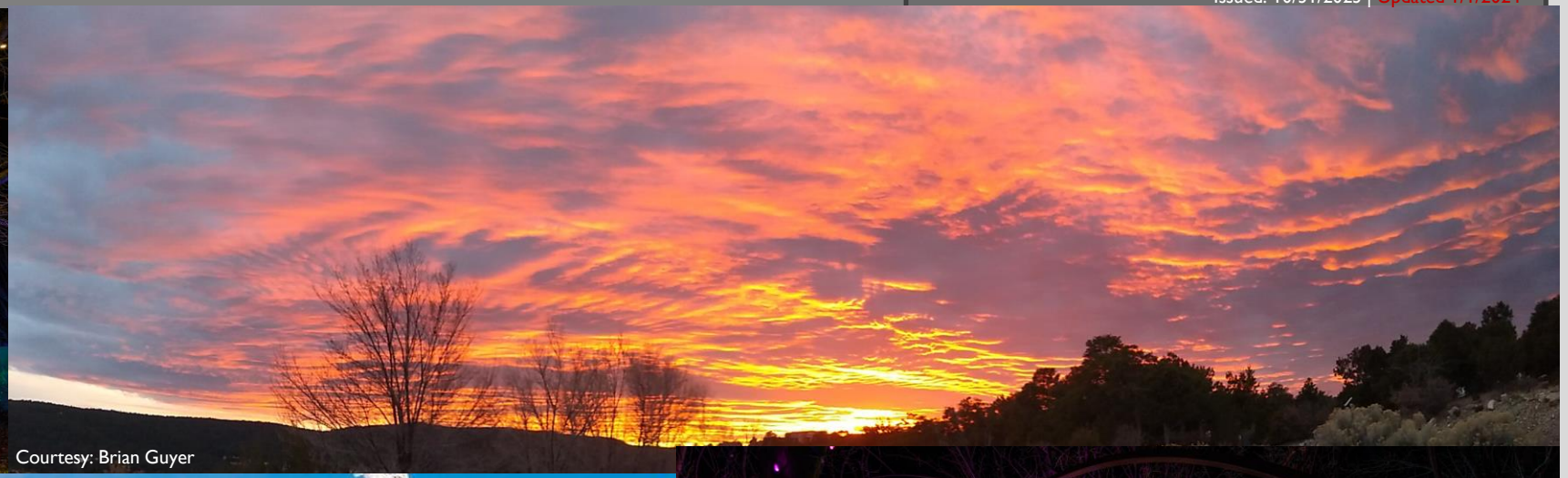
2023-24 Winter Outlook

For Northern and Central NM

Albuquerque
WEATHER FORECAST OFFICE
Issued: 10/31/2023 | Updated 1/1/2024


Courtesy: ABQ Biopark


Courtesy: Brian Guyer


Courtesy: Andrew Mangham


Courtesy: Angel Fire Resort


Courtesy: ABQ Biopark

How will a moderate to strong El Niño influence winter precipitation in central and northern NM this upcoming winter season?

2023-24 Winter Outlook

Current ENSO Status

Albuquerque
WEATHER FORECAST OFFICE

El Niño Southern Oscillation (ENSO) Status from the Climate Prediction Center (CPC)

ENSO Alert System Status: El Niño Advisory

El Niño conditions are observed.*

Equatorial sea surface temperatures (SSTs) are above average across the central and eastern Pacific Ocean.

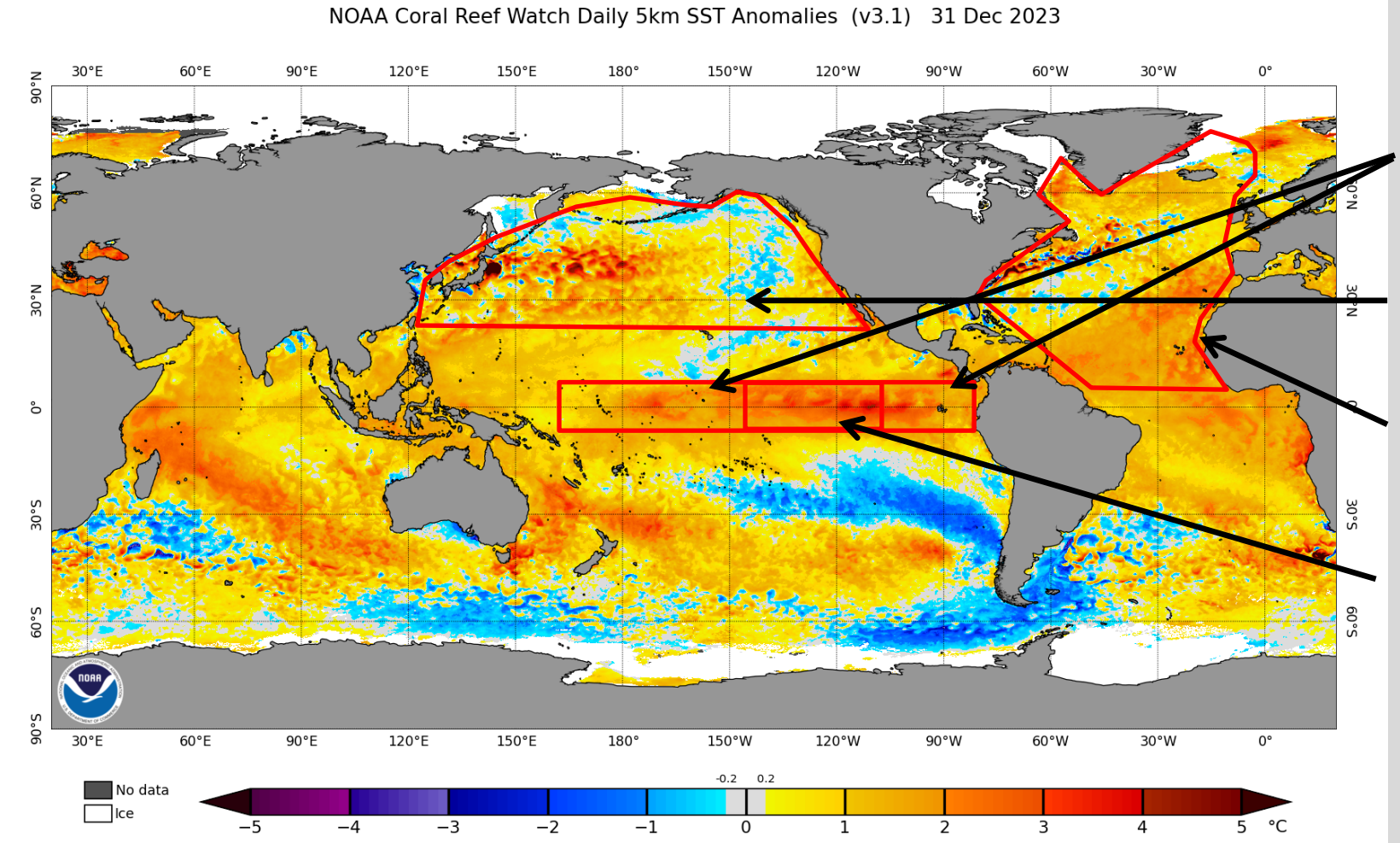
The tropical Pacific atmospheric anomalies are consistent with El Niño.

El Niño is anticipated to continue through the Northern Hemisphere spring (with an 80% chance during March-May 2024).*

2023-24 Winter Outlook

Sea Surface Temperature Anomalies or Difference from Average

Albuquerque
WEATHER FORECAST OFFICE



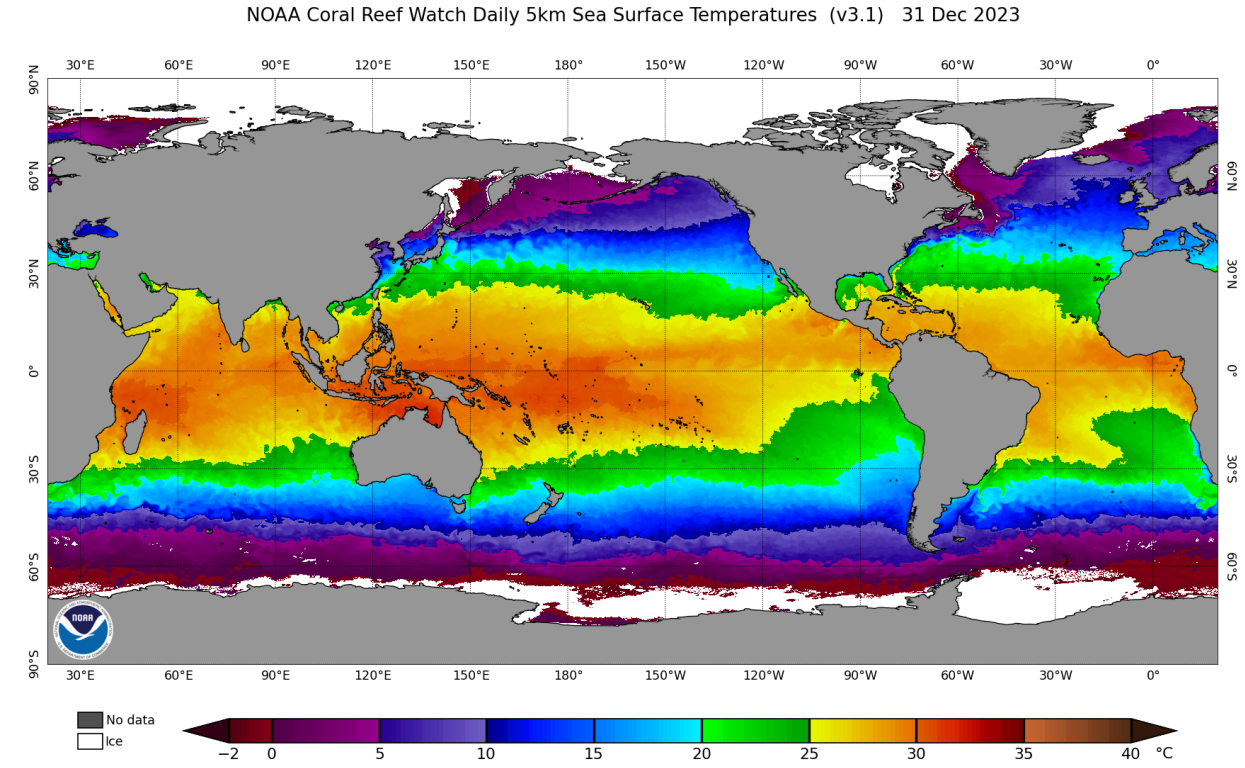
- Multivariate ENSO Index (**MEI**) for SEP-OCT 2023: +**0.3**
- Pacific Decadal Oscillation (**PDO**) for OCT 2023: -**1.71**
- Atlantic Multidecadal Oscillation (**AMO**) for OCT 2023: +**1.39**
- Oceanic Niño Index (**ONI**) (uses Niño 3.4 region - inner rectangle) for ASO 2023: +**1.5** (+**0.5** = El Niño)

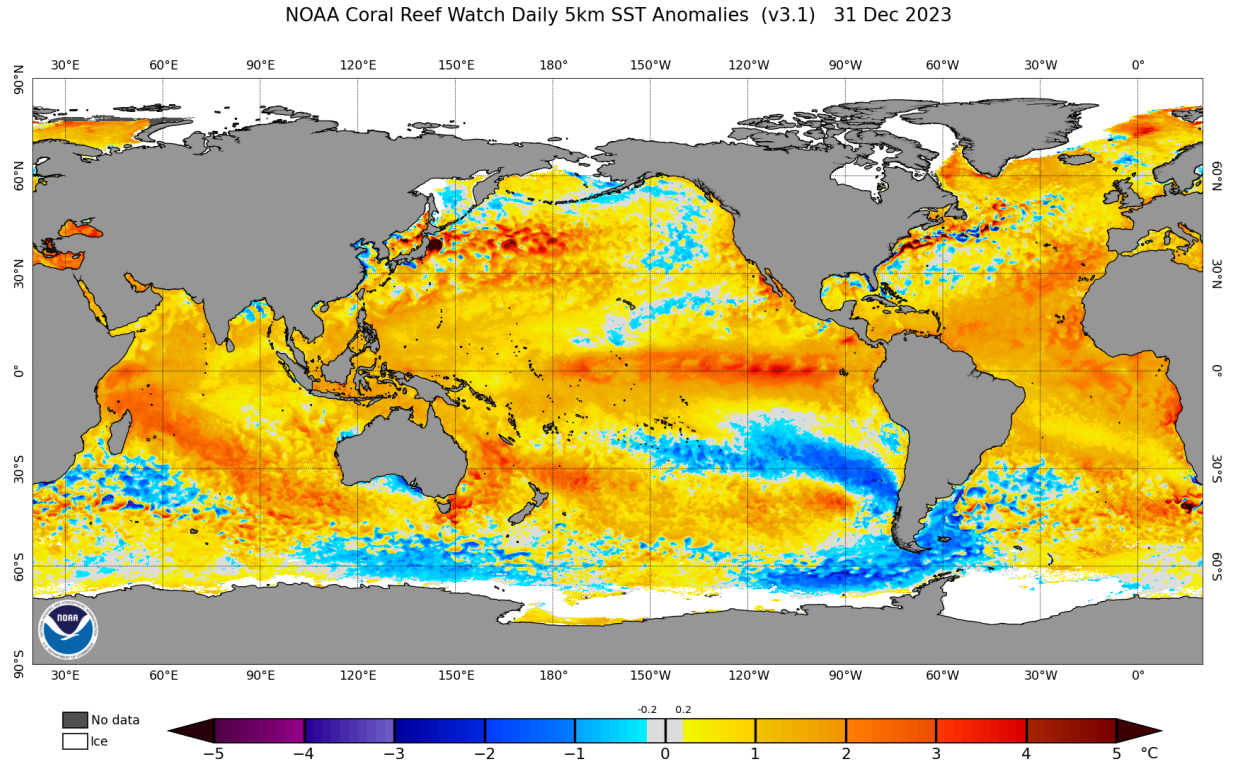
Latest weekly global SST anomalies showing an area of much warmer than average temperatures in the eastern equatorial Pacific in El Niño territory (+0.5°C or warmer than average in Niño 3.4 region for 3 month period). Also note the large expanses of well above average SSTs in the northern hemisphere.

2023-24 Winter Outlook

Current SSTs and SSTAs

Albuquerque
WEATHER FORECAST OFFICE



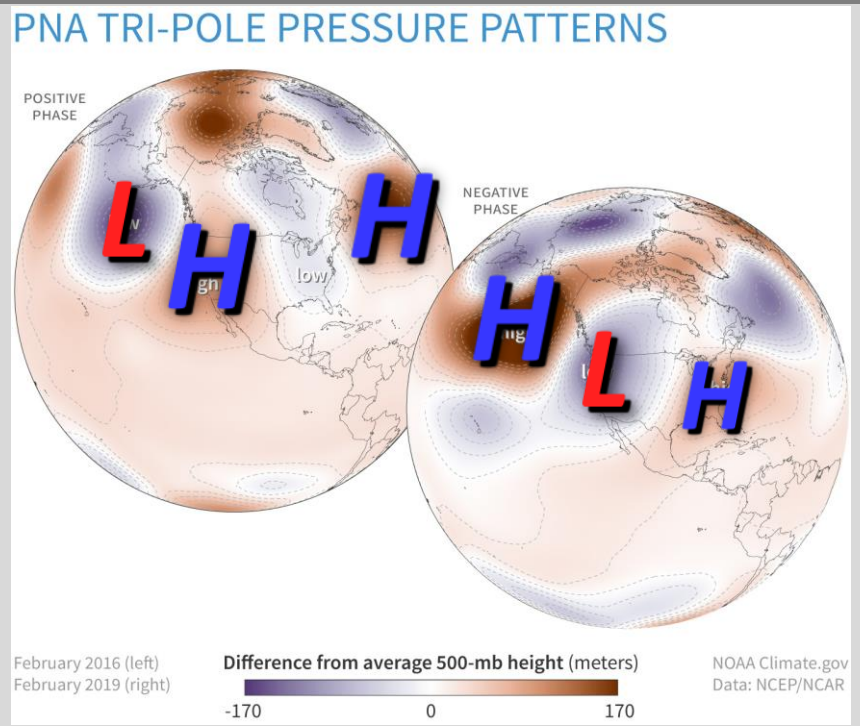


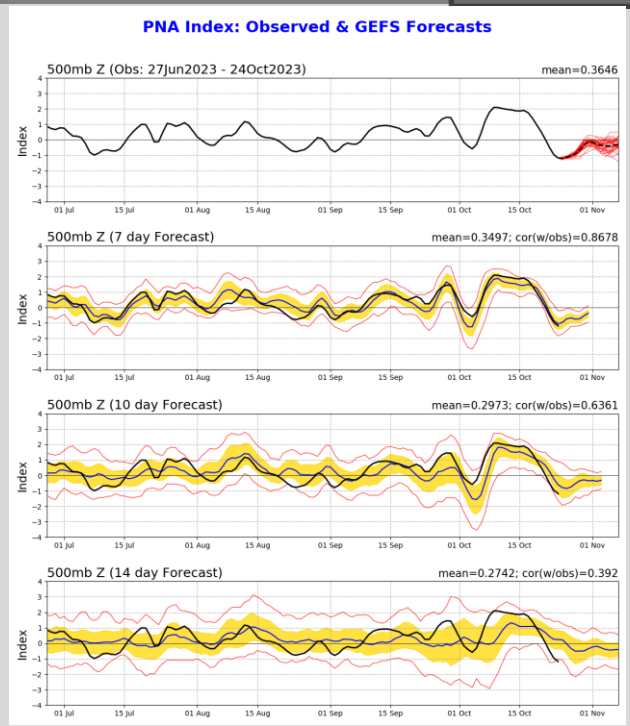
Sea surface temperatures (SSTs) on the left with difference from average SSTAs on right. El Niño is very evident along with other areas of expansive well above average SSTs in the northern hemisphere. Atmospheric Rivers (ARs) are long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics. Well above average SSTs in the northwest Pacific associated with a negative Pacific-Decadal Oscillation (PDO) allow for atmospheric rivers (ARs) to be more prolific and more frequent.

