Weather and Climate Summary and Forecast
March 2024 Report

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Summary:

- A more typical El Niño pattern arrived in February and appears to have some legs in early March. While some extreme rain and snow amounts have been seen, we needed this moisture badly.
- February temperatures were largely warmer than average[1] due to most of the west experiencing elevated minimum temperatures. Areas of California, where greater cloud cover and higher precipitation amounts occurred, saw closer to average or slightly below average temperatures for the month.
- Mountain basins saw some recovery in snow water equivalents over much of the western US. California will likely see a little more recovery in early March, while northern basins in the PNW are still relatively dry for this time of year and the drought forecast points to continued drier than average over the next couple of months.
- The first peak at the spring season forecast continues to broadly hold to a 'typical' El Niño pattern, drier and milder in the PNW and slightly wetter in California. All indicators are showing a continued weakening of El Niño with a La Niña watch for the fall now in place.
- All indicators are still pointing to a cool spring and slow start to the growing season, similar to last year.

Past Month and Water Year:

February 2024 brought significant changes in the winter precipitation pattern over the west with the jet stream dipping further south bringing significant moisture to California and into the Great Basin and Rockies (Figure 1). While much of the west was wetter than average for the month, much of the PNW and portions of the southwest saw below average precipitation. Temperatures for the month over the western US were largely warmer than average, running 1-3 degrees above normal. Slightly cooler than average conditions were seen in portions of California which was due largely to increased cloud coverage. The extreme departures from normal in the Plains (5-15 degrees warmer than average) continued into the rest of the eastern US where a very warm month was seen almost everywhere but Florida (not shown). Higher than normal precipitation amounts in the west extended into the central Plains but over the rest of the east dry conditions were dominant (not shown). Twenty-five percent below normal precipitation to a record driest February was experienced in the upper Midwest, Great Lakes, and New England. Warm conditions with strong winds fueled substantial fires in west Texas where less than 15% of normal precipitation occurred in February. These dry

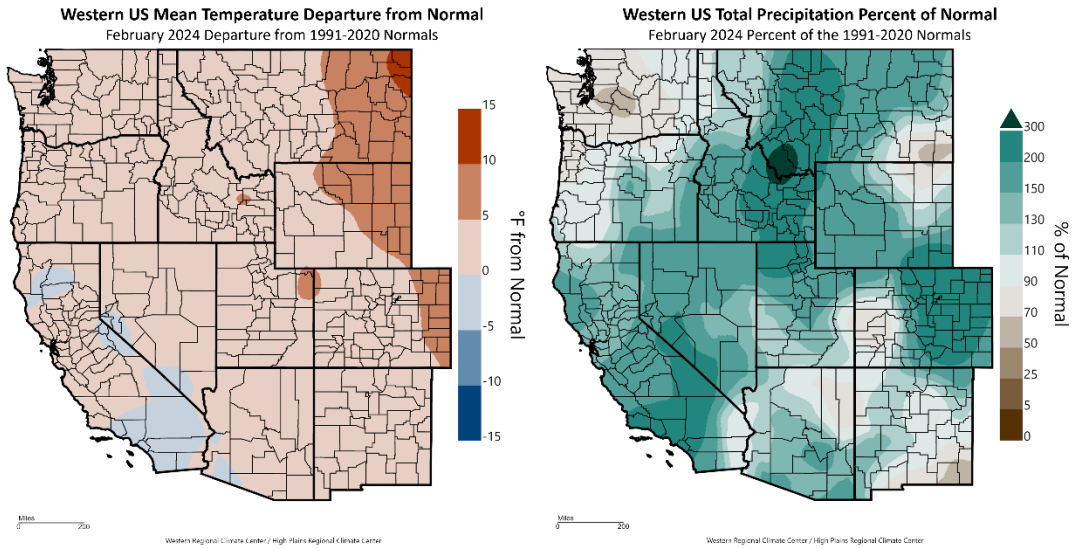

Figure 1 – Western US February 2024 temperature departure from normal (left) and percent of normal precipitation (right; images from Western Regional Climate Center, 2024: ACIS Climate Maps)

[1] Note that all references to normal or averages in this report are to the 1991-2020 climate normal for each weather/climate parameter unless stated otherwise. See this website (https://www.climateofwine.com/climate-normals) for more information on climate normal.

regions mirror those that have either stayed in drought most of the winter or have transitioned recently into drought (see Drought Section below).

