

Weather and Climate Summary and Forecast Fall/Winter 2016

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After a year where we were seemingly off by a month in terms of temperatures (March was more like April, June was more like July, September was more like October), October in the west felt much more like a November in terms of storms and precipitation! An early transition to a winter circulation pattern in the North Pacific held strong throughout the month with aggressive troughs that brought record-breaking precipitation to many locations. October precipitation amounts were 150 to over 400% of normal with dominant SW to NE storm track patterns from central California to the Northern Rockies and western Oregon into eastern Washington (Figure 1). However, areas of the west to the south and east of these storm tracks remained very dry. The troughs, cloud cover, and precipitation along these storm tracks also kept temperatures cooler than normal across northern California and into the PNW (1-5°F below normal), while much of the intermountain west was much warmer than normal (1-6°F above normal). Nationwide there were no other areas of blue outside of what you see in Figure 1, with the rest of the US substantially warmer than normal (bulk of the country was 4-6°F above normal). Precipitation amounts nationwide were mostly lower than normal with the exception of the southeast from the influence of hurricane Matthew (>400% of normal) and the Great Lakes region (100-200% of normal) (not shown). Overall the precipitation pattern and amounts in northern California and the PNW dominate the national map.

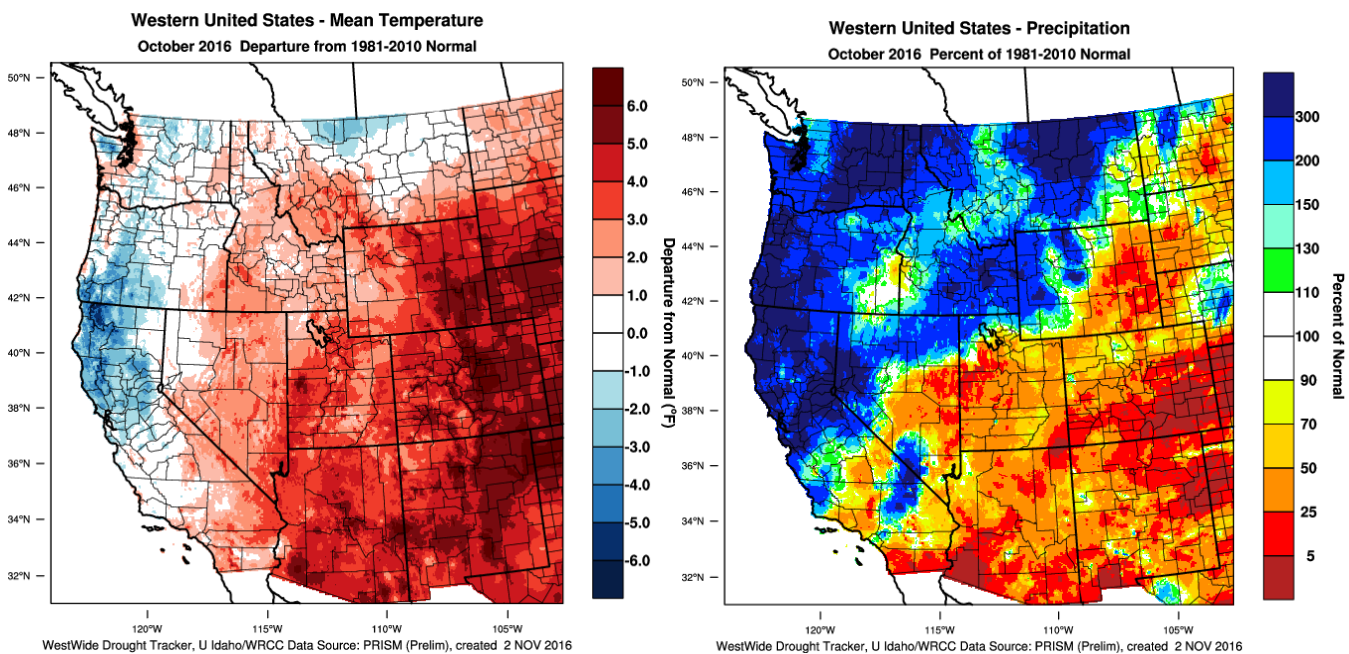


Figure 1 – Western US October 2016 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

