2020-21 Winter Outlook

For Northern & Central New Mexico

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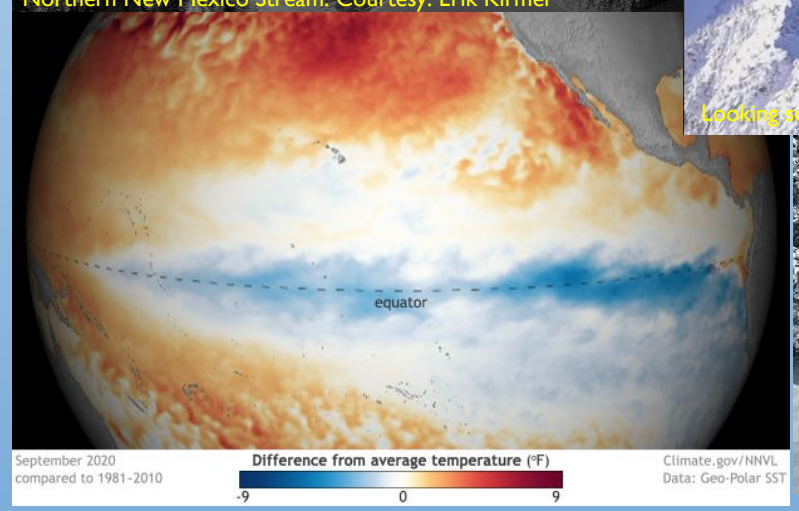
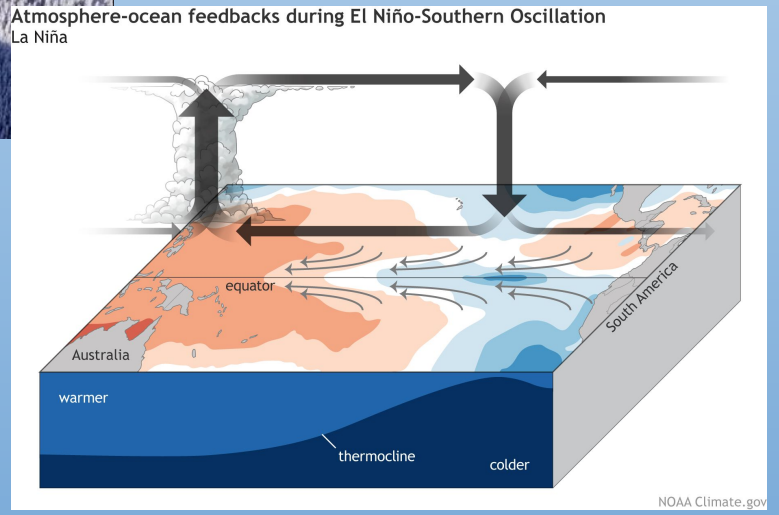
Northern New Mexico Stream. Courtesy: Erik Kirmer


Looking south at Trampas Lakes and Truchas Peaks. Courtesy: This American Land


View From Near Sandia Crest Looking Southeast Toward South Peak




Pajarito Mountain Glows With October Snow 10/27/20. L.A.Reporter



How will a strengthening La Niña, the cool phase of the El Niño-Southern Oscillation (ENSO) climate pattern, impact 2020-21 Winter precipitation and temperature in central and northern New Mexico? Will it be like traditional La Niñas of the past or more like the 2016 La Niña? Find out here in the 2020-21 meteorological winter outlook.

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Sea Surface Temperatures in mid October 2020

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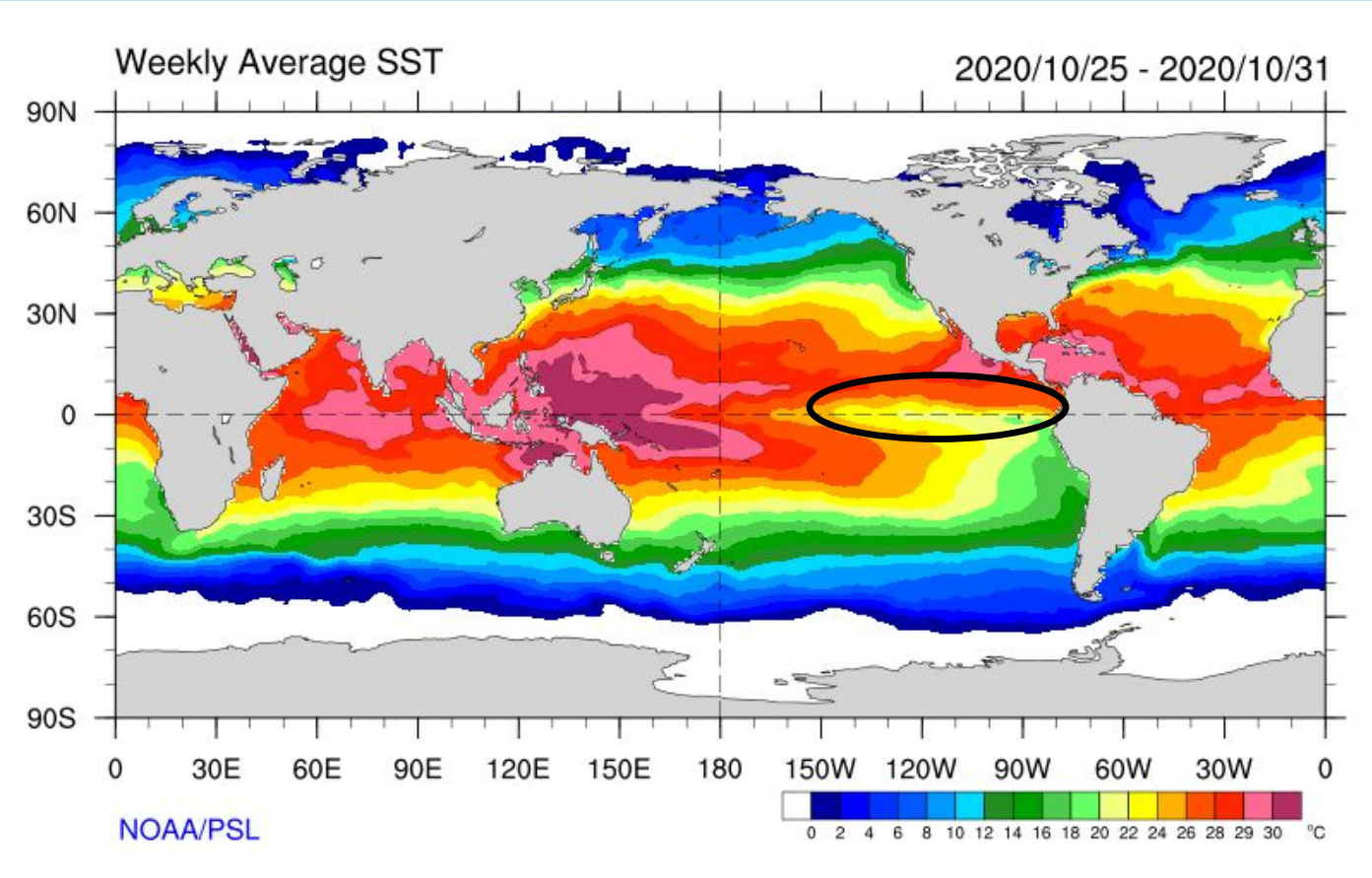

Figure 1. Global Sea Surface Temperatures (SSTs) from late September 2020. Instead of initially showing the typical temperature differences from average (next slide), these are the actual observed temperatures. What does it show? A significant temperature difference in the eastern equatorial Pacific Ocean. A weak La Niña is underway but there's a catch. The most recent La Niña analog (2016) showed that this gradient is sufficient to generate above average thunderstorm activity in the equatorial Pacific during winter (DJF). If this is the case again this year, near average precipitation may be possible this winter. Particularly for northern portions of the state.

2020-21 Winter Outlook

Weekly Sea Surface Temperature Observations & Oscillation Index Values

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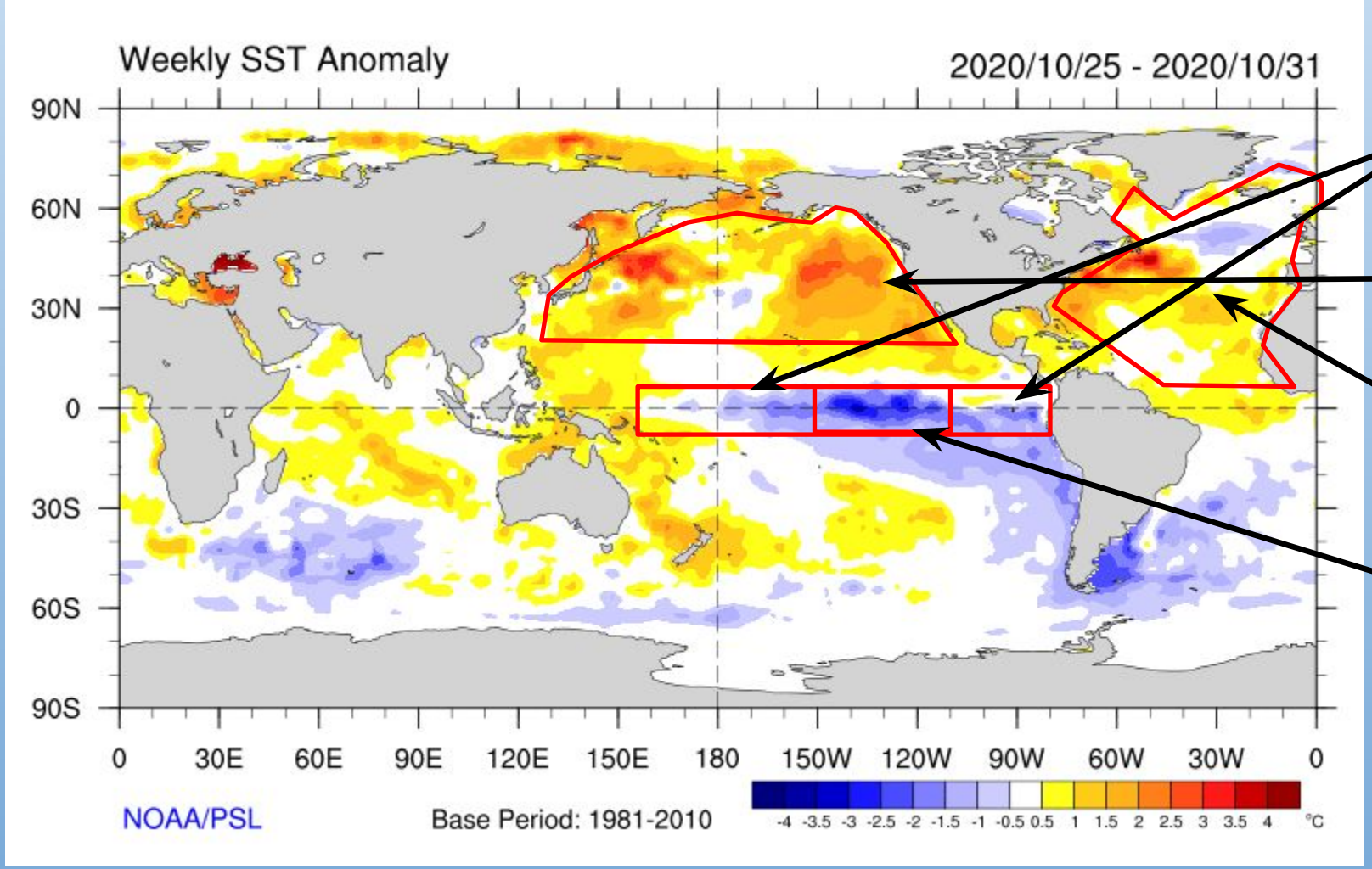

