

Weather and Climate Summary and Forecast April 2023 Report

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April 4, 2023

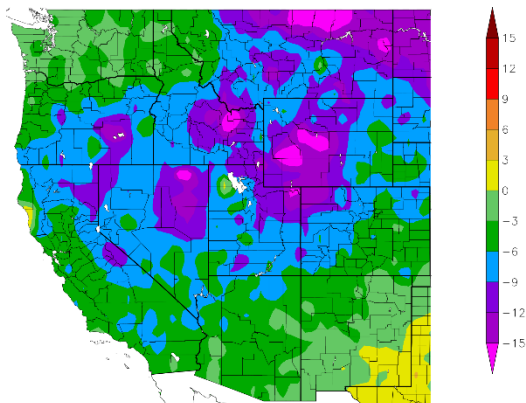
Summary:

- The North Pacific high-pressure ridge remains stubbornly west of its normal position. This has continued to allow low-pressure areas to dip south along the west coast. The meridional circulation over the west has kept temperatures well below average and brought anomalous precipitation south into California.
- Colder than normal¹ temperatures in March for the entire western US, especially in the intermountain region.
- March ended up dry across the northern PNW and scattered areas of the intermountain west while California's anomalous wet second half of winter continued with large inputs from atmospheric rivers.
- A slight warm-up and dry-down are coming in the short-term forecast into mid-April. However, the month is likely to hold to cool to average and wet in the PNW to average or dry heading south. While no large-scale cold events are on the horizon, the cooler conditions overall and any clearing skies at night will likely be an issue in all the usual places.
- Drought improvement across the west has been remarkable. Snow Water Equivalents range from 90-110% of normal in the PNW and northern Rockies to 150-250% above average in California, the Basin, and the rest of the Rockies.
- The forecast heading into spring and early summer tilts the odds to a cool period through April for the western US with California likely closer to seasonal while the PNW is likely to be cooler. Precipitation amounts are expected to be closer to average in the PNW and slightly below average in California. The tropics have faded to ENSO-neutral with continued expectation for El Niño in late summer or fall. PDO remains in a strong negative phase with quite cold near-shore SSTs along the western coast of North America, enforcing the cool spring likelihood and dare I say it, frost risk.

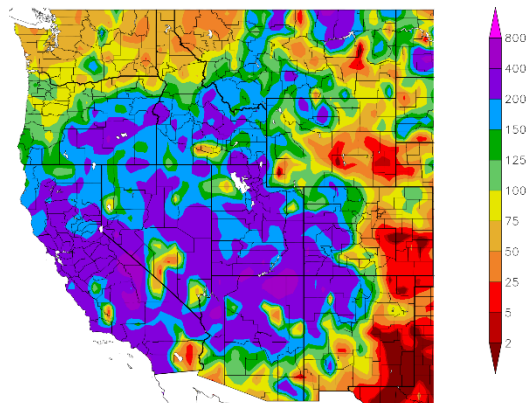
Past Month and Water Year to Date:

March continued the run of strong north-south meridional circulation over the eastern North Pacific and western US. The North Pacific high-pressure area has remained hundreds of miles to the west of its normal position, allowing flow out of the Gulf of Alaska to dip south along the west coast. The result has been much colder than average temperatures and numerous low-pressure areas entraining tropical moisture in atmospheric rivers. Temperatures for March (Figure 1) were substantially below average in the west and especially across the intermountain regions where temperatures were 10-15°F or more below average. The atmospheric river events impacted southern and interior regions of the west with

Departure from Normal Temperature (F)
3/1/2023 – 3/31/2023



Percent of Normal Precipitation (%)
3/1/2023 – 3/31/2023



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NOAA Regional Climate Centers

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Figure 1 – Western US March 2023 temperature departure from normal (left) and percent of normal precipitation (right; images from the High Plains Regional Climate Center, NOAA).