2023-24 Winter Outlook

Pacific Decadal Oscillation (PDO)

Albuquerque
WEATHER FORECAST OFFICE



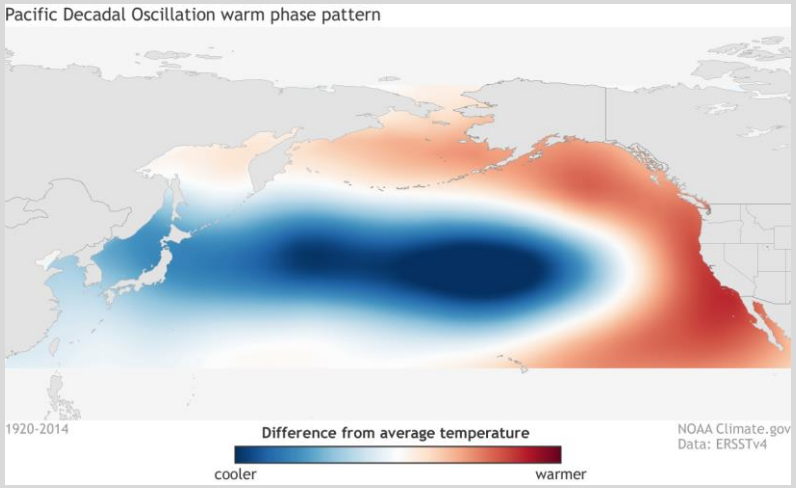


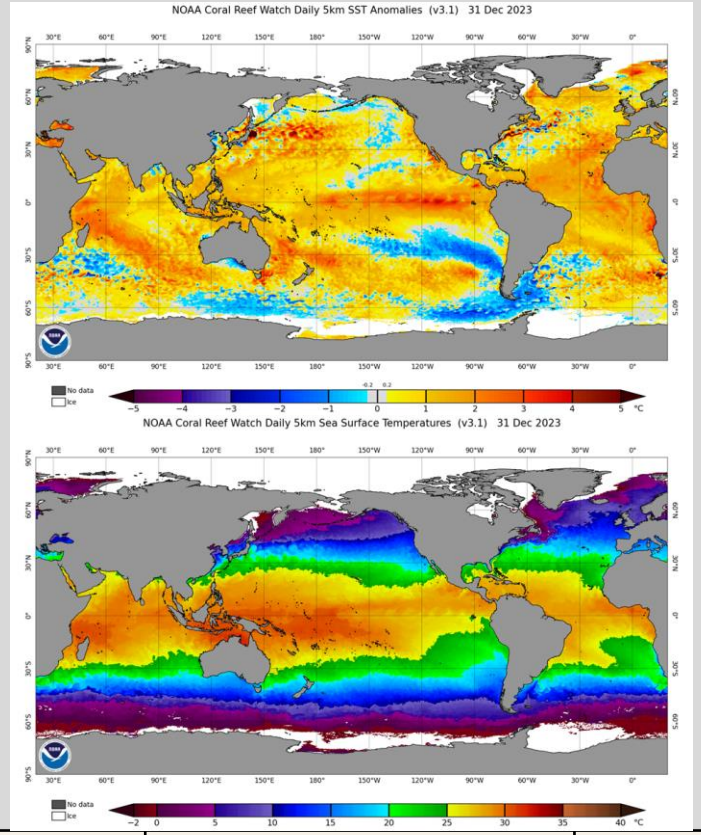
Similar to how a river will flow faster when pinched between two boulders, the atmosphere has similar disruptions due to Earth's geography, the spin of the planet, and differences in solar heating. One such semi-permanent feature is the Asian-Pacific or East Asian jet stream, a fast moving river of air that rips off the coast of Japan and crosses over a large swath of the North Pacific Ocean. This jet stream is a major reason the PNA pattern exists; the PNA prefers to exist near the exit region of this jet—and in fact derives some energy from this jet, especially in the winter (1). 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. The negative state of the PNA results in the same pattern except with opposite anomalies (regions that have above-average pressure become below-average and vice versa). These changes to the atmospheric circulation influence surface climate conditions. During the positive PNA, a big anomalous ridge of high pressure over Canada results in fewer cold air outbreaks over Alaska, Canada, and the northern tier of the United States (the opposite is true for negative PNA). Texas, the Southeast United States, and most of the East Coast trend colder thanks to the anomalous trough of low pressure over this region. The PNA is considered the second "leading" pattern of the Northern Hemisphere, with the Arctic Oscillation or North Atlantic Oscillation in first place because it describes slightly more of the atmospheric variations across the hemisphere. (Luann Duhlman - Climate.gov).

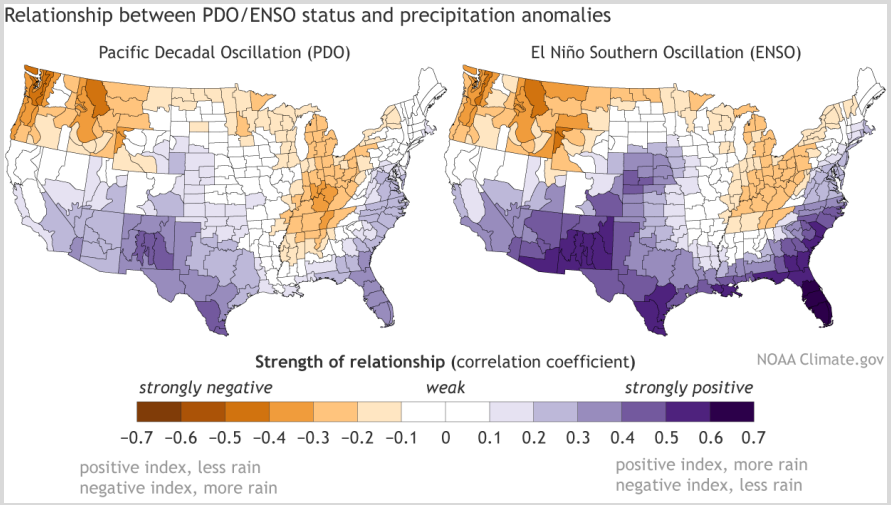
2023-24 Winter Outlook

PDO's Influence on NM

Albuquerque
WEATHER FORECAST OFFICE







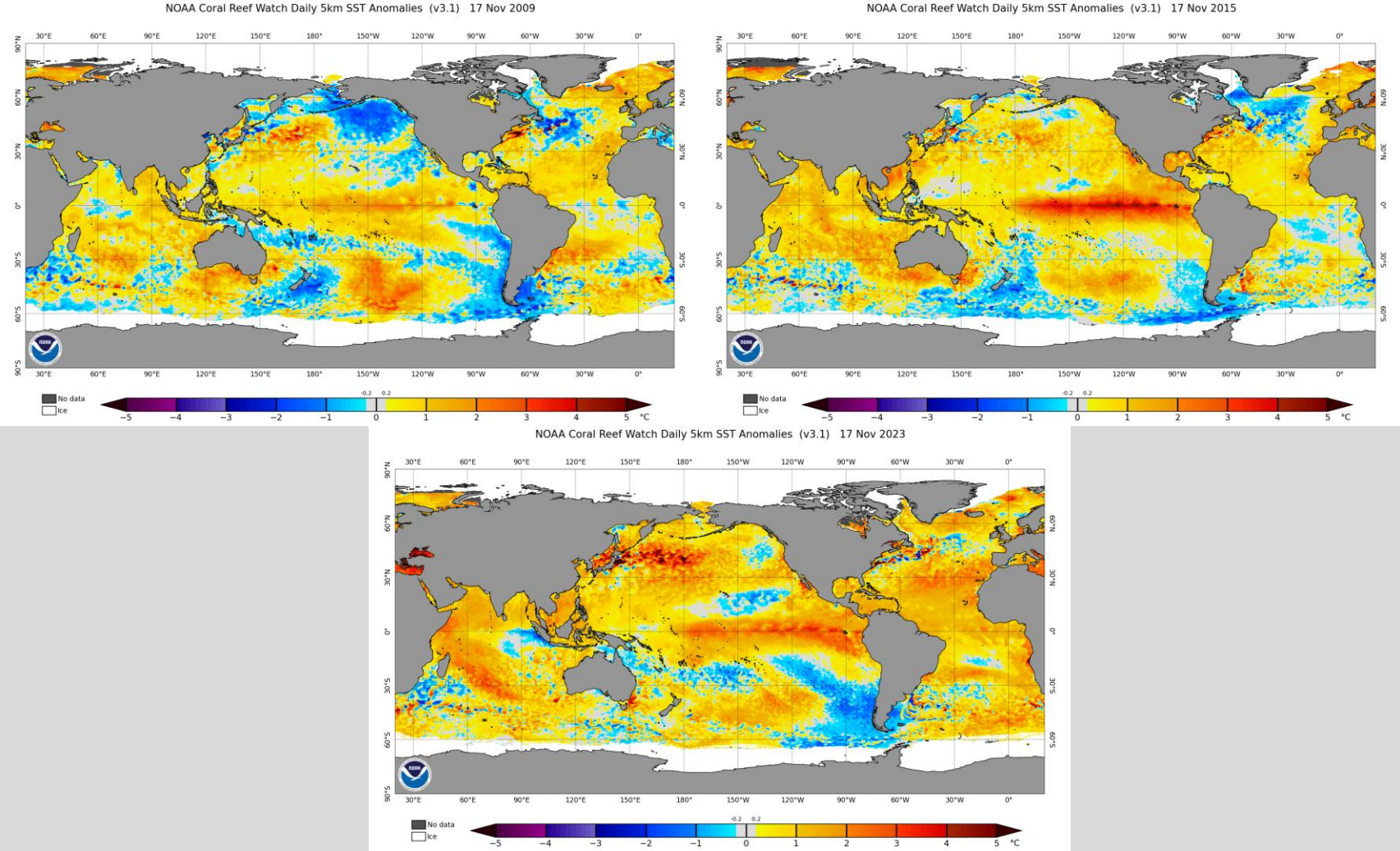
PDO Aug, Sep, Oct 2023	PDO Aug, Sep, Oct 2018	PDO Aug, Sep, Oct 2015
-1.68, -2.13, -1.71	0.03, -0.08, -0.41	1.34, 1.35, 1.08

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 correlates well with above average winter precipitation in the southwest United States. A negative phase of the PDO in 2023 would have normally reduced the strength of the relationship, but there are signs that may be changing. Why? The El Niño of 2018 showed that a strong and long-lived SST gradient near the Marshall Islands in the CPAC can act at times to create a negative Pacific North American (PNA) pattern.

2023-24 Winter Outlook

Albuquerque
WEATHER FORECAST OFFICE

Comparing This Year With Recent El Niño Climate Patterns' SSTAs

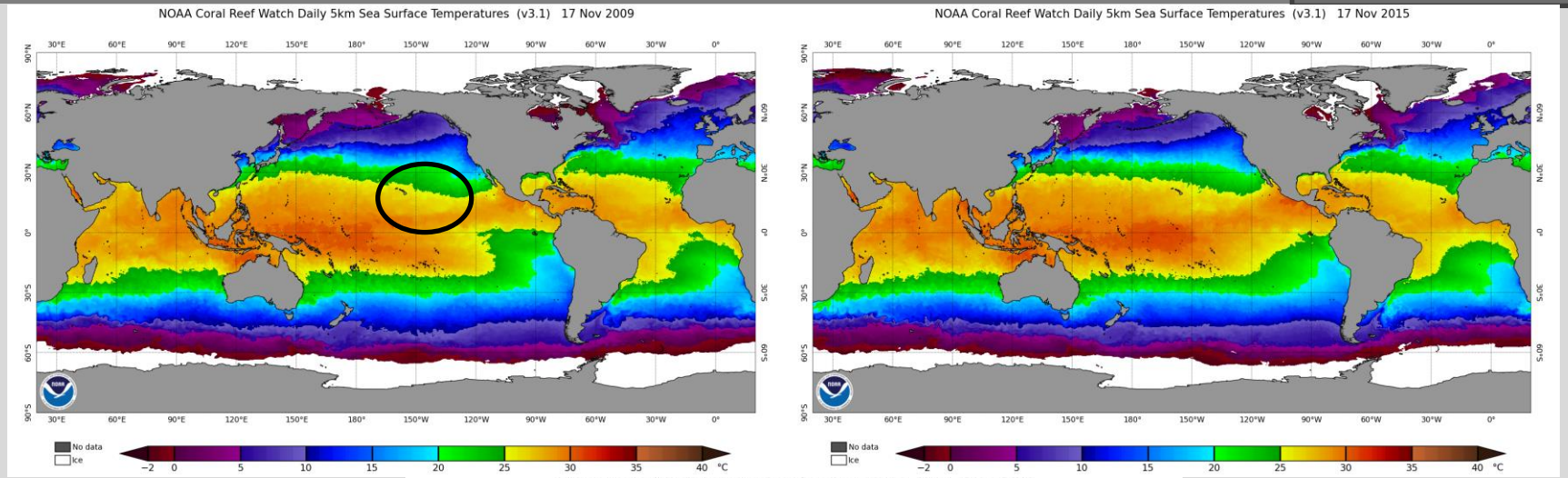


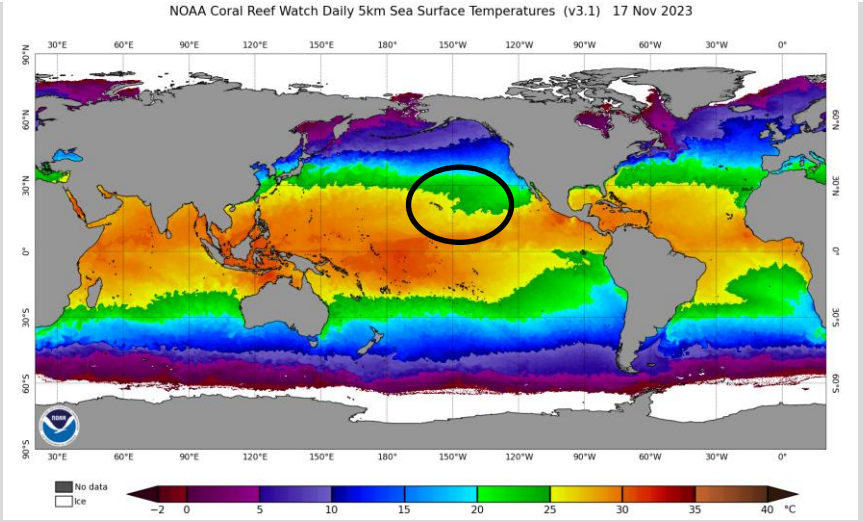
Comparing this year's El Niño to recent moderate to strong events. SST gradients or difference from average are notably dissimilar when comparing 2023 to the 2015-16 event. What does it mean? All El Niño climate events are different from one another. A negative PDO (warm water in the northwest PAC with relatively cool waters along the west coast of North America) is what separates this year compared to the strong El Niño of 2015-16. This year is looking more like the moderate El Niño of 2009-10 due to the negative phase of the PDO.

2023-24 Winter Outlook

Albuquerque
WEATHER FORECAST OFFICE

SST Gradients



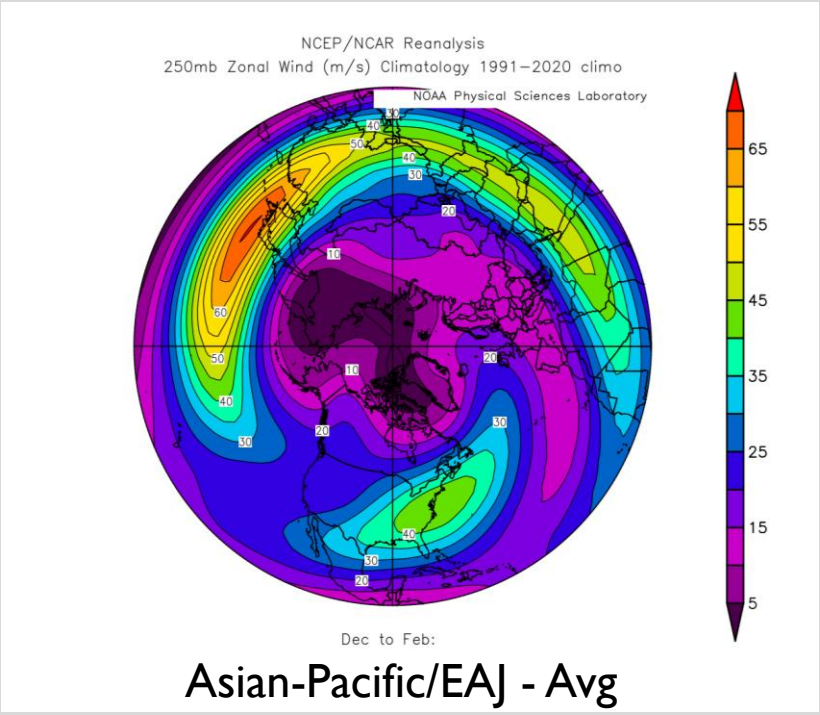


ENSO prediction, after all, is all about the SST gradients. While warm water is necessary for thunderstorms to develop, surface convergence can be key to where deep convection in the tropics and subtropics develops most commonly during the upcoming winter season. Where does the 2023 SST gradient set up in the EPAC? 2023 is showing signals that are closer to 2009 than 2015 thanks to a negative or cool phase of the PDO.

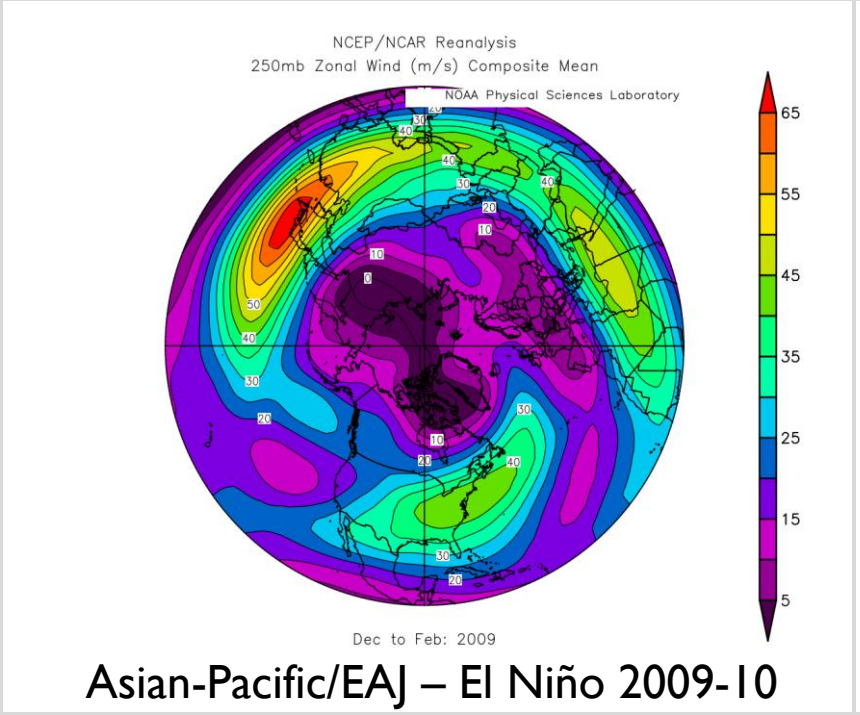
2023-24 Winter Outlook

How El Niño Influences the Asian-Pacific Jet

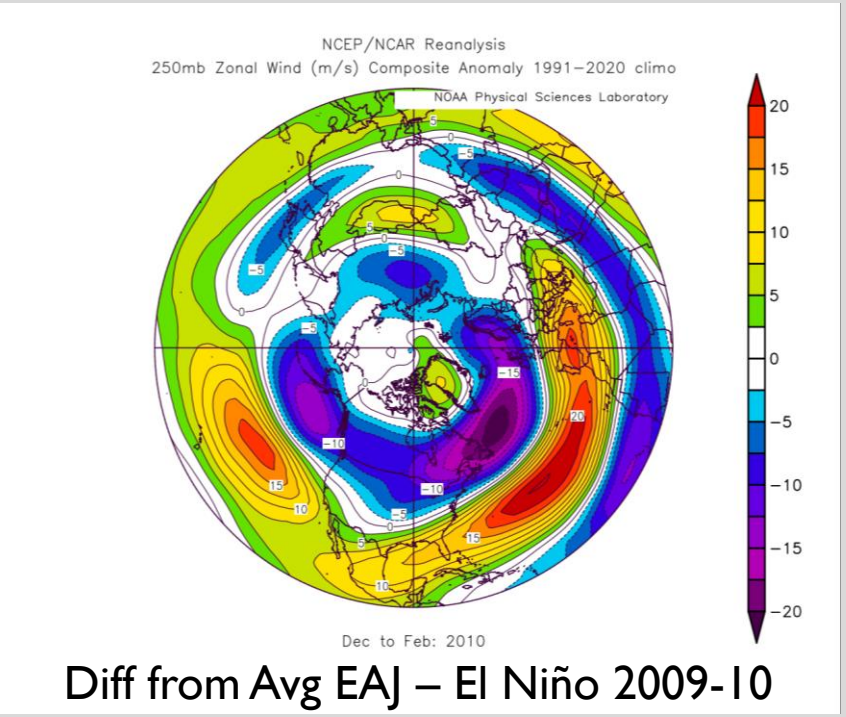
Albuquerque
WEATHER FORECAST OFFICE



Asian-Pacific/EAJ - Avg



Asian-Pacific/EAJ – El Niño 2009-10



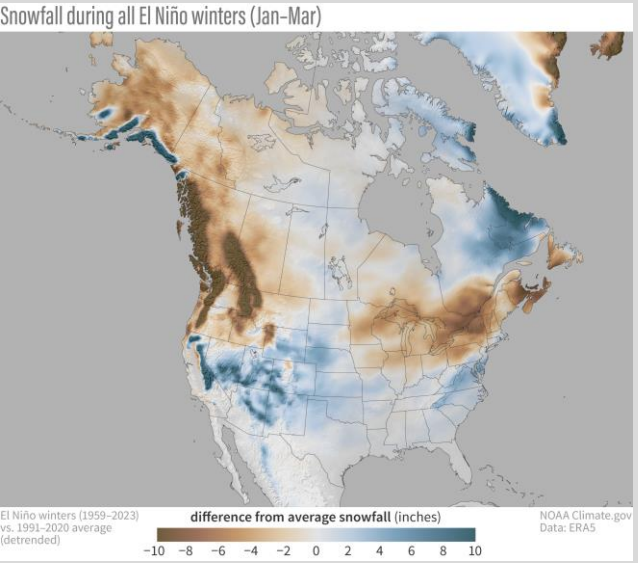
Diff from Avg EAJ – El Niño 2009-10

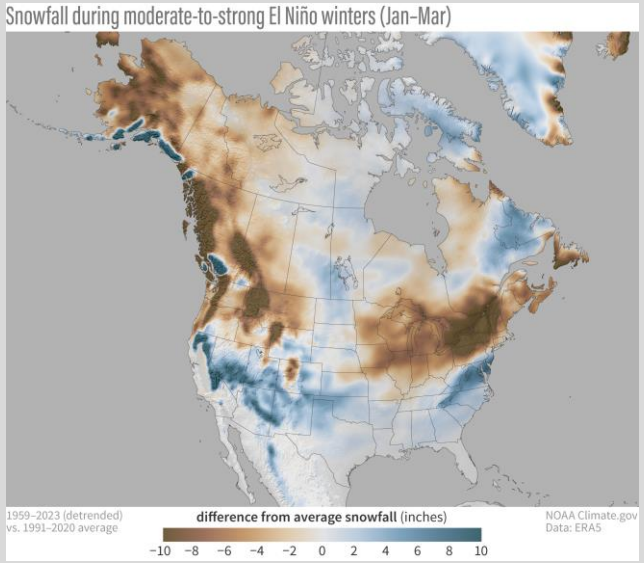
All this talk of how thunderstorms in the tropics and subtropics act on the storm track or jet stream, but what is it really we are talking about? This. The above images show a typical wintertime Pacific-Asian or East Asian Jet stream on the left and how the 2009-10 El Niño climate pattern changed the status quo (middle). The typical wintertime jet on the left peaks near 70 m/s or 157 mph just off the coast of Japan and gets much weaker as it translates eastward into the Pacific Ocean. During El Niño, the Pacific and Atlantic jets are enhanced. Why? More thunderstorm activity farther eastward creates this enhanced Northern Hemisphere circulation and weather/climate patterns are temporarily changed. A relatively subtle change is observed when it's averaged out over three months, but the overall concept hopefully makes some meteorological and climatological sense.

