across the western U.S. will likely continue into spring. An active storm track across the western U.S. would suggest that winds across northern and central NM could trend higher (or above) average this spring.

Majority of Climate Models Continue Warming SSTs

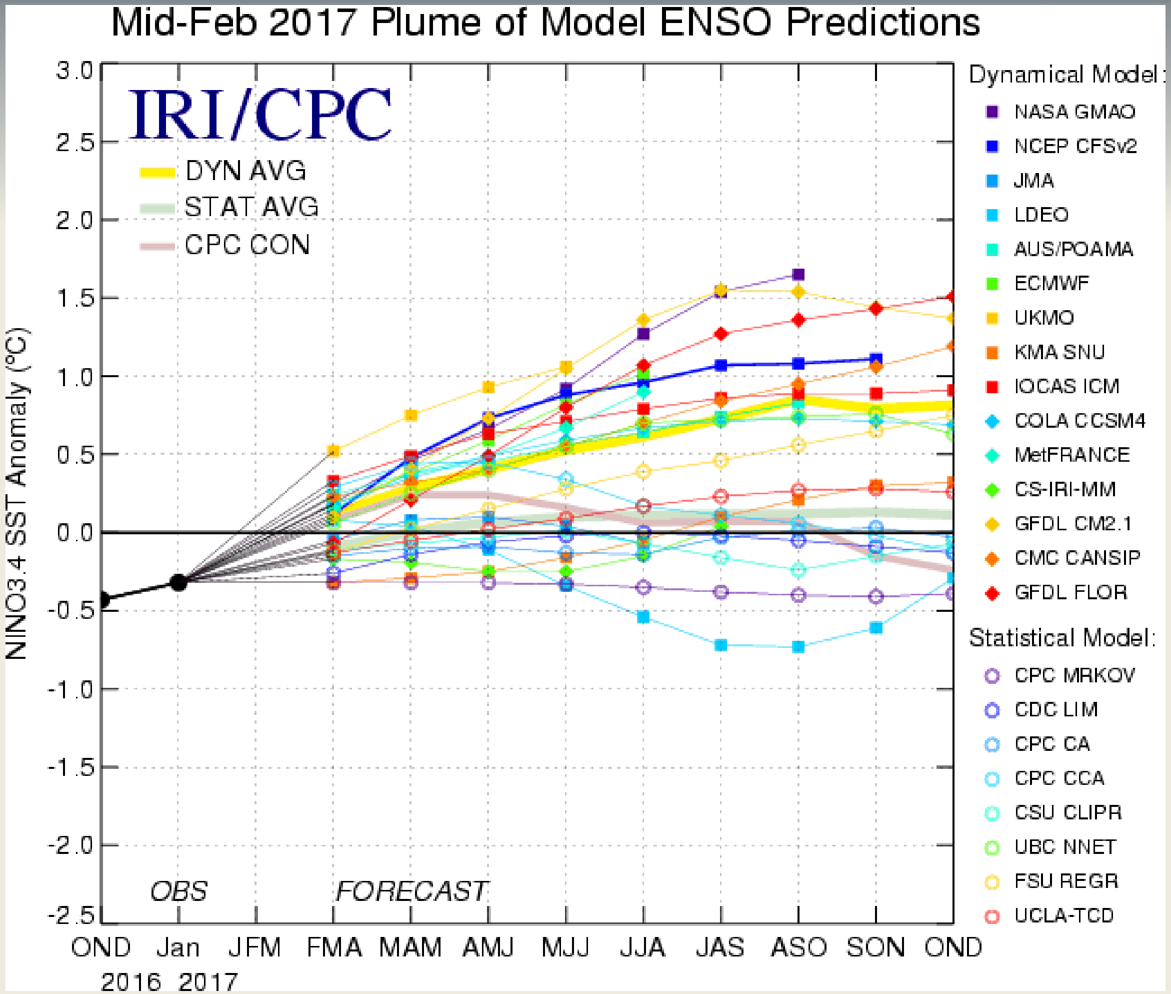


Figure 28. Surprisingly, most climate models bring the equatorial Pacific back into El Niño territory by early to mid summer.

Summary

- 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 March, April and May 2017 will most likely range from slightly below to near 1981-2010 climatological averages.

- Positive correlations with PMM and precipitation combined with climate model temperature and precipitation forecasts suggest that snowfall will be near to slightly below climatological averages in MAM 2017.

- 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 MAM 2017 will mostly 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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