

Weather and Climate Summary and Forecast Winter 2016-17

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December 5, 2016

Well after an October that felt more like November, we just finished a November that felt more like October! Temperatures during the month of November were warmer than normal across the west ranging from 0.5-1.0°F in portions of California to nearly 12°F above normal in the northern Rockies (Figure 1). All-time records were set for the month of November in many locations in Oregon, Washington, Idaho, Utah, Wyoming, Montana and Colorado. The records were generated not from record daytime temperatures, which were close to normal, but from record nighttime temperatures. As a result, agricultural areas over the majority of the west did not see a frost during the month and many have not seen a frost yet this fall. After a relatively wet October, especially in the northern half of the western US, November was near normal to moderately dry over the west (Figure 1). Areas receiving more than normal precipitation during the month were largely confined to the coast and into portions of the desert SW, while much of the interior Basin and into the northern Rockies were much drier than normal. Nationwide the rest of the US except Florida and along a portion of the eastern seaboard was substantially warmer than normal. Preliminary data is pointing to November 2016 being the warmest November on record for the US. During the month, most of the cold air from the Arctic was shifted toward Siberia with up to 40-60 degree below normal conditions for nearly the entire month. Precipitation amounts nationwide were mostly lower than normal, especially in the extremely dry southeast and mid-Atlantic states where fire dominated the news in November. Wet conditions during the month were confined to portions of the desert SW into Texas and in the upper Great Plains (>200% of normal) (not shown).

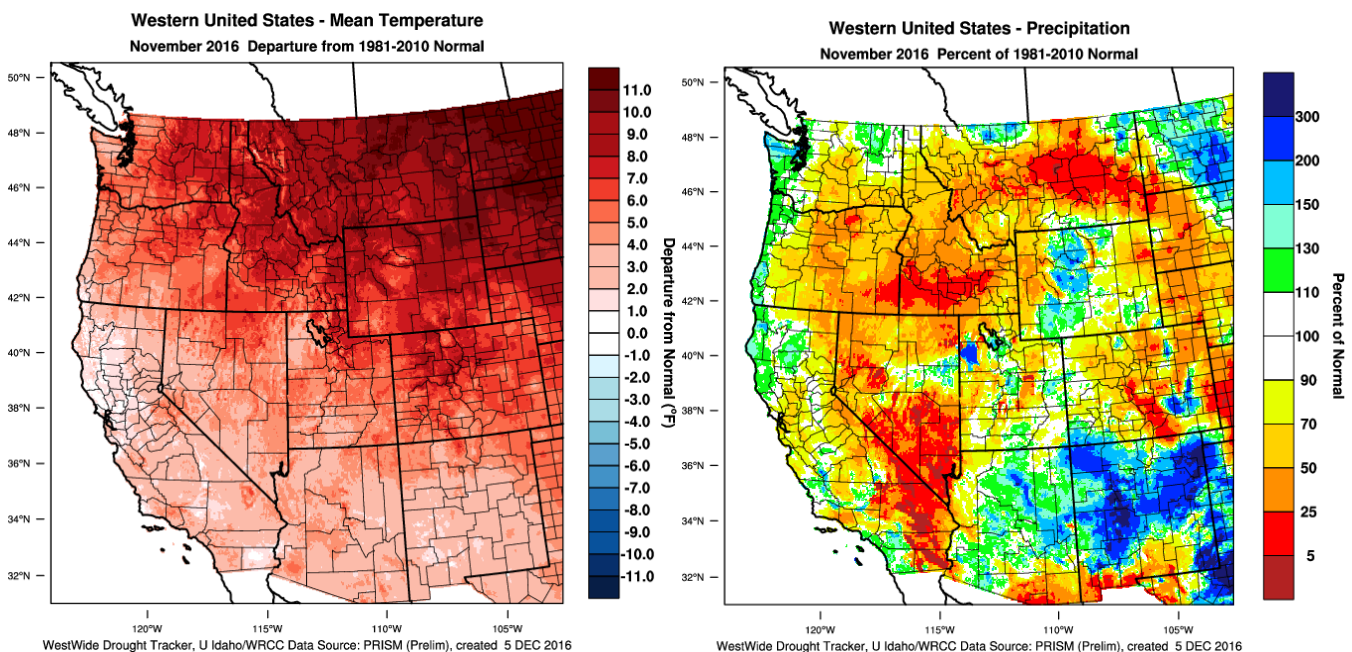


Figure 1 – Western US November 2016 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