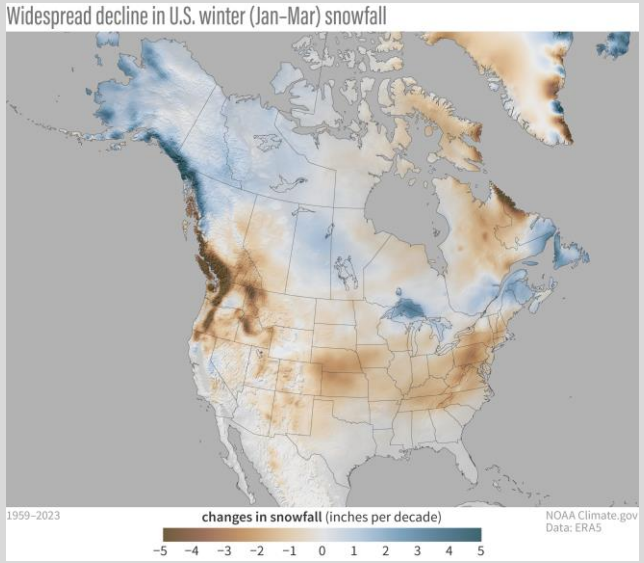
2023-24 Winter Outlook

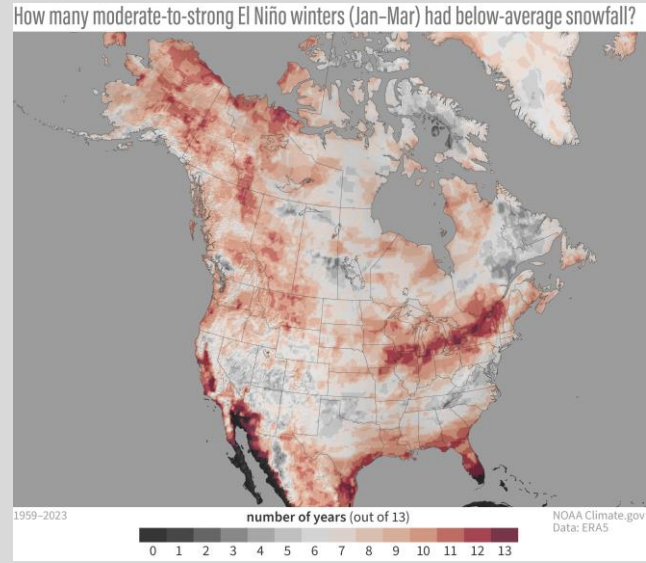
How El Niño Influences Snowfall in North America

Albuquerque
WEATHER FORECAST OFFICE









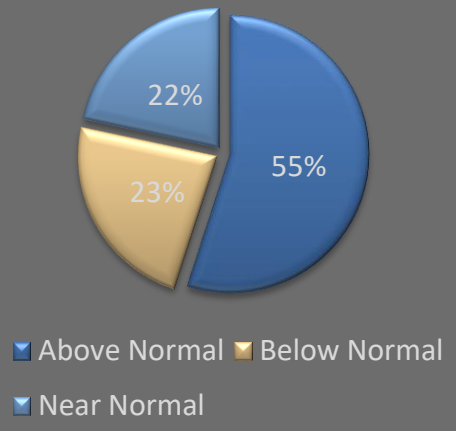
Various snowfall graphics relating to the El Niño climate pattern from January through March. Note the moderate to strong El Niño influences on the top right. Storm track dips farther south compared to weaker events, and the Central Rockies lose out. Also note the overall snowfall decline over much of the lower 48 states. Courtesy: Climate.gov

2023-24 Winter Outlook

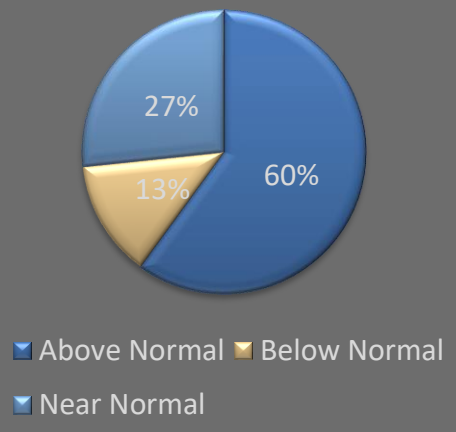
How El Niño Influences Precipitation in Different Climate Regions of NM since 1950

Albuquerque
WEATHER FORECAST OFFICE

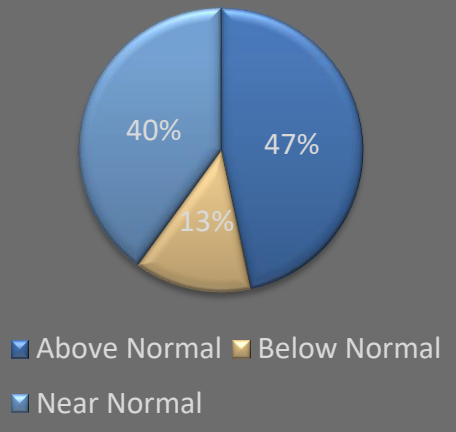
New Mexico



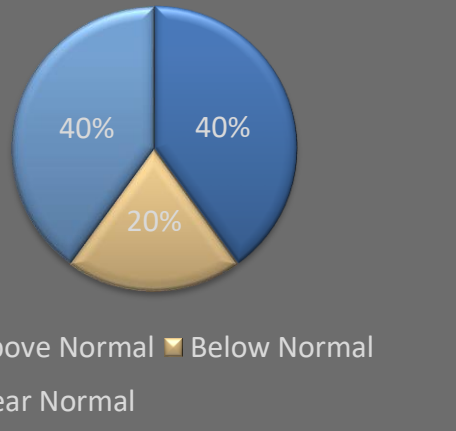
Northwest Plateau



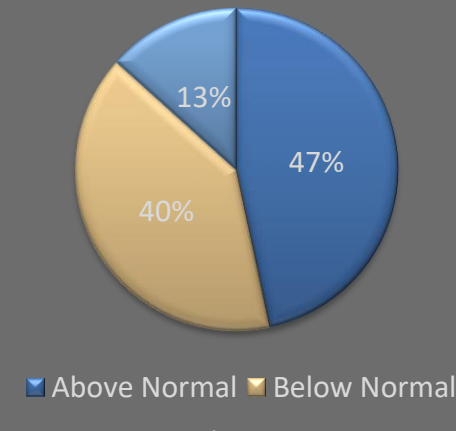
Central Highlands



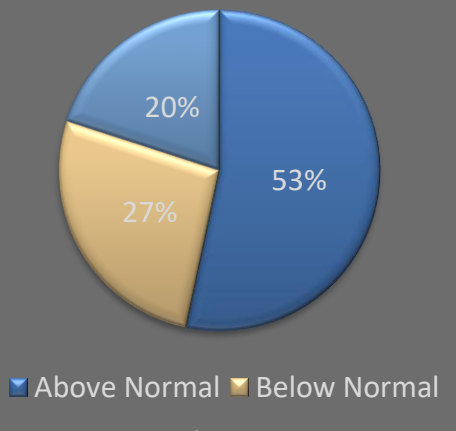
Northern Mountains



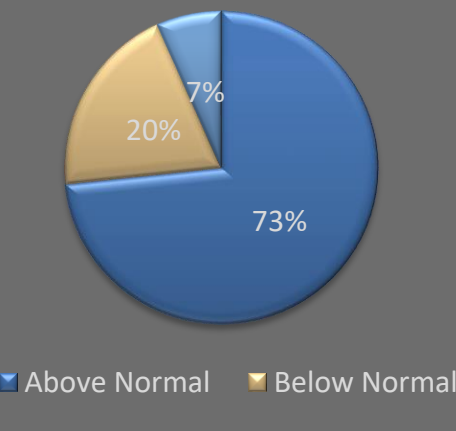
Northeast Plains



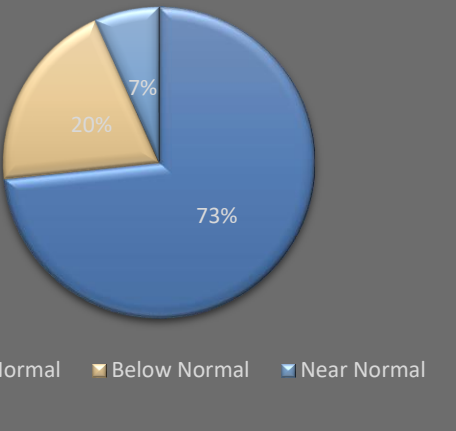
Rio Grande Valley



Southern Desert



Southwest Mountains

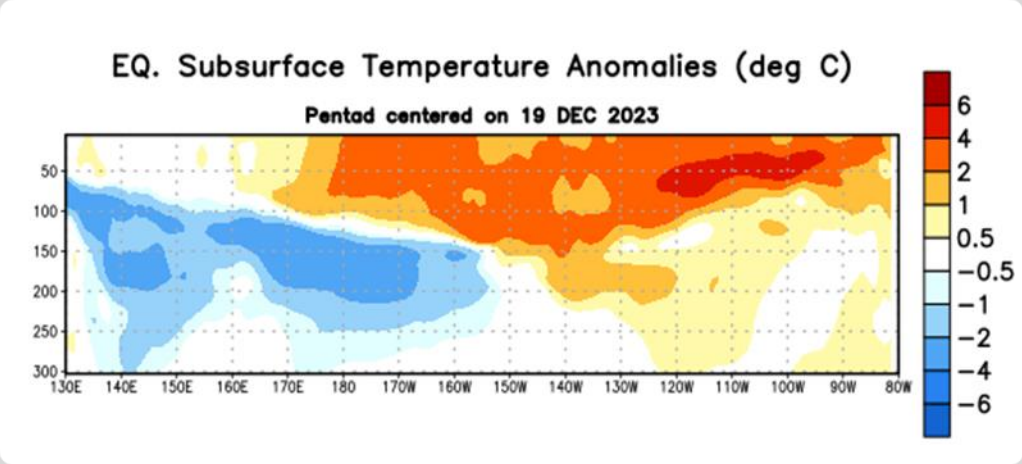


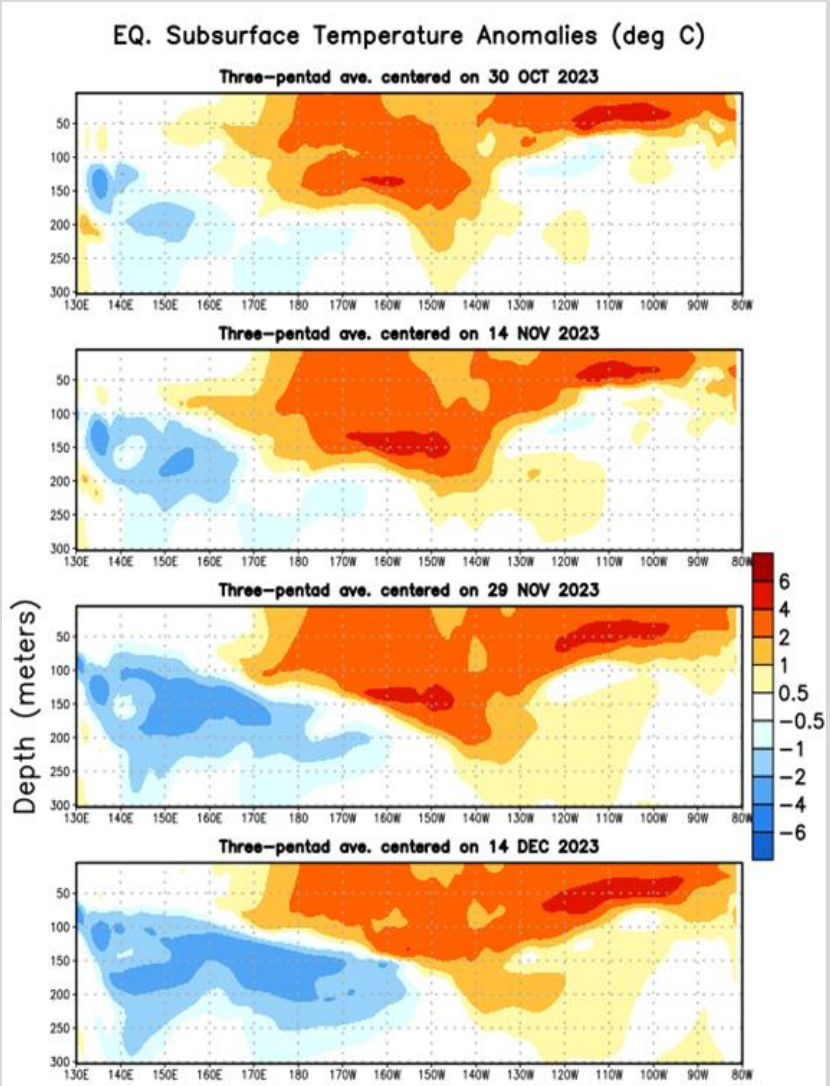
Precipitation difference from average in NM's climate divisions during moderate to strong El Niño climate patterns since 1950. Southern and western portions of the state benefit the most from El Niño. Could that, however, be changing?

2023-24 Winter Outlook

Subsurface Pacific Ocean Temperatures

Albuquerque
WEATHER FORECAST OFFICE



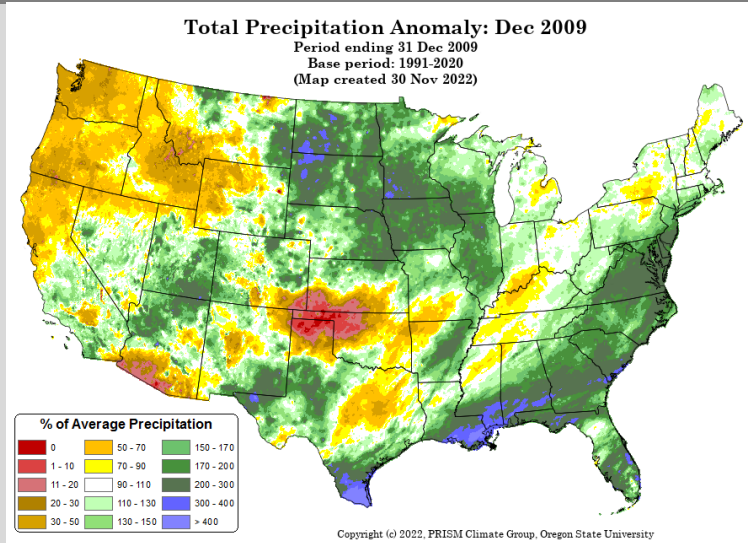


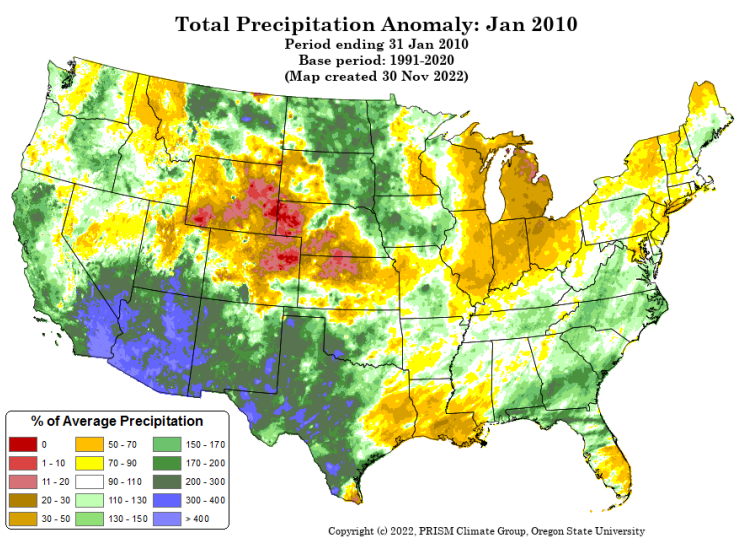
Positive subsurface temperature anomalies are present over most of the equatorial Pacific Ocean.

