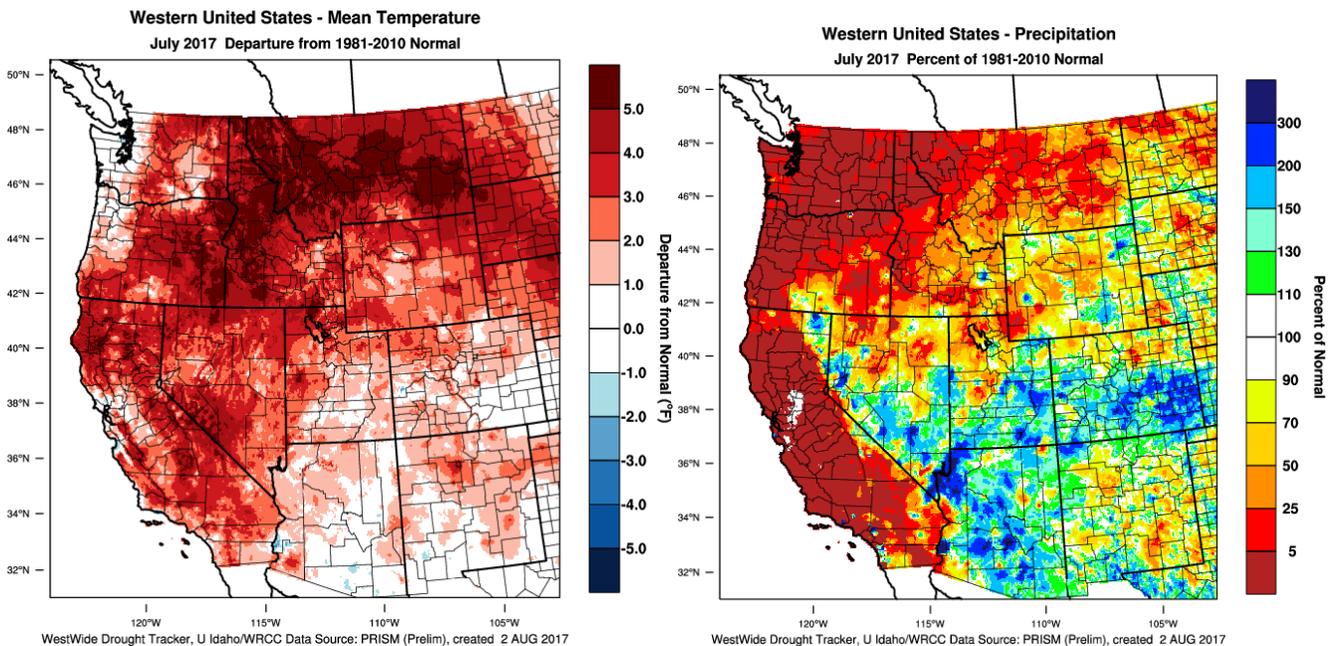


# Weather and Climate Summary and Forecast Summer 2017

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July largely held true to forecast, although it ended with the start of one of the most extreme heat waves in decades in the PNW. Overall July ended up generally warmer than the 1981-2010 average for the majority of the western US (Figure 1). Areas in the northern Rockies saw the warmest conditions of 4-5°F above normal, while most other areas saw 1-2°F above normal. A few regions saw average to slightly cooler than average conditions in July; including western Washington, isolated areas of eastern Washington, extreme northwest Oregon, and in isolated areas around the Bay Area, the Salinas Valley, and portions of the southwest (Figure 1). From scattered reports around the west, the warm conditions have moved many close to the start of véraison (north) and others well into véraison (south). The warmth in the west extended across the US to the Plains, while portions of the south and southeast were closer to normal, and the extreme northern Great Lakes and New England were slightly cooler than normal (not shown).