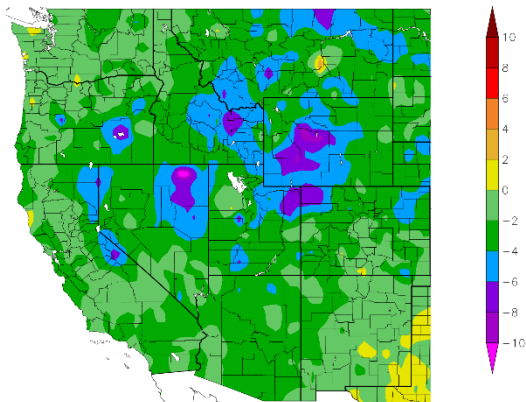
¹ Note that all references to normal or averages in this report are to the 1981-2010 climate normal for each weather/climate parameter unless stated otherwise. Also, note that the 1991-2020 climate normals are starting to become available across reporting agencies and will be used in this report when possible.

many areas seeing 200 to 800% of normal precipitation for the month. For the PNW, the northern portion across into Montana experienced 45-90% of normal for March while interior regions received inputs from the atmospheric rivers, providing substantially more precipitation than normal (Figure 1).

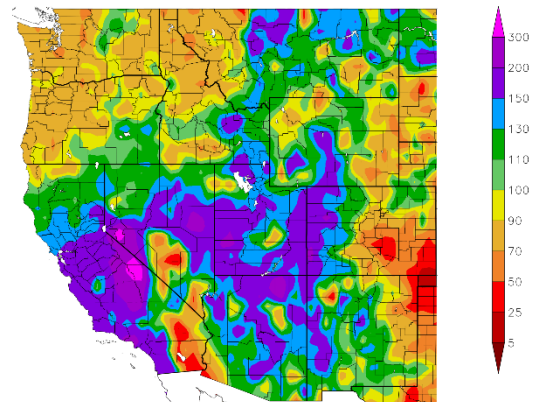
There were strong east-west differences in temperatures across the country during March; while the west remained colder than average, the south and east were substantially above average (3 to 7°F) for the month (not shown). Large areas of the central portion of the country saw below average precipitation during March, with the exception of the areas in the mid-south and into the Great Lakes which saw strong thunderstorm activity with heavy rainfall and numerous damaging tornadoes (not shown).

From October through March (water-year) precipitation amounts in the western US are showing a north-south difference which is largely due to the southward displacement of the normal west coast storm track (as described above). Most of California has clearly seen a miraculous turnaround from earlier in the water year with 120 to over 300% of normal precipitation now for the water year to date (Figure 2). However, the area from northern California through western and northern Oregon, most of Washington, northern Idaho, and western Montana has received 50-90% of normal. This is completely flipped from what seasonal modeling was depicting at the start of the water year. For the rest of the US, the eastern half of the country from the Plains to the east coast has been much warmer than average for the water year with the warmest conditions (up to 6°F above average) experienced in New England. Precipitation amounts for the water year are mixed across the eastern half of the country with substantially drier than normal amounts experienced in the Plains, much of Texas, and Florida, while the mid-south, southeast, and portions of the eastern seaboard have been closer to average or slightly wetter than average (not shown).

Departure from Normal Temperature (F)
10/1/2022 – 4/3/2023



Percent of Normal Precipitation (%)
10/1/2022 – 4/3/2023



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Figure 2 – Western US Water Year (October 1, 2022 to April 4, 2023) temperature departure from normal (left) and percent of normal precipitation (right; images from the High Plains Regional Climate Center, NOAA).

