

Weather and Climate Summary and Forecast March 2019 Report

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Summary:

- Dramatic flip from a mild winter to a top five coldest February on record in many locations in the western US!
- Split flow over the west, supported by moisture from the tropics, set in place strong atmospheric river flows bringing significant precipitation to many areas. With cold air in place over the west, precipitation events have helped bring the majority western US snowpacks to above average and lowered or completely removed drought conditions in many areas.
- The current colder than average temperatures are likely to remain through mid-month as will the plume of moisture into California.
- I know it is hard to believe, but regardless of how cold it has been, temperatures forecast for March through May continues the odds toward a warmer than average western US, while precipitation is forecast to be near average.

Can one month make a winter? The answer appears to be yes for February 2019! After a very mild first half of winter, conditions flipped dramatically in late January. It started with a shift in very cold air (the polar vortex) into the eastern US while the west was forecast to see a ridge build and stay mild. However, the polar air pushed further south and west than most anticipated and stayed entrenched for the entire month of February. While the cold air was continuing to push out over the US, a persistent Alaskan blocking flow, plus a split flow in the circulation over the Pacific allowed for substantial moisture to move over the colder air dumping unreal amounts of snow in California and returning snowpacks to above normal over most of the western US! One thing to note in all of this, as much as the majority of the US has been colder than normal, the Arctic, much of Siberia, and Europe has been that much, or more, warmer than average! In summary, the western US saw a top five coldest February on record with most areas seeing temperatures 2-12°F below normal to as much as 22°F below normal in eastern Montana (Figure 1). The rest of the country generally saw near average to warmer than average conditions during February, especially the Gulf

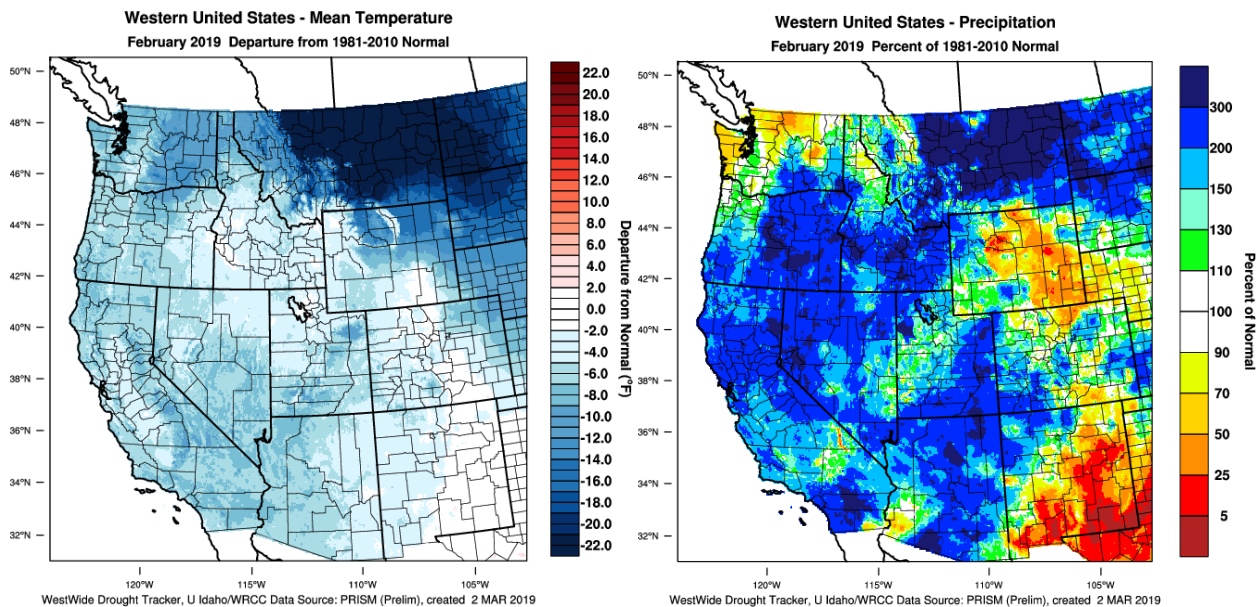


Figure 1 – Western US February 2019 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Coast and southeast (not shown). Precipitation amounts in February were mostly substantially above normal (130-300%) reducing drought conditions considerably (see below), except in portions of Washington, Wyoming, and New

Mexico (Figure 1). Conditions varied across the rest of the country with substantially higher than average precipitation across the northern Plains and Great Lakes (big snow events) and in the Ohio River valley where a prolonged plume of moisture from the split flow in the west and Pacific brought extensive flooding. Only Texas and portions of the southeast experienced below normal precipitation for the month (not shown).