The water year to date remains warmer than average over the entire western US (Figure 2). From October 1, 2023, through February 29, 2024 temperatures have so far been averaging roughly 2.4 degrees above average with the warmest areas being central California, southern Oregon across into the northern and central Basin, and into the northern Rockies and Plains. Other areas of the west (i.e., northern areas of the PNW and southwest) are now between 0.5-2.0 degrees above average. The bulk of the continental US has also been warmer than average for the water year so far (not shown). The northern Plains across the Great Lakes and into New England have seen the warmest conditions, 4-8 degrees above average, while small areas along the Gulf Coast are the only areas that have seen below average temperatures (0-1 degree). For the water year to date, precipitation amounts in the western US have been on the dry side so far but with some areas making up their deficits over the last month or so. The driest regions are much of the northern Rockies of Montana and Idaho, which have experienced 30-90% of normal precipitation and have 80% or less of snow water equivalents (SWE) in mountain basins (Figure 2). Portions of inland California, the Great Basin, and the southwest have been dry until late with the last week or so of February and the first few days of March bringing precipitation totals to mostly above average and SWE in mountain basins above average. For the rest of the country, the water year to date has been drier than average in the northern Plains, Ohio River Valley, mid-south, and west Texas, while wetter than average conditions have been experienced in the central to southern Plains, Florida, and the central Atlantic states into New England (not shown).

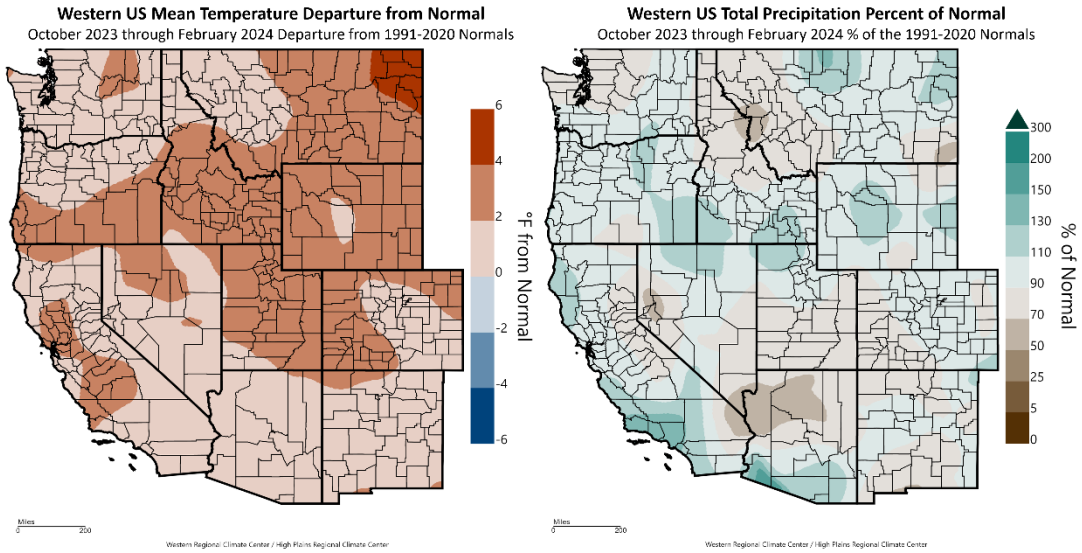

Figure 2 – Western US Water Year (October 1, 2023, through February 29, 2024) temperature departure from normal (left) and percent of normal precipitation (right; images from Western Regional Climate Center, 2024: ACIS Climate Maps).