- Multivariate ENSO Index (MEI) for AUG_SEP 2020: **-1.2**
- Pacific Decadal Oscillation (PDO) for SEP 2020: **-0.70**
- Atlantic Multidecadal Oscillation (AMO) for SEP 2020: +**0.31**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for JAS 2020: **-0.6**

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

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Sub-Surface Temperature Departures in the Equatorial Pacific

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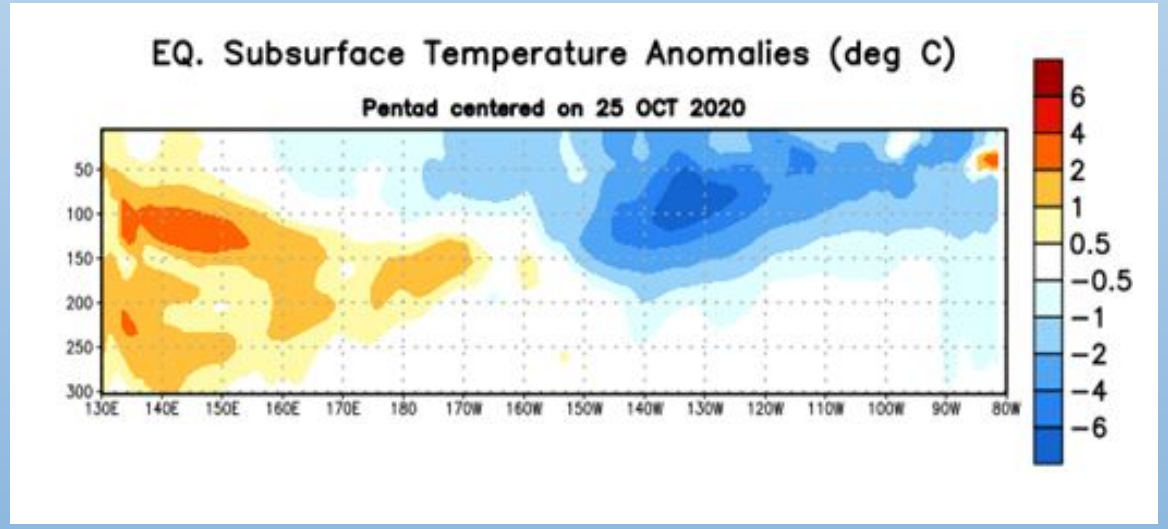

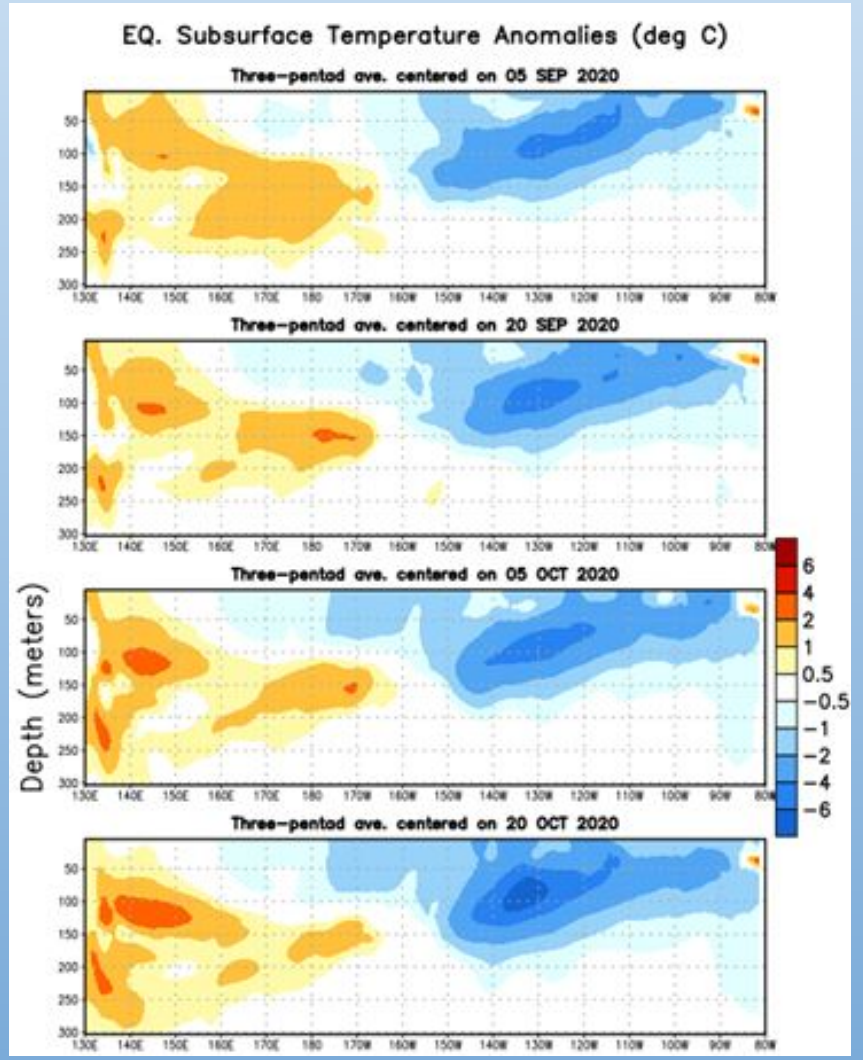

Figures 3-4. Since early September, negative subsurface temperature anomalies have continued to intensify in the central and eastern equatorial Pacific Ocean while positive subsurface temperature anomalies have strengthened in the western Pacific.

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Why SSTs in the Eastern Pacific Ocean Are So Important WRT to Climate

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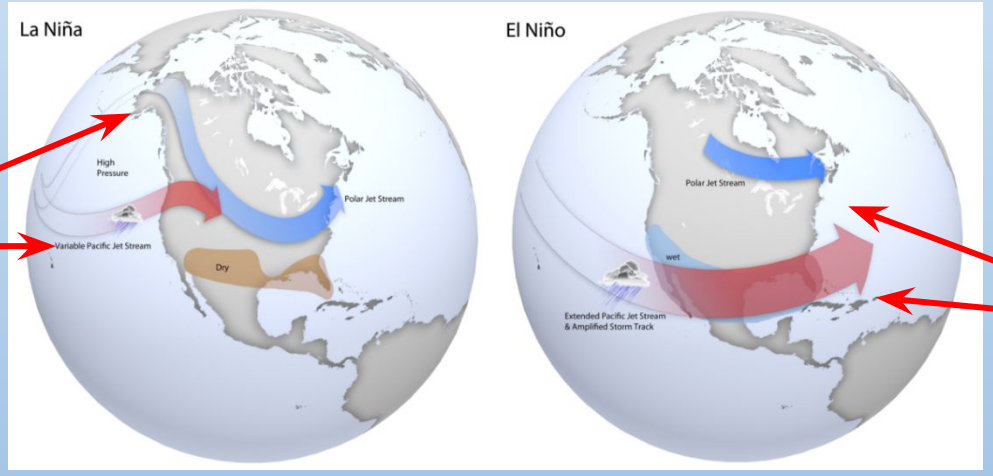
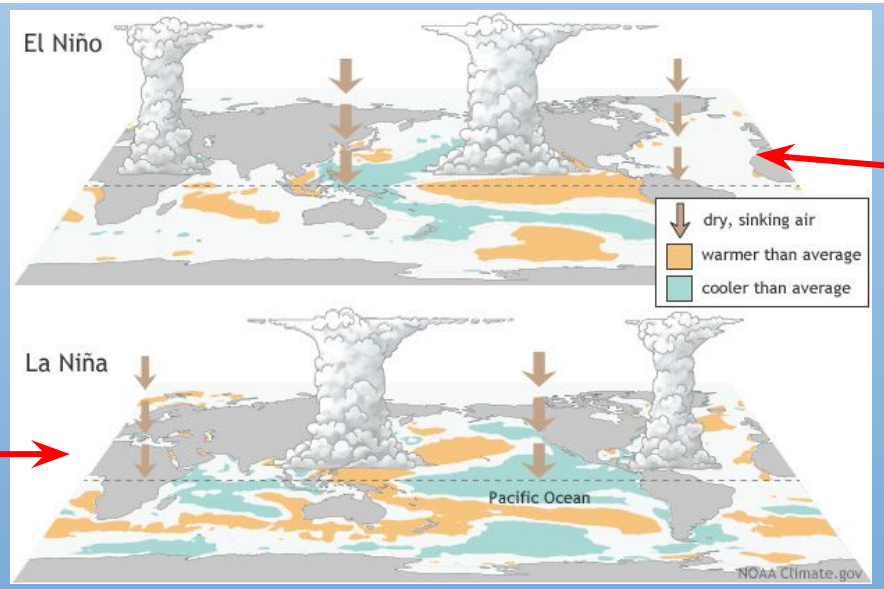
Typical Jet Stream Pattern during La Niña



Typical Jet Stream Pattern during El Niño



Typical Tropical circulations during El Niño

Typical Tropical circulations during La Niña

Figures 5-6. 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 moderate to strong La Niñas of the past and the polar jet stream generally remains north of New Mexico.

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How La Niña Affects Climate

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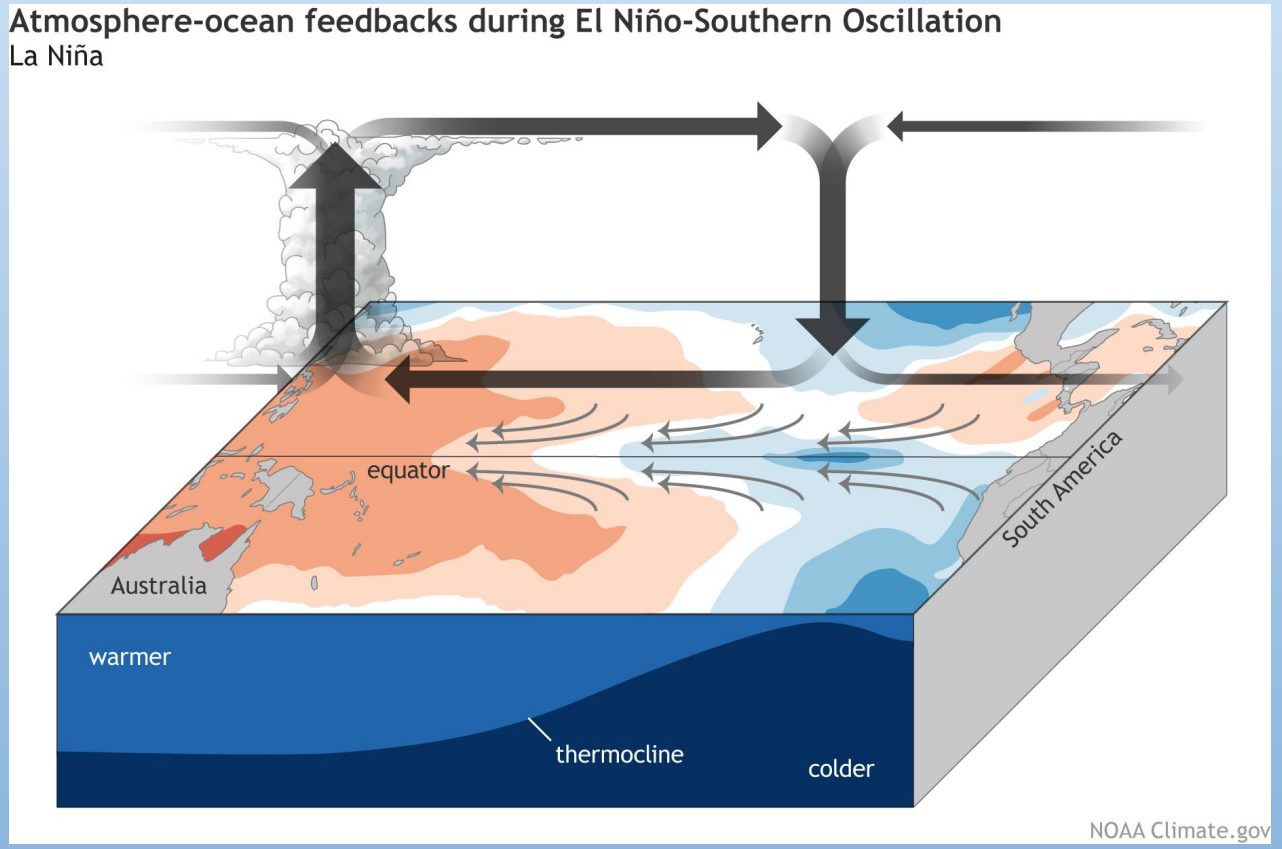

Figure 7. During traditional La Niñas of the past, the difference (or gradient) in temperature between the relatively warmer western Pacific and the cooler eastern Pacific becomes greater than normal. Over the western Pacific, warmer temperatures cause air near the surface to rise, moisten, and become convective, leading to thunderstorms and more rain. Over the cooler eastern Pacific, air begins to sink more and dry out. With the increases in sinking motion over the eastern Pacific and rising motion over the western Pacific, the trade winds that typically blow from east-to-west along the equator become even stronger. The most recent La Niña event, showed however, how a temperature difference in the far eastern equatorial Pacific can result in a least bouts of thunderstorms and more active weather for the Southwest U.S. at times during winter. These thunderstorms help draw the storm track or Polar Jet Stream farther south.