Figure 2 shows the influence of the much colder than average February, which took a relatively mild winter over the west and turned the water year to date (starting October 1st) temperatures to near average to colder than average. Scatter locations in central California, Washington, and Idaho are running 1-2°F warmer than average while portions of eastern Washington and Oregon along with the Great Basin and the Rockies are running 1-2°F cooler than average during the water year to date (Figure 2). The colder than average conditions in the Great Basin and Rockies extends into the entire central portion of the country, Great Lakes, and northern New England, while the southeast has been warmer than average (not shown). The wetter than average February in the west (Figure 1) brought the water year to date conditions to largely above average for most regions (Figure 2) and has relieved some of the drought concerns (see below). Portions of western Oregon and Idaho and much of Washington continue a drier than average or near average winter so far (Figure 2). The eastern US has largely seen precipitation amounts running 110-200% of normal so far this winter (not shown).

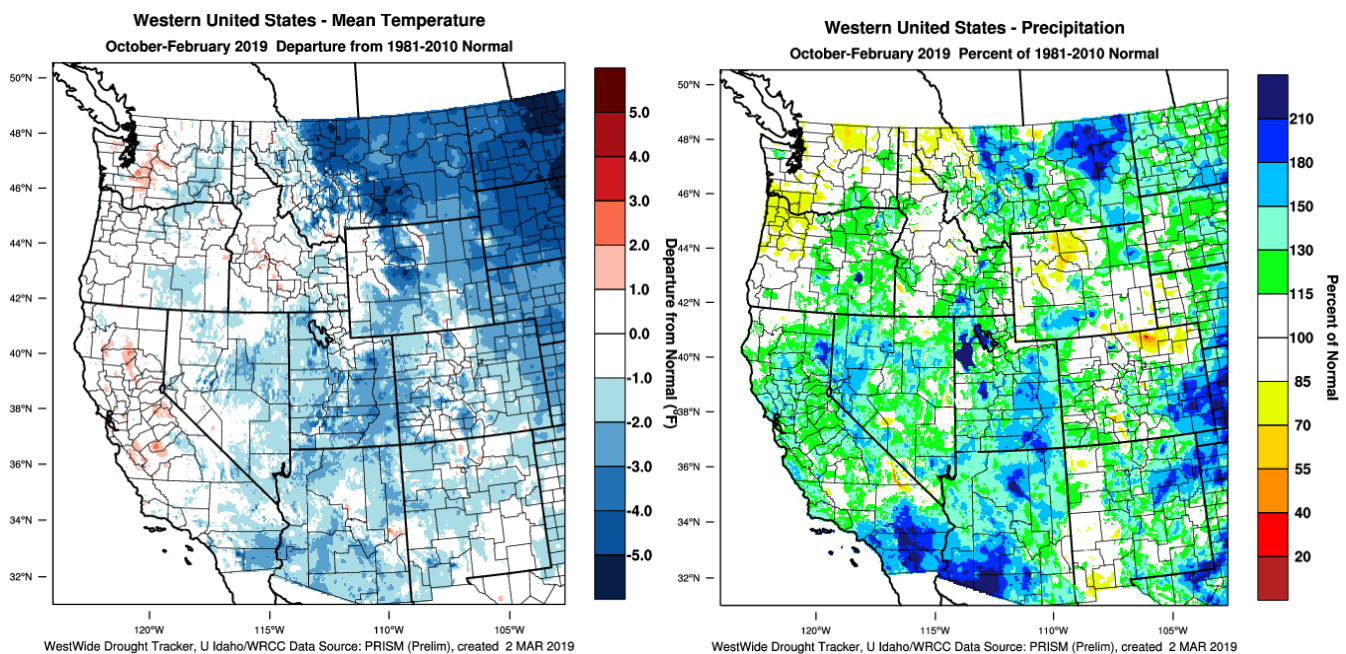


Figure 2 – Western US October 2018 - February 2019 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Drought Watch – Dramatic turn-around for many areas in the west, especially California! While the current US Drought Monitor map (Figure 3; left panel) shows continued dry conditions in the west, February rain and snow amounts have helped remove drought completely in some areas and lower the magnitude in others. For example, the drought footprint in California is now the lowest it has been in nearly ten years and snowpacks have rebounded over most the western US to 100-150% of normal. As a result, the US drought footprint has continued its decline. However, portions of the western US continue to see drought conditions with the main areas of moderate to extreme drought over the Four Corners region and much of Oregon. The longer-term outlook for the US through May shows some dramatic changes as well and will likely continue to do so with the next release. Areas of the Four Corners, the Great Basin, and Oregon will likely see some improvement or complete drought removal over the next three months. In spite of recent increases in snowpack in Oregon, the forecast continues to exhibit concern for long-term persistent drought in portions of Oregon (Figure 3, right panel).