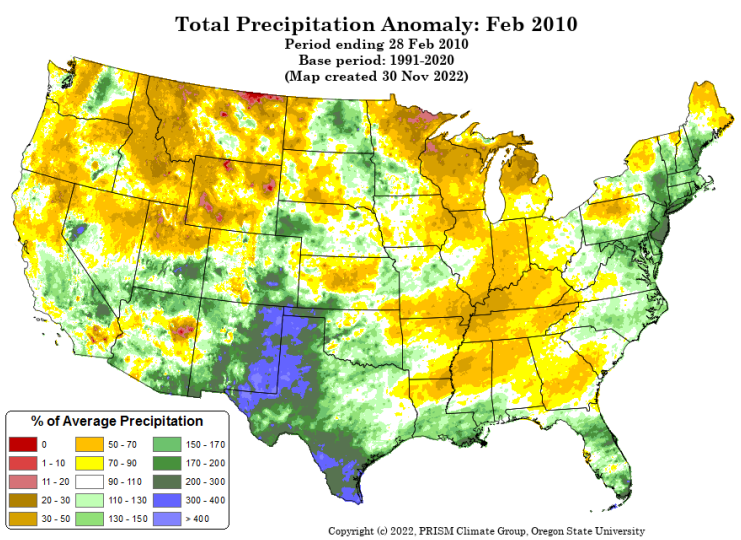
2023-24 Winter Outlook

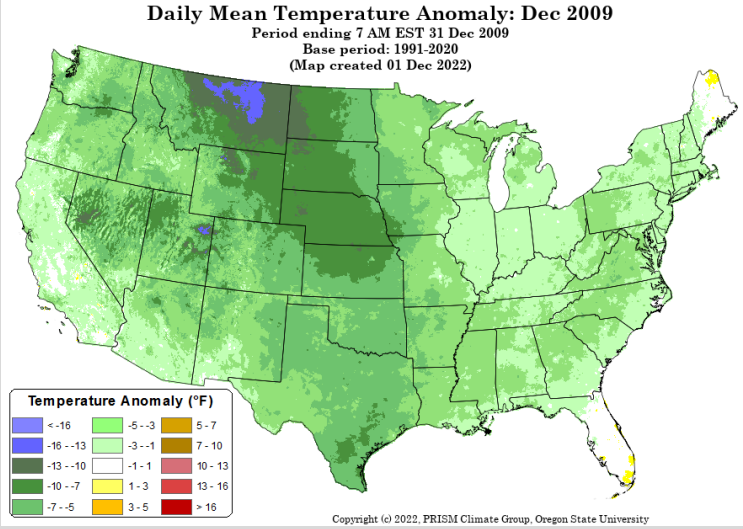
Previous Moderate to Strong El Niño Climate Pattern

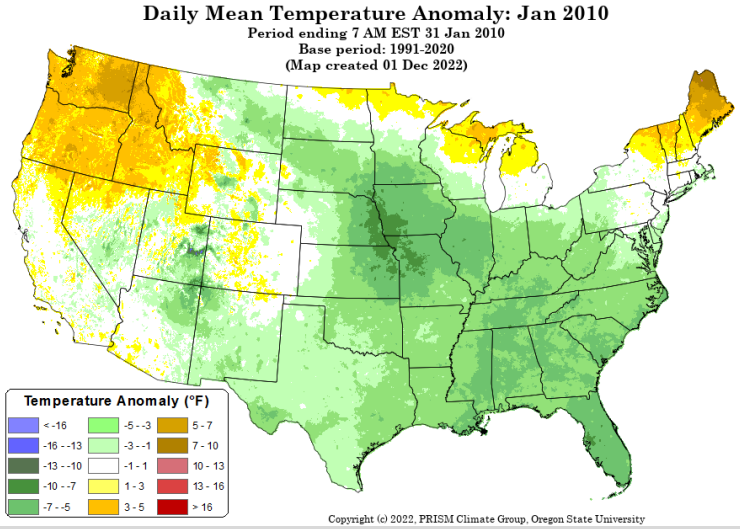
Albuquerque
WEATHER FORECAST OFFICE

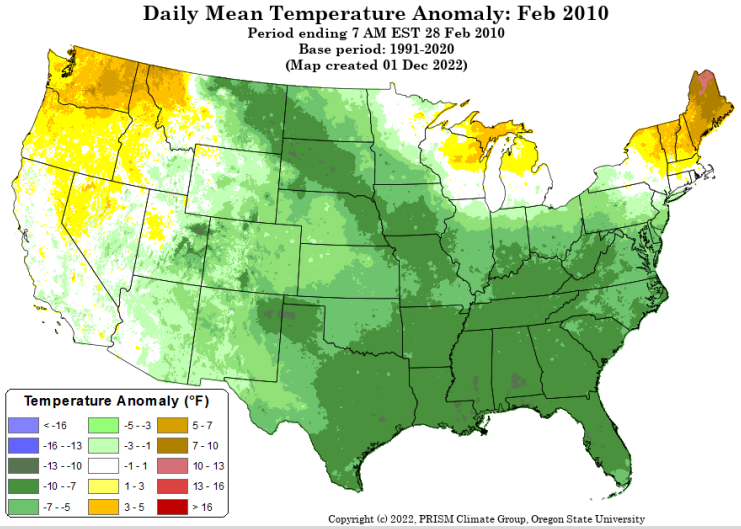










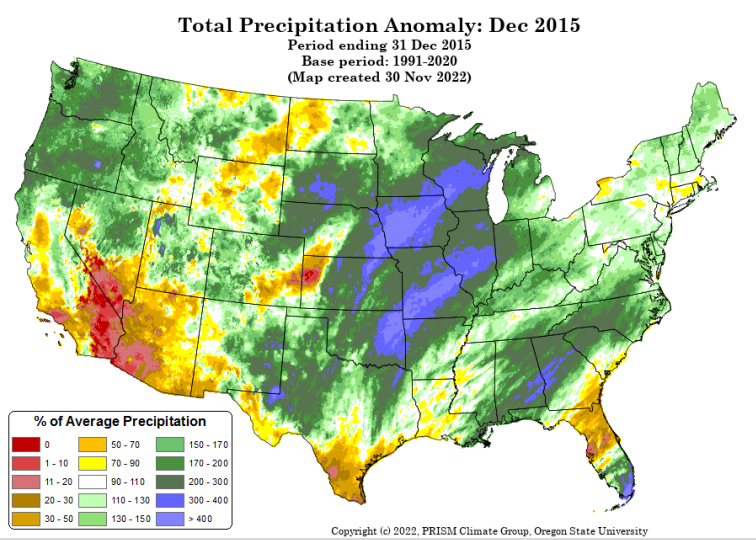


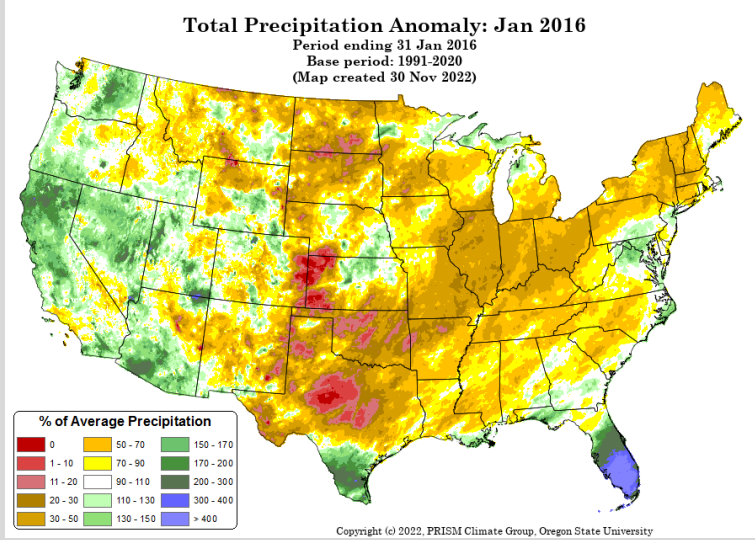
What were precipitation and temperatures like in winter during the last moderate to strong El Niño in 2009-10? The entire state measured above average precipitation and below average temperatures.

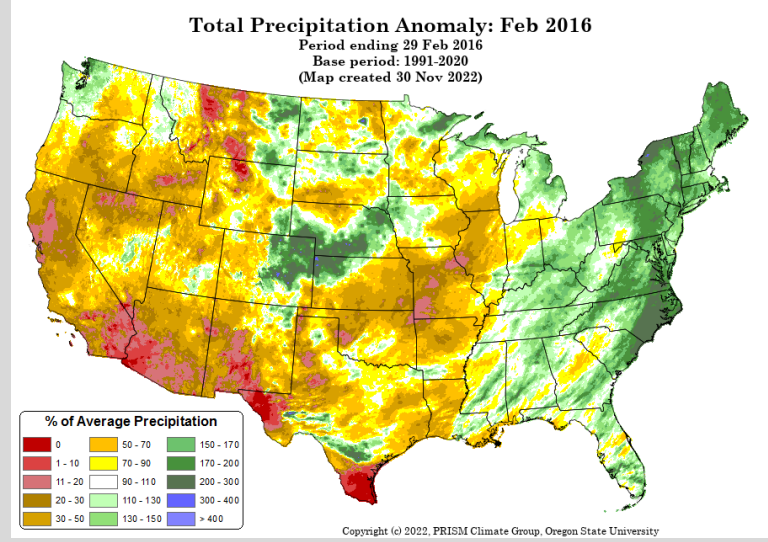
2023-24 Winter Outlook

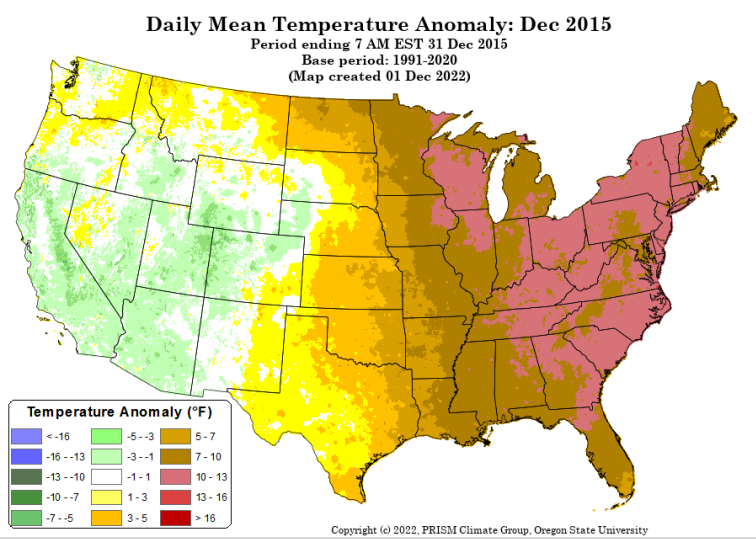
Albuquerque
WEATHER FORECAST OFFICE

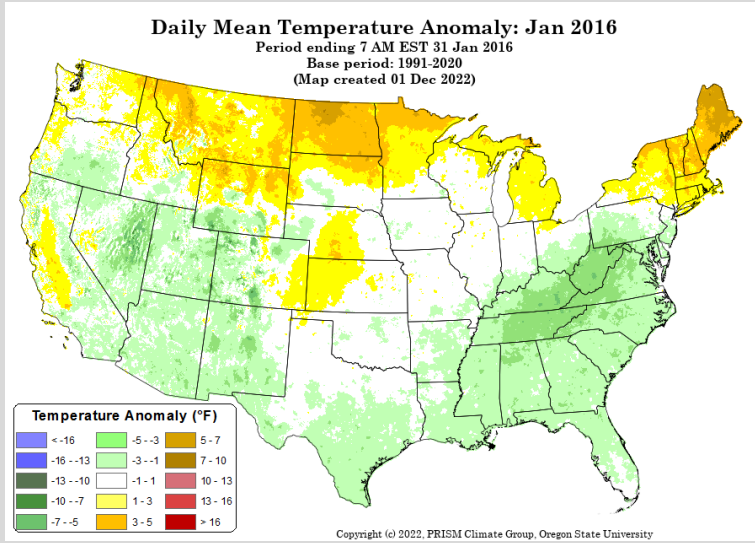
Most Recent Analog Year

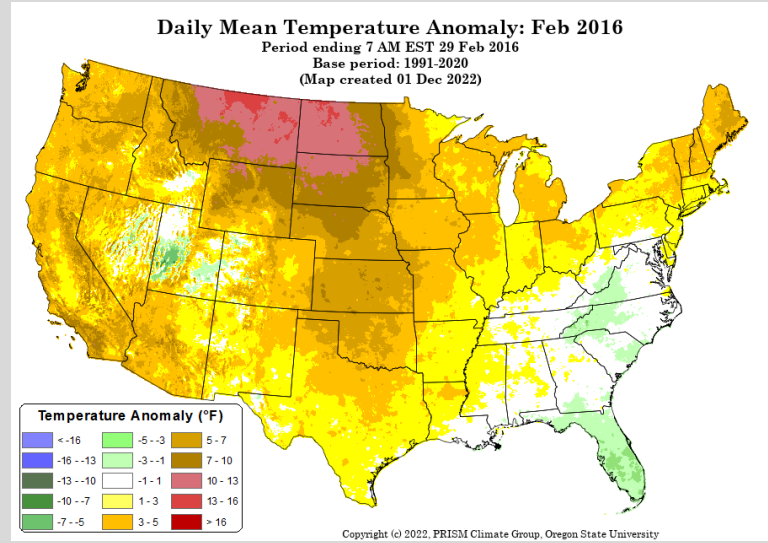










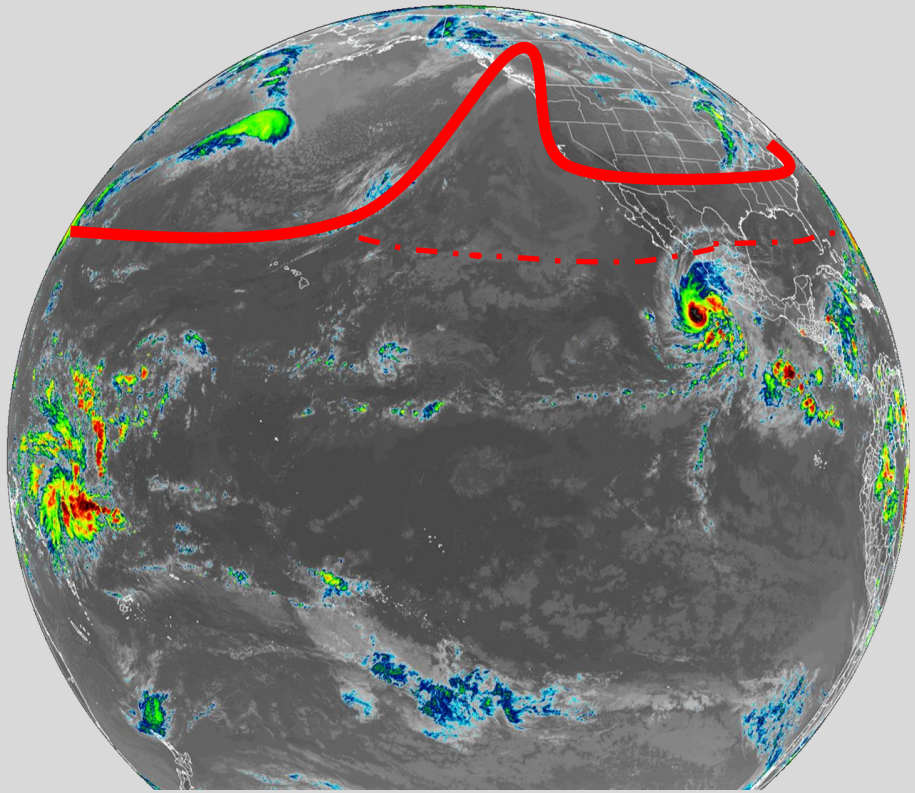


What was winter like during the last strong El Niño in winter 2015-16? One major winter storm in late December 2015 was able to keep winter precipitation near average, otherwise, the storm track went too far south for much of winter. This El Niño is looking different than the 2015-16 event in large part due to a negative or cool phase of the PDO.

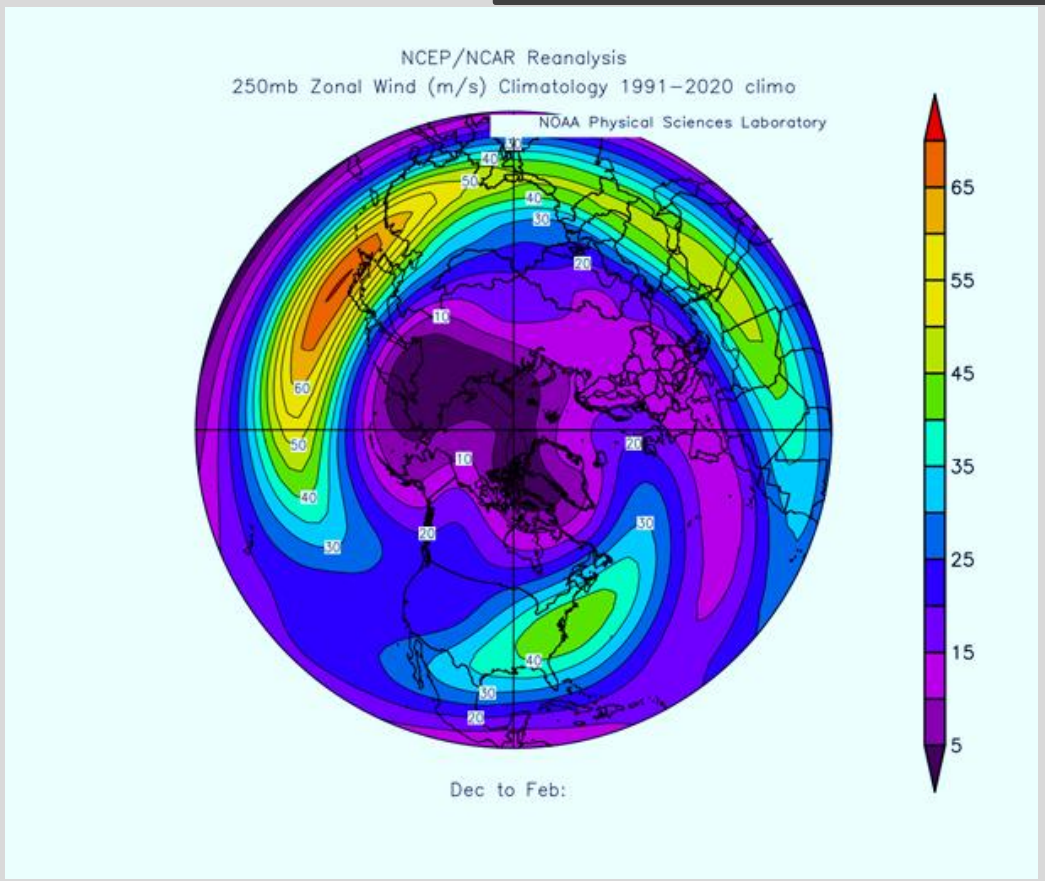
2023-24 Winter Outlook

An Easier Forecast This Year?

Albuquerque
WEATHER FORECAST OFFICE



An absence of thunderstorms in the equatorial EPAC forces the polar jet stream (red line) to split in two (subtropical jet = dashed line) and a high amplitude ridge of high pressure develops over the eastern Pacific.

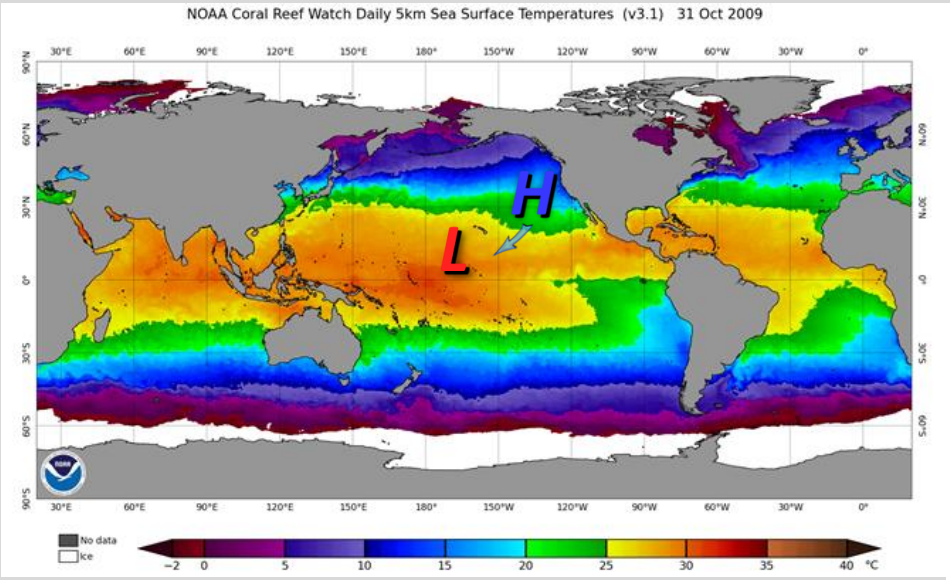


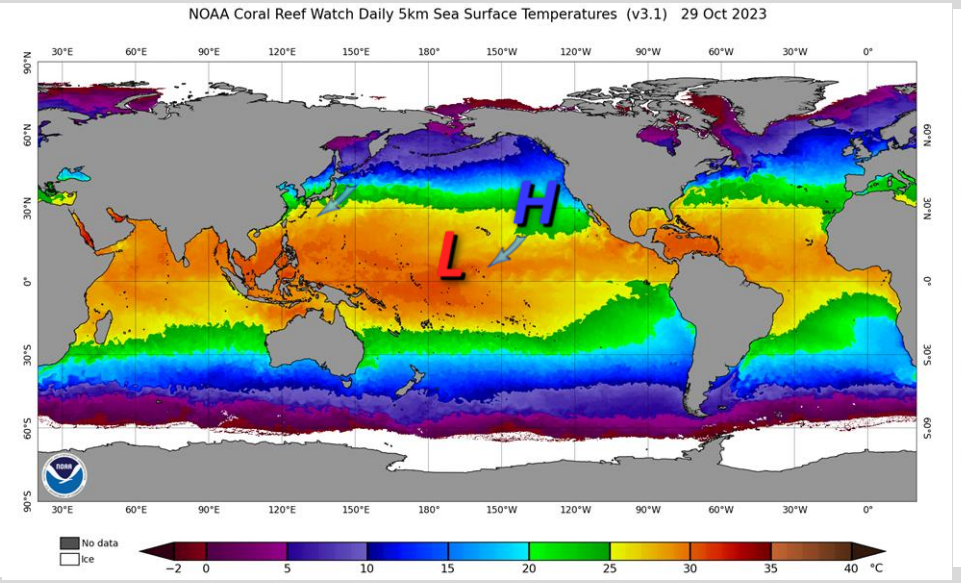
Why might this El Niño be easier to forecast than the 2015-16 event? When a strong Pacific-Asian or East Asian Jet (EAJ), born on a strong temperature difference between the poles and equatorial WPAC, runs into a lack of thunderstorm activity in the equatorial EPAC where the temperature difference is much less, it must split in two to get back into thermal balance. As a result, an upper-level ridge of high pressure builds downwind and so on and so forth. For example, the above satellite image shows the lack of thunderstorms in much of the EPAC. If SST anomalies hold as they did in 2009-10 and 2018, this is the weather pattern that could end up being rather common during DJF 2023-24.