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Madden-Julian Oscillation (MJO) and El Niño

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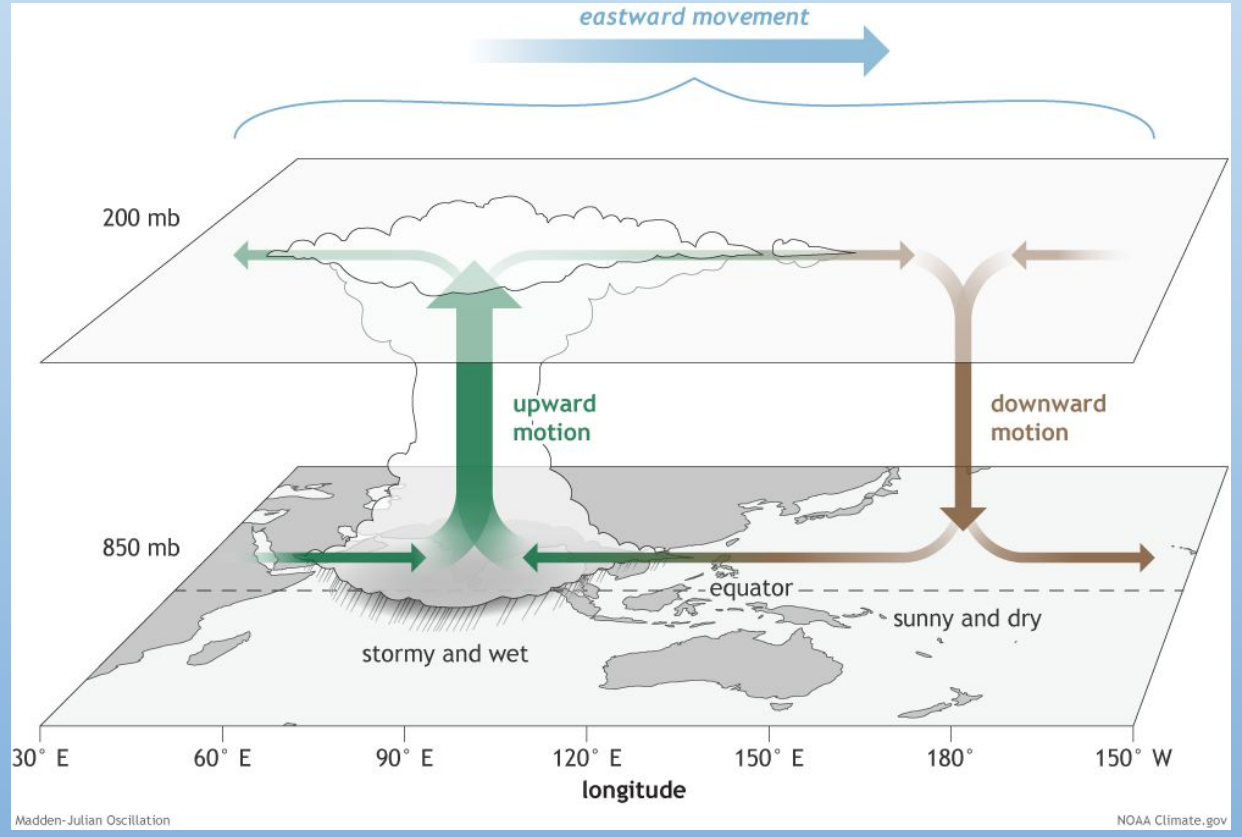

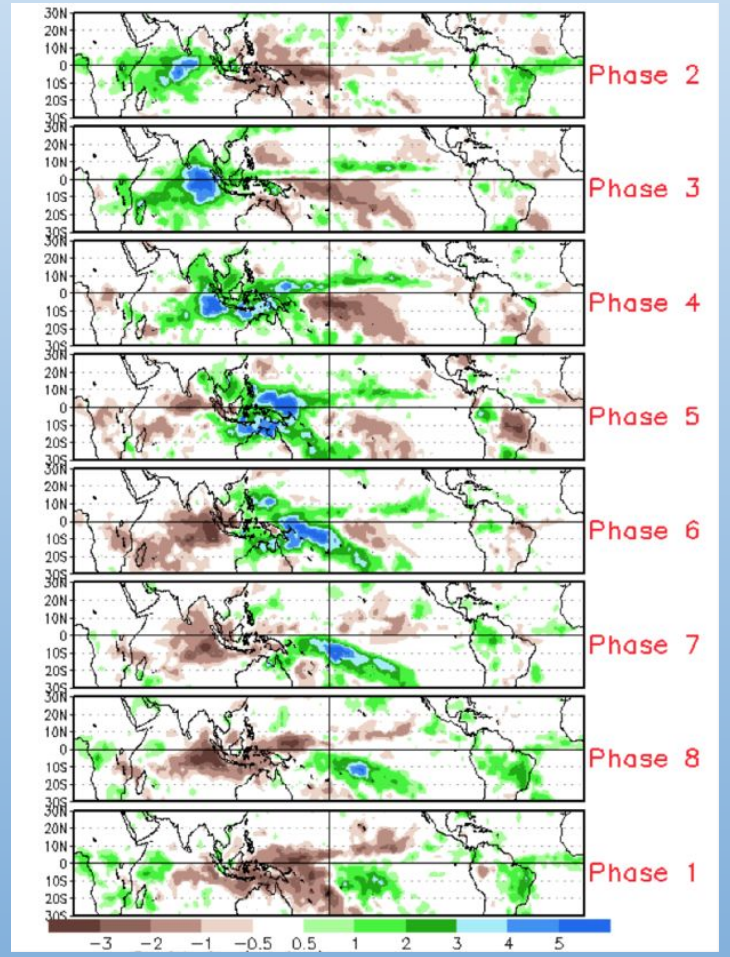

Figures 8-9. The Madden-Julian Oscillation (MJO) is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the rising air in the stormy area causes surface winds to blow toward the active area. During a developing La Niña, the trade winds are stronger than average, helping to bring cooler waters up to the surface. If the MJO is active/strong, it typically changes the wind patterns temporarily and helps La Niña develop.

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Madden-Julian Oscillation Cont'd

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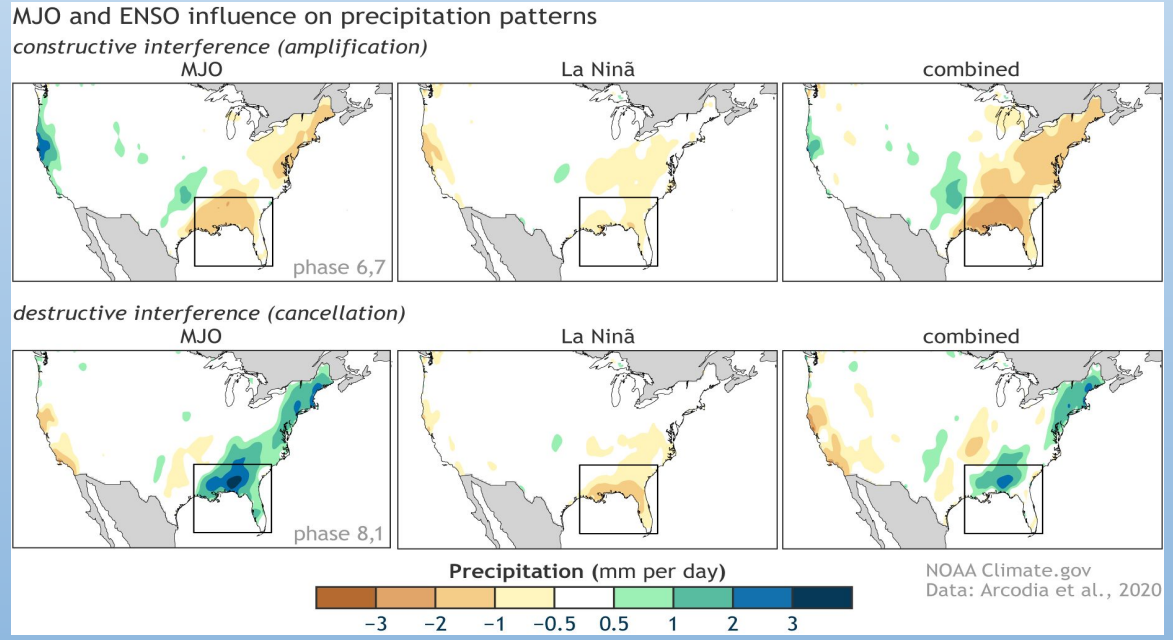

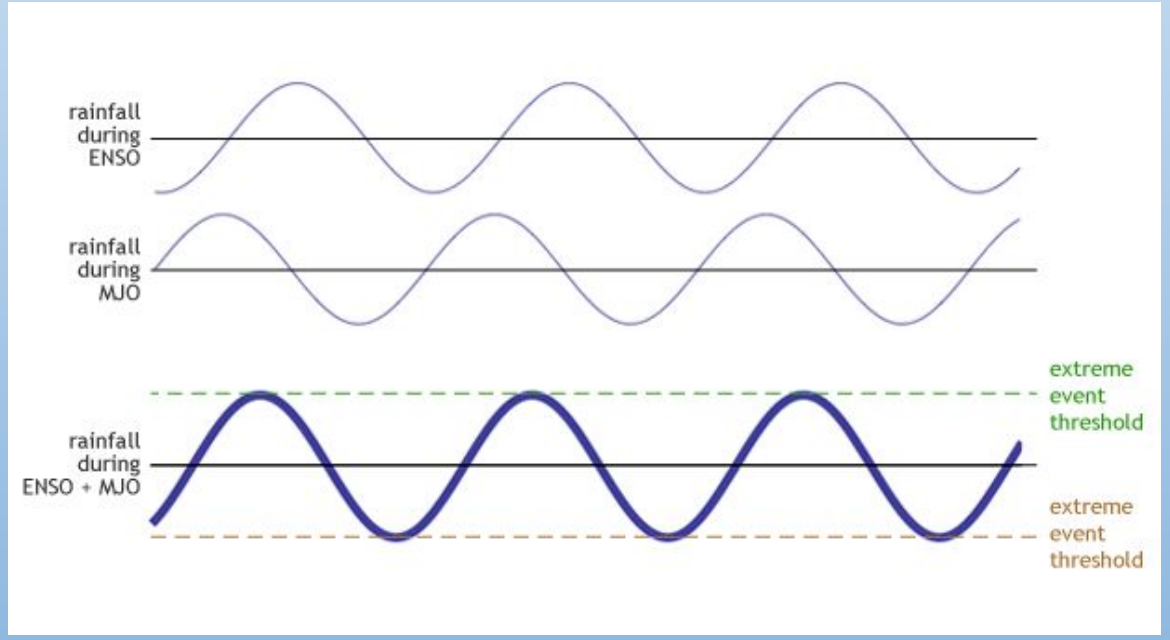

Figures 10-11 These illustrations show why the timing of the MJO is so important during stronger ENSO events. If the MJO lines up (constructive interference or amplification) with La Niña for example, the total effect is amplified (top row of left image). If the two atmospheric oscillations are not in phase with one another, they can cancel each other out or have muted results (bottom row left figure). The MJO is of course on a shorter time-scale but in the arid Southwest U.S., one or two major storm systems can make or break a season.