While the western US continues to be warmer than normal for the year, the coolish September and October lowered the cumulative conditions since the first of the year (Figure 2). Average temperatures for the period are now running from 1-3°F or more above the 1981-2010 climate normals for much of California, Oregon, Idaho and Washington. However, scattered areas throughout the west have trended to average, especially in the Four Corners region of the southwest. The warmest areas of the west remain in the northern Rockies to the Dakotas where temperatures have been 2-4°F above normal. The general pattern continues across the entire US, with temperatures running 1-3°F above normal in most regions but 4-5°F or more above normal in the northern Rockies and Plains states and closer to normal in southern Texas and southern Florida (not shown). October precipitation (Figure 1) brought amounts to date to 110 to 200% of normal from central California into western Oregon, across most of Washington and into

portions of Idaho and the northern Rockies (Figure 2). Dry conditions 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 extend out of the northern Rockies and into the Great Plains then south into the Mississippi and Ohio river valleys then Texas, while portions of the southeastern US and New England have been drier than average so far this year (not shown).

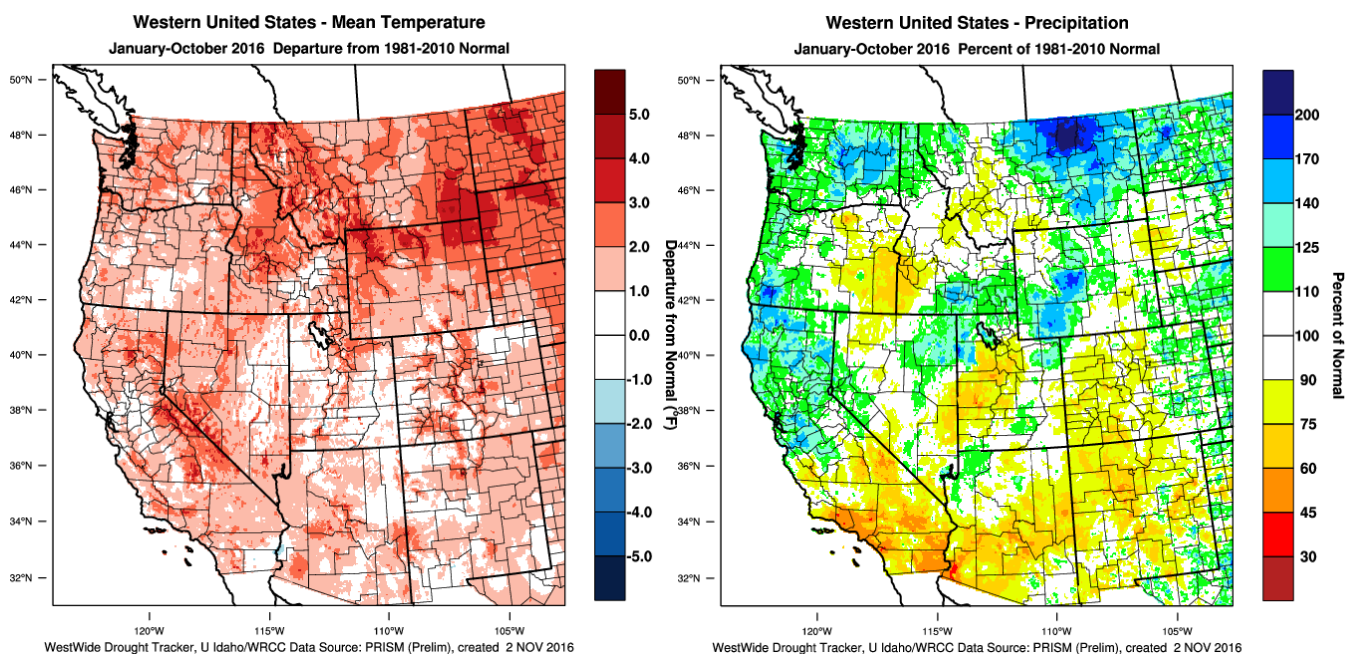


Figure 2 – Western US year to date (January through October 2016) temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Heat accumulation for the western US was near normal for October, ending the growing season higher than normal over most of the western portions of California, Oregon, and Washington (Figure 3). Growing degree-day (GDD) accumulation in October was near normal to slightly below normal in the PNW. Whether you use March through September or April through October, the GDD accumulated this year was about the same with overall accumulations from 100 to 500 units higher than the 1981-2010 normals throughout much of the western wine regions. However, inland areas of the PNW have trended much closer to normal. Four long-term monitored locations in Oregon show that GDD ended up below that of 2015 and very similar to values seen in 2013 and 2014 (see Appendix Figure 1).