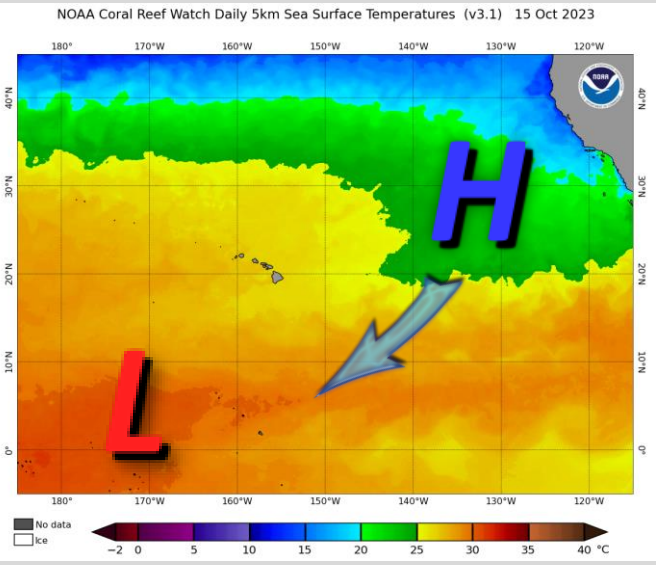
2023-24 Winter Outlook

A Closer Look at SSTs

Albuquerque
WEATHER FORECAST OFFICE





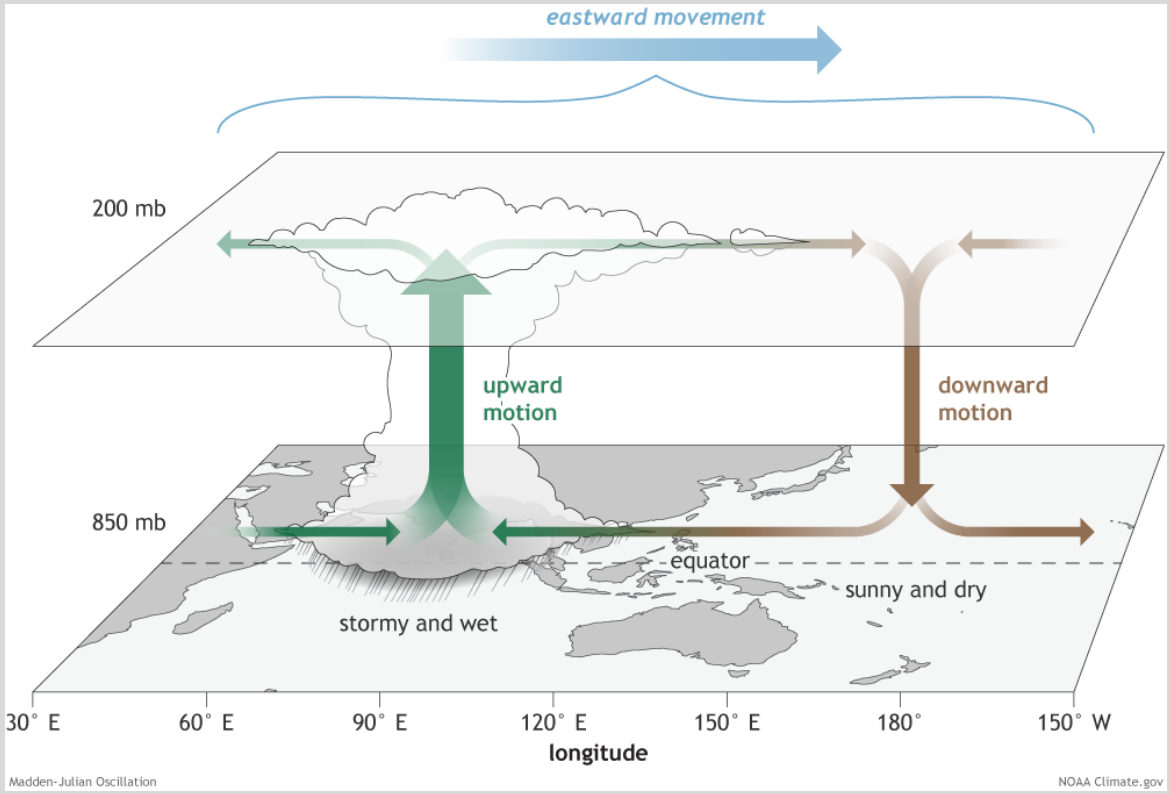


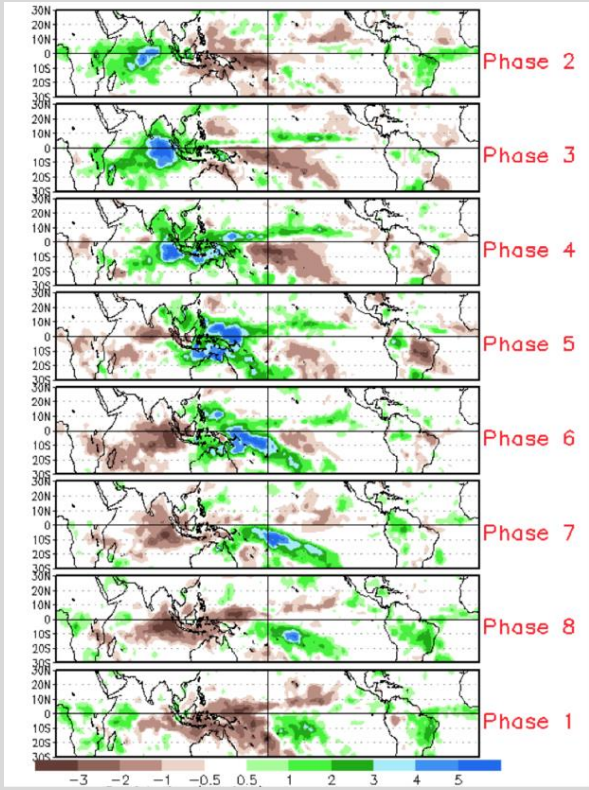
The Micronesia/Marshall Islands low in 2009-10 helped get convection and a negative Pacific North American (PNA) pattern going at times during winter. Why is this important? It looks like a similar set up in the northern Pacific Ocean in 2023, thunderstorms are likely to be common in this region in DJF due to anomalously strong surface convergence. When the polar or East Asian Jet (EAJ) moves just east of the thunderstorms in the CPAC and the associated strong temperature difference, the jet must get back into thermal balance and split (previous slide). A high amplitude ridge of high pressure develops in the EPAC as a result and an upper-level trough and stormy weather forms over the Western U.S.

2023-24 Winter Outlook

Madden-Julian Oscillation (MJO)

Albuquerque
WEATHER FORECAST OFFICE



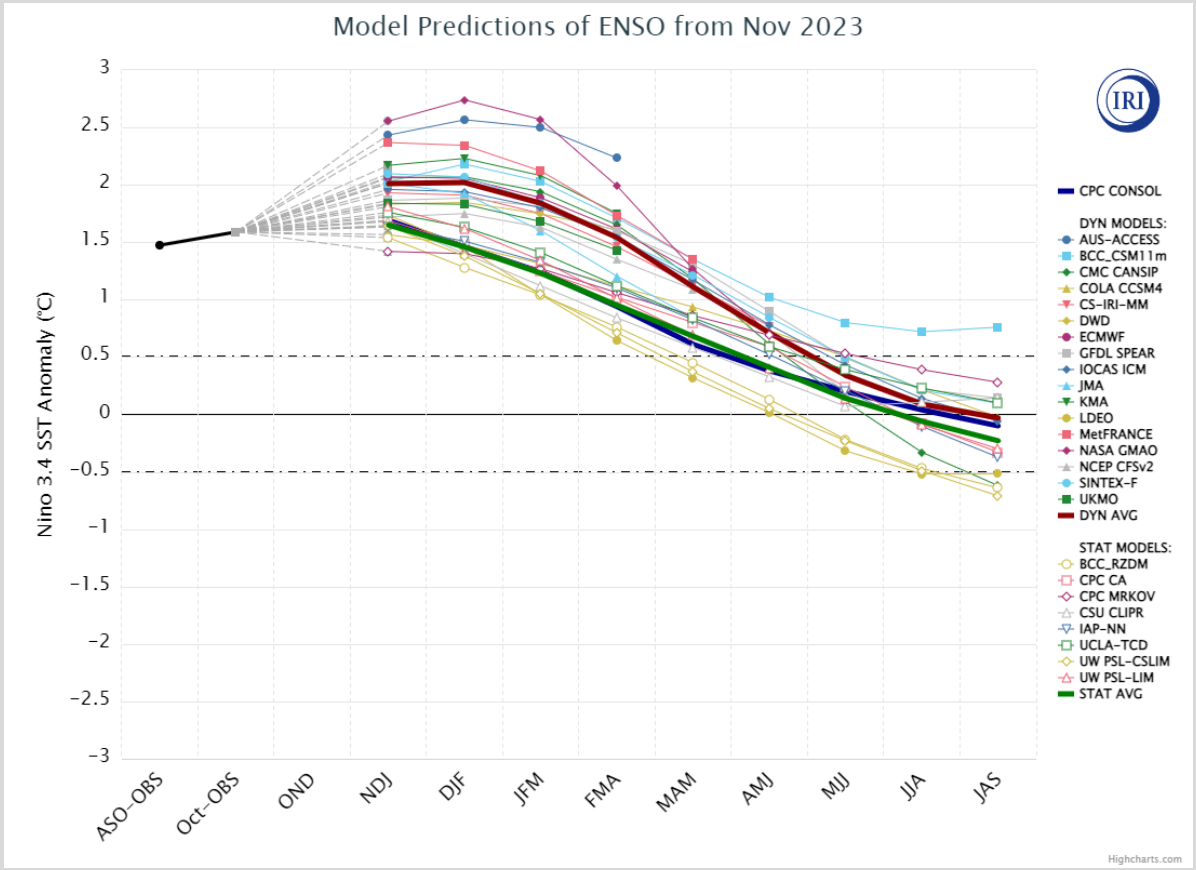


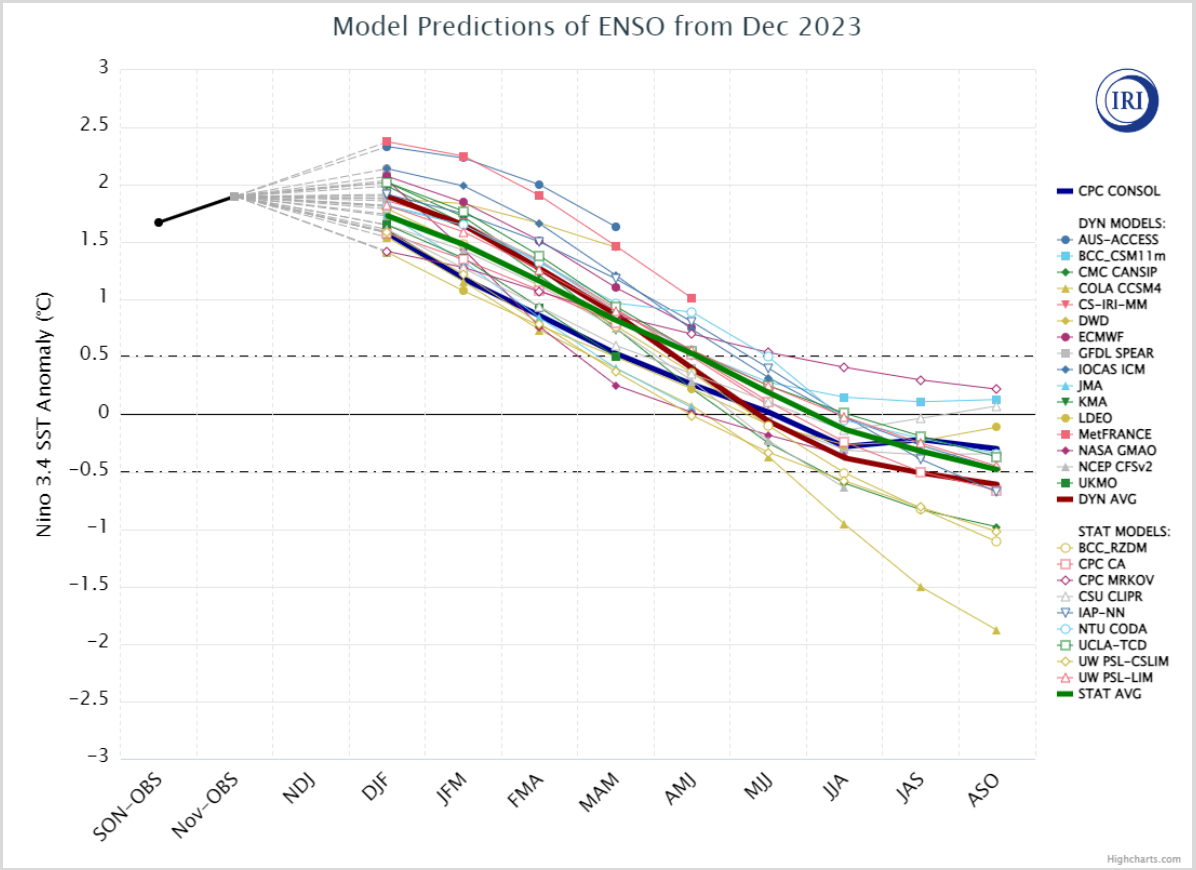
The Madden-Julian Oscillation (MJO) is an area of enhanced thunderstorms that travels around the world every 30 to 60 days from west to east along/near the equator. Ahead and behind the active stormy area are areas of suppressed convection and drier conditions. The MJO affects near-surface wind patterns, because the rising air in the stormy region cause 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. When La Niña comes to an end, the enhanced trade winds weaken, allowing warmer water to return to the eastern Pacific and either neutral conditions or an El Niño to develop. This warmer water allow thunderstorms related to the MJO to continue eastward into the EPAC, influencing the jet stream. Typically, El Niño results in above average precipitation in New Mexico during the cool season.

2023-24 Winter Outlook

SST Model Predictions from IRI

Albuquerque
WEATHER FORECAST OFFICE



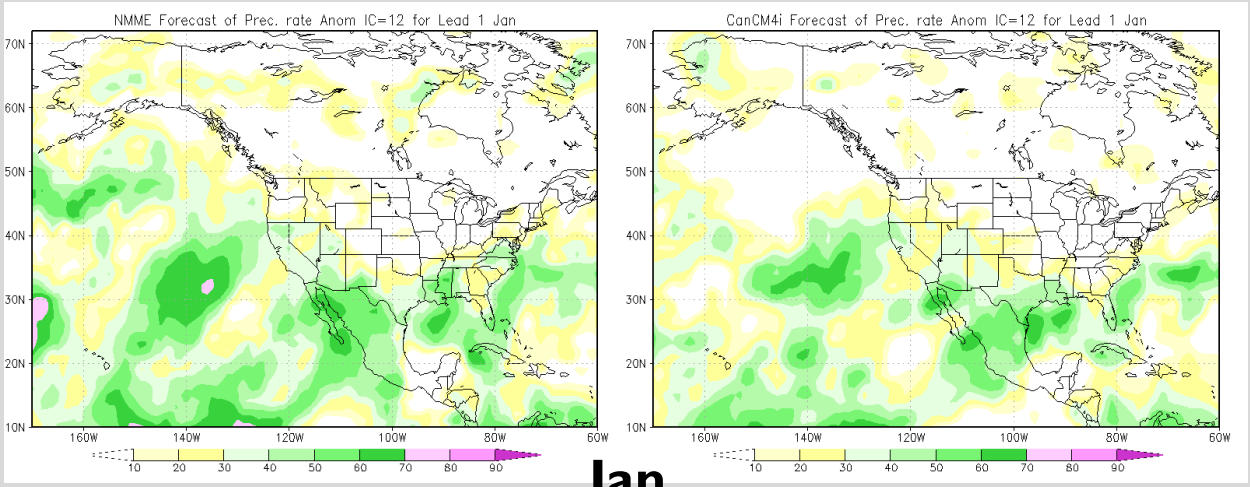


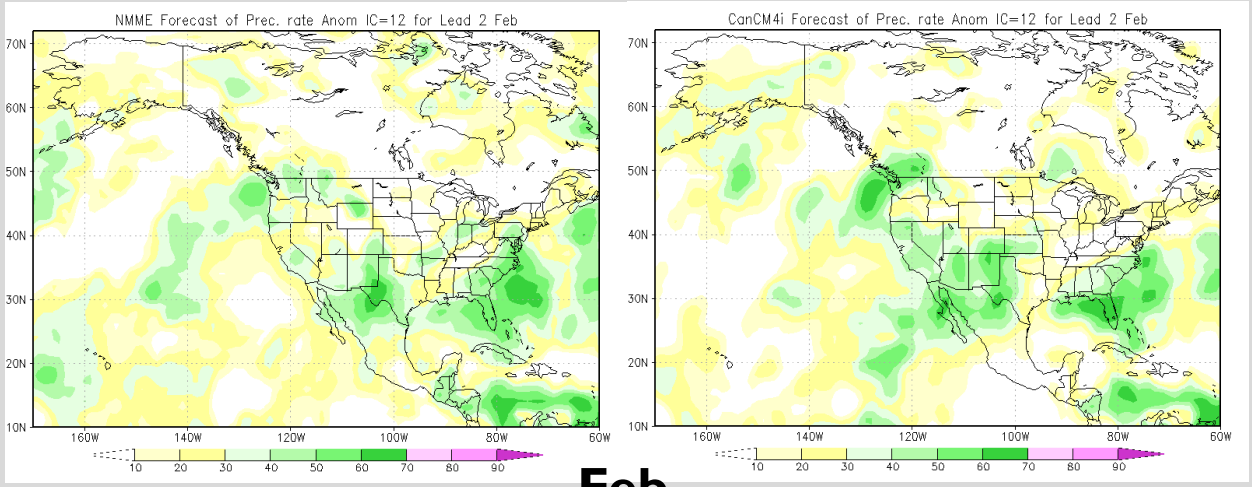
Model prediction of ENSO from November and December 2023. Dynamical model average cools SSTs below El Niño thresholds by late spring or early summer 2024.