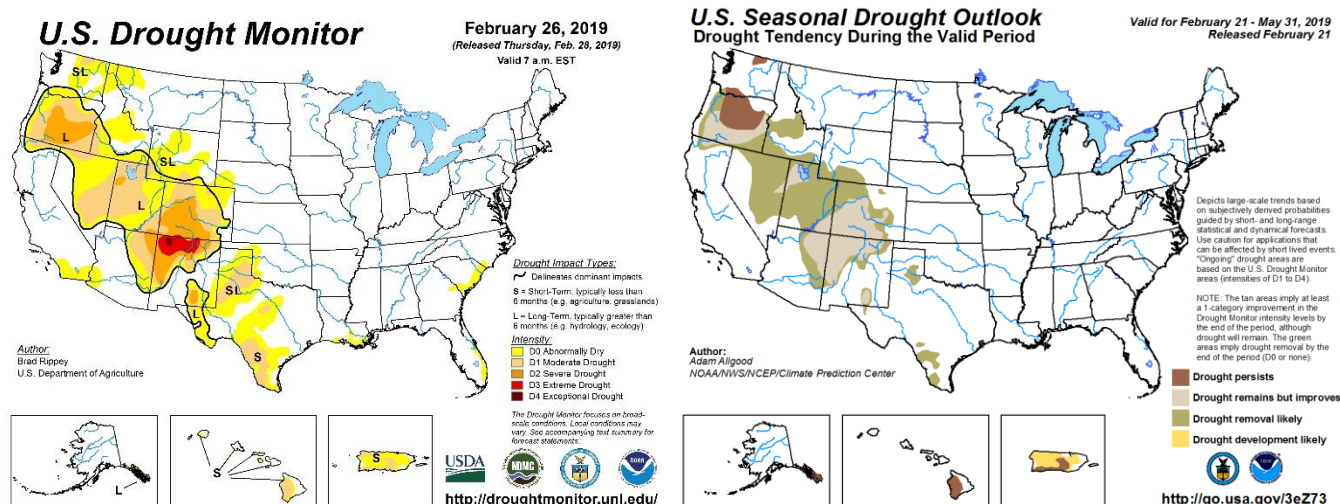


Figure 3 – Current US Drought Monitor and seasonal drought outlook.

ENSO Watch – Last month I said that this “El Niño appears to be a wimp” yet California is getting hammered as we might expect from an El Niño. However, not all El Niños are created equal and often there are numerous other atmosphere and ocean conditions that are playing a role (see discussion in the first section). What we do know is that the generally warmer than average SSTs (Figure 4) do contribute moisture to the atmospheric rivers that have brought record-breaking amounts of moisture into California. Will this continue? El Niño-level SSTs the tropical Pacific cooled to a borderline El Niño level in January and February, while subsurface waters continued to be warmer than average. However, the atmosphere had not been showing patterns typical of El Niño and finally developed in late January and early February. Collective forecasts of models show a return to weak El Niño-level SSTs into summer. The official CPC/IRI outlook, now carrying an El Niño advisory, calls for a 65% chance of El Niño prevailing during February-April, decreasing to 50% for April-June. If the El Niño conditions continue to hold to weak, the weather across the western US will still likely continue to follow the slightly warmer and drier than average conditions in the 90-day forecast (especially in the PNW and the northern tier of states) and beyond (see forecast periods below and Appendix Figure 1). Areas across the southern portion of the country will likely see a wetter than average late winter and early spring, which has already played out to some degree.