Drought Watch – February circulation changes brought more troughs and precipitation to the west and east coast while the middle of the country was dominated by a ridge that brought unseasonably warm conditions over much of the heartland. The result to the country's drought coverage and pattern has been for continued help over the west but furthered drought in the middle of the country. Both an extremely warm winter and a growing concern for lack of snow this current water year are showing up in the drought development in the northern Plains and Rockies (Figure 3). The overall drought footprint for the continental US has increased slightly from last month with roughly 47% in drought, although the most extreme drought categories dropped slightly to close to 8%. Areas in drought across the western US stayed close to the same as last month (~52%) with the most extreme categories increasing to just above 11%. While February was moderately wet in the PNW, Washington's drought area rose to nearly 45% of the state with the most extreme categories making up close to 2% of the state. Precipitation in February helped drought concerns in eastern Oregon (Figure 1) but not statewide with the overall drought footprint increasing to just over 36%, although the extreme drought categories (severe, extreme, and exceptional) remain off the map. Drier conditions inland kept Idaho with drought coverage at close to 50% with the most extreme drought categories (mostly in the northern portion of the state) increasing to roughly 11%. February precipitation in California was generally greater than average keeping the

state mostly drought free (Figure 1). The drought level in California dropped slightly to right at 7% in some level of drought but continued with no areas with the more extreme drought categories (Figure 3).

The seasonal drought outlook heading into spring is shown in Figure 3. The outlook is pointing to some improvements in the overall drought footprint in the US, especially in the lower Mississippi River valley. The PNW is forecast to see drought continue or develop in a few areas west of the Cascades and inland areas along the Cascades of Oregon and Washington (Figure 3; right panel). From central Idaho north into the Sawtooth mountains and across the northern Rockies drought is forecast to persist, while additional areas in the northern Plains to the Great Lakes and upper Midwest are likely to see drought develop further. Continuing drought is likely over much of Arizona, New Mexico, and Texas with additional areas in the region developing closer to drought status over the next three months.

