

Weather and Climate Summary and Forecast Summer 2016

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The month of July saw the continued flip, flop of the western US temperatures. It was warm early, very cool in the middle of the month and then very warm toward the end of the month. The cool downs over the last two months appear to be more and more related to the cooling off of North Pacific SST (see North Pacific Watch below). The conditions appear to have come from a westward shift of the high pressure ridge much farther off the coast than normal. This allowed cooler air to flow down from the Gulf of Alaska and into the PNW. The result was the PNW seeing its first cooler than average month in nearly four years (Figure 1). This affect carried south into portions of coastal and inland California, but gave way to warmer than normal conditions in southern California and much of the southwest (Figure 1). Temperatures ranged from average to 2.5°F below normal across the PNW to average to 4.5°F warmer than average in the southwest (Figure 1). In terms of precipitation, most of California and into the Great Basin was substantially below normal while coastal northern California and into Oregon, Washington and Idaho where wetter than normal (Figure 1). Nationwide, much of the country was drier than normal with the exception of the Ohio River Valley and the upper Midwest which was wetter than normal (western Kentucky saw its wettest July ever). Temperatures in July saw the bulk of the southern portion of the country from the southwest to the southeast and up throughout New England largely warmer than normal, while the upper Midwest was near average (not shown).

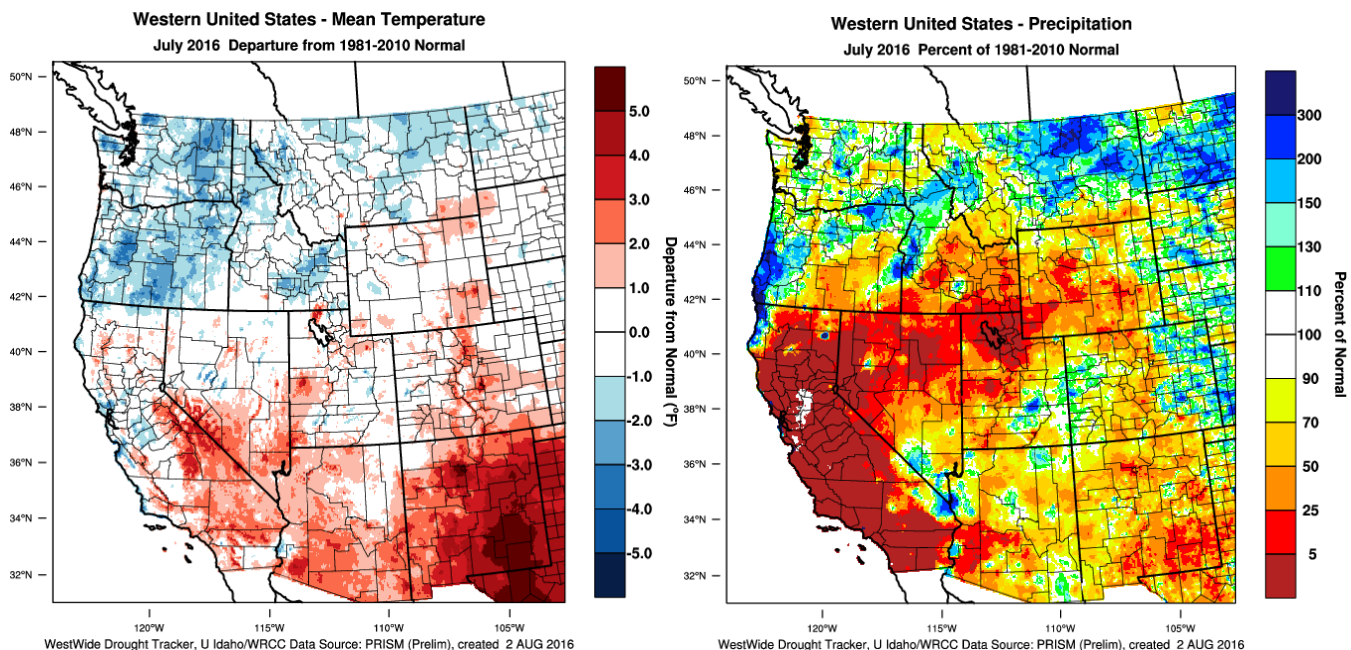