2023-24 Winter Outlook

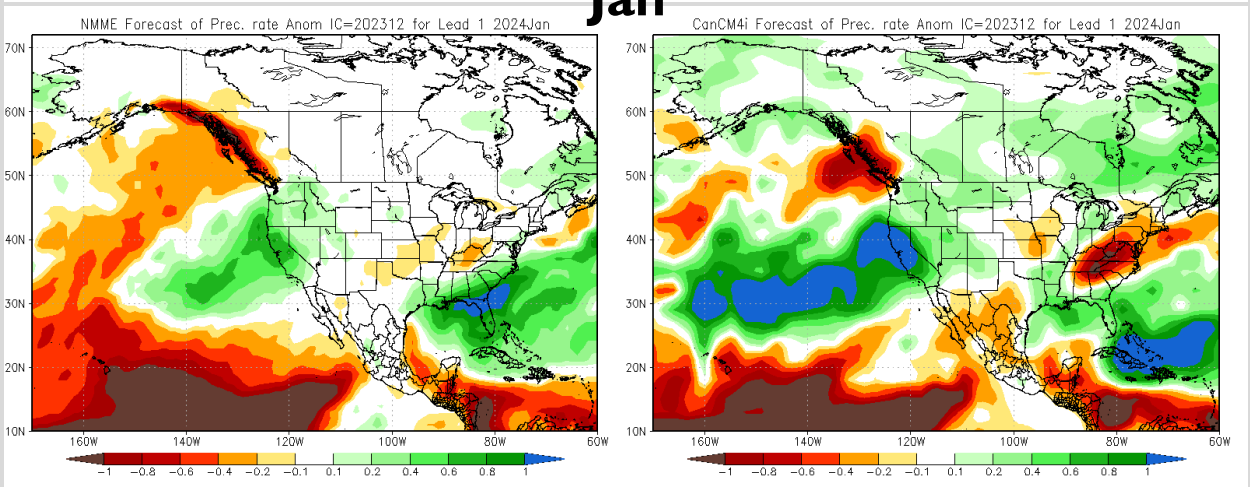
Climate Model Forecasts – Dec & Jan

Albuquerque
WEATHER FORECAST OFFICE

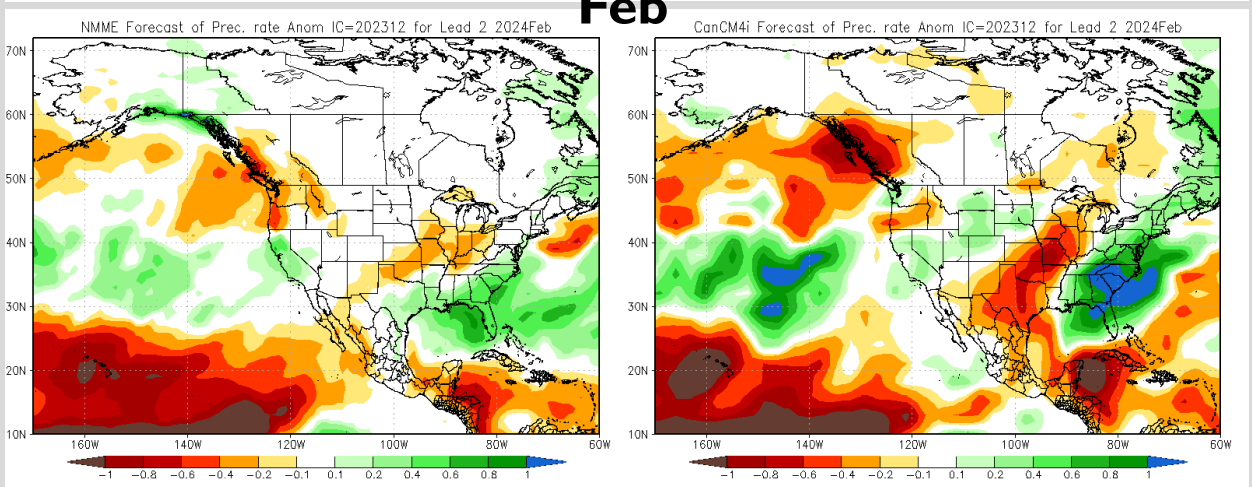




Jan



Feb

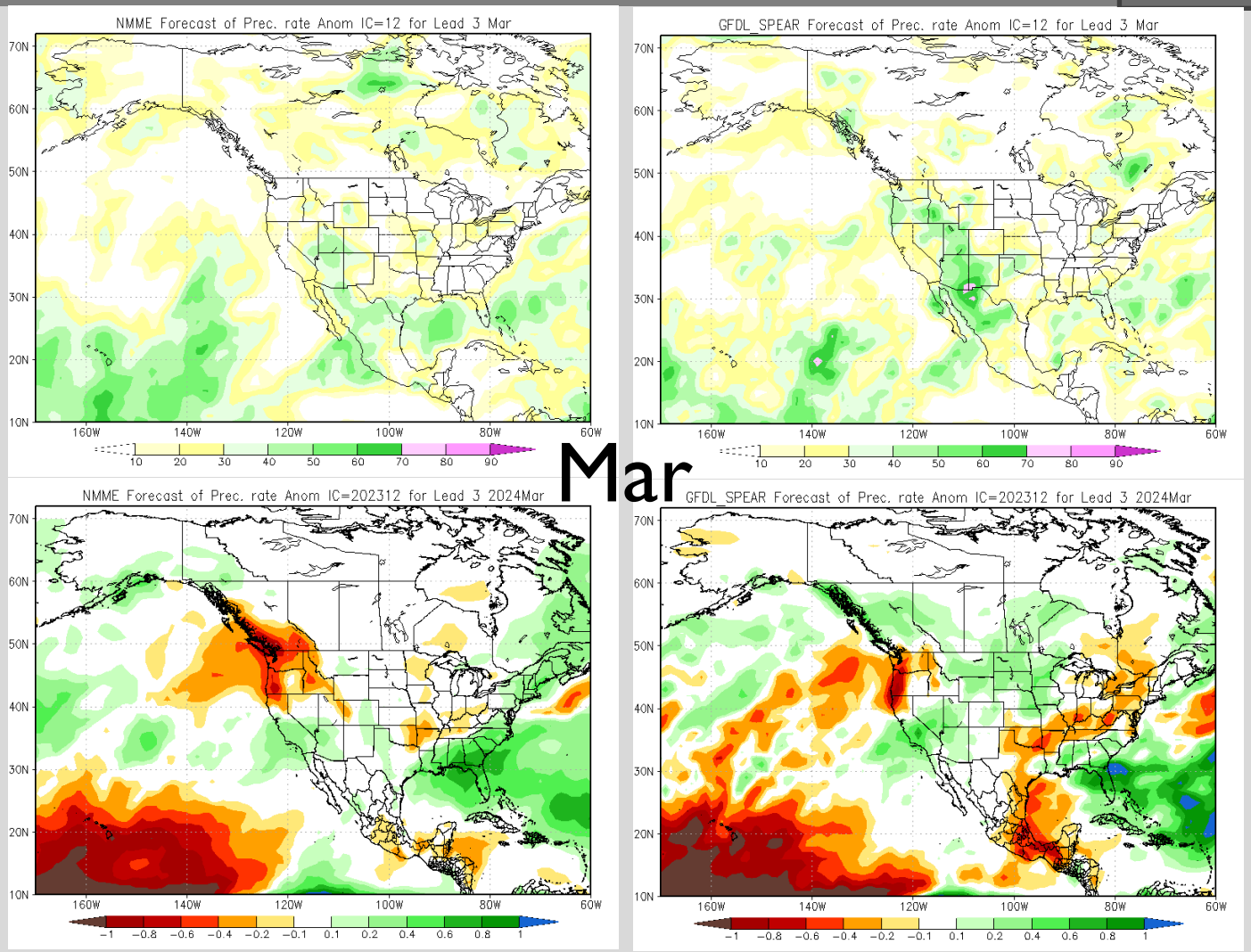


Model precipitation rate anomaly from the two climate models that have the highest forecast skill percentages (top row), the North American Multi-Model Ensemble (NMME) and the Canadian CM4i models for January and February. Both models show fair to good forecast skill for NM during DJF and are predicting above to well above average precipitation for northwest NM.

2023-24 Winter Outlook

Climate Model Forecasts - Feb

Albuquerque
WEATHER FORECAST OFFICE

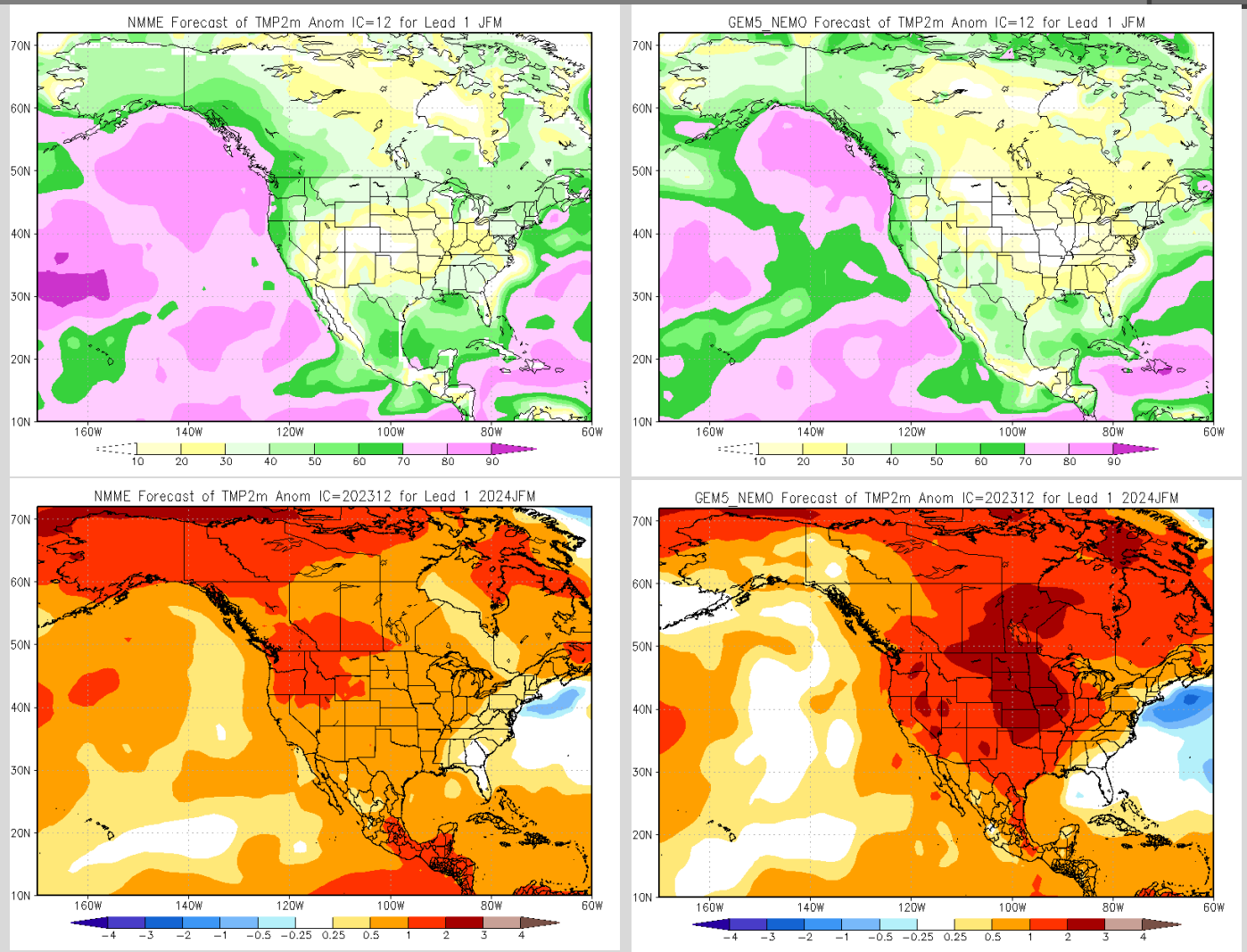


Model precipitation rate anomaly from the two climate models that have the highest forecast skill percentages (top row) for February 2024, the North American Multi-Model Ensemble (NMME) and the GFDL_SPEAR. Both models show fair to good forecast skill for NM during February and are forecasting near average precipitation.

2023-24 Winter Outlook

Climate Model Forecasts - Temperatures

Albuquerque
WEATHER FORECAST OFFICE

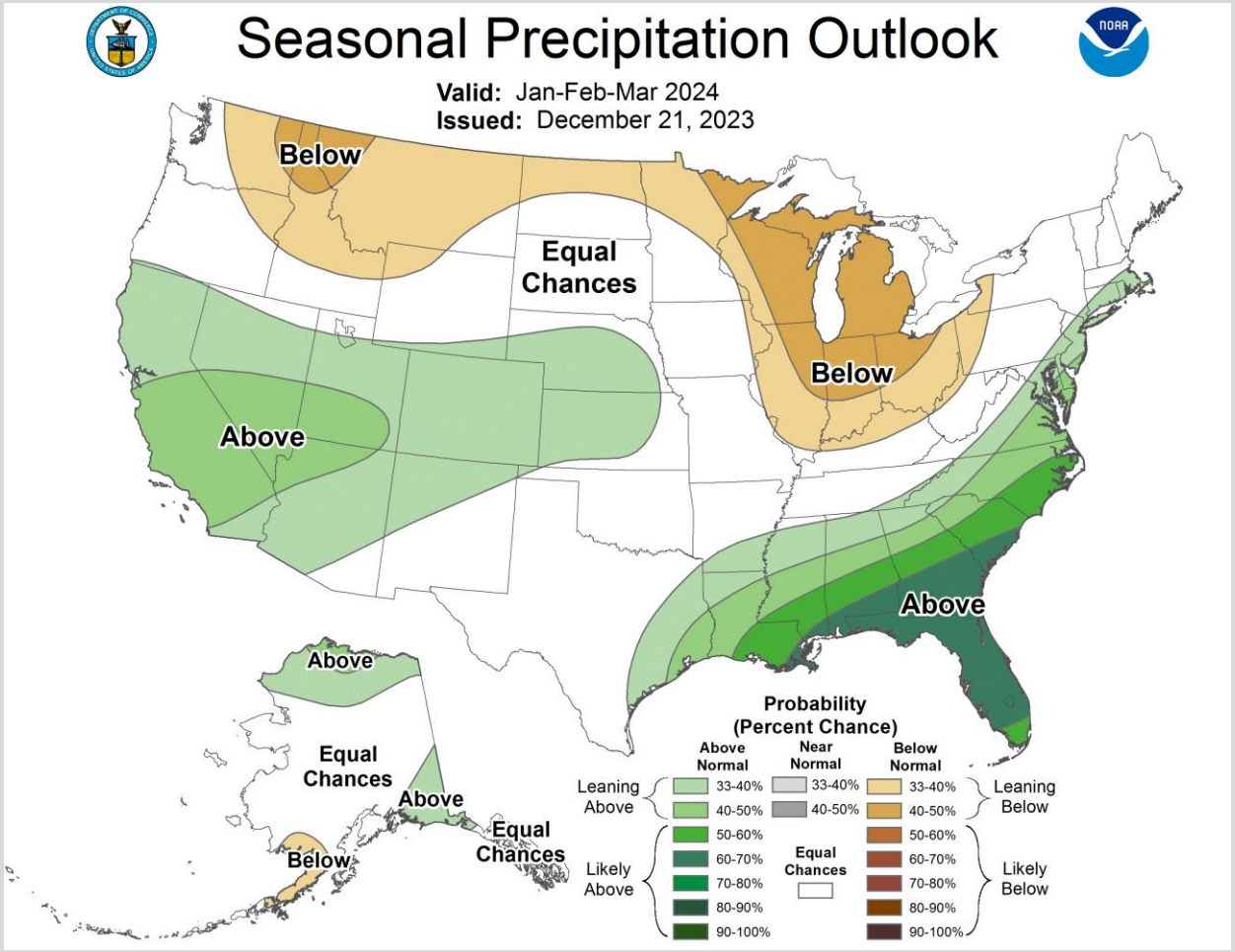


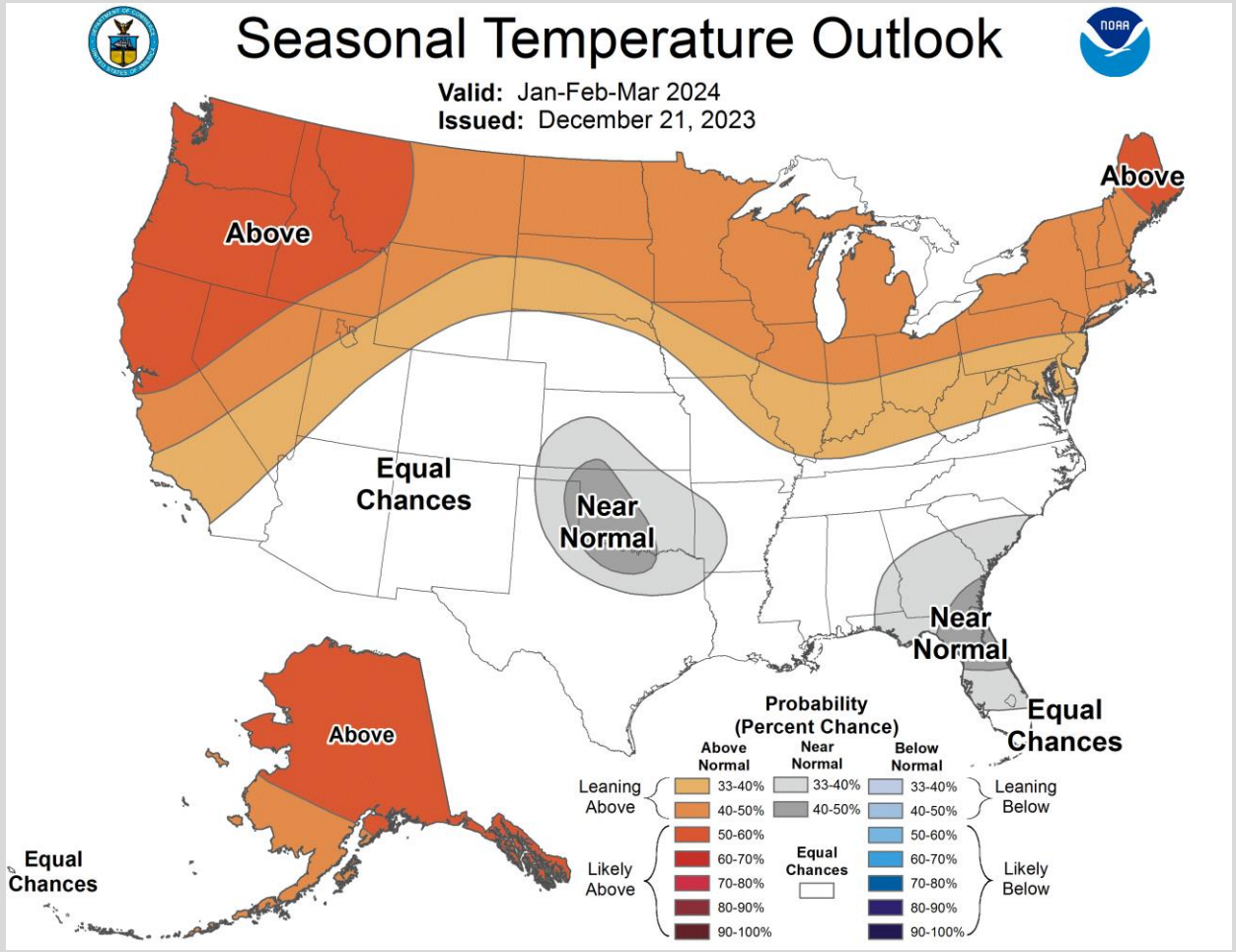
Temperature difference from average forecasts from the two climate models that have the highest temperature forecast skill (top row), the North American Multi-Model Ensemble (NMME) and GEM5_NEMO models. Both model forecasts are predicting near to slightly above average temperatures in JFM.