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The Pacific Decadal Oscillation (PDO)

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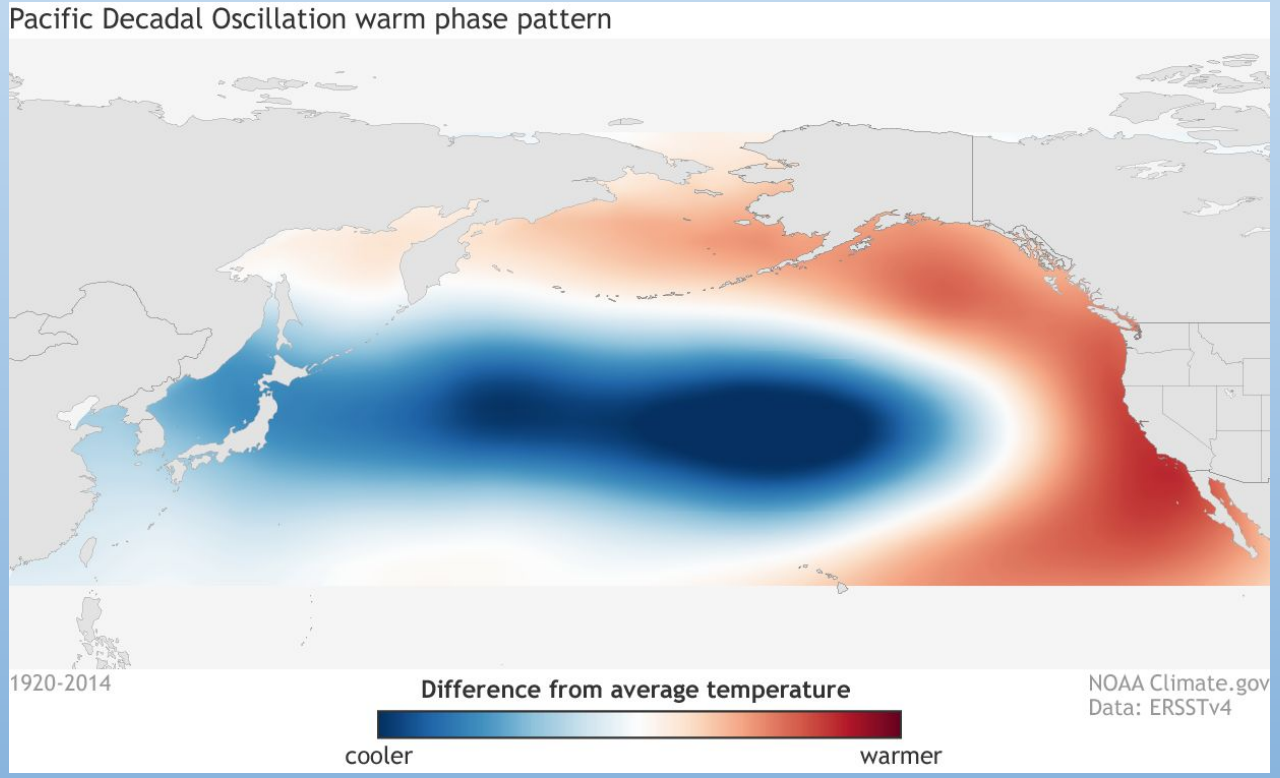
A key factor during a positive PDO is increased low-level moisture availability in far northeast Pacific/Gulf of CA.



PDO Aug,, Sep, Oct 2020	PDO Aug, Sep, Oct 2016	PDO Aug, Sep, Oct 2010-11	PDO Aug, Sep, Oct 2007-08
0.38, -0.70, ??	0.56, 1.88, 1.17	-1.27, -1.61, -1.06	0.5, -0.36, -1.45

Figure 12. Typical Sea Surface Temperature Anomaly (SSTA) patterns in the North Pacific Ocean during a positive Pacific Decadal Oscillation phase (PDO). As with ENSO, a positive PDO typically correlates well with above average winter precipitation in the southwest United States.

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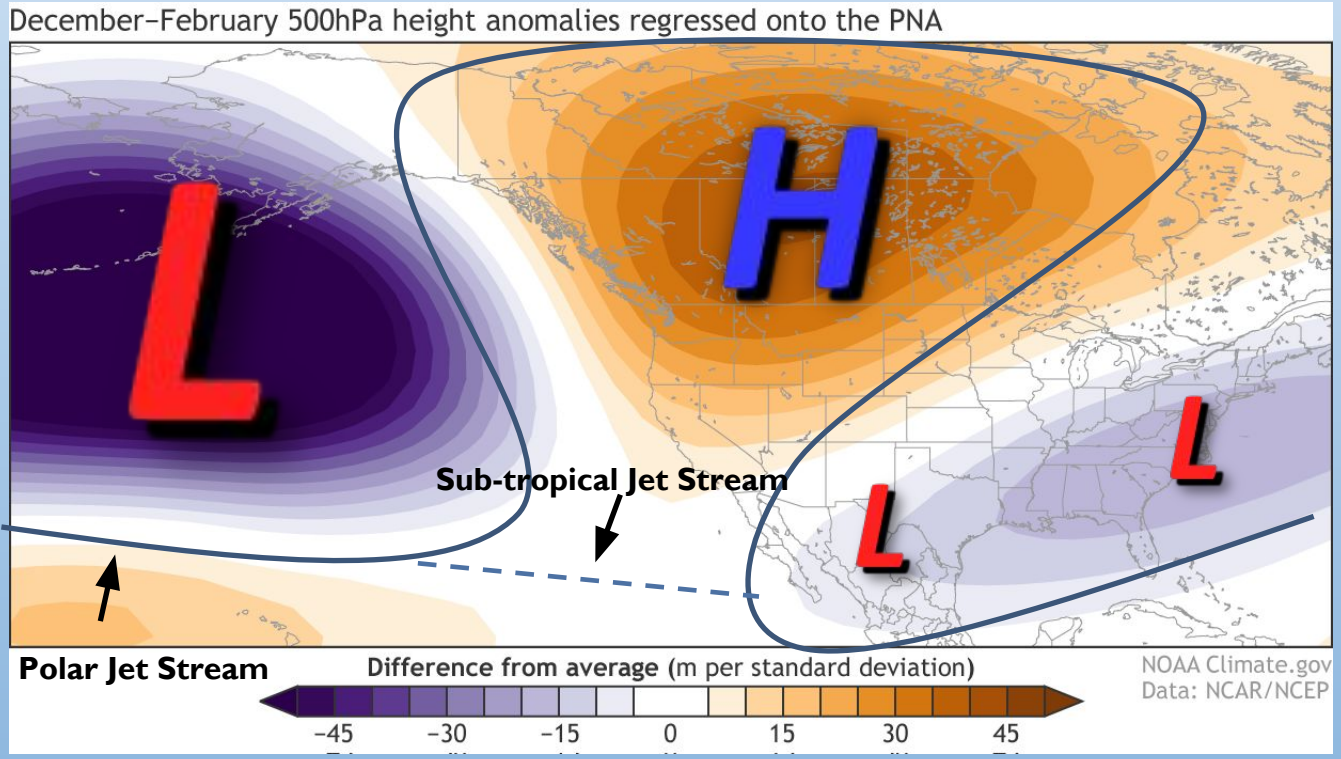
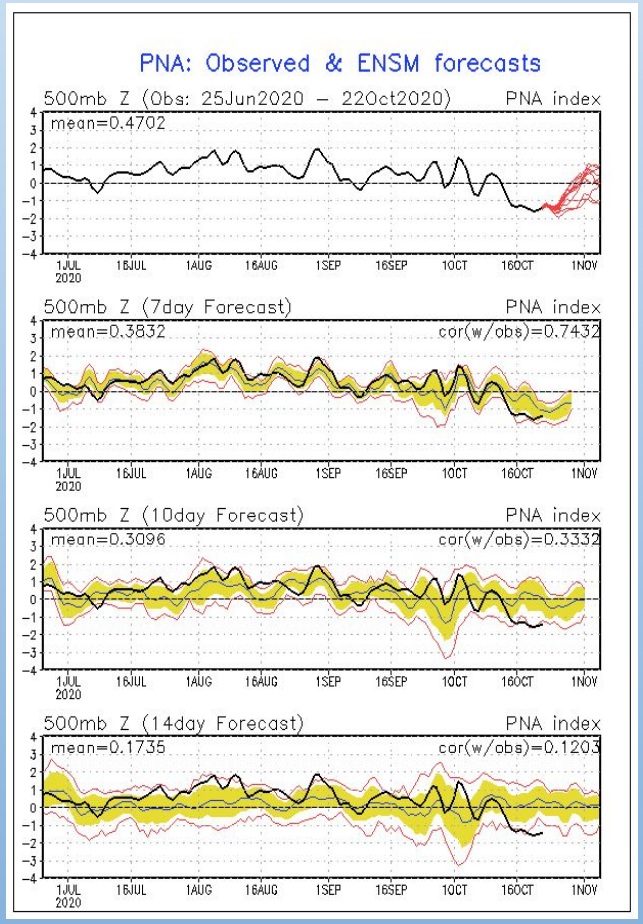
Positive Pacific-North American Teleconnection Pattern (PNA)





Figures 13-14. December-February 500-hPa geopotential height anomalies regressed onto the monthly PNA index. Data shown for 1979-80 to 2018-19. Purple shading indicates below-average pressure and winds that flow counter-clockwise following the contours. Orange shading denotes above-average pressure and winds that flow clockwise. In the positive state of the PNA, above-average pressure is found over the subtropical Pacific (close to Hawaii) and centered over western Canada. Below-average pressure occurs over the North Pacific Ocean and along the southeastern United States. Major winter storms for NM generally occur during the transition from a negative to positive phase. This is the pattern forecast for the last week of October 2020.