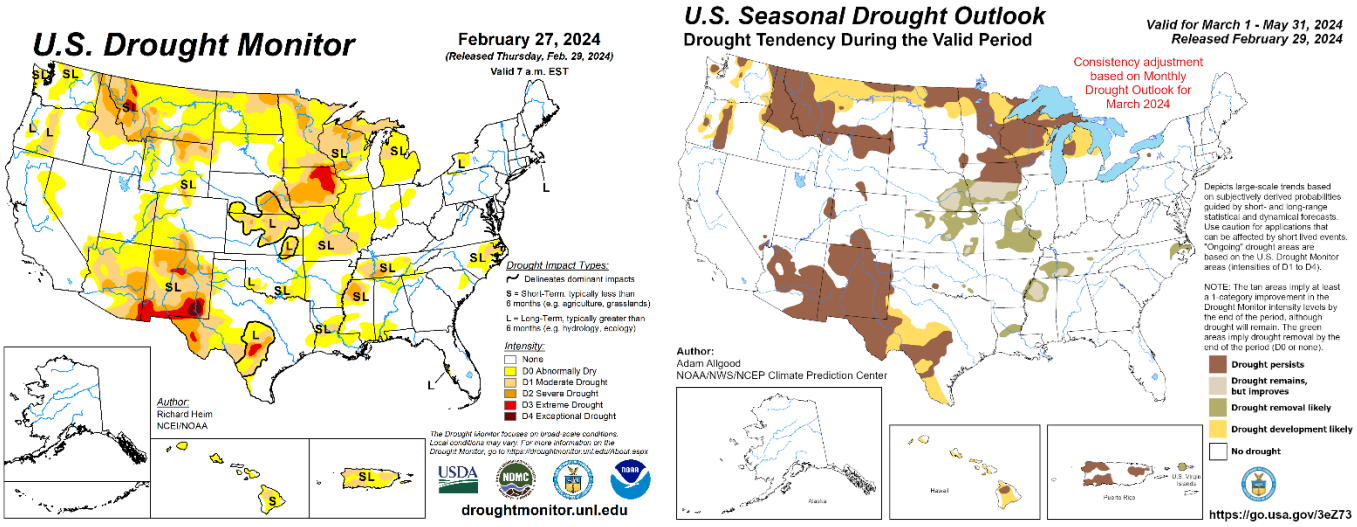

Figure 3 – Current US Drought Monitor and seasonal drought outlook.

ENSO Watch – Positive sea surface temperature (SST) anomalies have continued to weaken across the Tropical Pacific, although conditions remain in El Niño territory as of mid to late February. Both ocean heat content with depth and SSTs are quite warm (Figure 4), however, key variables in the atmosphere and ocean are showing signs of a shift to more neutral conditions. The Climate Prediction Center (CPC) and numerous other agencies are forecasting that a transition from El Niño to ENSO-neutral is likely by April-June 2024 (79% chance). Afterward, there are increasing odds of La Niña developing in June-August 2024 (55% chance). As such an El Niño Advisory remains in place, but a La Niña watch is now given for the longer term. While the first half of winter brought rather atypical El Niño temperature and precipitation patterns over the western US, the general circulation pattern over the eastern North Pacific shifted bringing the storm track further south, which is more typical in El Niño winters. The result has been some much needed precipitation for California and the southwest. Will it be enough to bring snow water equivalents to average or even above average for the winter remains to be seen. But so far it has been a great turnaround for mountain basins over most of the west.

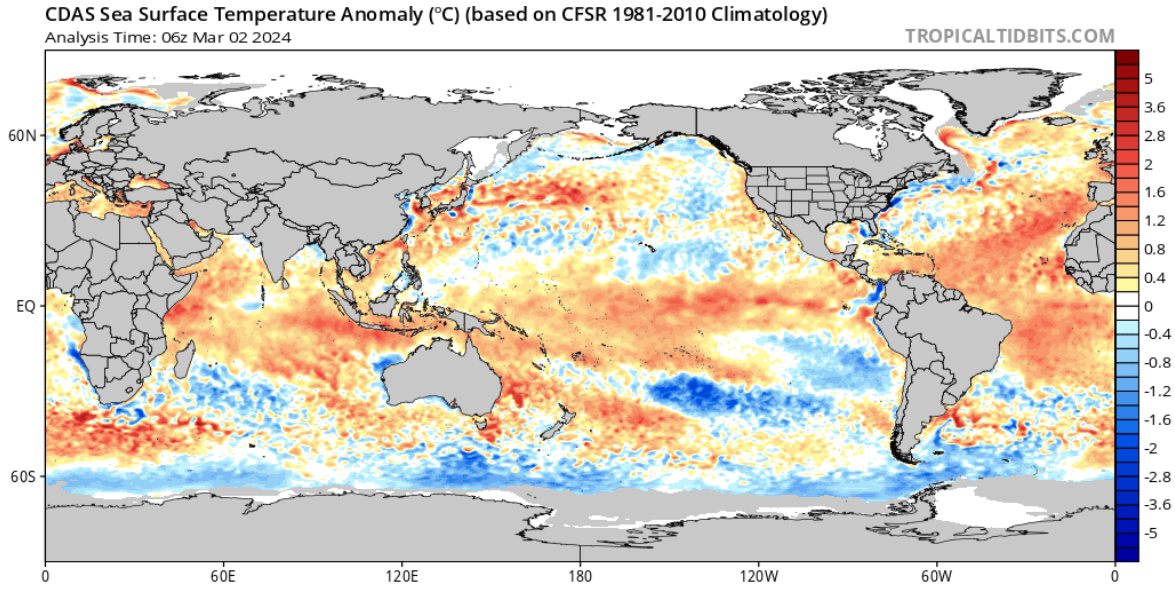

Figure 4 – Global sea surface temperatures (°C) for the period ending March 2, 2024 (image from Tropicaltibits.com).