Figure 1 – Western US July 2016 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Cumulative conditions since the first of the year continue to show a largely warmer than normal western US with precipitation amounts mixed (Figure 2). Average temperatures for the period have run 1-5°F or more above the 1981-2010 climate normals for much of California, Oregon, Idaho and Washington. While portions of Montana and the Dakotas have been up to 6°F above normal, areas in eastern Nevada and the Four Corners have been closer to normal for the year to date. This pattern continues across the entire US, with temperatures running 1-3°F above normal in most regions but 5°F or more above normal in the northern Rockies and Plains states and closer to normal in Texas and the middle Atlantic states (not shown). For 2016 precipitation amounts have been 90 to 150% of normal from Northern California across to Nevada and into much of the Washington and the Rockies (Figure 2). Dry

conditions have been seen across eastern Oregon into Idaho and eastern Montana along with Southern California and across the southwest. The wetter than average conditions extends out of the northern Rockies and into the Great Plains then south into the Ohio River Valley and the Gulf Coast states, while portions of the eastern US have been drier than average so far this year (not shown).

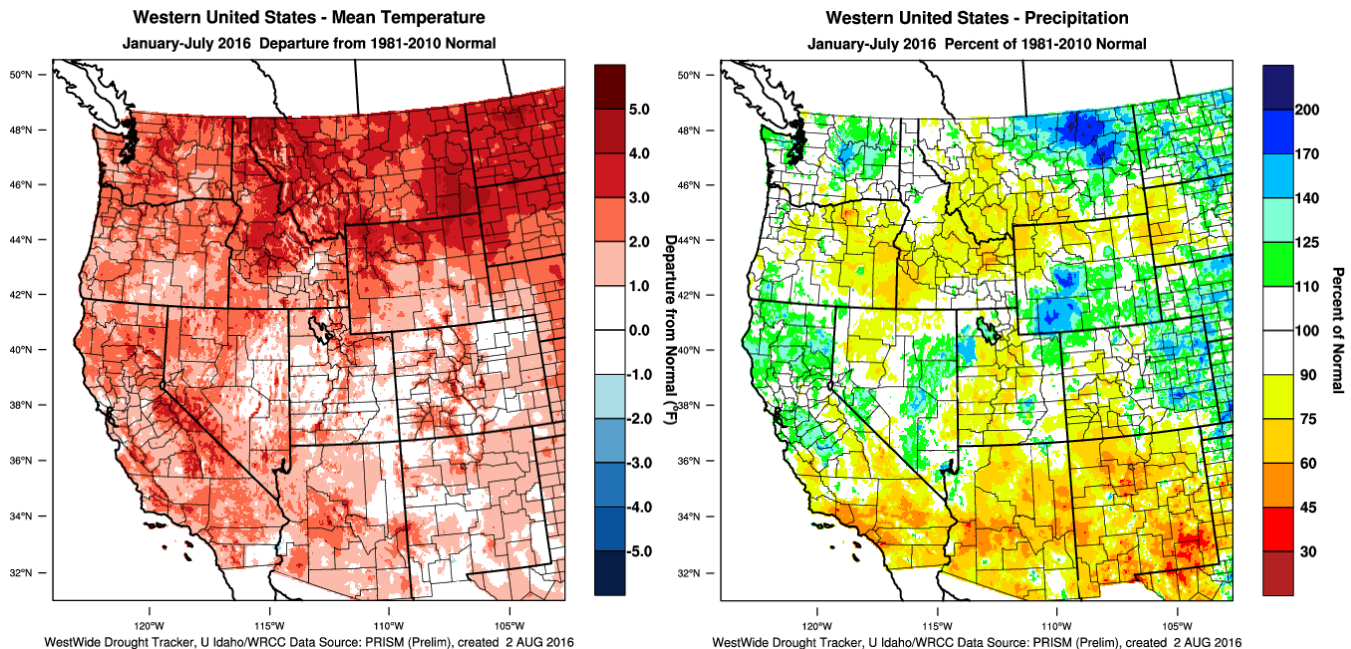


Figure 2 – Western US year to date (January through July 2016) temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Following the general spatial temperature patterns in Figure 1 and 2, growing degree-days are higher than normal over most of the western portions of California, Oregon, and Washington (Figure 3; new data from the CIRC). January through July accumulations are running 100-500 units higher than the 1981-2010 normals throughout much of the western wine regions, with the exception of a portion of the North Coast in California. While GDD accumulations are still running roughly 10-20 days ahead of the long term average, the cool down in June and a relatively cool July brought 2016 down below values seen during 2015 (see the Appendix Figure 1 for four locations in Oregon).