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Comparing Late Oct 2016 Global SSTAs to Late Oct 2020

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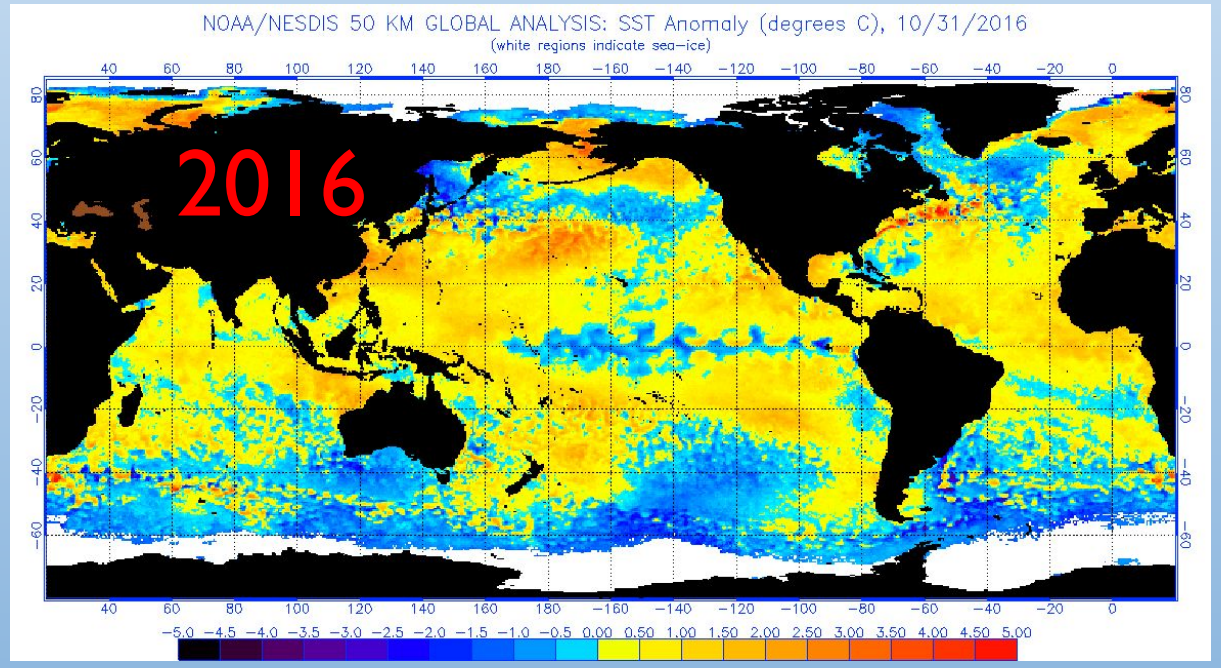

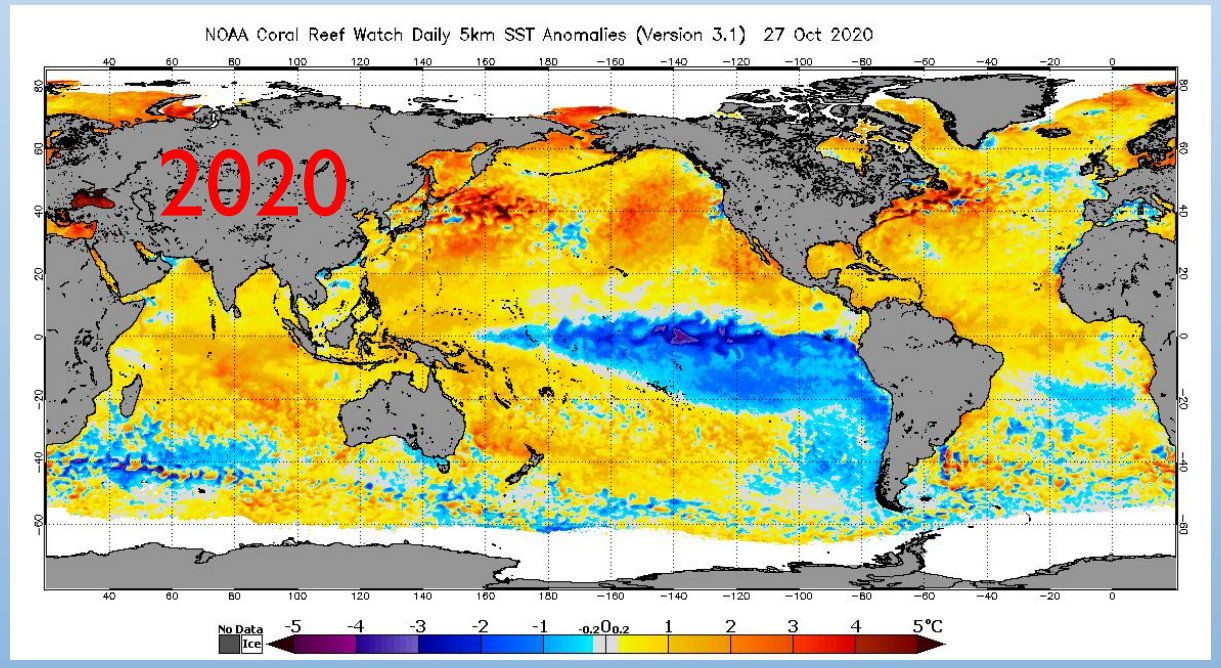

Figures 15-16. SSTAs from the most recent "analog" year, 2016 and current conditions. Note some similarities as well as significant differences. Despite the difference in the resolution of data (50-km to 5-km), the world's oceans as a whole are warmer compared to 2016 and the current La Niña is stronger at this point in time relative to 2016.

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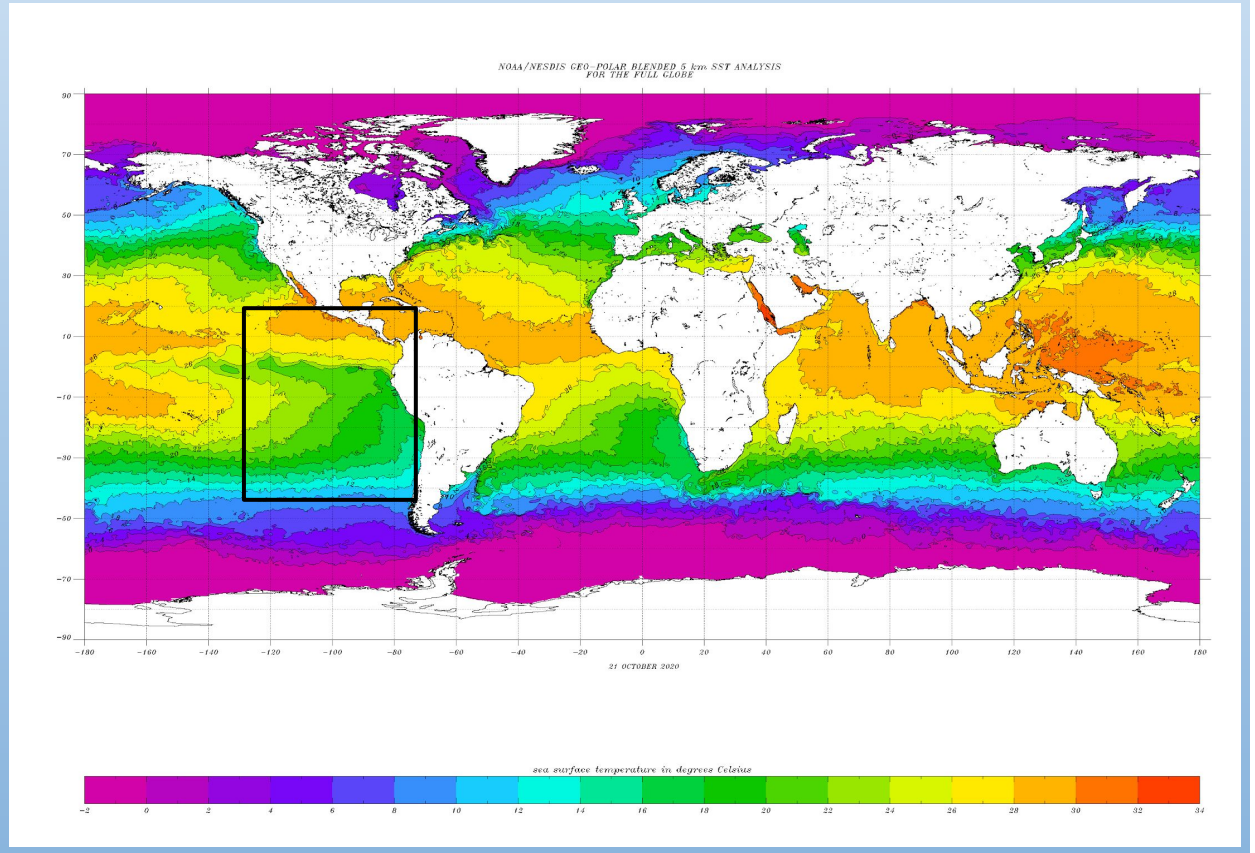

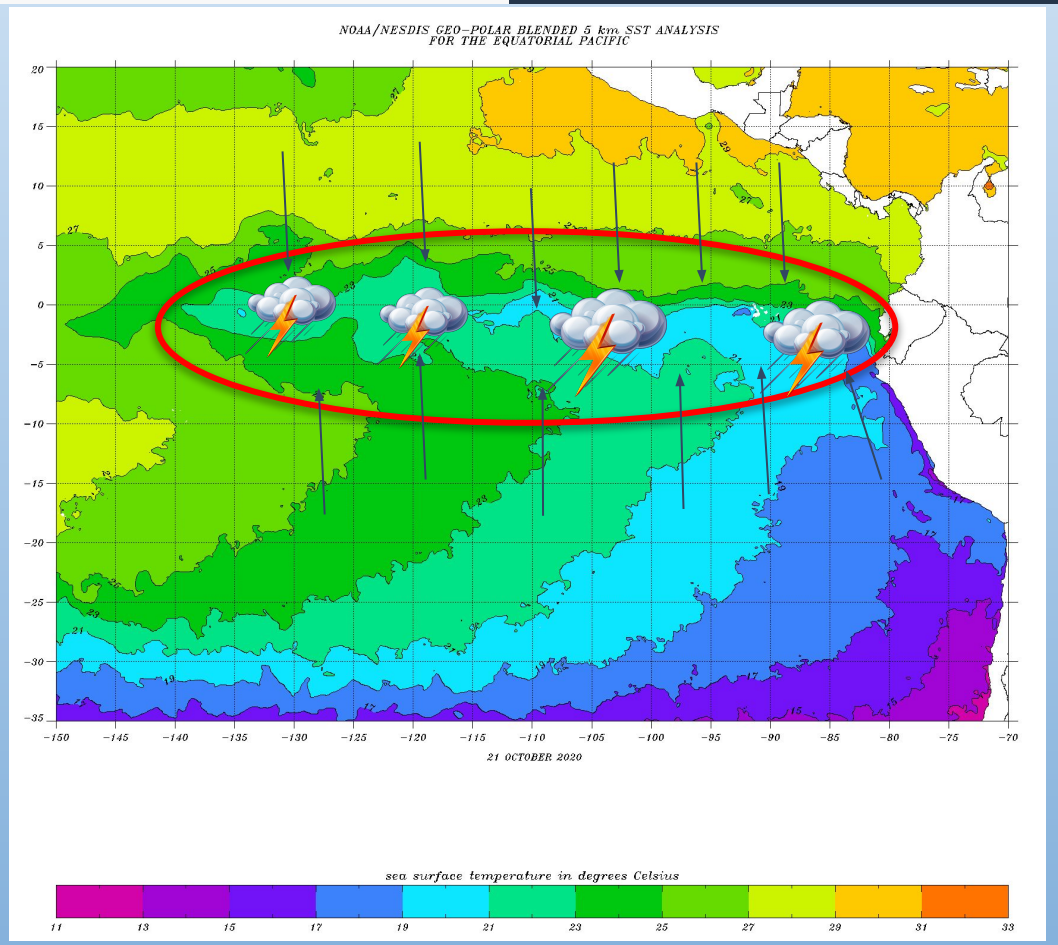

Figures 17-18 Late October 2020 5-km SSTs plots showing a temperature difference or gradient in the eastern equatorial Pacific. It's these gradients that can lead to winds at the surface converging, helping to generate thunderstorms. The upward vertical motion associated with the thunderstorms helps draw the storm track or polar jet stream southward. Additionally, if this La Niña is more of a Modoki or Central Pacific La Niña, thunderstorms in central equatorial Pacific can lead to a highly amplified flow very similar to what we saw with the historic late October 2020 winter-like storm.