2023-24 Winter Outlook

Climate Prediction Center (CPC)

Albuquerque
WEATHER FORECAST OFFICE





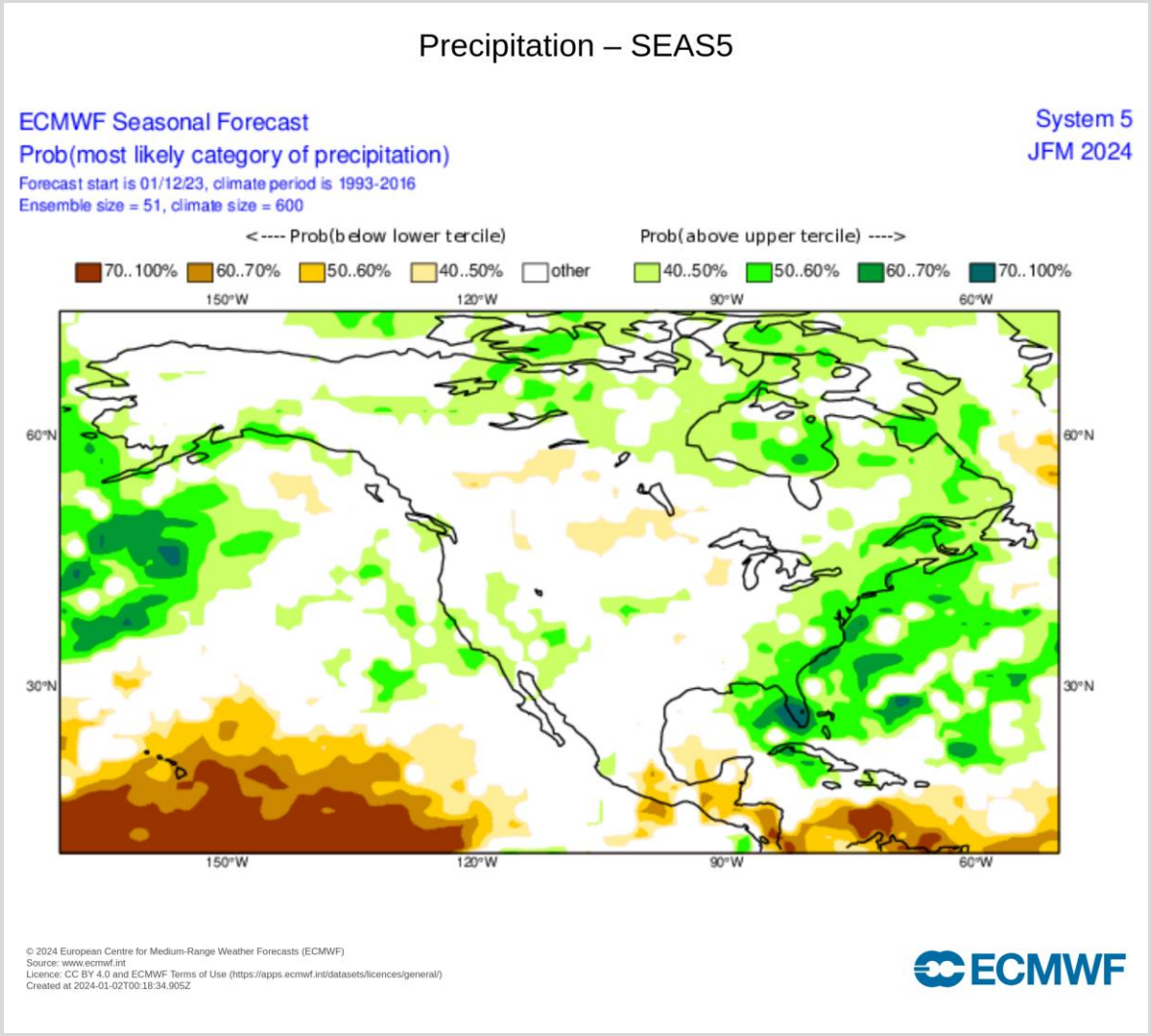
NWS's Climate Prediction Center's Official 2023-24 Outlook for January, February and March 2024 showing probabilities leaning above average precipitation in northern NM with equal chances of slightly above or slightly below average temperatures.

2023-24 Winter Outlook

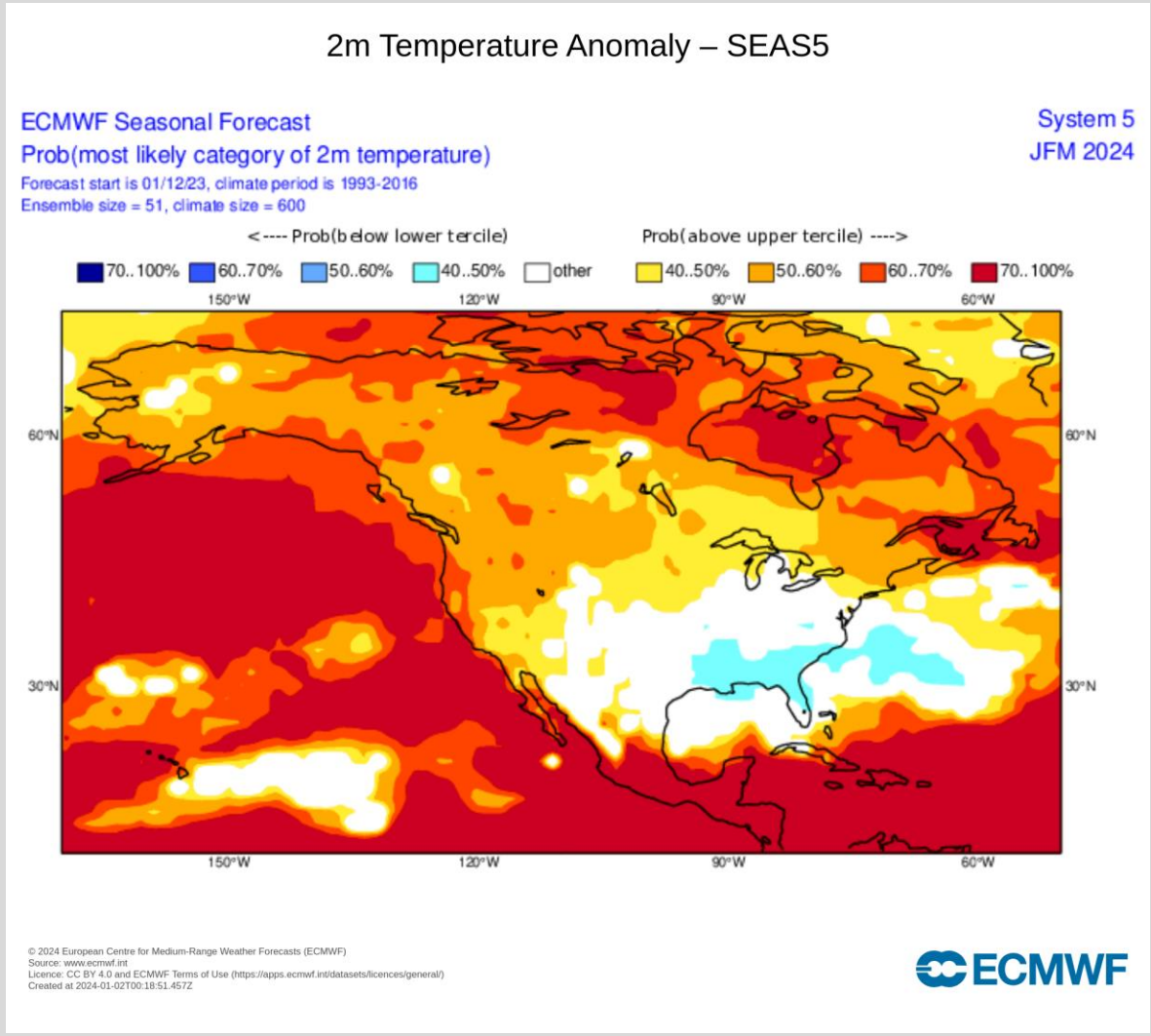
European Center for Medium Range Weather Forecasts (ECMWF)

Albuquerque
WEATHER FORECAST OFFICE

Precipitation – SEAS5



2m Temperature Anomaly – SEAS5

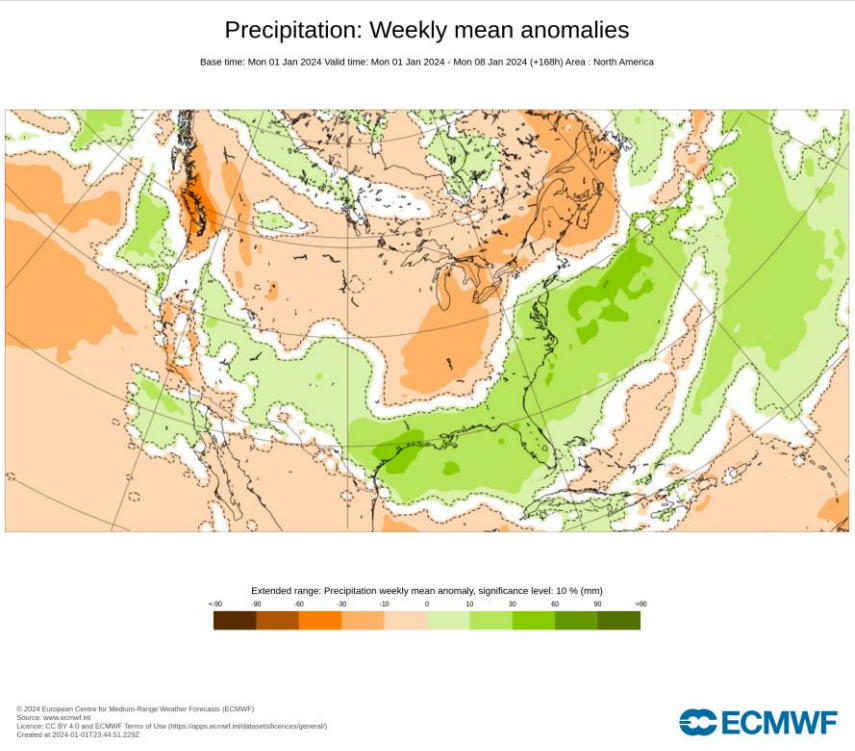


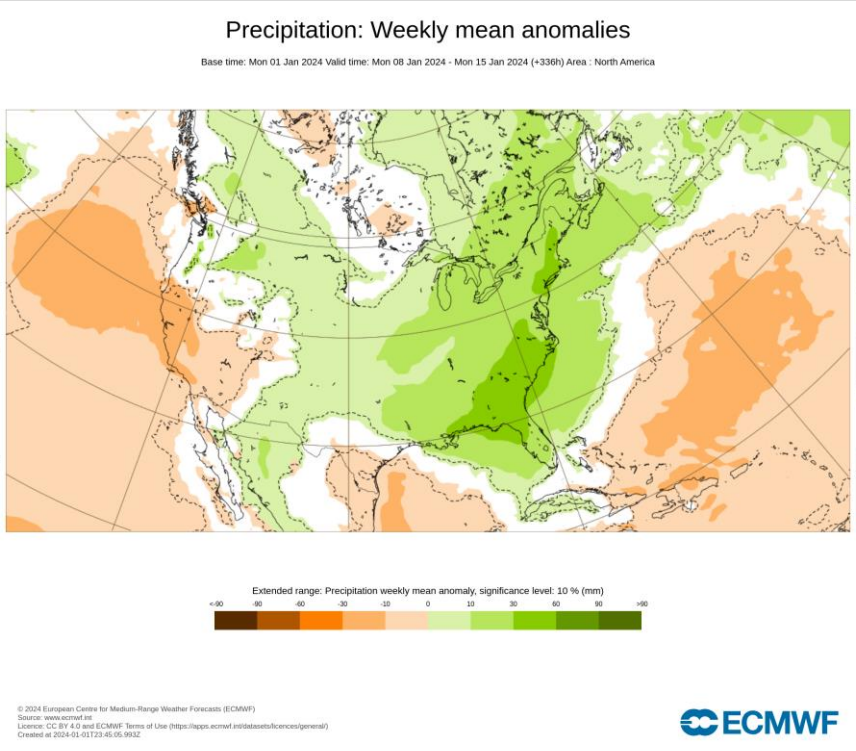
Seasonal precipitation and temperature difference from average forecast from the European Center for Medium Range Weather Forecasts (ECMWF) model forecasting above average precipitation for portions of NM and slightly near average temperatures.

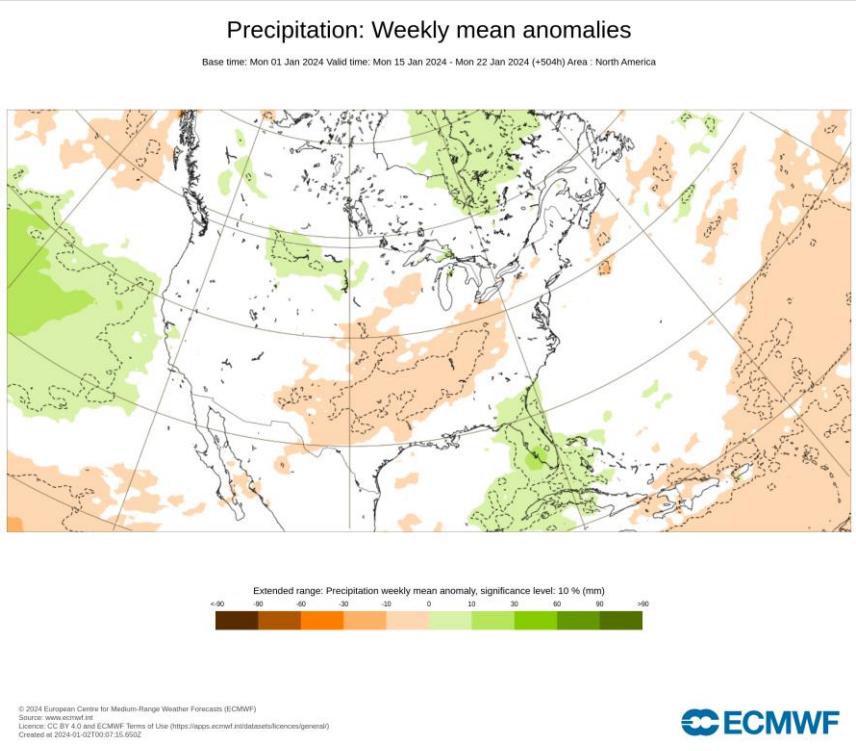
2023-24 Winter Outlook

ECMWF (ENS) - Precipitation

Albuquerque
WEATHER FORECAST OFFICE





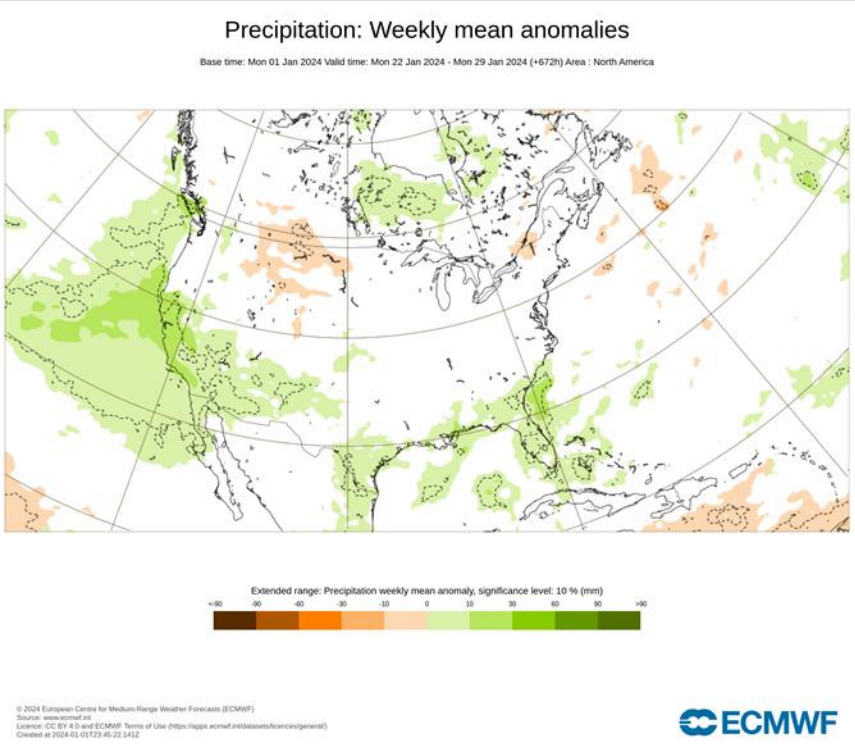


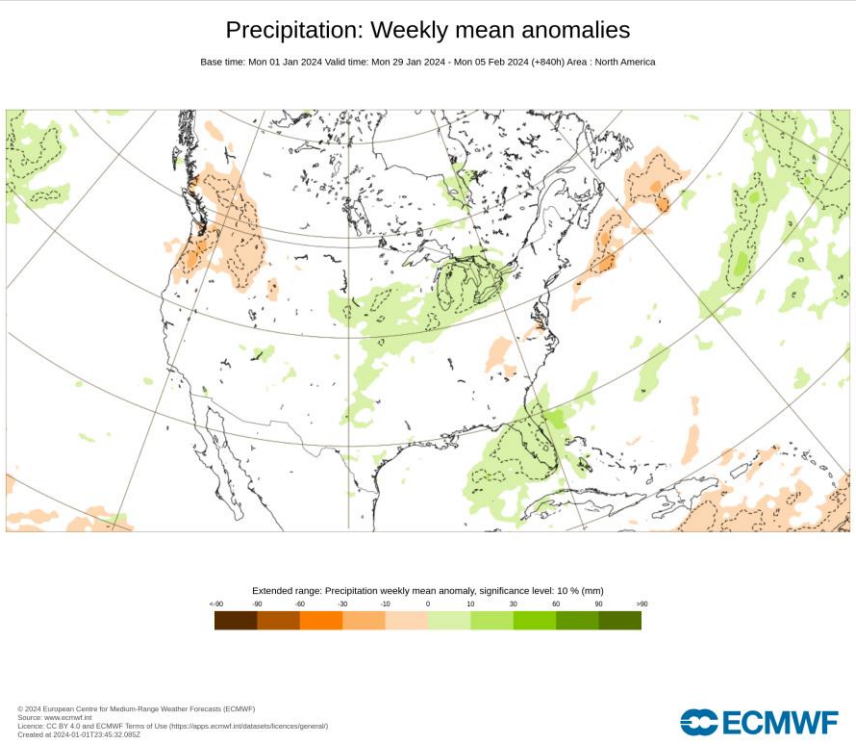
ECMWF ENS model is forecasting slightly above to above average precipitation for much of NM through January (updated 1/1/24). Keep in mind that the weather/climate signal from the skilled ENS model is often subtle. Similar to meteorology, pattern recognition is key to climate prediction.