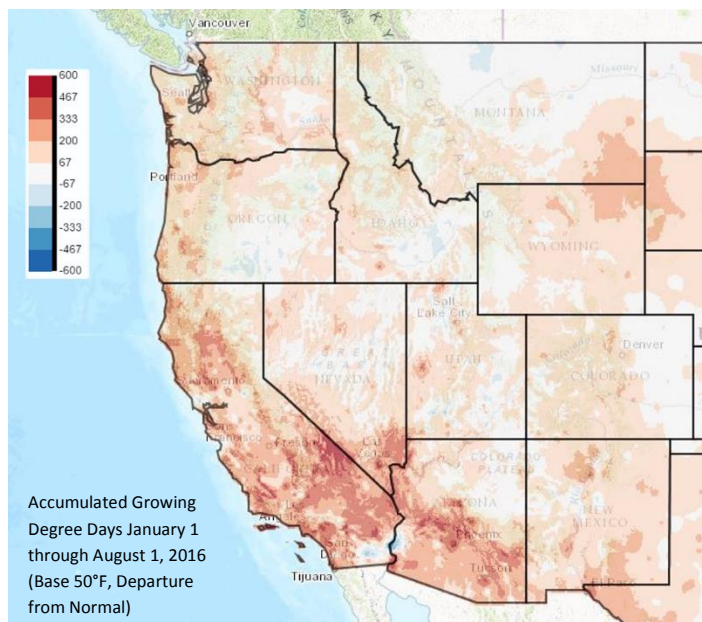


Figure 3 – Western US January through July 2016 growing degree-days departure from the 1981-2010 normals (image from Climate Impacts Research Consortium, University of Idaho).

Drought Watch – Again not much change from last month with western US drought conditions lessened in some areas but expanding in others. Conditions since the first of the year have also not changed much with central and southern California and into the southwest and Great Basin continuing to be very dry (Figure 4). The US seasonal drought outlook forecasts that the driest regions in California, Nevada and eastern Oregon will likely persist through the end of October and beyond, while drought development is likely into the inland Pacific Northwest. Some drought removal is likely in Arizona as the monsoon season is expected to pick up over this time period.