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Precipitation and Temperature Anomalies

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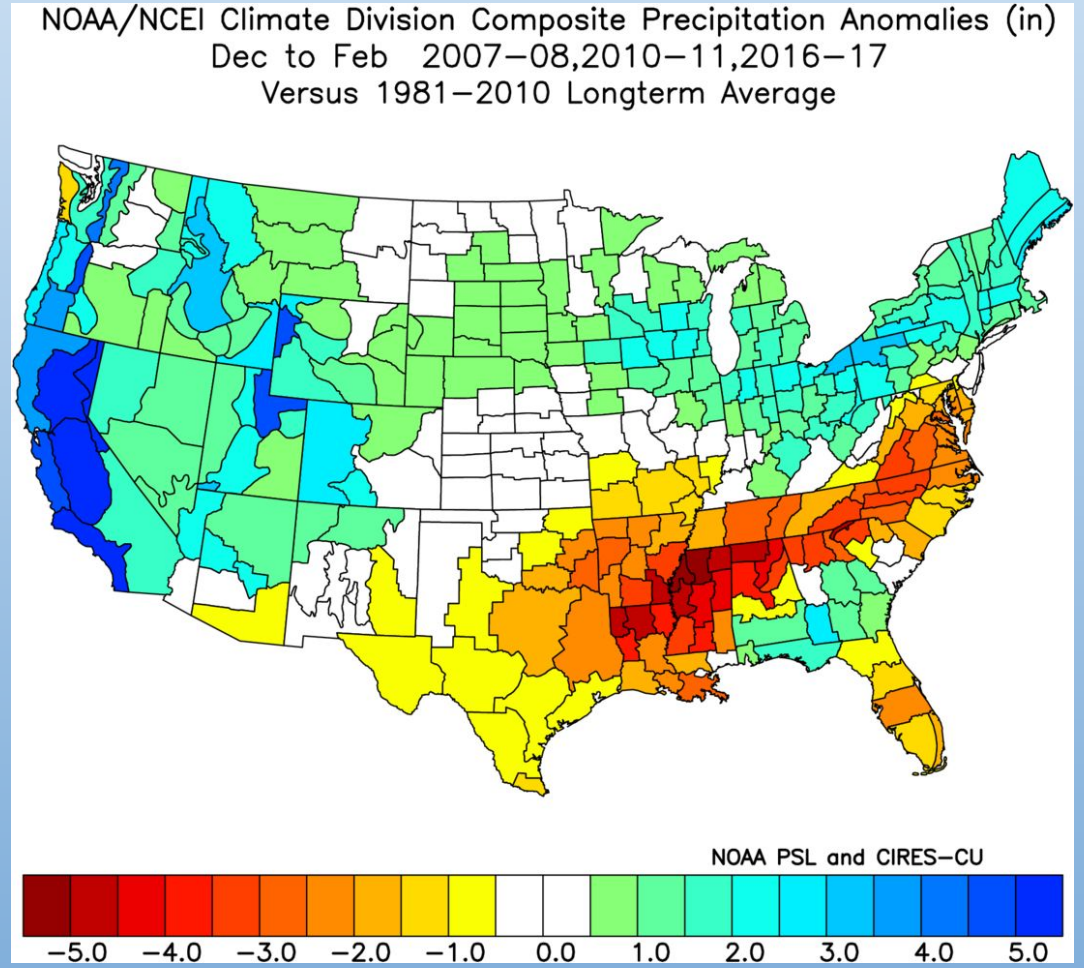

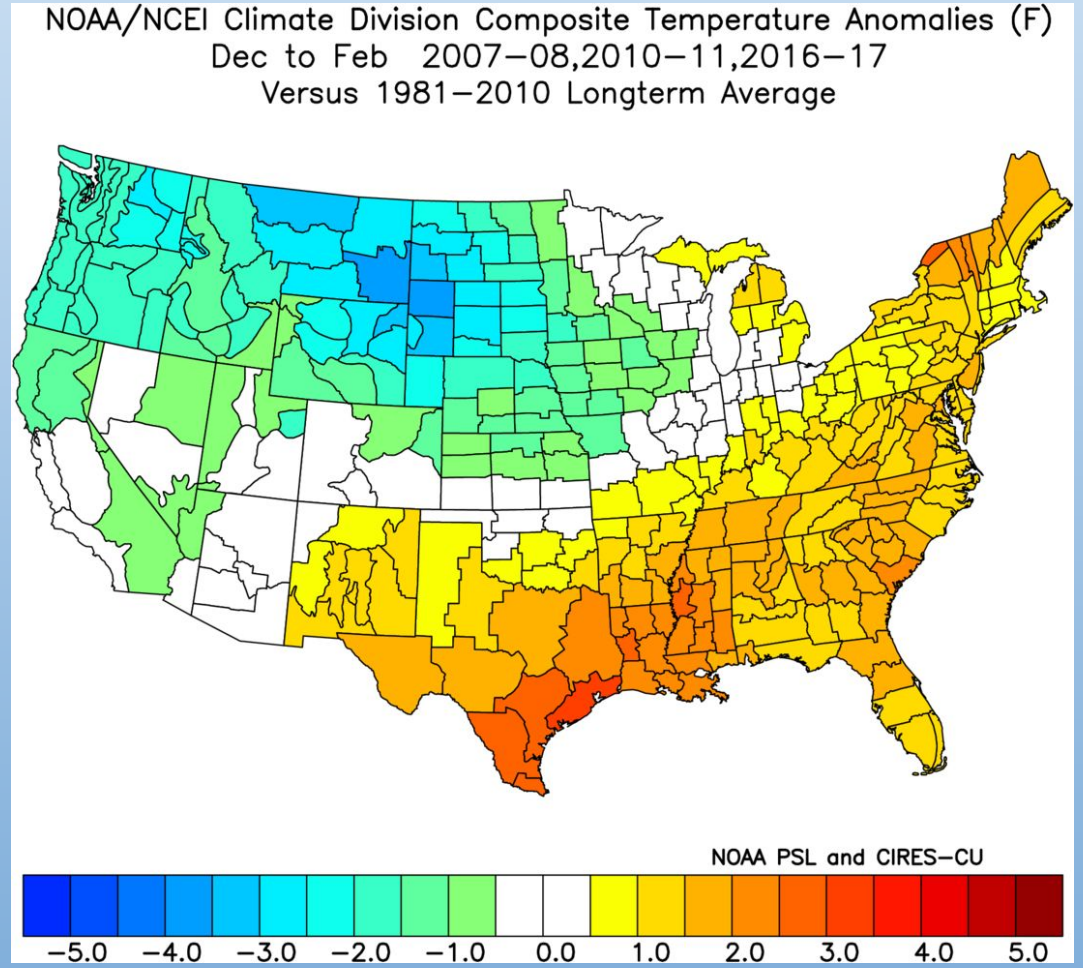

Figures 19-20 . DJF Precipitation and Temperature anomaly plots for CPC's climate divisions comparing recent analog years, 2007-08, 2010-11, and 2016-17 with 30-year climatological averages. Two climate divisions in northwestern New Mexico were slightly above average for precipitation while central and eastern divisions were very near average with regard to precipitation. Temperatures were above 1981-2010 climatological averages for much of the state.

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Most Recent (2016-17) Analog Year Precipitation

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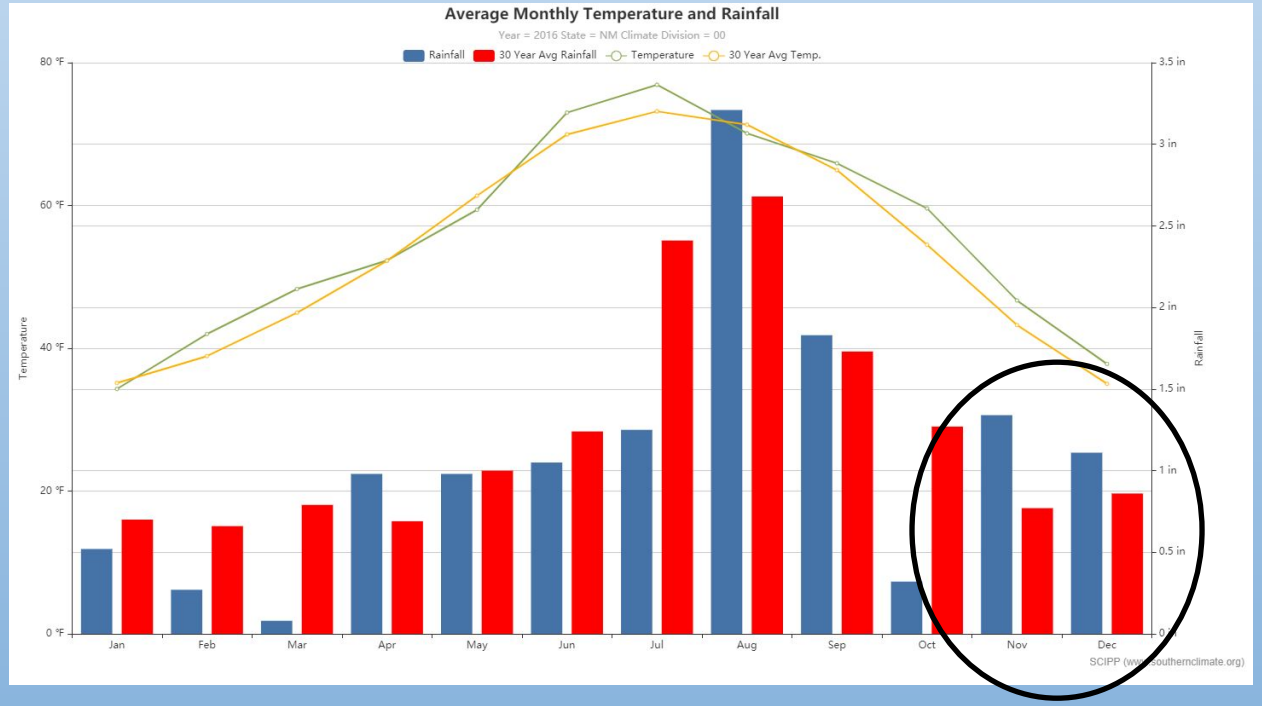

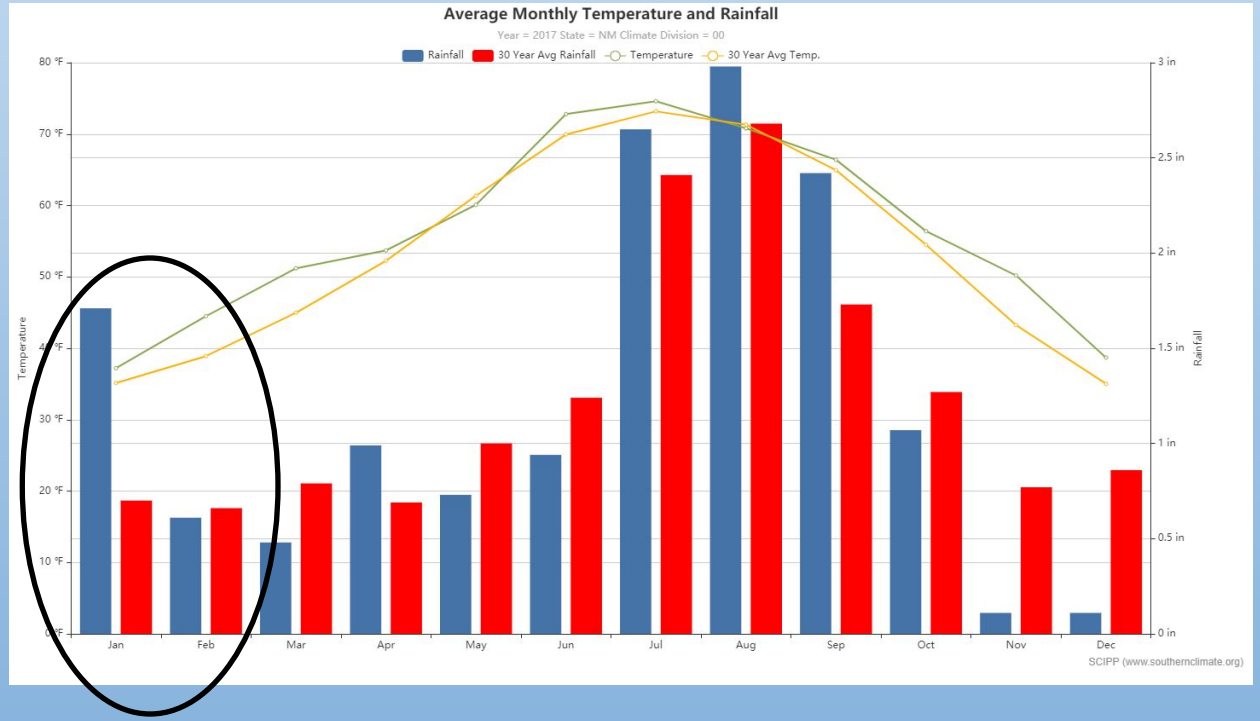

Figure 21-22. Precipitation was above average across New Mexico in December 2016, January 2017 and slightly below average in February 2017.