After a warm November the western US continues on pace to end up warmer than normal for the year (Figure 2). Average temperatures year to date are trending 0.5-2.5°F or more above the 1981-2010 climate normals for much of California, Oregon, Washington and Idaho. There are still a few areas trending to average, but they are isolated to mostly around the Four Corners region of the southwest. The warmest areas of the west continue to be in the northern Rockies to the western Dakotas where temperatures have been 2-5°F above normal for the year. The general nationwide pattern continues from last month with much of the US running 1-3°F above normal, but 4-6°F or more above normal in the northern Rockies and Plains states (not shown). With our relatively wet October, western

US precipitation is running 110-140% of normal from central California north into western Oregon then across into much of Washington and the northern Rockies (Figure 2). Dry conditions (50-80% of normal) continue to hold across eastern Oregon into Idaho and eastern Montana along with Southern California and across the southwest. Nationwide the wetter than average conditions for the year extend out of the northern Rockies and across much of the Great Plains then south into Texas and the Mississippi River valley. November continued the extreme drought conditions across portions of the southeastern US and New England (not shown).

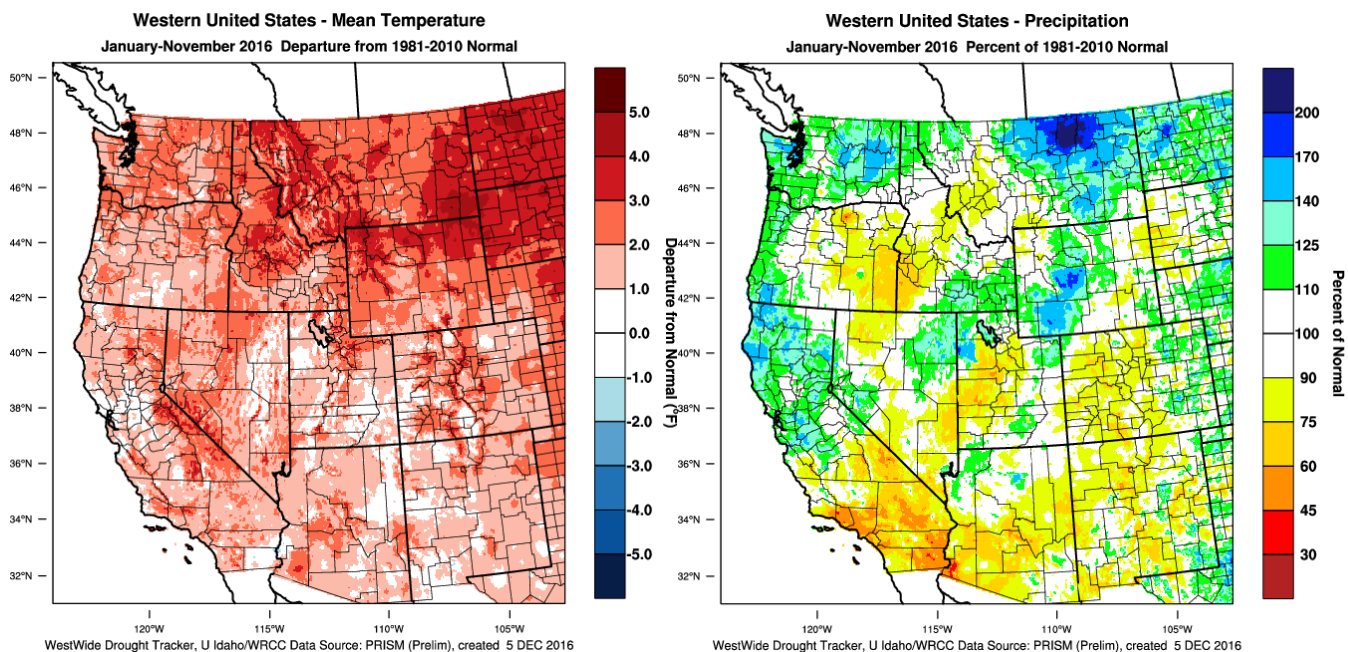


Figure 2 – Western US January-November 2016 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Drought Watch – Not much change from October with the most recent Drought Monitor indicating continued moderate to exceptional drought in portions of central to southern California into Nevada and eastern Oregon (Figure 3). Some extensions of drought areas into the Great Basin and central Rockies are now seen due to a slow start to the snow season. The month saw some reduction in the drought conditions in the New England states while the extreme drought conditions continue across much of the southeast. The US seasonal drought outlook (Figure 3) forecasts that the driest regions that remain in California, Nevada, and Arizona will likely persist through the end of January and beyond. Continued drought removal is likely in northern California and eastern Oregon.