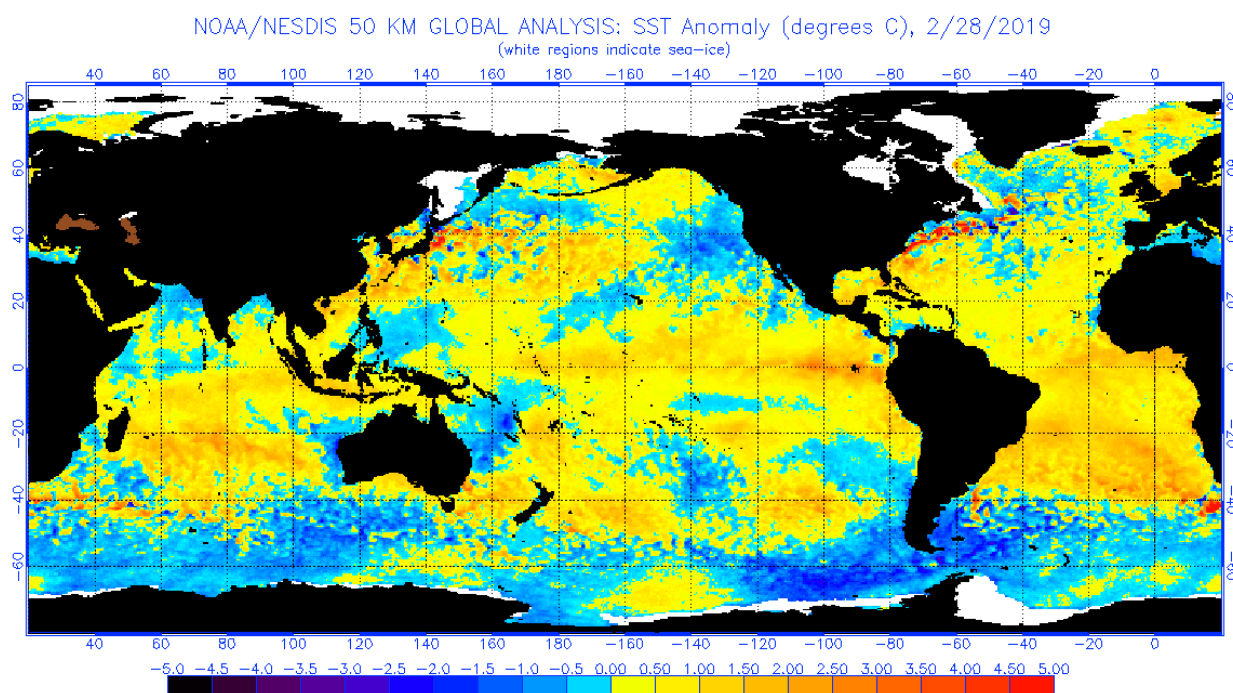


Figure 4 – Global sea surface temperatures (°C) for the period ending February 28, 2019 (image from NOAA/NESDIS).

North Pacific Watch – The Pacific overall remains much warmer than average, however, a large area of cooler than average surface waters has developed in the North Pacific over the last month (Figure 4). Surface SSTs in this area have been influenced by the larger area colder than average air filling out over the western US. The colder surface waters can then reinforce the current atmospheric conditions over the west. There is some indication that the colder conditions are mostly near the surface and might rebound quickly with more seasonal air circulation over western North America. Regional forecasting agencies are continuing to say that the overall warmth of the Pacific (see Tropics above) will likely to enhance the normal weather/climate patterns in the west during weak to moderate El Niño years (see the MAM forecast below).

Forecast Periods:

6-10 Day (valid March 7-11): The current colder than normal conditions are forecast to continue through this forecast period. The entire west coast, across the Rockies, northern tier of states across to the mid-Atlantic and New England will very likely see significantly below normal temperatures. The only exception is a narrow zone across southern New Mexico, Texas and along the Gulf Coast into Florida which is likely to be slightly warmer than average for this time of year. In terms of precipitation, the current plume of moisture streaming into California is likely to hold through this forecast period. The result will likely cause the majority of the US to see above average precipitation through mid-month. The exceptions appear to be the NW portions of Oregon and Washington along with the northern Great Lakes and southern Texas where near normal to slightly below normal precipitation is expected.