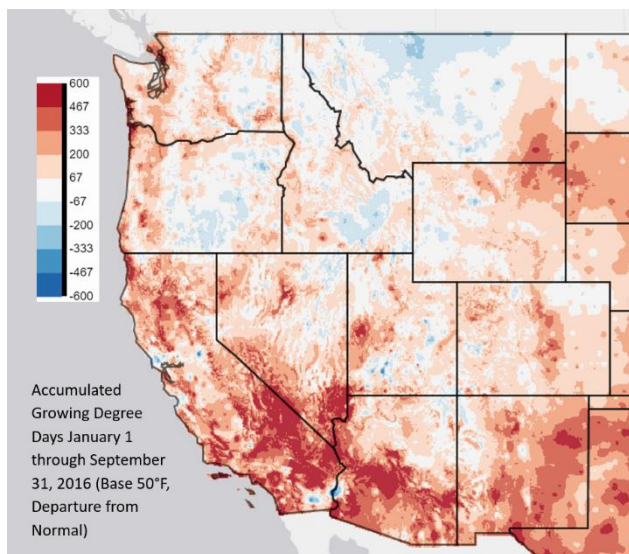


Figure 3 – Western US January through October 2016 growing degree-days departure from the 1981-2010 normals (image from Climate Impacts Research Consortium, University of Idaho).

Drought Watch – The wet October has altered the short to long term drought conditions in the western US. Portions of Northern California, western Oregon, Washington and the majority of Idaho have all seen drought conditions removed (Figure 4). However, portions of central to southern California into Nevada and eastern Oregon continue to show moderate to exceptional drought conditions. Other areas of the US experiencing drought include New England and the piedmont area of the southeast. The US seasonal drought outlook forecasts that the driest regions that remain in California, Nevada, and Arizona will likely persist through the end of January and beyond. Some drought removal is likely in northern California and eastern Oregon and across scattered areas in the northern Rockies.

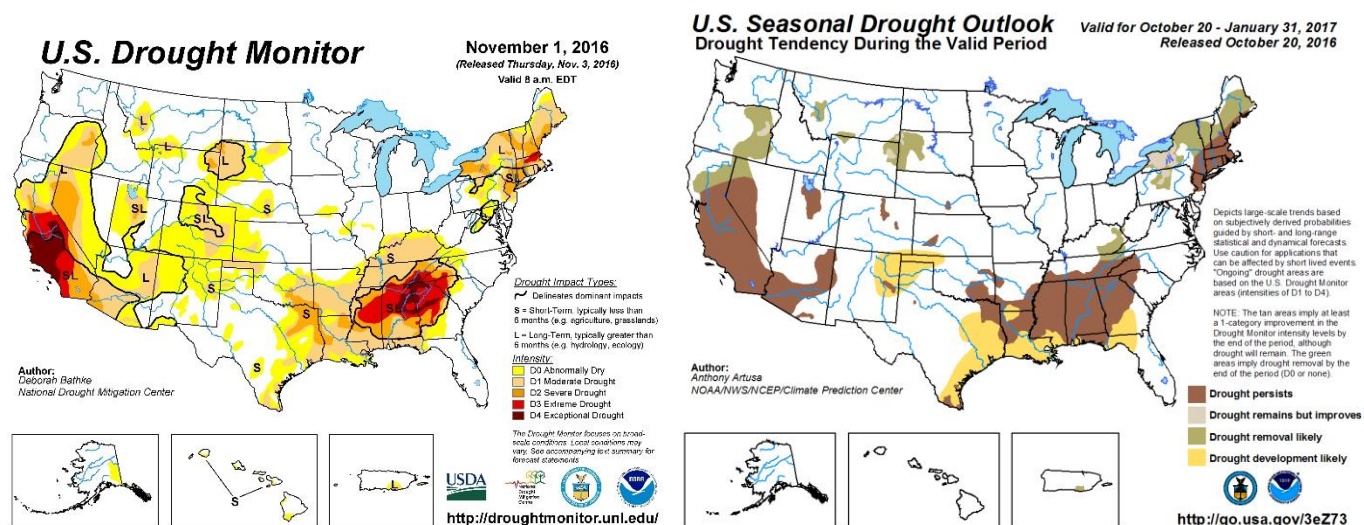


Figure 4 – Current US Drought Monitor and seasonal drought outlook.