North Pacific Watch – Not much change in the overall pattern in SSTs across the North Pacific over the last month. Warm SSTs continue to occur out over the middle of the North Pacific and along the west coast of the US (Figure 4), although cooler anomalies have started to cover a greater area than they have in the last few months. These conditions have the Pacific Decadal Oscillation (PDO) remaining in a negative phase but dropping steadily from a peak in the middle of 2023. Moving into the second half of the winter North Pacific SSTs are more in phase with the tropical Pacific (warm) than they have been. The result has been a more typical El Niño pattern with precipitation south into California, which appears to be driving some of the forecast into spring for the west.

Forecast Periods:

Next 5 Days: A cool start to the month with the jet stream far south pushing moisture into California. The PNW is on the northern side of the jet stream with cold and snow even down to lower elevations. A pattern shift will push the jet stream northward giving us a couple of days of drier weather, but cooler temperatures will remain for most of the western US especially if skies clear.

6-10 Day (valid March 9-13): A cold front will stretch out along the west coast bringing slightly warmer temperatures from southerly airflow but staying generally near average to below average over the west. Precipitation will likely stay above average for much of the west into mid-month with northern California and southern Oregon into the PNW having the greatest chance for above average amounts. Cold in the west flips to warm in the east with a high likelihood of warmer than average temperatures across the northern Plains, Great Lakes, and into New England. In terms of precipitation, the middle of the country is expected to see near normal amounts while the eastern seaboard is expected to see above average amounts for this time of year.

8-14 Day (valid March 11-17): Back and forth between cool and wet and cool and dry into mid-month. Enough cold air aloft that with any surface heating it should produce locally intense showers and graupel across areas of the west. The general pattern for temperatures has the PNW likely staying below average, with California closer to average, while the east is likely to remain much warmer than average for this time of year. Overall precipitation amounts into mid-month are likely to continue above average in the PNW while California gets a little reprieve from the onslaught with closer to average precipitation amounts for this time of year. The rest of the country has a decent chance of seeing above average precipitation, except New England which is forecast to see near normal amounts.

30 Day (valid March 1-31): “In like a lion, out like a lamb” may hold for March 2024 with a slight warm up at the end of the month. However, colder than average temperatures through mid-month or later will likely result in March bringing below average temperatures to central and southern areas of the western US and closer to normal for the PNW (Figure 5). The eastern US is forecast to see a much warmer than average month, which continues a very warm winter so far.

The southerly jet stream pattern in early March will likely continue the above average precipitation centered on California and across into the Rockies, while the PNW and portions of the southwest are more likely to be slightly above to slightly below average (Figure 5). Dry conditions are forecast to remain in the fire prone areas of Texas, while a very wet month is forecast for the south and southeast.

90 Day (valid March-April-May): Heading into spring the 90-day forecast is maintaining the overall outlook for a warmer than average central to northern California, PNW, and the northern tier of states (Figure 5). This continues to be related to the El Niño conditions in the tropical Pacific, albeit with some potential waning of the event (see ENSO Watch above). Southern California across the southwest, central Plains, and southern states have equal chances of slightly above average to slightly below average temperatures into spring. The three month precipitation forecast is pointing to the PNW likely continuing with dry conditions while California and the bulk of the interior western US and the Rockies have equal chances of dry to wet conditions. South Texas and New Mexico are also forecast to have a greater chance of below average precipitation into spring, while the south and southeast have a greater chance of seeing above average precipitation (Figure 5).