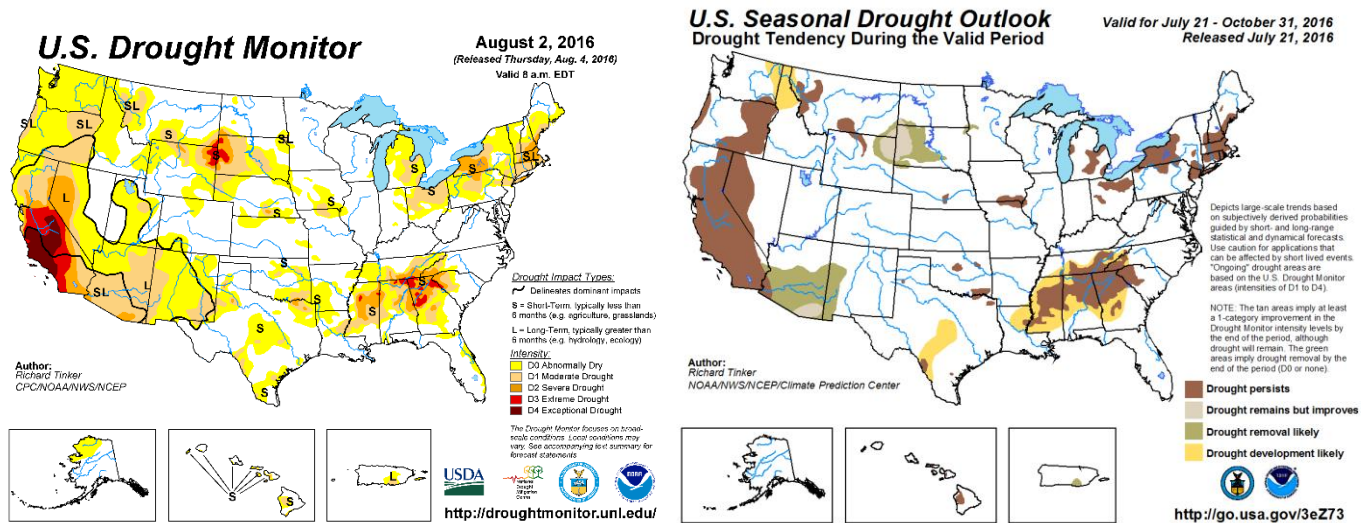


Figure 4 – Current US Drought Monitor and seasonal drought outlook.

La Niña Watch – To remind everyone this space has shifted from focusing on El Niño to paying more attention to potential La Niña developments. The shift to cooler surface waters in the tropical Pacific across the equator toward the central Pacific reflects the continued waning of El Niño and the developing La Niña conditions. Prediction models are in agreement that La Niña development is extremely likely by fall. If the transition into La Niña conditions by fall materializes, the western US would likely experience a colder and snowier winter. I will monitor this over coming months as there is some lead time forecasting that can come from knowing the combined conditions in the tropics and north Pacific (see below).

North Pacific Watch – Again some changes here, but not dramatic or straightforward. Warmer than average sea surface temperatures (SST) along the west coast in the North Pacific continue (Figure 4), but the magnitude and spatial extent of the warm waters has declined from the conditions seen during 2012-2015. The cooler than average conditions out over the central North Pacific also extends further east and covers a greater area than the last few years. The last 30 days have seen the warm pool in the North Pacific expand again (slightly) with the warmer coastal waters along the west coast helping bolster a warmer than average growing season. But it is important to note that the cooler pool of water might be indicative of a slowing of this effect. Early evidence is showing that my hunch last month, that the interesting June and now July trough conditions and slightly cooler air flow are a result of this shifting SST and the resulting circulation adjustments over the North Pacific. Long range forecasts are typically driven by conditions in the North Pacific and the state of ENSO in the tropics. If we continue to see a shift to cooler waters in the North Pacific AND the tropics continue to transition to La Niña, the western US will likely shift into a cooler regime, especially into the fall and winter. As such I will monitor how it evolves over the next few months.