La Niña Watch – Will it, or won't it ... earlier this summer the forecast community was sure that La Niña conditions were developing for this winter. Then in September meteorological agencies from around the world cancelled their months-long lookout for La Niña. Then, last week, the agencies reversed the forecast saying that there is now a 70 percent chance of La Niña forming, and were confident enough to fold that prediction into the Winter Weather Outlook. If true, that means 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 2). While the uncertainties surrounding the dynamics are evident, the conditions have some calling for a continued weak La Niña while others are pointing to likely stronger development. The October-November weather experienced across the US is certainly pointing to weak La Niña influences and the tropical SST are showing renewed signs of cooling (Figure 4). 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 – Over the past 30-60 days there has been a considerable shift in North Pacific SST (Figure 4) moving from the large warm pool (the Blob) to near normal and now a large zone of cooler water extending from the Russian coast across to North America. Cooler waters in the North Pacific are tied to 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. Positive PDO is often correlated with warmer and drier conditions in the PNW and, when in sync with El Niño, has produced some of our warmest and driest years in the western US. Conversely, a negative PDO produces colder and wetter (snowier) winters and is enhanced by La Niña. If the North Pacific continues to transition to cold and a weak or maybe even stronger La Niña develops, the conditions would likely bring us a more normal winter than we have seen in a while.

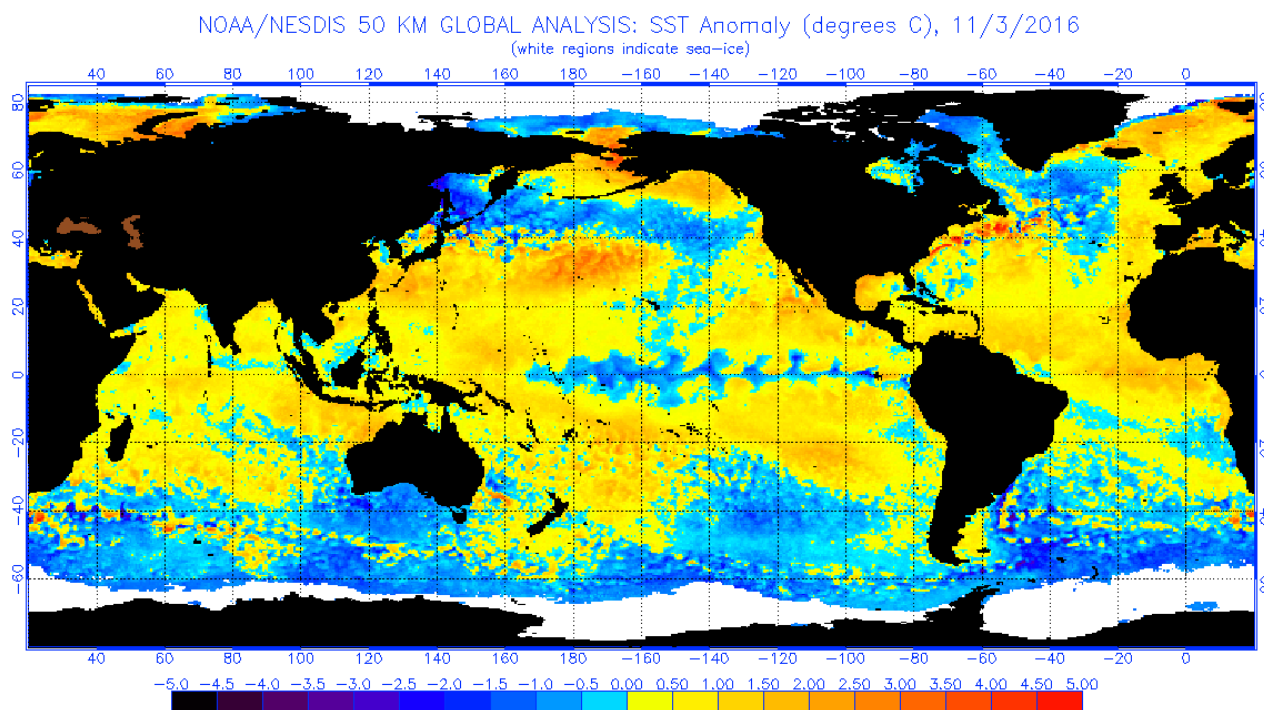


Figure 4 – Global sea surface temperatures (°C) for the period ending November 3, 2016 (image from NOAA/NESDIS).