Drought Watch – What a turnaround for the west. From December to now, anomalous precipitation events facilitated by a western shift in the Pacific high-pressure ridge, have lowered drought concerns over most of the west (Figure 3). Drought declarations are still with much of the west, but the magnitude and spatial depiction have changed tremendously. The drought coverage in the continental US has dropped to nearly 50%, continuing the month over month declines since December, according to the U.S. Drought Monitor. The Northern Plains south to Texas continues to be the driest region in the country, while the eastern US is now largely free from drought, except south Florida. The most dramatic improvements in drought conditions have clearly occurred across California, the Great Basin states, and the Rockies where record-breaking precipitation (both snow and rain) fell across the region. For the western US, drought conditions have declined, from over 90% in some level of drought three months ago to just under 65% now. The most extreme categories of drought (extreme and exceptional) have continued to drop across the west with the level at close to 1%, the lowest level in nearly 10 years. By state, Washington still has roughly 50% of the state in the lowest levels of drought (same as last month). Oregon now has the largest area of extreme drought categories (severe, extreme, to exceptional) at 32% and overall, with drought coverage depicted at close to 88%. Idaho also remains mostly in drought

with nearly 96% of the state seeing drought conditions with a small area slipping into the severe drought category. For California, the state started the water year in October at 100% in some level of drought and 40% in either extreme or exceptional drought. Today the state has dropped to just less than 45% in some level of drought with the more extreme drought categories remaining off the map for two straight months.

The seasonal drought outlook moving into spring and early summer continues to point to improvement across most of the western US (Figure 3, right panel). The improvement or removal of drought status is forecast for most of California, Oregon, the Great Basin, and portions of the northern Rockies. Portions of southern California, the Great Basin, the Four Corners region, western Montana, and the northern Cascades are expected to remain in drought or develop further as we move into summer. The area of the country expected to experience worsening drought conditions continues to focus on the central Plains south into Texas and shifting west into New Mexico (Figure 3).

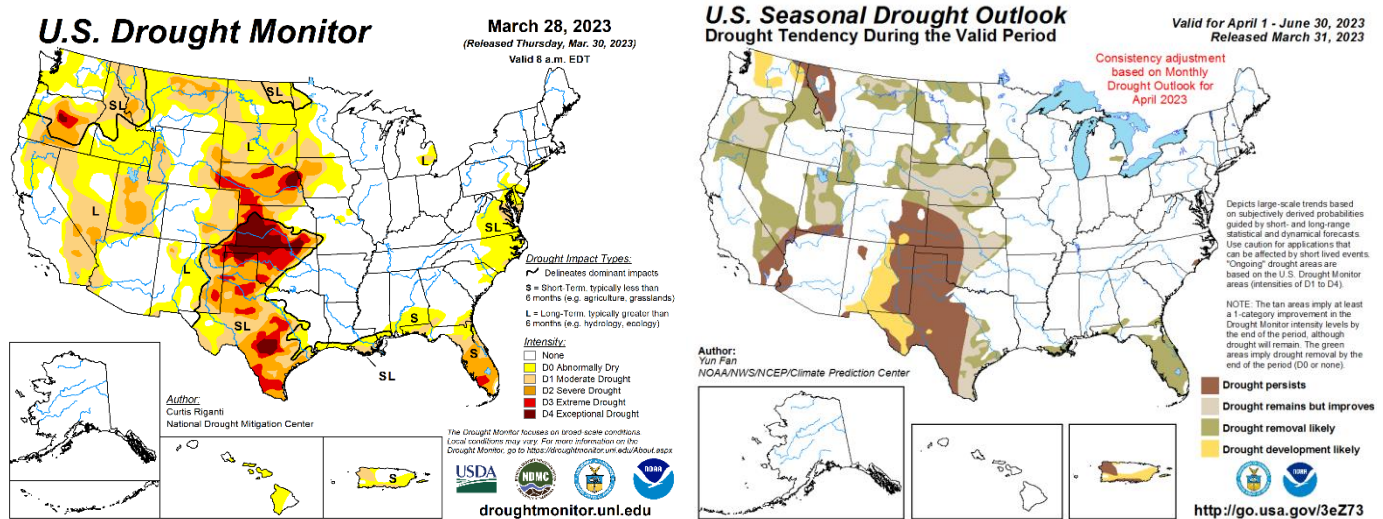


Figure 3 – Current US Drought Monitor and seasonal drought outlook.