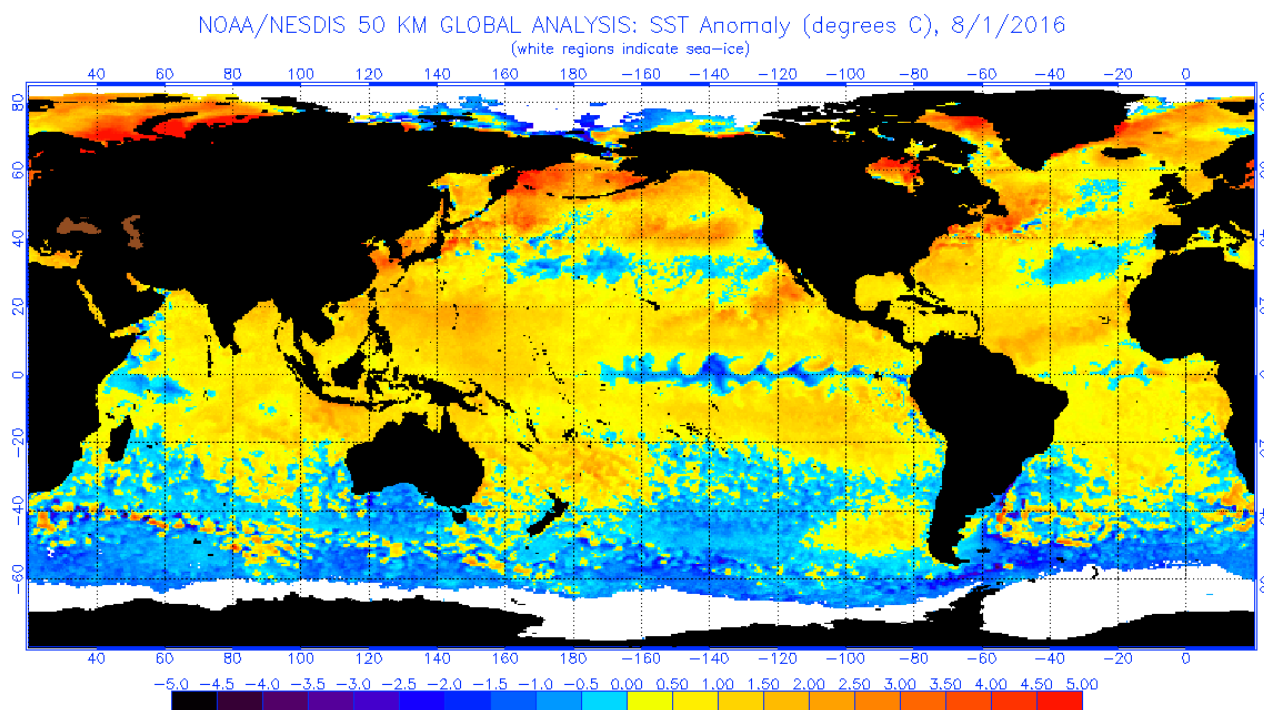


Figure 4 – Global sea surface temperatures (°C) for the period ending August 1, 2016 (image from NOAA/NESDIS).

Forecast Periods:

6-10 Day: The short term forecast is showing a high likelihood for a warmer than normal period across the PNW with portions of central to southern California and into the Great Basin being cooler than normal due to some monsoon flow cloud cover out of the Pacific. Even with the monsoon flow much of this region will likely be dry and the PNW is forecasted to be normal, or in other words dry as it usually is this time of year.

8-14 Day: PNW remains similar to the 6-10 day forecast with normal to warmer than normal conditions likely. Main shift in the west during this period is that central to southern California and the southwest are likely to return to much warmer than average conditions. Precipitation forecasts into the second and third weeks of August continue the normal to drier than normal conditions from the early part of August.