Forecast Periods:

6-10 Day: On and off periods of clouds and showers will continue during this period, but after a very active October we will likely be drier and warmer than average through mid-November. The 6-10 day outlook from the CPC shows a high likelihood for drier than average PNW due to a more northerly storm track. This drier pattern extends eastward to the Mississippi river valley. Also after the previous 15-30 days were relatively cool, temperatures into the middle of the month of November are forecast to have a high probability of being warmer than normal for the western two-thirds of the county. The eastern third of the US will finally see a more winter like pattern and should be colder than average.

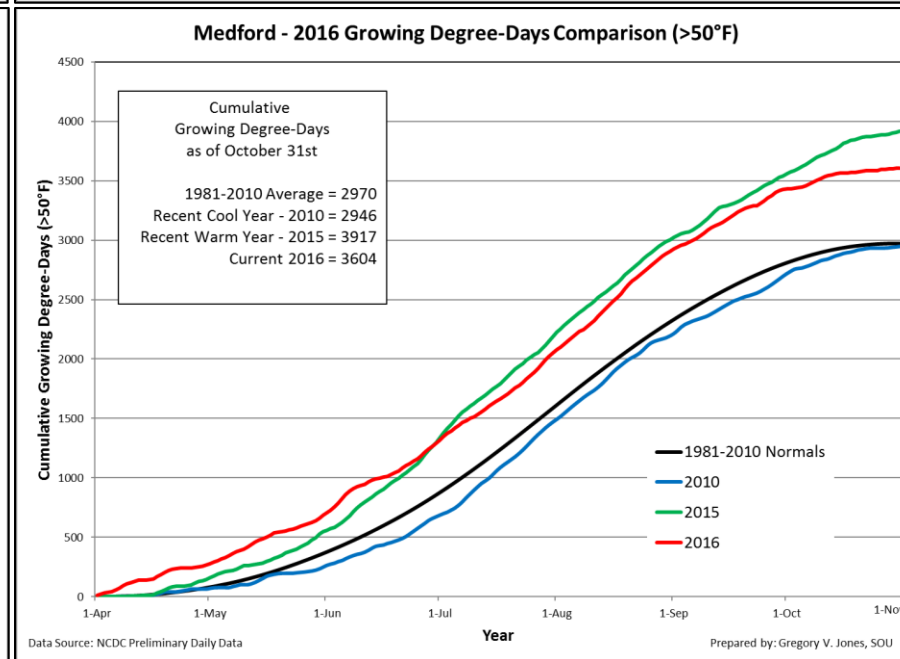
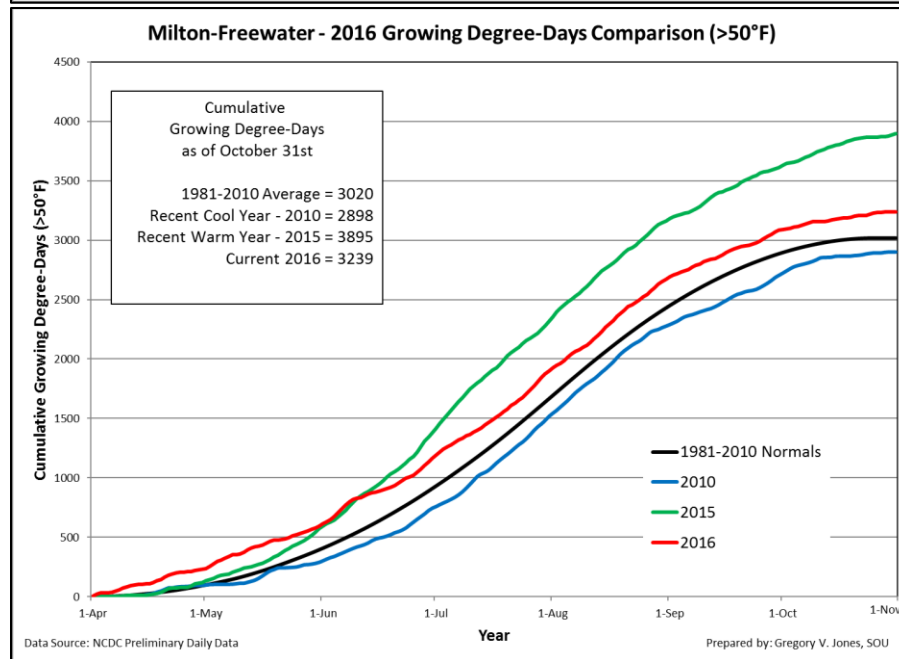