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Climate Prediction Center's Official 2020-21 Winter Outlook

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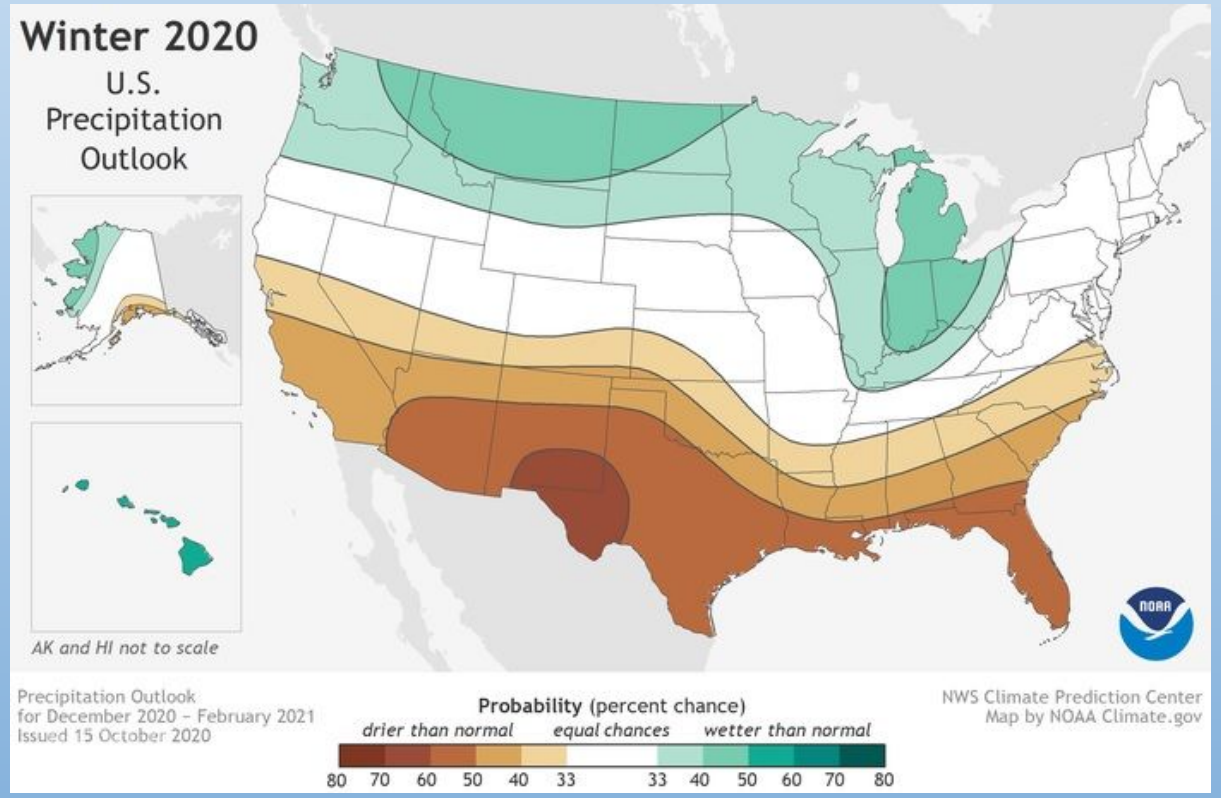

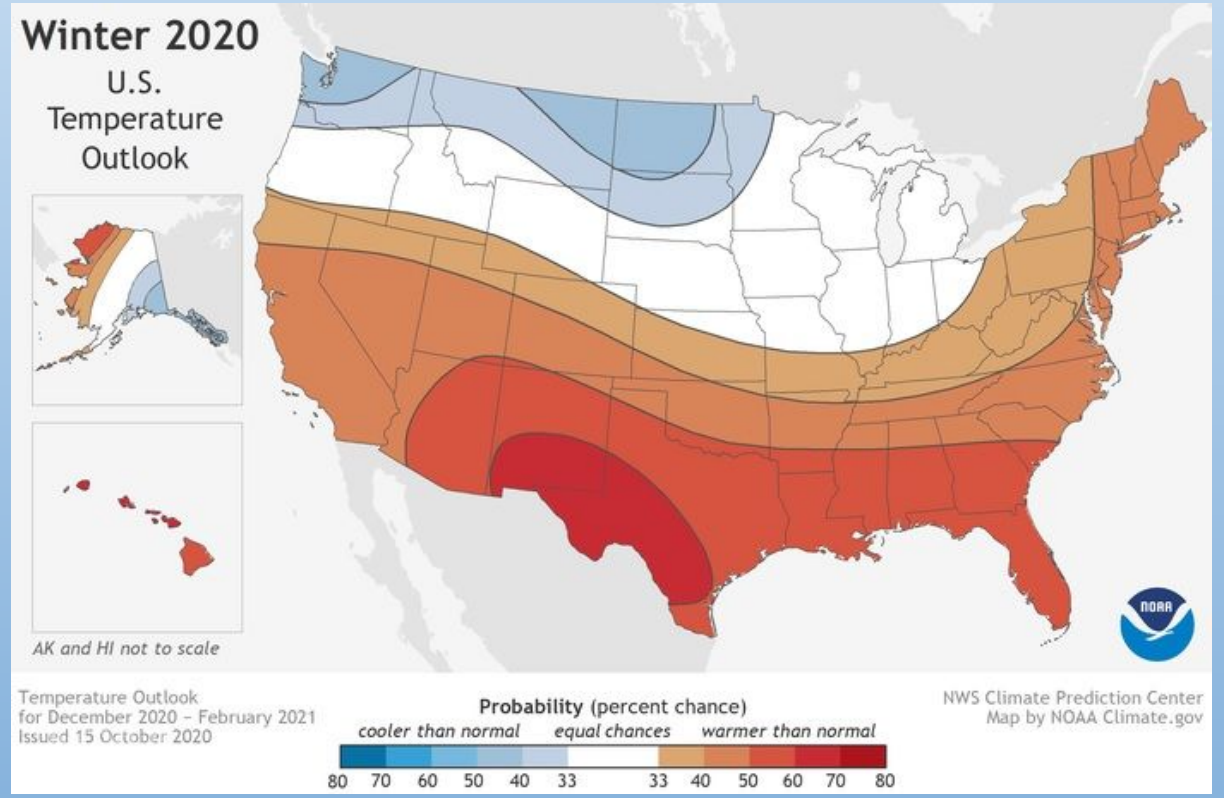

Figures 23-24. CPC's DJF 2019-20 precipitation and temperature forecasts favoring below average precipitation and above average temperatures for all of New Mexico. The chances for a drier than average winter increase as you move south through NM.

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Numerical Climate Prediction Model Precipitation for DJF

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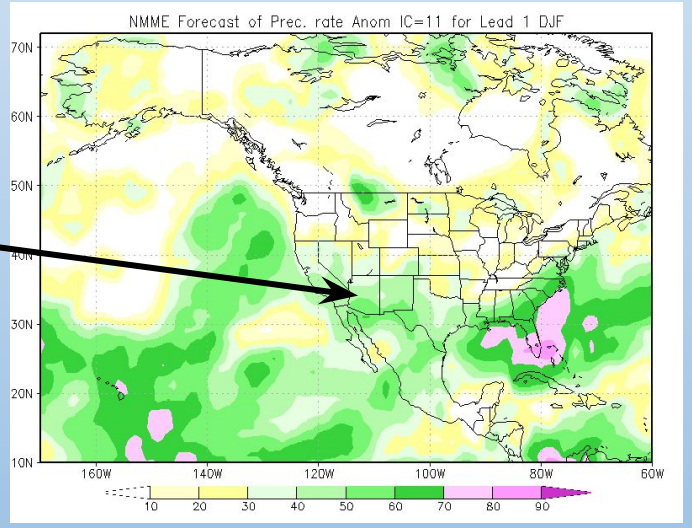
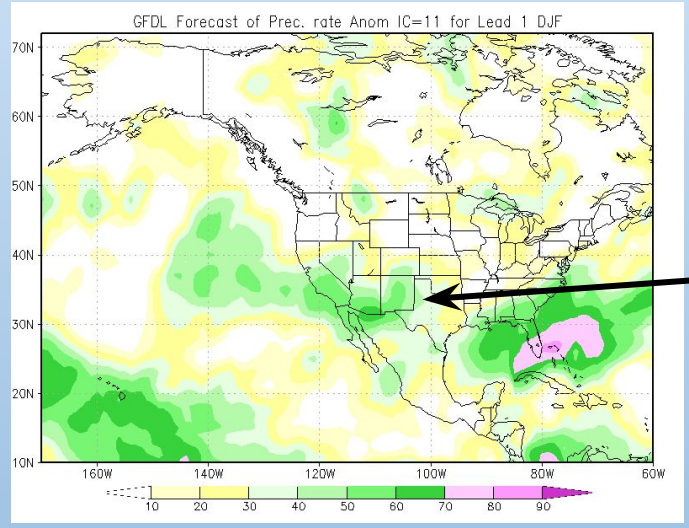
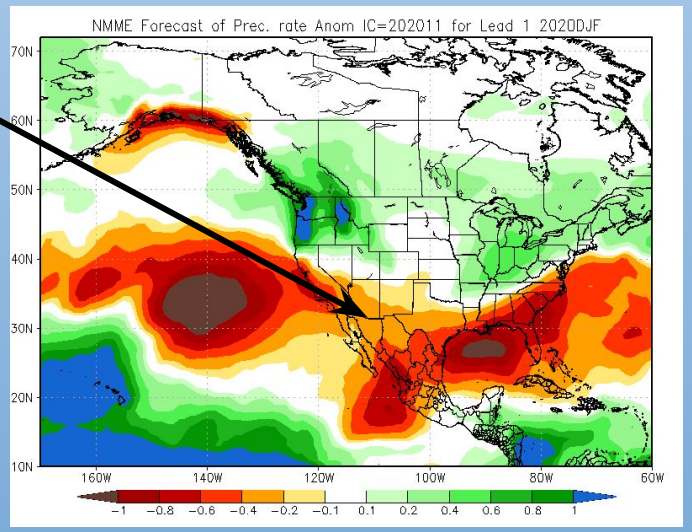
Highest model skill in DJF across southern NM.