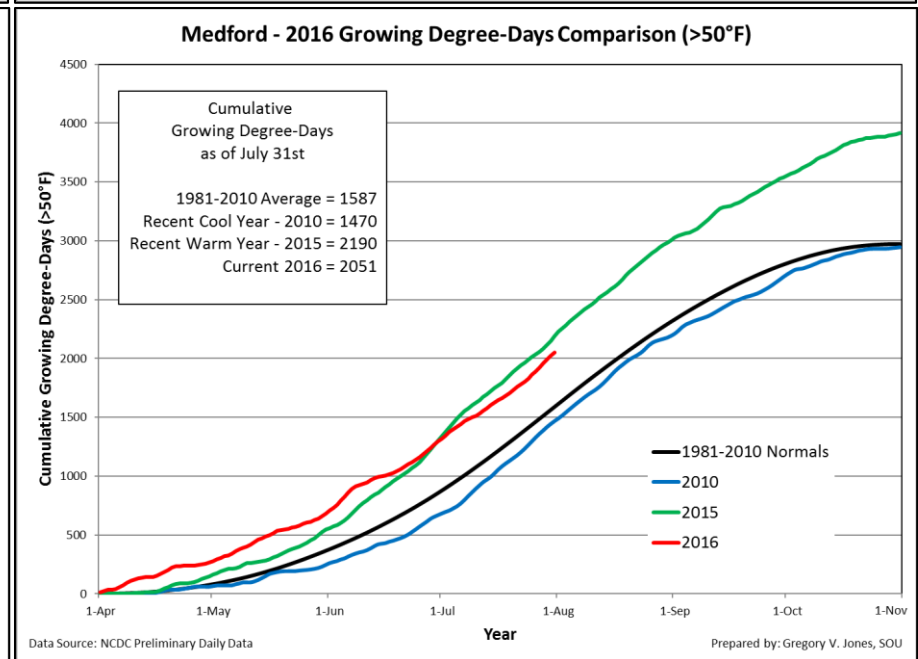
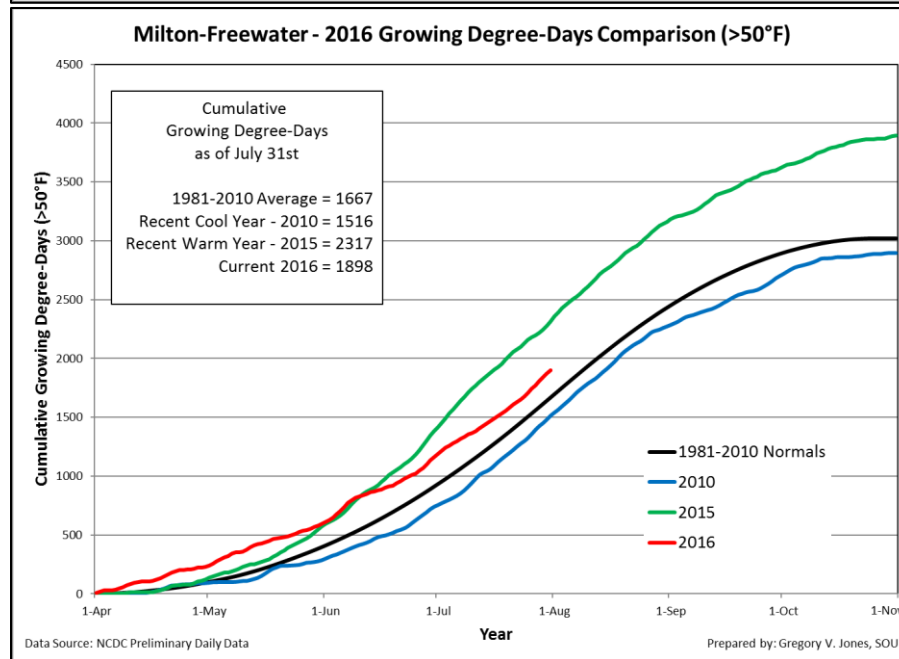
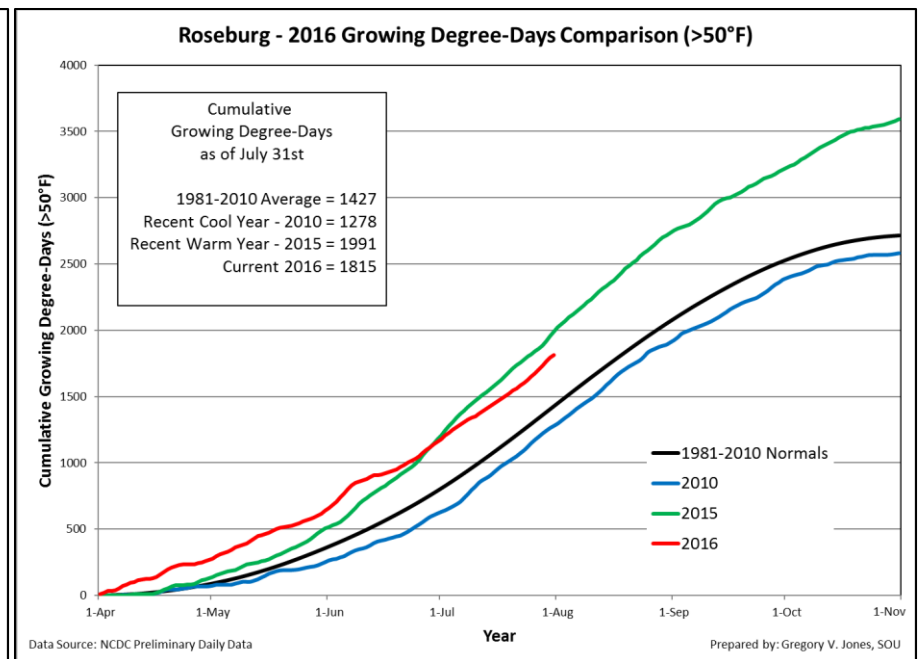
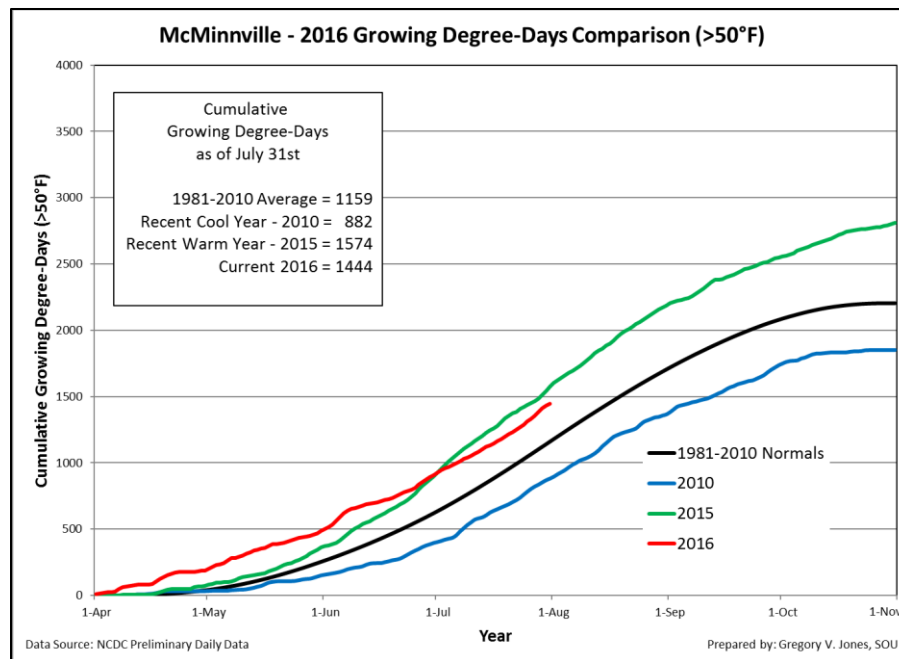
30 Day: The outlook through the rest of August points to a greater chance of warmer than normal conditions through the west, but especially from southern California into the southwest and Great Basin. Precipitation during the remainder of August is forecasted to below normal in the PNW, especially the inland PNW, while the remainder of the western US has an equal chance to be slightly above average, normal, or slightly below average (in other words no evidence for the dynamics needed to drive summer precipitation at this point).