ENSO Watch – Sea surface temperatures (SSTs) in the central-eastern equatorial Pacific have continued to weaken moving the region from La Niña to ENSO neutral (Figure 4). Most ocean and atmosphere variables also are now consistent with neutral conditions. The Climate Prediction Center (CPC) gave its last La Niña Advisory in early March,

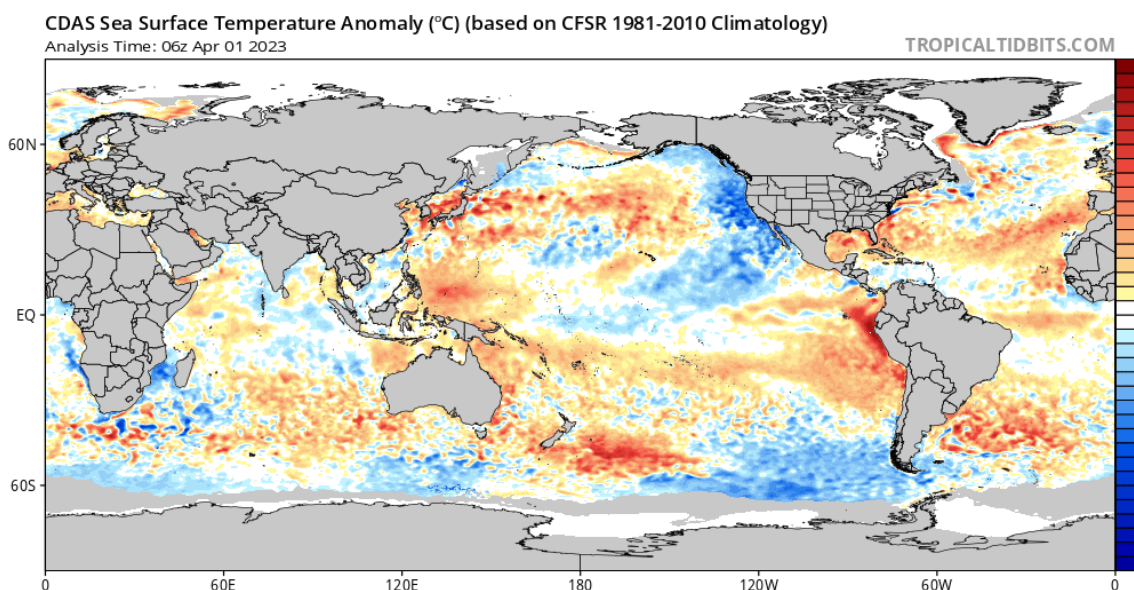


Figure 4 – Global sea surface temperatures (°C) for the period ending April 1, 2023 (image from Tropicaltidbits.com).

which signaled the end of the La Niña, which has been forecast for many months now. Most models and forecasters point to neutral conditions staying in place through mid-summer at the minimum, then El Niño becoming the dominant category from July-August 2023 (60-67% chance) and lasting into winter 2023.

While the wild winter weather of 2023 appears to be mostly behind us, it is worth mentioning again how anomalous the extreme precipitation (atmospheric rivers and historic snow events) in California have been. A westward shift in the Pacific high-pressure ridge starting in late December ushered in a period of amplified meridional circulation allowing flow out of the Gulf of Alaska to send low-pressure cyclones further southward along the west coast. The position of these events, including 'bomb cyclone' formations, allowed for the entrainment of tremendous amounts of tropical moisture (atmospheric rivers) that brought record breaking precipitation to California. At this point, it looks like this pattern may shift enough over the short-term to bring us back to more normal conditions for this time of year.