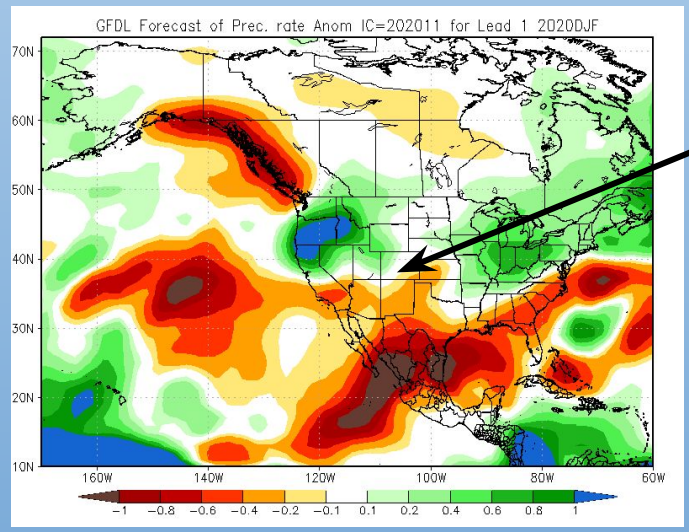




Highest model skill in DJF in central NM.

Orange equates to below average precipitation rates.





White equates to near average precipitation rates.

Figures 25-28. 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_CM2.1) model. Forecasts range from near average in far northern New Mexico to below average precipitation central and south for DJF 2020-21.

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Numerical Climate Prediction Model Temperatures for DJF

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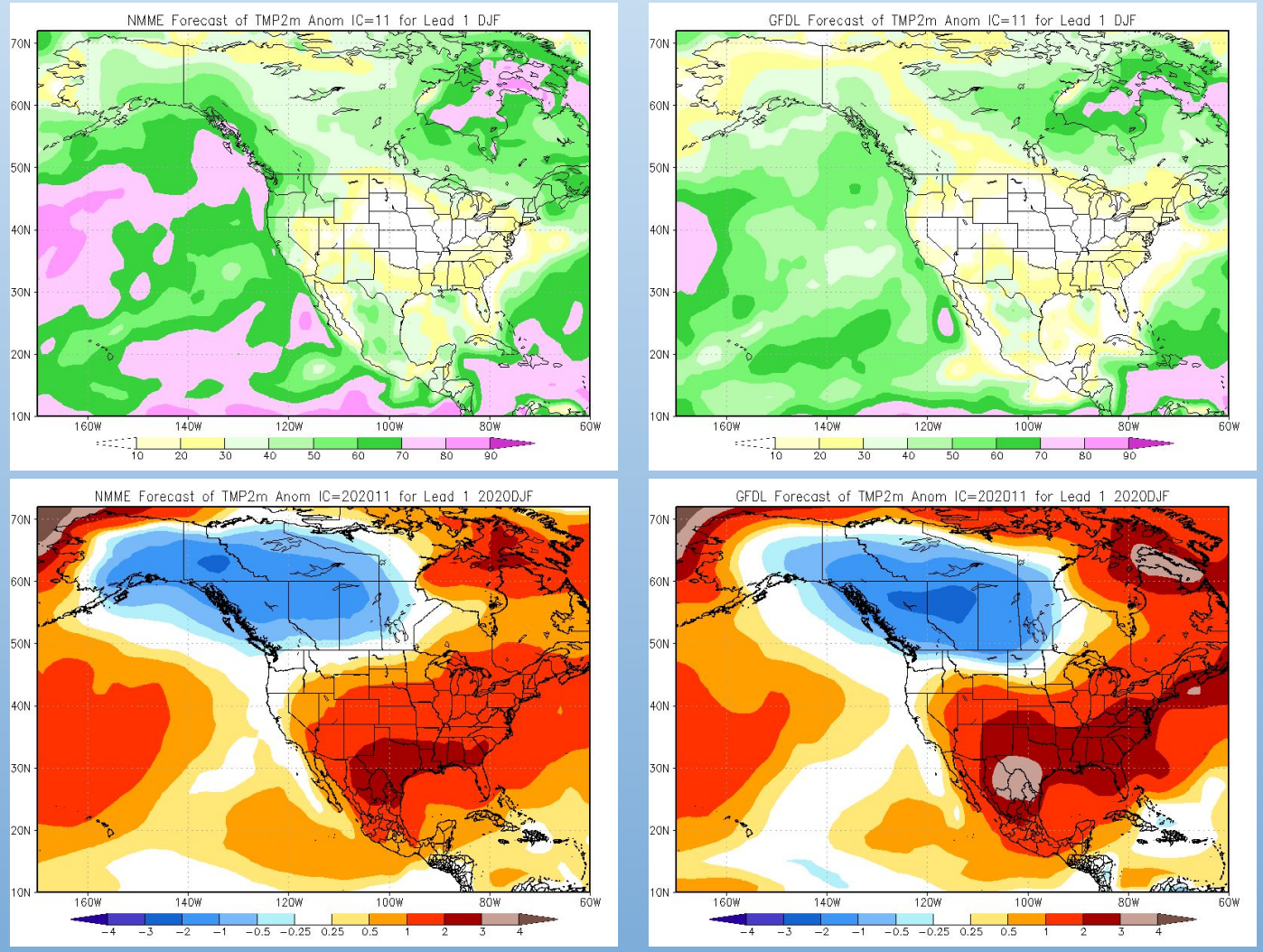

Figures 29-32. Two meter (6.5 feet above ground level) temperature anomaly forecasts from the two climate models which have the highest forecast skill percentages, the North American Multi-Model Ensemble (NMME) and the Geophysical Fluid Dynamics Laboratory (GFDL_CM2.1) model. Both models forecast above to well above average temperatures during DJF 2020-21 for NM.

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Japan Agency for Marine-Earth Science & Technology (JAMSTEC)

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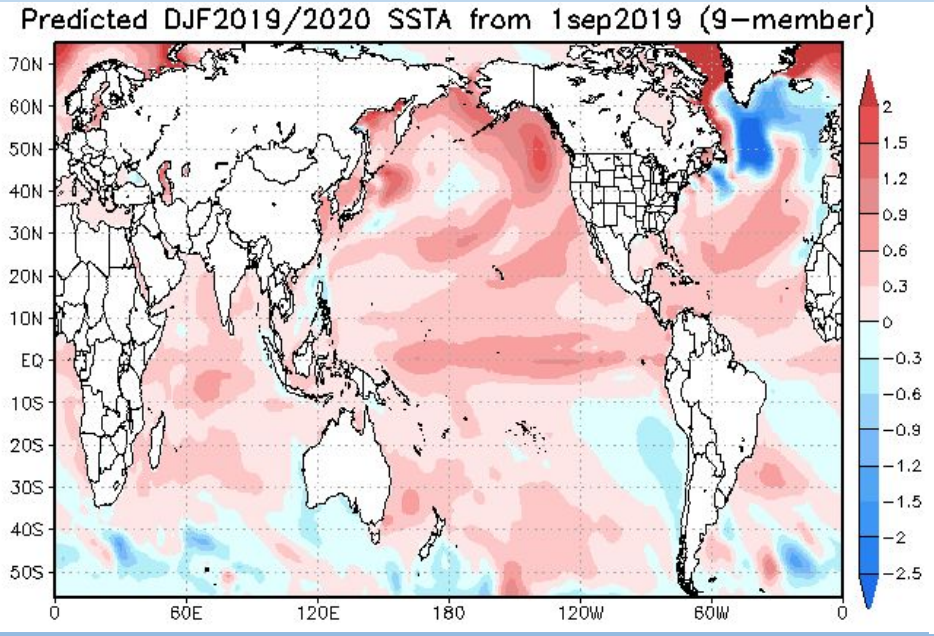

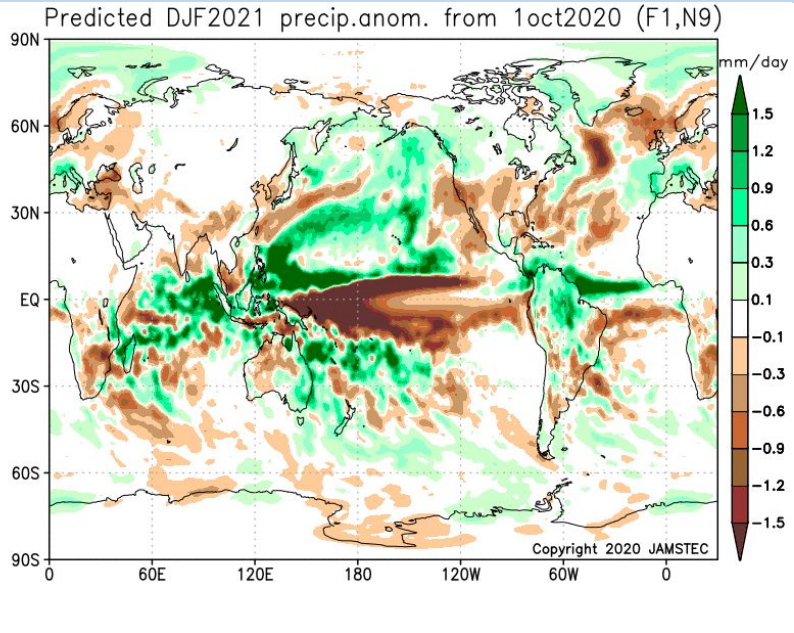

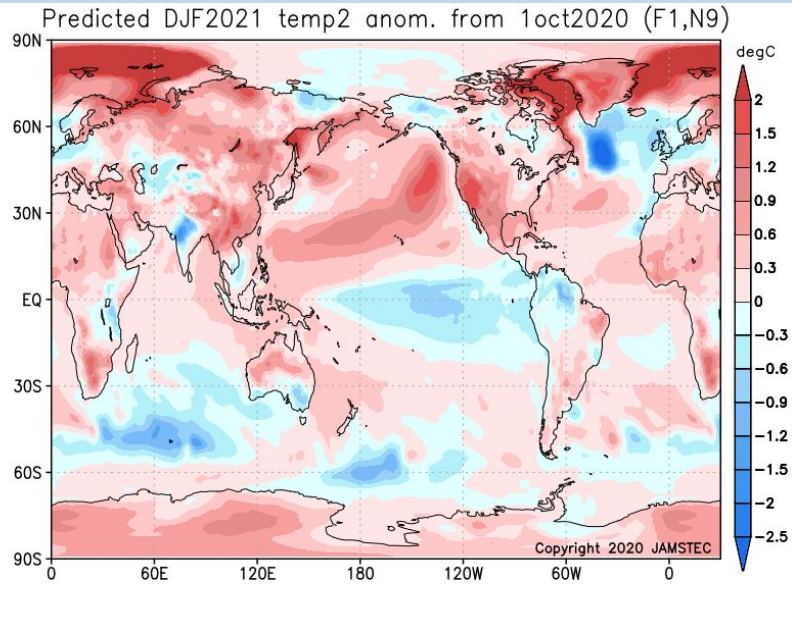

ENSO forecast from JAMSTEC:

Observation shows that the La Niña continues to develop. The SINTEX-F predicts that this La Niña will be more La Niña Modoki-like and will persist in this year. Then, it will start to decay from early 2021. We need to be careful of its impact as it may be different from that of a canonical La Niña.

Figures 33-35. JAMSTEC is forecasting a central Pacific or Modoki La Niña this winter. Their ensemble climate model (SINTEX-F) is also forecasting below average precipitation for much of the southwestern U.S. along with warmer than average temperatures for the vast majority of the lower 48 states.

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Summary

- Precipitation data from three analog events (2007-08, 2010-11 and 2016-17) 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) 2019-20 will most likely range from slightly below to below 1981-2010 climatological averages with the most likely area near average across the northern quarter of the state.

- Snowfall data from three previous weak to moderate La Niña events suggest that snowfall will range from slightly below to below average amounts in DJF 2020-21 with the northern quarter of the state favored with the best chances for a near average winter.

- Temperatures trends from the past 15 years combined with forecasts from the most highly skilled climate models suggest temperatures will be above average in DJF 2020-21.

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Outlook Information

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

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