90 Day: While it may sound like a broken record, the August-September-October (ASO) forecast continues the 30 day August forecast as given above. The majority of the continental United States has elevated chances of well above average summer temperatures, according to the latest outlook from NOAA's Climate Prediction Center (see Appendix Figure 2). There are no substantial changes to the pattern in the western US with everywhere in California, Oregon, Washington and Idaho expected to see higher than normal temperatures. Like the temperature forecast, the precipitation forecast for the west does not change much from the August outlook, with much of the west forecasted to have an equal chance to be slightly above average, normal, or slightly below average, while portions of the inland PNW are forecasted to be drier than normal. Precipitation occurrence and accumulation over the next three months

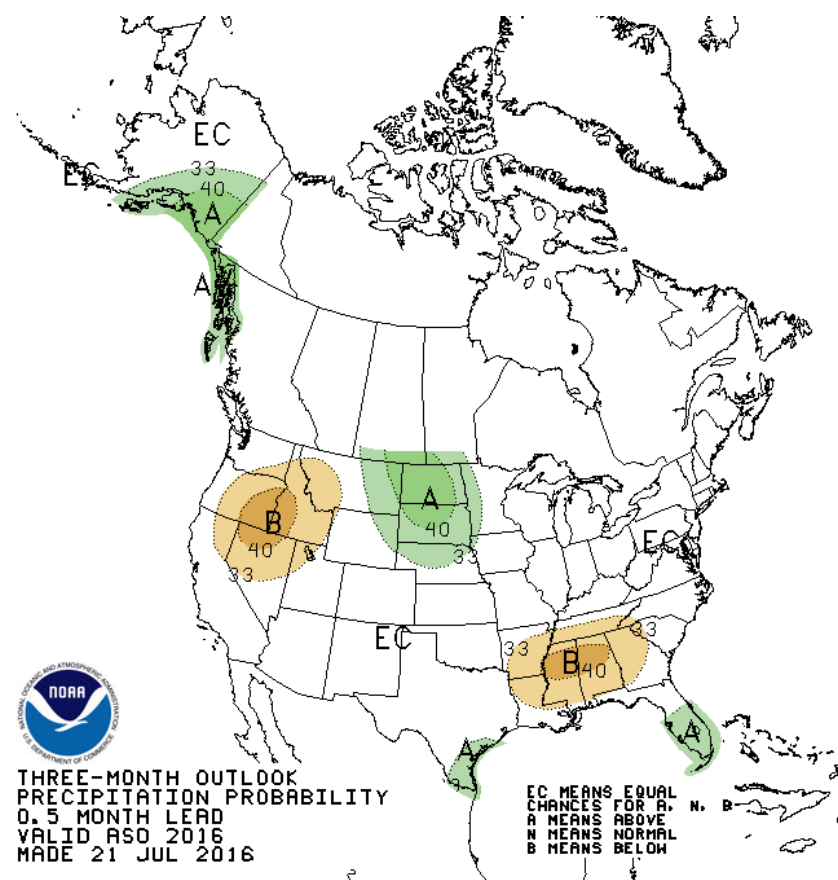
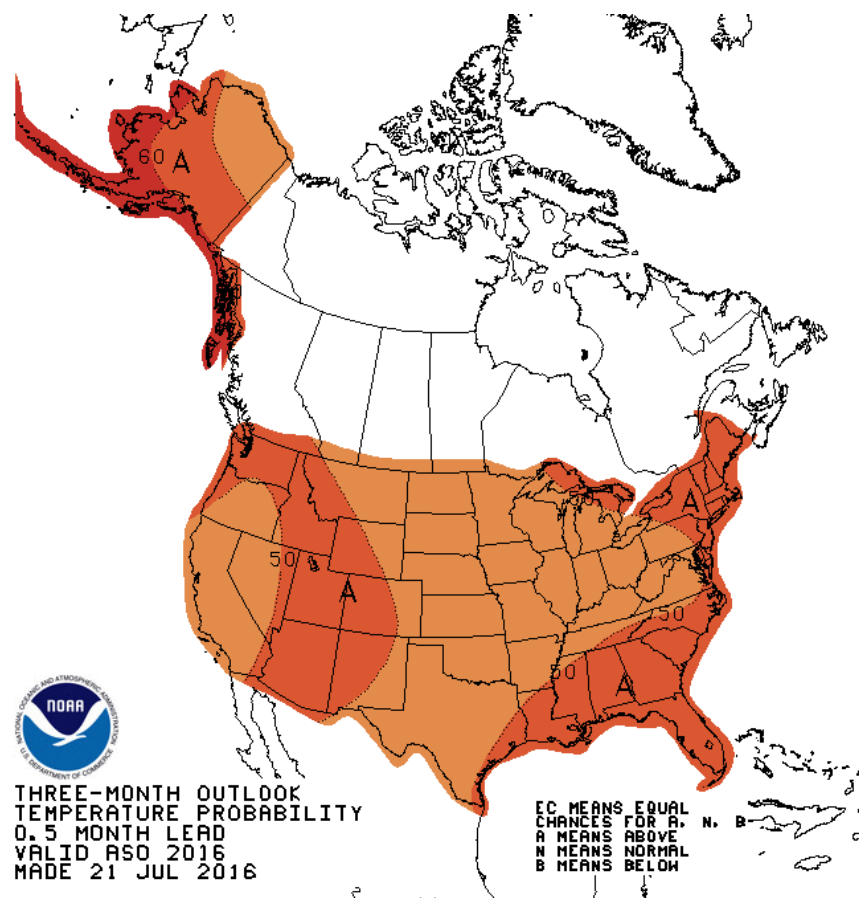
will be driven by increasing chances of warm season thunderstorms which are typically quite spotty, so amounts received will vary tremendously.

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Appendix Figure 1 – Cumulative growing degree-days (base 50°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 August, September, October (Climate Prediction Center, climate.gov).