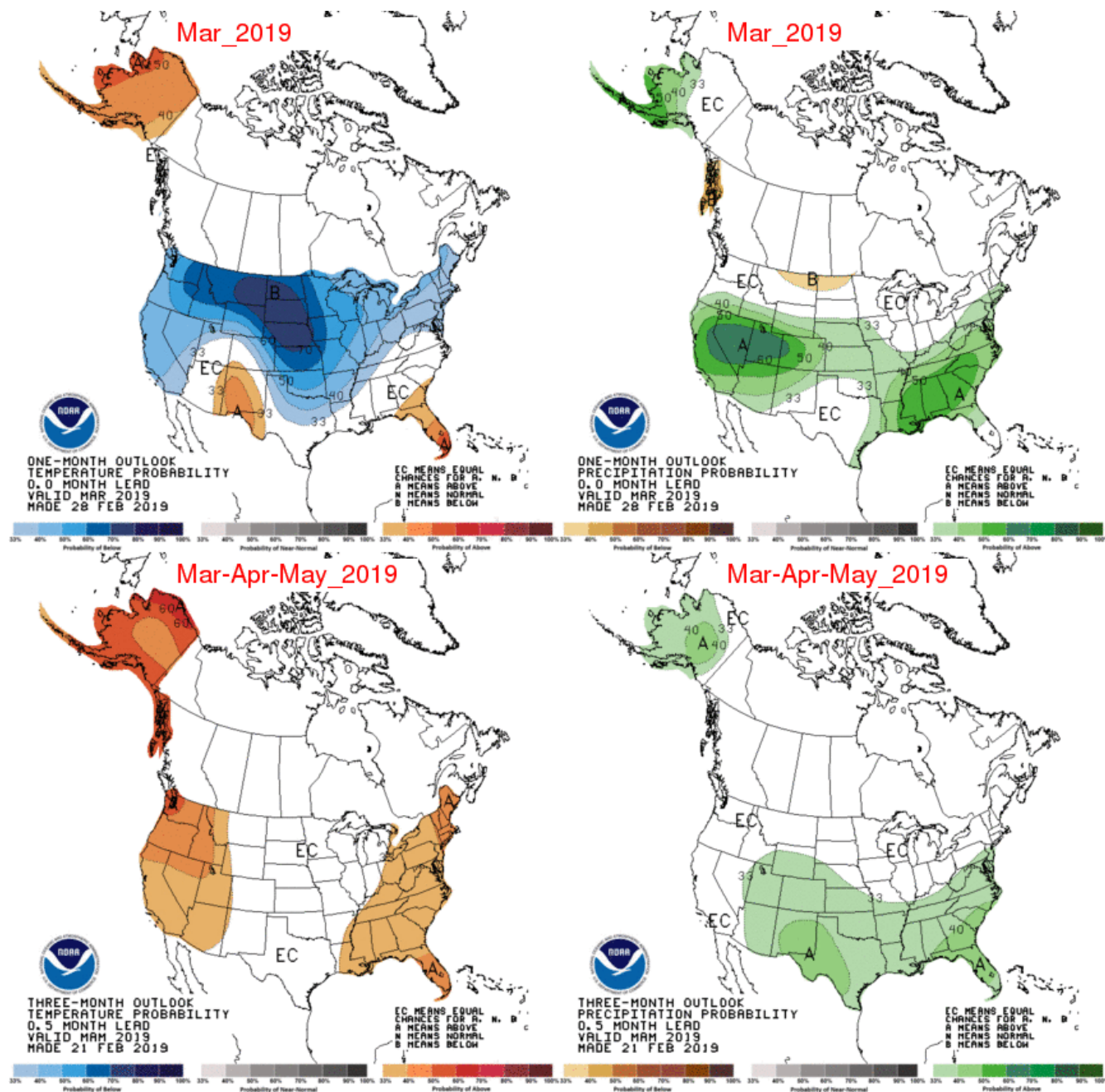
8-14 Day (valid March 9-15): Colder than normal conditions continue from the previous forecast period into mid-month with very little change geographically. Highest probabilities for colder than average temperatures are over the western US and across the northern Rockies in the Plains. The precipitation forecast into mid-month points to the majority of the country likely seeing greater than average precipitation for this time of year. The only slight shift from the previous forecast is for the expected dry conditions in the NW of Oregon and Washington to spread across the inland PNW and into the northern Rockies.

30 Day (valid March 1-31): The colder than normal first half of the month looks to dominate the forecast for the month as a whole (revised official forecast). The majority of the country is likely to see colder than normal conditions, this is especially likely in the northern Rockies, the Great Plains, and into the Great Lakes where a near constant plume of cold air is streaming out of the northern reaches of Canada (see Appendix Figure 1). Portions of New Mexico, west Texas and Florida are the only areas likely to see above average temperatures. For precipitation, the 30-day forecast for March indicates that the month will be dominated by the plume of moisture streaming into California and across the Rockies along with a wetter than average Gulf Coast and the southeastern US. The PNW across the northern tier of states will likely see near average precipitation amounts for the month of March.

90 Day (valid March-April-May): In spite of the colder conditions forecast for the majority of the US in March, the 90-day forecast shows the likelihood of a warmer than average western US, especially in the PNW, and from the Gulf Coast up along the east coast (see Appendix Figure 1). The middle of the country has equal chances of being slightly warmer to slightly cooler than average. The three month forecast window for precipitation indicates an equal chance of being near normal for the west coast and the northern tier of states. Above average precipitation during the MAM three-month period is forecast for the Four Corners, southern Rockies and across the southern tier of states.

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Appendix Figure 1 – 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).