North Pacific Watch – Sea surface temperatures along the North American coast have cooled even further and extended further west and southwest (Figure 4). The pattern continues to show the strongly negative Pacific Decadal Oscillation. The overall pattern shows some contraction of the broad warmer than normal conditions over much of the central to western ocean basin. The amplified meridional circulation over the west coast described above has supported the wind field along the coast, enhancing the cooler than normal surface temperatures in place. This type of pattern in cooler North Pacific SSTs has had a strong influence on our cooler than average temperatures over the last few months and will likely continue to influence the seasonal forecast (see below). During these conditions, there is a tendency for a cooler PNW as we transition into summer. For California, cool to average temperatures are likely into early summer with precipitation transitioning to average or below average.

Forecast Periods:

Next 5 Days: Cool conditions over the next few days give way to a hint of spring later in the first week of the month. Warmer conditions start off in southern to central California, to seasonal in northern California, then coolish in the PNW. Temperatures will warm into the 60s north and 70s and even some low 80s in central to southern California. Dry from central to southern California with wet conditions from northern California into the PNW for the next couple of days, then drying out slightly for most everyone except in extreme northwestern Washington and the northern Cascades. **FROST:** No widespread frost is expected in the first week of the month for the west coast.

6-10 Day (valid April 7-11): Moving into the second week of April the warmth will likely continue with slightly above average temperatures forecast from central California north into the PNW. Southern California into the Great Basin and northern Rockies likely to see near average temperatures. Much of the rest of the country is expected to be cooler than average with the exception of Florida and the southeast which is forecast to see warmer than normal temperatures. The forecast hints at a big dry down for much of the west into the second week of the month with below average precipitation from the west coast all the way across the Rockies and into the Great Lakes. The southern states from New Mexico across the south and southeast into southern New England are forecast to see above average precipitation for this time of year. **FROST:** Concern of course comes from clear skies at night during what is forecast to be a drying period. Air mass source is critical during this period, from the west no frost is likely but from the north or northeast frost is much more likely.

8-14 Day (valid April 10-16): The slight warm-up across the west is forecast to continue through to mid-month. From the Plains west, temperatures are forecast to be seasonal to slightly above average. Cooler to seasonal temperatures are anticipated in the Great Lakes to near average elsewhere in the east. Below average precipitation is forecast for much of the western US, except the PNW where near average amounts are anticipated. Dry conditions are likely to extend across the central part of the country with near average to slightly above average precipitation along the coastal zones from Texas to New England. **FROST:** Same concern as the previous forecast period.

30 Day (valid April 1-30): Even with the warm-up mid-month, the overall forecast for April is calling for a cooler than average month from the southwest to the PNW and across to the Great Lakes (Figure 5). The anticipation from long range models is that the end of April will turn cooler for the west, although how much cooler is not clear at this point. The rest of the country is forecast to be near average to above average south and east. The month is forecast to see

above average precipitation from northern California, across the PNW, and into the northern Great Basin. Near average precipitation is forecast for the central portion of the country, while the Mississippi and Ohio river valleys into the Great Lakes are anticipated to see above average precipitation for the month (Figure 5).

90 Day (valid April-May-June): Heading into the first half of summer, the 90-day forecast is hinting at much of the western US likely to experience a near average period. Below average temperatures are forecast into the intermountain area of the northern Great Basin and in the northern Plains, which hints at the possibility of cooler air mass excursions (Figure 5). Warmer than average temperatures are forecast for much of the southern states, from the southwest, across the south and southeast, and extending into New England. The season precipitation forecast is calling for most of the western US to have equal chances to see slightly above to slightly below amounts, while the northern PNW and desert southwest are forecast to see a dry period. Higher than average precipitation amounts are expected in and around the Great Lakes while near average precipitation is forecast elsewhere (Figure 5).