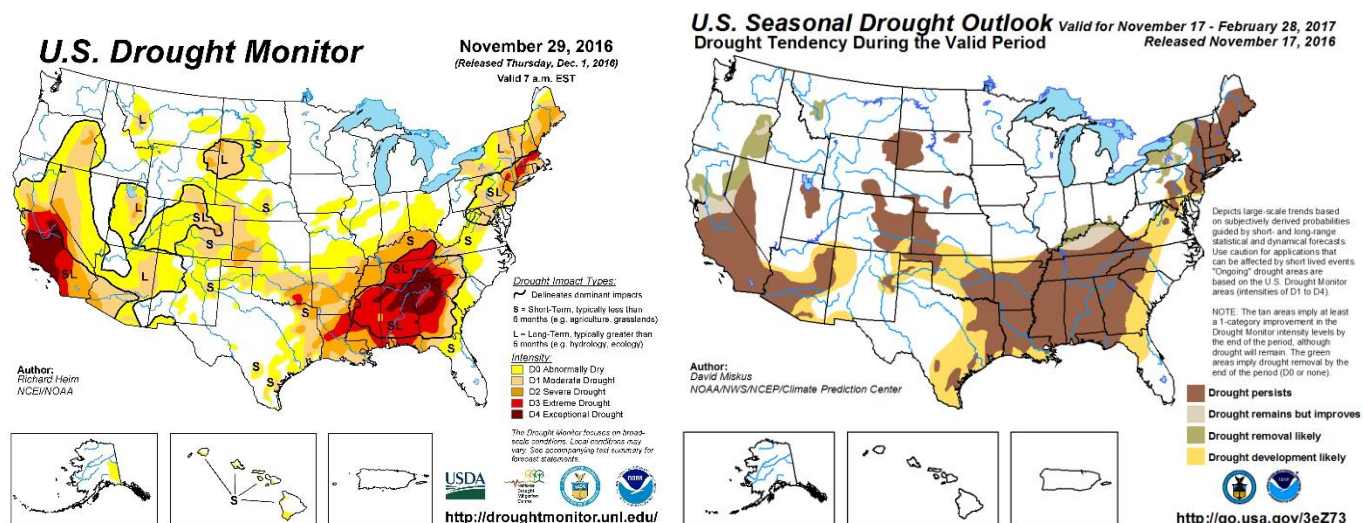


Figure 3 – Current US Drought Monitor and seasonal drought outlook.

La Niña Watch – After a couple of months of yes, then no, then yes on La Niña, October conditions in the Tropical Pacific developed enough to call it on and brought the western US a peek at conditions normally observed during La Niña winters. The wet and cool PNW along with warm and dry conditions in California during October showed all the signs of a clear shift to La Niña. However, the month of November did not play out the same with generally warm conditions across the west and mixed precipitation for the month (see sections above). Given the current atmospheric and oceanic conditions (Figure 4), along with model forecasts, the forecaster consensus favors the continuation of weak La Niña conditions through December-January-February. In addition, the consensus favors the La Niña to be short-lived, with ENSO-neutral favored beyond December-January-February. If the forecasted conditions hold true, the next few months will be warm and dry in the southern half of the US; wet and ‘coolish’ in the north (see forecast periods below and Appendix Figure 1). However, as mentioned here previously, conditions in the North Pacific have already and will likely continue to play a more prominent role for our winter (see below).

North Pacific Watch – Considerable cooling in North Pacific SST continues (Figure 4). Conditions across the North Pacific reaching toward the west coast of the US have cooled over 5°F over the past 12 months. Cooler waters in the North Pacific are tied to the positive phase of the Pacific Decadal Oscillation or PDO, a large-scale, long-term climate variability mechanism in the North Pacific Ocean that is closely associated with El Niño-La Niña cycles. The current conditions show a North Pacific that is slightly out of phase with the Tropical Pacific. During conditions like this the expected role that one or the other mechanism plays is not straightforward. Given the magnitude of the cooling in the North Pacific and a weak La Niña I would expect a relatively cool and wet PNW and a moderately dry and warm southern California extending across the desert southwest. If the cool waters extend all the way to west coast and become entrenched, a very wet winter will likely unfold followed by a cool and late spring. The next 30 days in Pacific sector SST and circulation pattern developments will be important to watch.