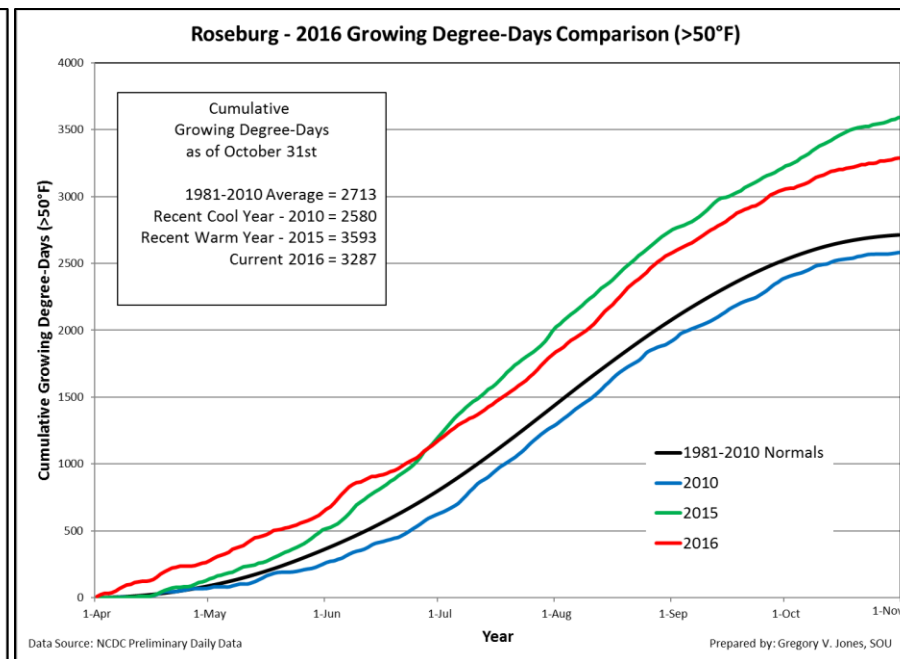
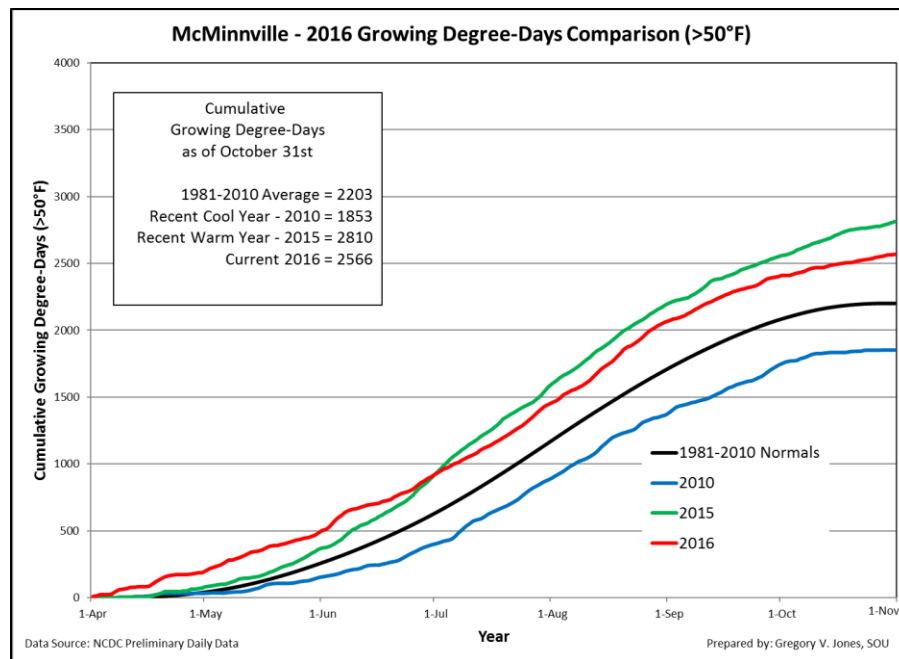
8-14 Day: While we have clearly moved into a more normal pattern for the early part of winter, all models are pointing to a warmer and drier period through just prior to Thanksgiving. Temperatures appear to continue the general warmer than normal conditions from the 6-10 period. While not extremely warm, the milder than average conditions are projected by the CPC to expand across the majority of the country. This is largely due to the lack of cold air in the Arctic currently. The precipitation forecast during this period continues to show the entire PNW having a higher likelihood of drier than average conditions. The likelihood for dry conditions extend across much of the US while the eastern seaboard is forecast to be wetter than average.