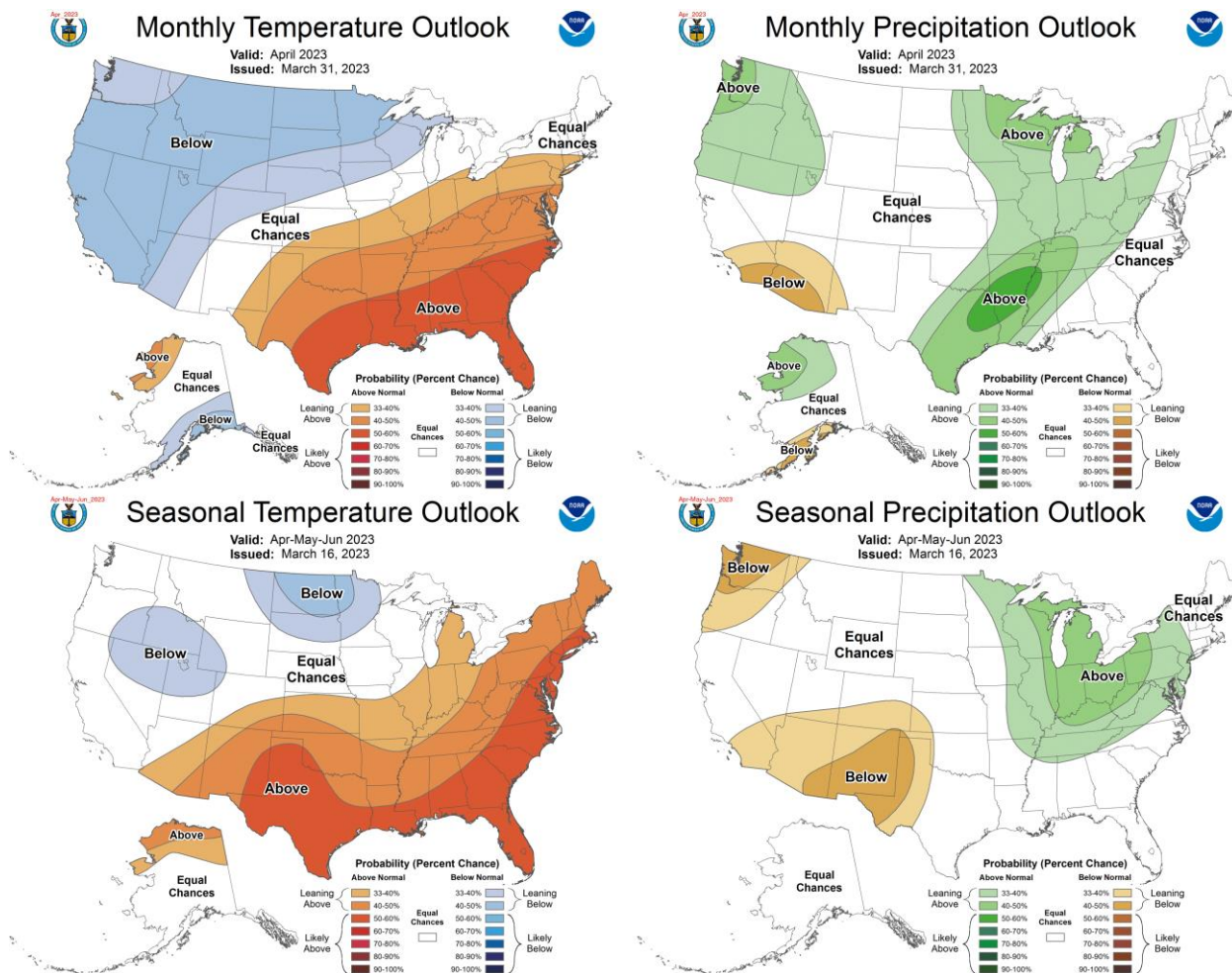


Figure 5 – Temperature (left panel) and precipitation (right panel) outlooks for the month of April (top panel) and April, May, and June (bottom panel) (Climate Prediction Center, climate.gov).

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