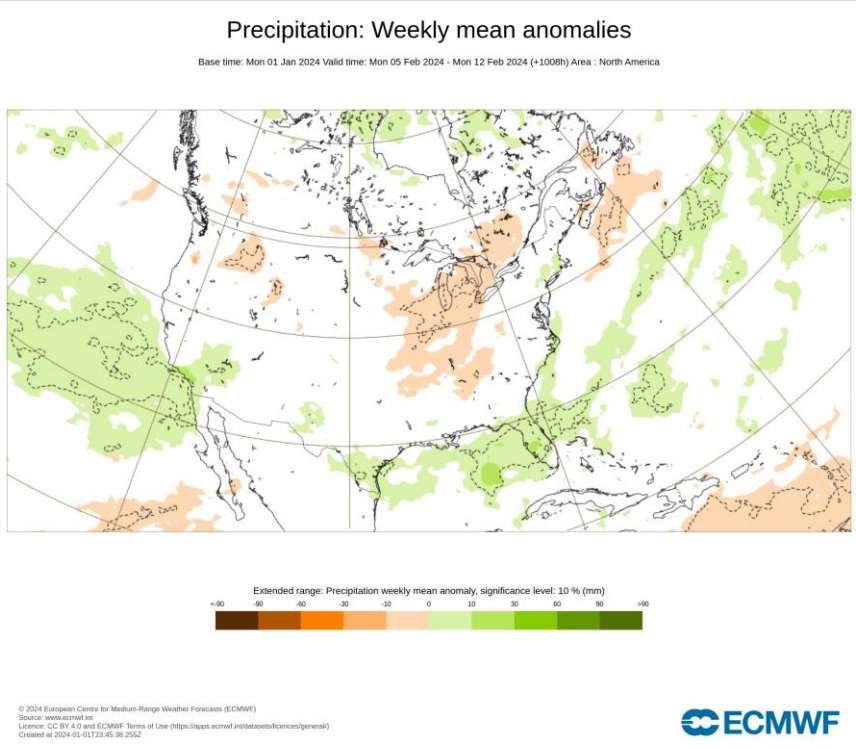
2023-24 Winter Outlook

ECWMF (ENS) - Precipitation

Albuquerque
WEATHER FORECAST OFFICE





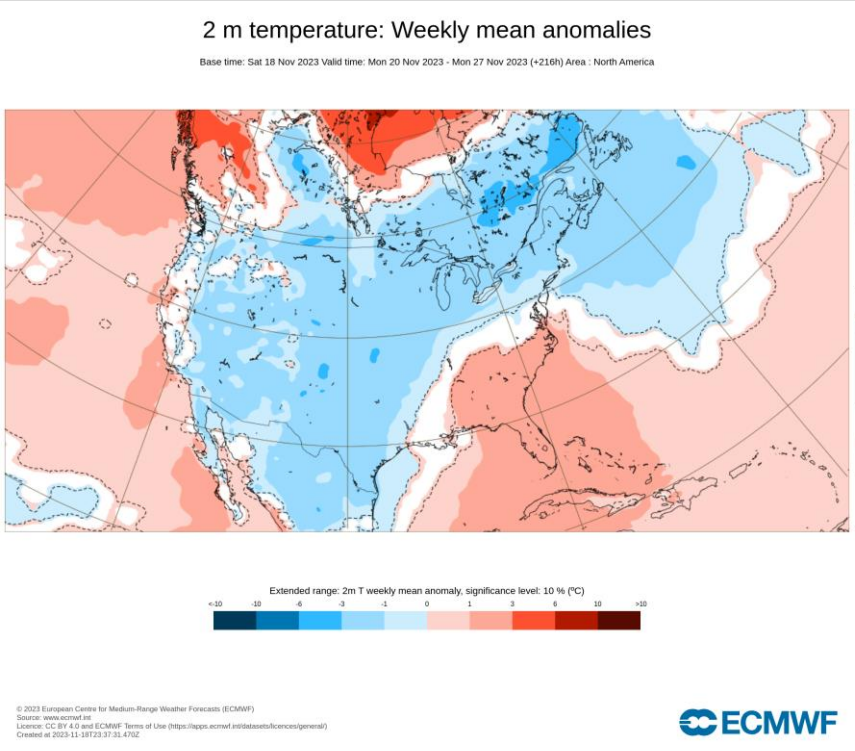


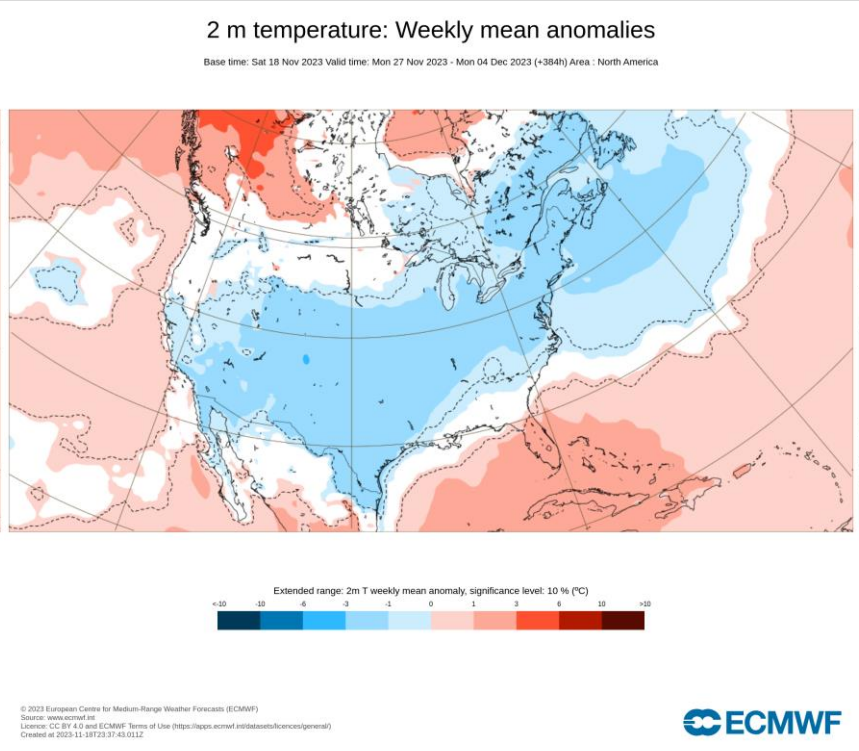
Weekly difference from average precipitation forecasts from the ECMWF for late January into early February 2024. The ensemble model is forecasting near normal to above average precipitation for portions of the Southwest U.S.

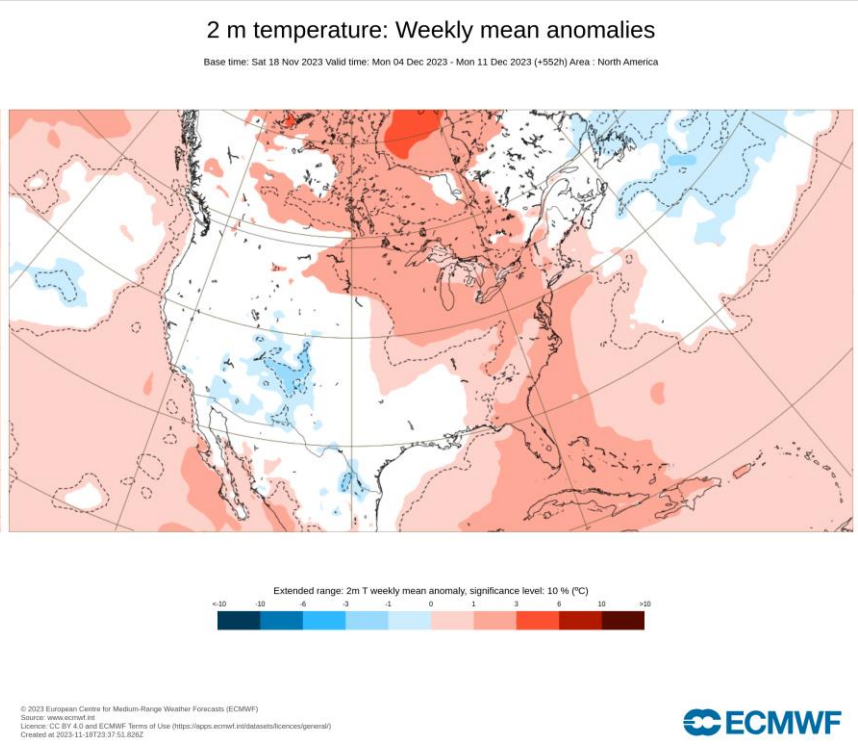
2023-24 Winter Outlook

ECWMF (ENS) - Temperature

Albuquerque
WEATHER FORECAST OFFICE





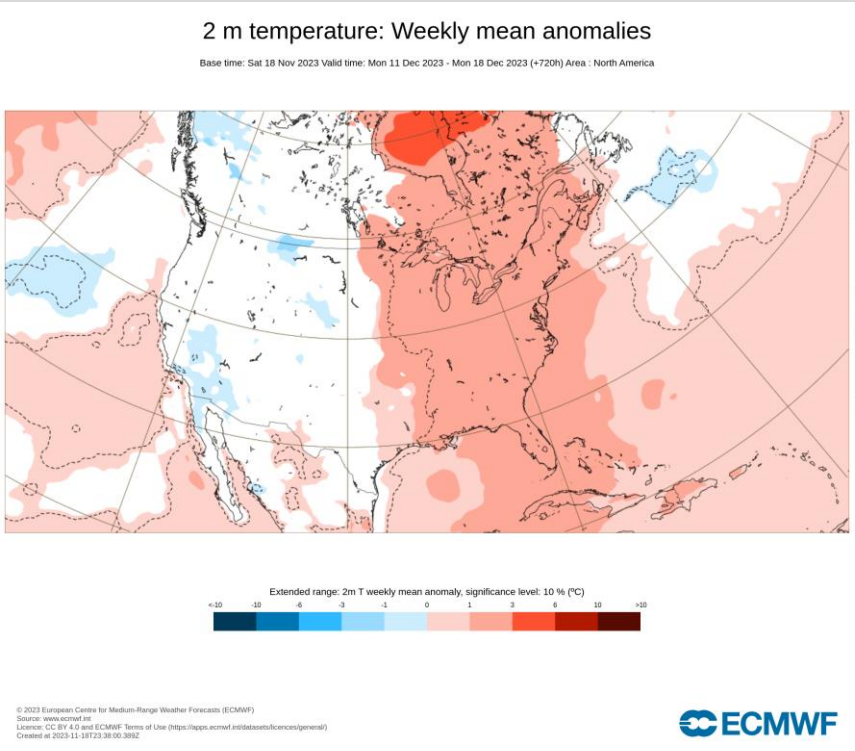


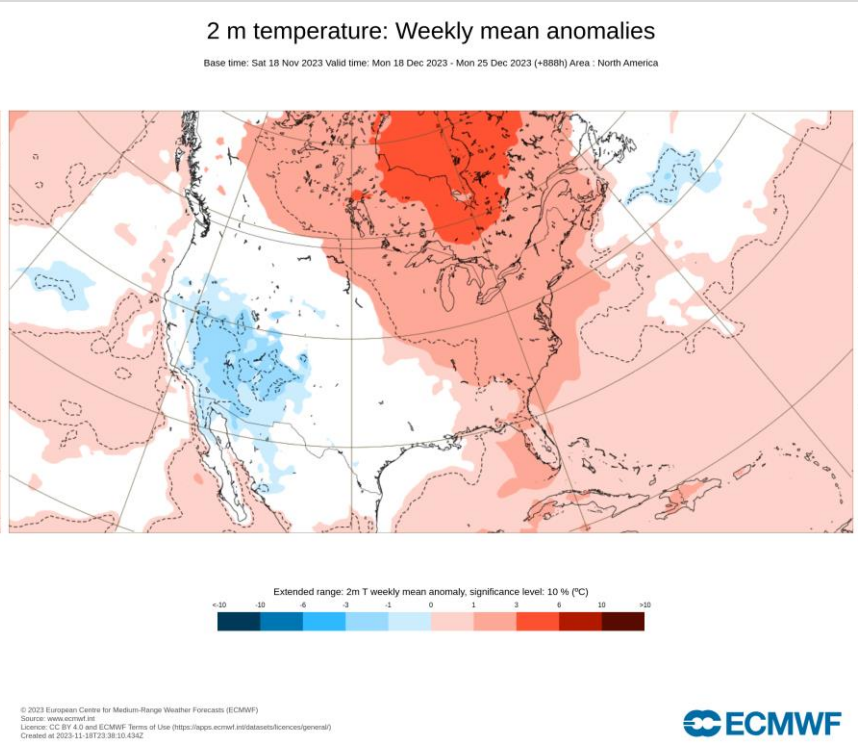
Weekly difference from average temperature forecasts from the European Center for Medium Range Weather Forecasts (ECMWF) for late November into early December 2023. ECMWF's extended ensemble model keeps the Southwest U.S. cooler than average during late November and into early December.

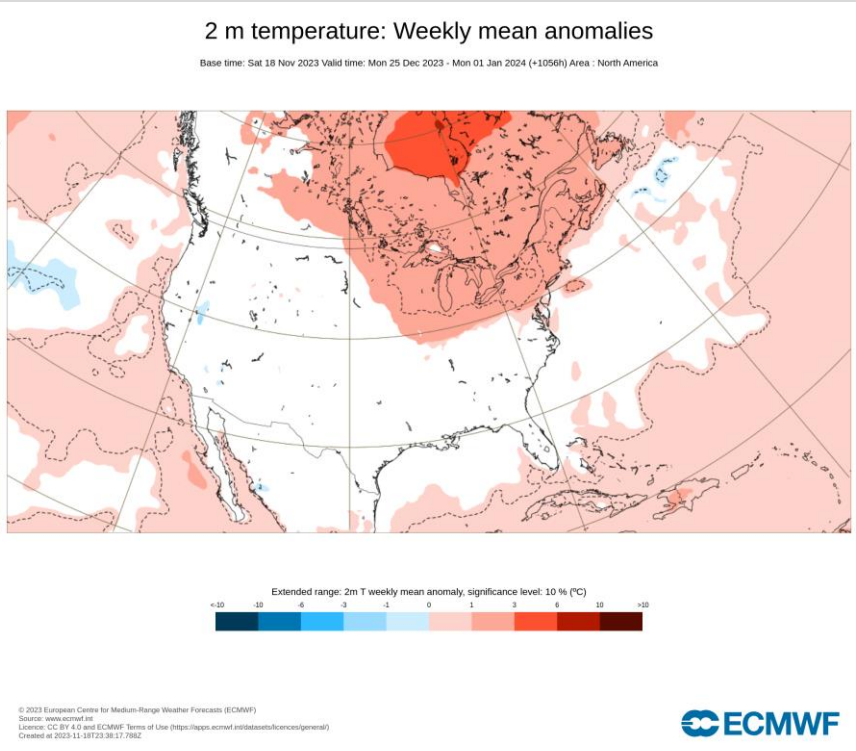
2023-24 Winter Outlook

ECMWF (ENS) - Temperature

Albuquerque
WEATHER FORECAST OFFICE





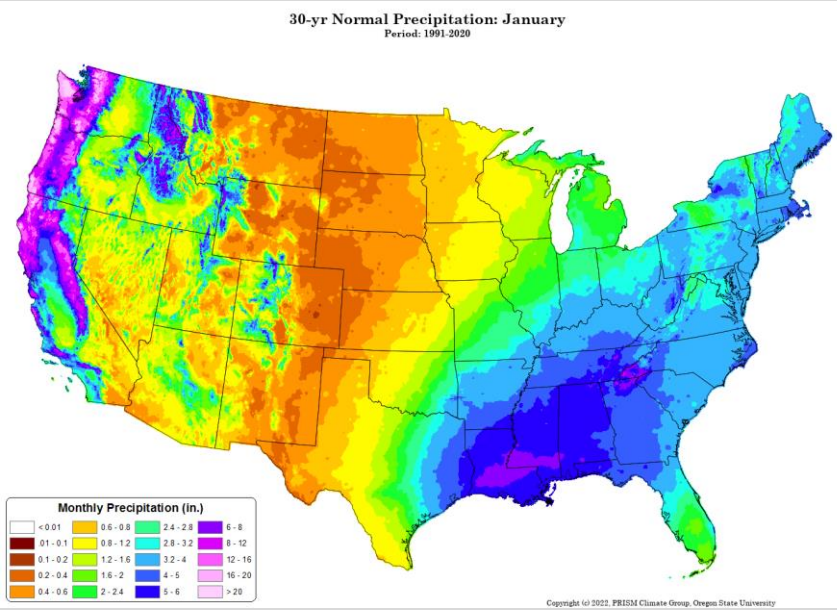


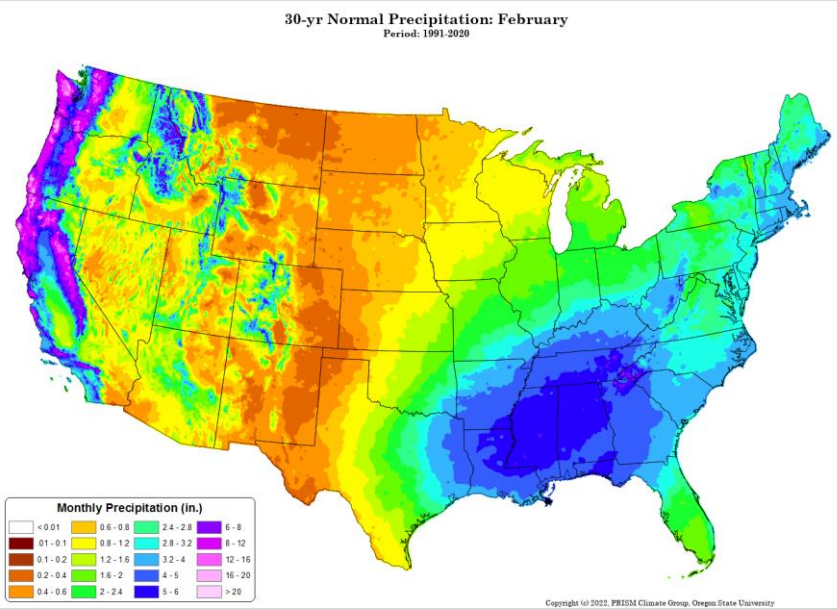
Weekly difference from average temperature forecasts from the European Center for Medium Range Weather Forecasts (ECMWF) for early to late December. ECMWF's extended ensemble model keeps the Southwest U.S. temperatures slightly below average during this time.

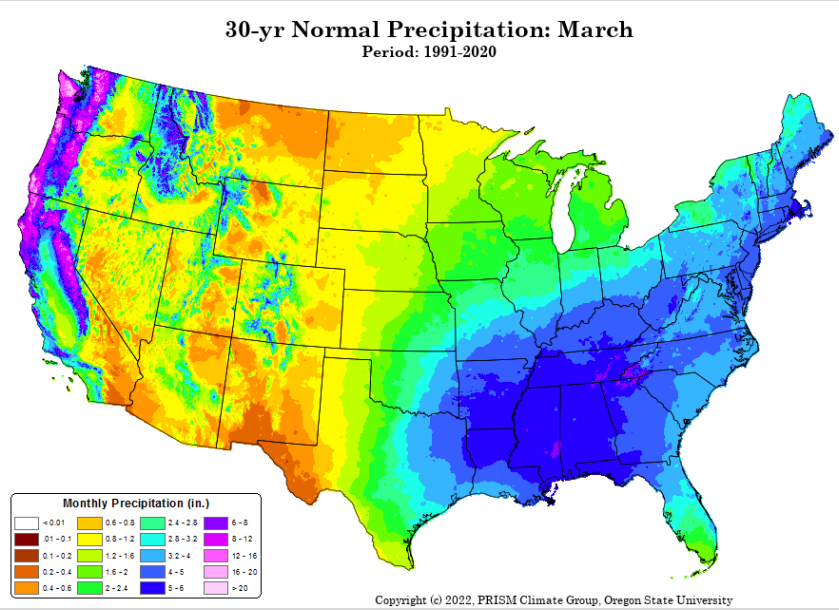
2023-24 Winter Outlook

What is Average?

Albuquerque
WEATHER FORECAST OFFICE







What is average or "normal" precipitation for each month? These charts show normal or average precipitation for JFM.

2023-24 Winter Outlook

2023-24 Winter Forecast

Albuquerque
WEATHER FORECAST OFFICE

December: Forecast confidence is high for above to well above average precipitation. Forecast confidence is also high for near to slightly below average temperatures. Additionally, thanks in large part to El Niño, odds are much higher than typical for a white Christmas for much of the state. (updated 11/19/23).

January: Forecast confidence is very high for above to well above average precipitation and below average temperatures in central and northern NM (updated 1/1/24). Global numerical forecast models are in very good to excellent agreement with one another predicting a very active month of January.

February: Forecast confidence is high for above to above average precipitation and near average temperatures (updated 1/1/24).

2023-24 Winter Outlook

Albuquerque
WEATHER FORECAST OFFICE

- Outlook provided by National Weather Service Forecast Office Albuquerque, NM.
- For further information contact Andrew Church: andrew.church@noaa.gov (505) 244-9150