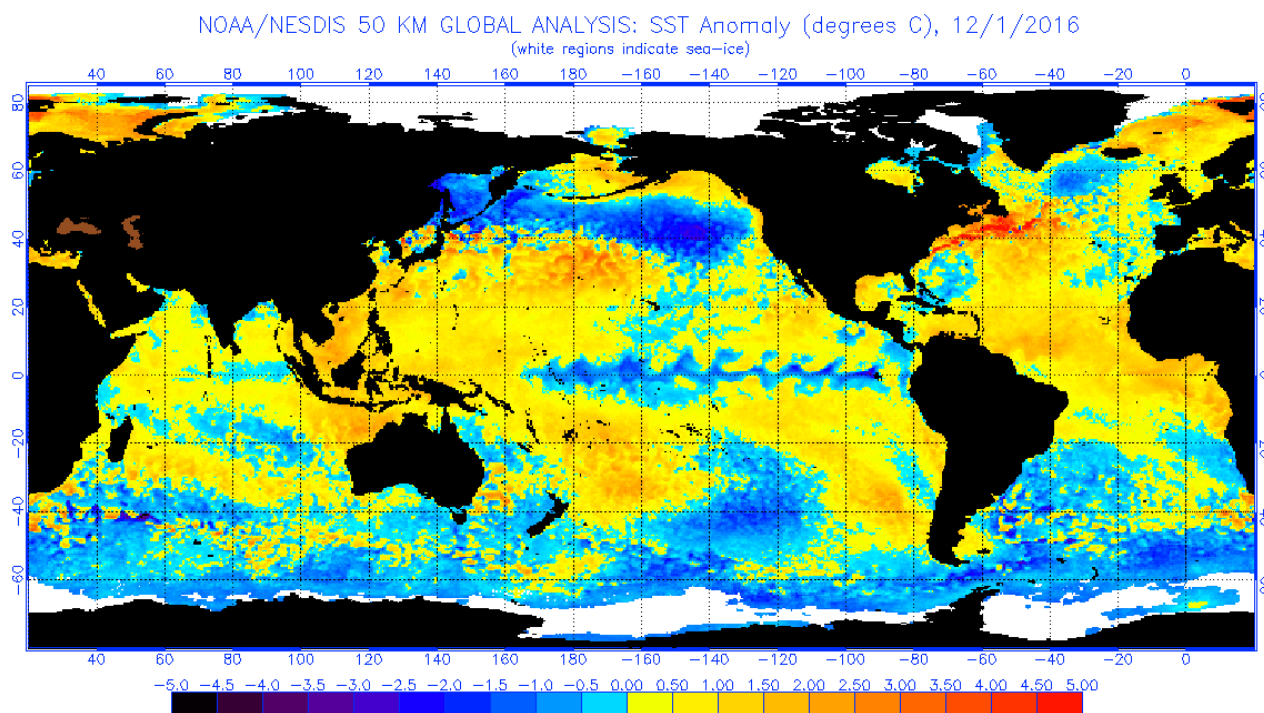


Figure 4 – Global sea surface temperatures (°C) for the period ending December 1, 2016 (image from NOAA/NESDIS).

Forecast Periods:

6-10 Day: During the next ten days the coldest air of the winter will flow down over the bulk of the United States in a one, two punch. The core of the cold air will affect the northern Rockies and upper Great Plains states, then move east and south across the US. However, the west will not be left unscathed and likely to see the coldest temperatures of the winter so far, low snow levels and average to greater than average precipitation. The period forecast continues

the relatively warm conditions across the southern tier of states and dry conditions in Southern California and across the southwest into Texas.