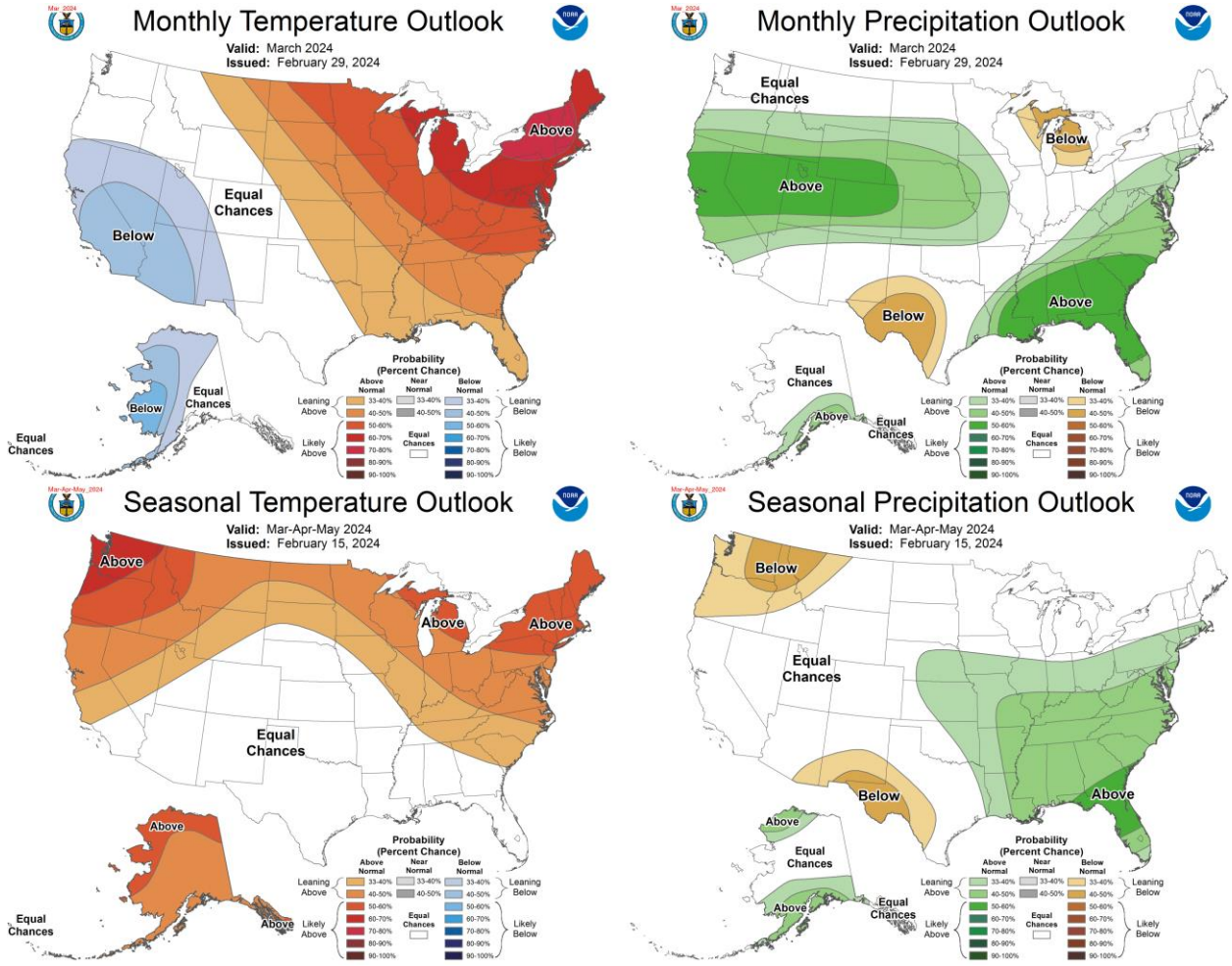

Figure 5 – Temperature (left panel) and precipitation (right panel) outlooks for the month of March (top panel) and March, April, and May (bottom panel) (Climate Prediction Center, climate.gov).

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