30 Day: The 30 day forecast for the month of November continues the dominant theme of being warmer than normal. With the exception of the extreme southeast and Florida, the rest of the country is projected by the CPC to end up with a warmer than average November. The forecast is largely driven by the current lack of cold air in the Arctic. The overall 30 day precipitation forecast for the month of November is mixed across the country, with precipitation amounts likely to be above average in the PNW, dry across the intermountain west, wet in Texas and the dry in the southeast. The wetter than average conditions in the PNW will likely come from late month precipitation, but not likely to come close to the amounts of rain we saw in the month of October (see Appendix Figure 2).

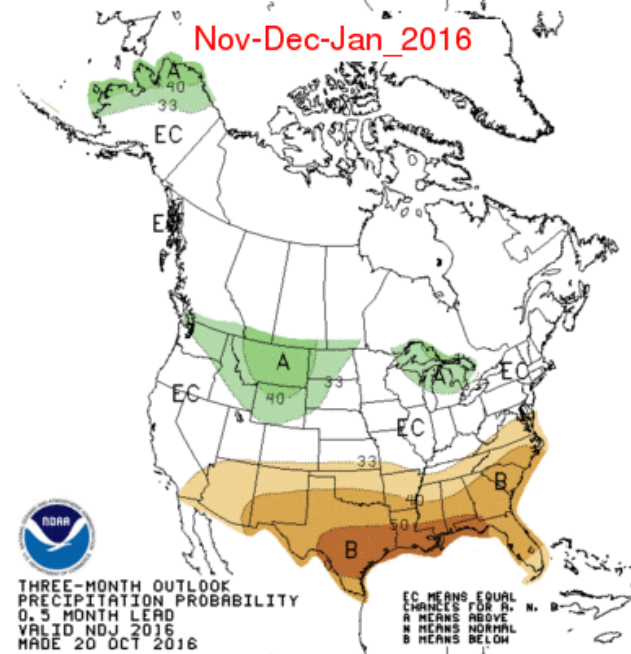
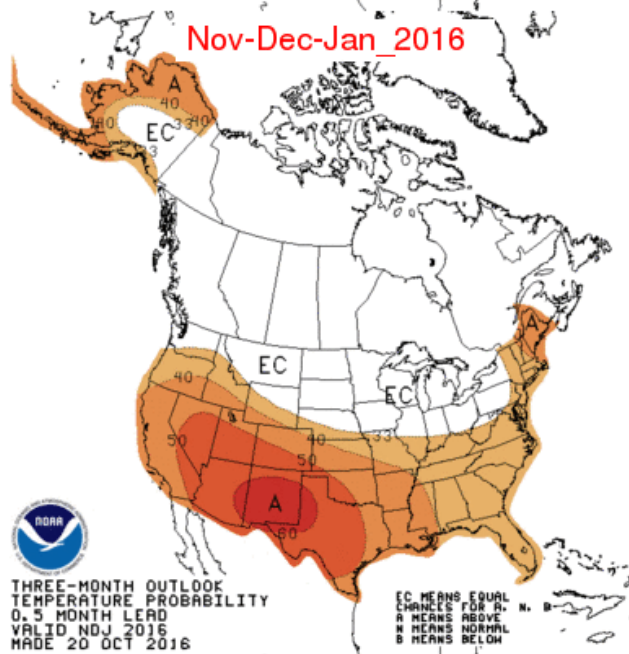
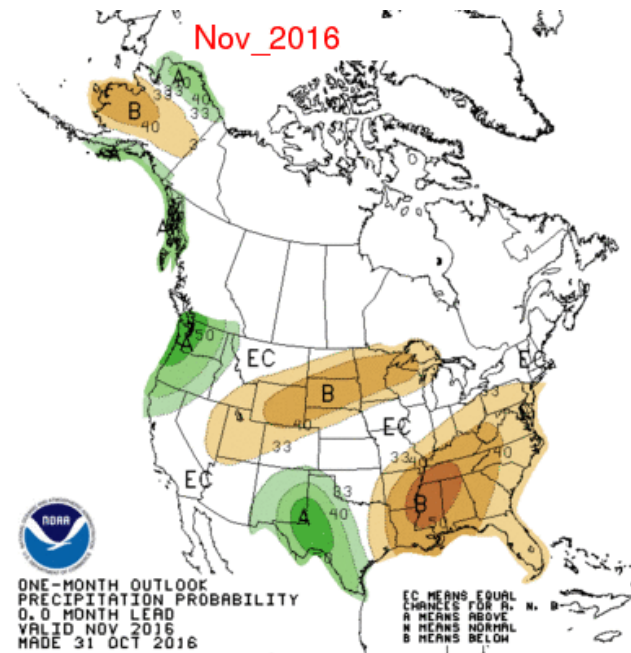
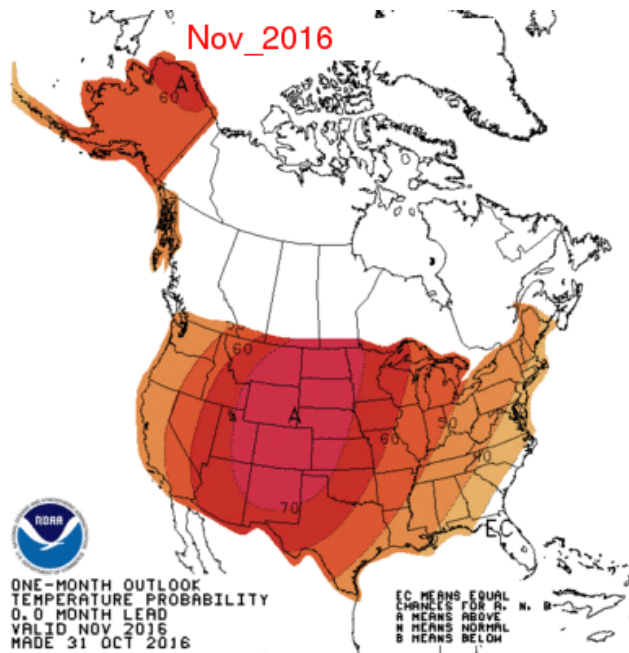
90 Day: The long lead forecast from the CPC reflects some of the uncertainty in the development of La Niña and conditions in the North Pacific. The forecast is continuing to point to the winter months of November-December-January (NDJ) having elevated chances of above average temperatures for the majority of the continental United States (NOAA's Climate Prediction Center, see Appendix Figure 2). The exception to this is the northern tier of states where the CPC has called for an equal chance of being slight warmer to slightly cooler than average. The winter precipitation forecast is holding to a likely higher than average rain/snow across the northern states, with much of the west and middle states forecasted to have an equal chance to be slightly above average, normal, or slightly below average, while the majority of the southern states are forecasted to be drier than normal. However, one troubling aspect is the statistics related to our fall to winter precipitation amounts in the west. Statistically speaking, a wet fall early winter has a high likelihood of being followed by a dry rest of the winter, which is often accompanied by colder than average conditions. Time will tell.

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Appendix Figure 1 – Cumulativegrowing degree-days (base50°F, no upper cut-off) for McMinnville,Roseburg,Milton-Freewater, and Medford, Oregon. Comparisons between the current year (2015) and a recent cool year (2010), a recent warm year (2015) and the 1981-2010 climate normals are shown (NCDC preliminary daily data).



Appendix Figure 2 – Temperature (left panel) and precipitation (right panel) outlooks for the month of November (top panel) and November, December, and January (bottom panel) (Climate Prediction Center, climate.gov).