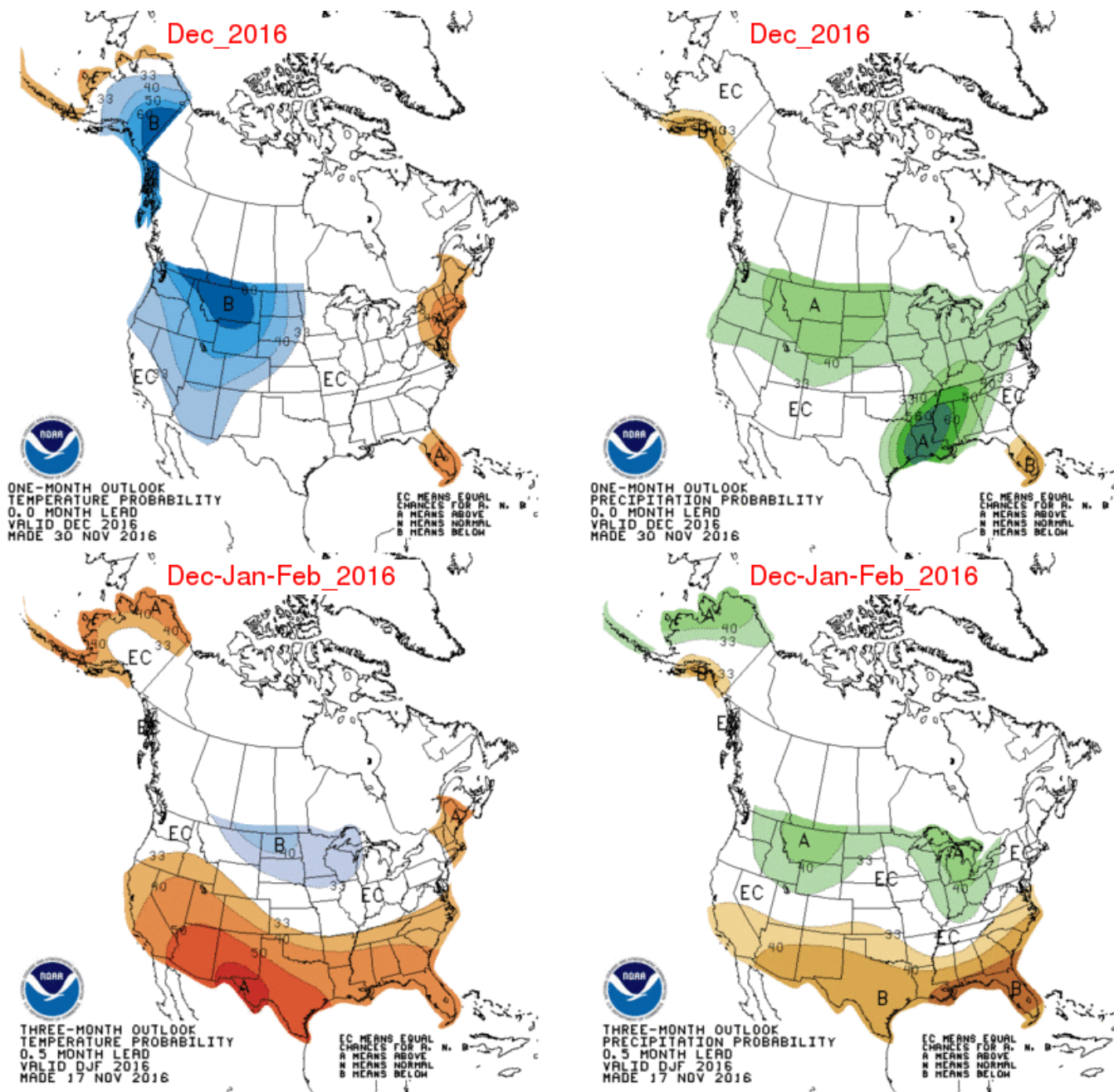
8-14 Day: A mixed message in the forecast extended beyond the 6-10 day above. Some models are hinting a general warm up over most of the west with the coldest air kept in the eastern two-thirds of the country. However, other models keep the west in a normal to cooler than normal period. The regional to national precipitation likelihood pattern does not change much from the 6-10 day with dry conditions in Southern California and across the southwest into Texas while the rest of the country will likely be wetter than normal.

30 Day: For the western US the 30 day forecast for the month of December appears to be dominated by the cool outbreaks over the next 10 days (see Appendix Figure 1). The bulk of the PNW and Rockies are given a high likelihood of having a cooler than normal month, while portions of California and much the rest of the US are given equal chances of being slightly above to slightly below normal. The only exception to this pattern is southern Florida and New England where temperatures are forecast to be above normal. The December precipitation forecast follows the general pattern out in the 8-14 day forecast with a high likelihood of wetter than average conditions across the northern tier of states and across the Mississippi River valley into the southeast (see Appendix Figure 1). This would be very welcome in the southeastern US where exceptional drought conditions are currently. Central to Southern California across the southwest to Texas is forecasted to have equal chances of being slightly above to slightly below normal in terms of precipitation.

90 Day: The long lead forecast for the core of winter (December-January-February; DJF) from the CPC continues to reflect some uncertainty in the development and longevity of La Niña and the conditions in the North Pacific. The forecast points to DJF as having elevated chances of above average temperatures for the majority of the southern continental United States (NOAA's Climate Prediction Center, see Appendix Figure 1). The exception to this is the northern Rockies and Plains where the CPC has called for cooler than normal conditions with everything in between having an equal chance of being slight warmer to slightly cooler than average. The DJF winter precipitation forecast is holding to a likely higher than average rain/snow amounts across the northern states, with much of western Washington, Oregon, Northern California and the center of the US states forecasted to have an equal chance to be slightly above average, normal, or slightly below average. The remainder of the southern portions of the US from central California across to the middle Atlantic states are forecasted to be drier than normal.

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Appendix Figure 1 – Temperature (left panel) and precipitation (right panel) outlooks for the month of December (top panel) and December, January, and February (bottom panel) (Climate Prediction Center, climate.gov).