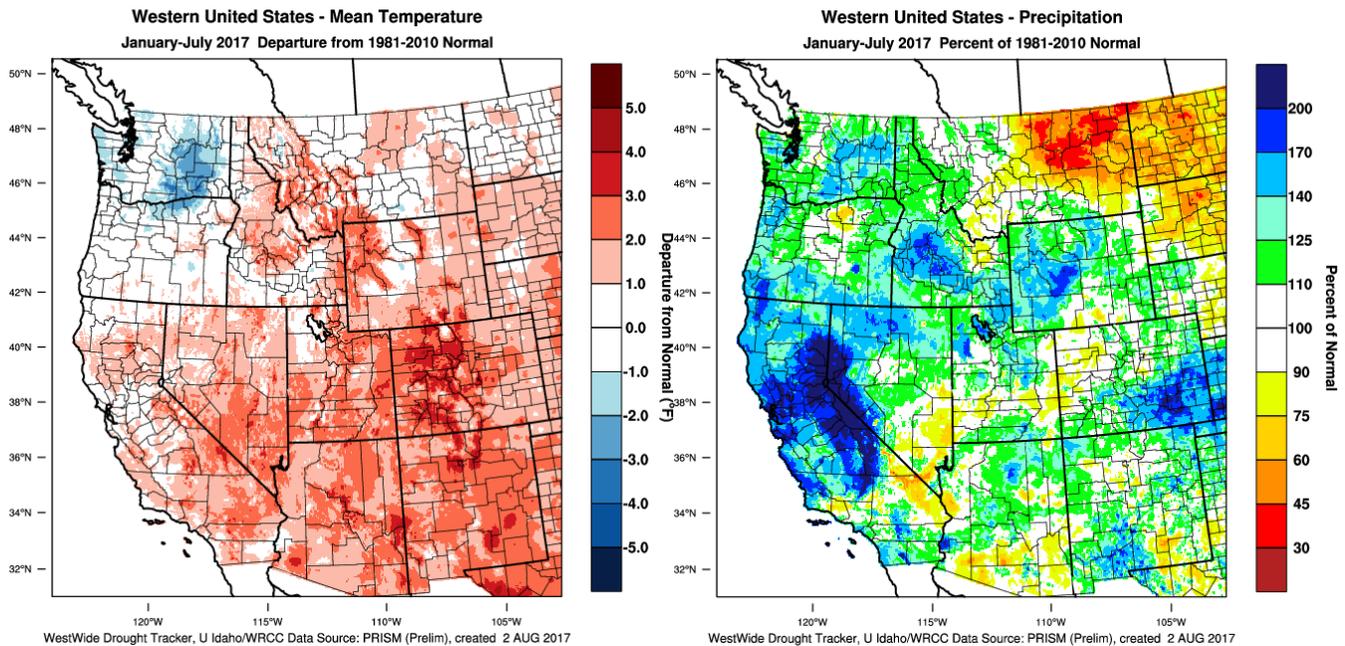
July precipitation in the western US was largely absent with many stations in Washington, Oregon and California recording no measurable rainfall resulting in less than 5% of normal (Figure 1). Isolated rain events due to thunderstorms and some monsoon flow contributed to relatively wet zones along the eastern flank of the Sierra Nevada mountains, throughout Arizona and portions of the Four Corners (125-300% of normal; Figure 1). Precipitation amounts nationwide were widely scattered during the month of July. The dry conditions in the west dominated the pattern along with a slightly wet southern tier of states and a moderately wet Ohio River valley extending to southern New England (not shown).



**Figure 1** – Western US July 2017 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

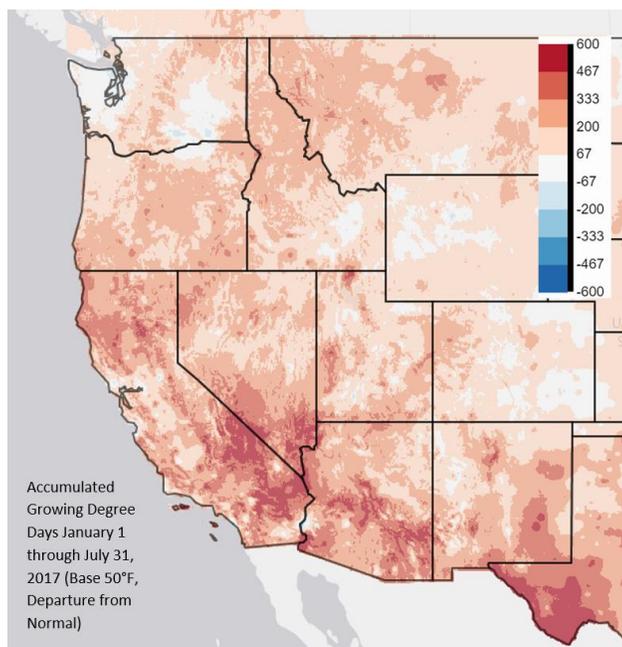
The general pattern of temperatures from the first of the year continues, although July pushed conditions in the western US closer to average (Figure 2). California continues to run warmer than average, Oregon is average to slightly below average, and Idaho is warmer than average. Washington continues to show the effects of a cold late winter with year to date temperatures running below average. The remainder of the western US ramped up and is now running 1-3°F above average. The rest of the country was also substantially warmer than average during January through July (not shown). July precipitation in the west (Figure 1) did not alter the cumulative precipitation pattern

for the first half of 2017, which continues to show overall wetter than average conditions in the western US (Figure 2). Drier than normal conditions are seen in southern Nevada, southern Arizona, and eastern Montana. The continued dry conditions in the northern Great Plains remains one of the driest areas in the US (not shown), while the rest of the eastern US has experienced average to wetter than average conditions year to date (not shown).



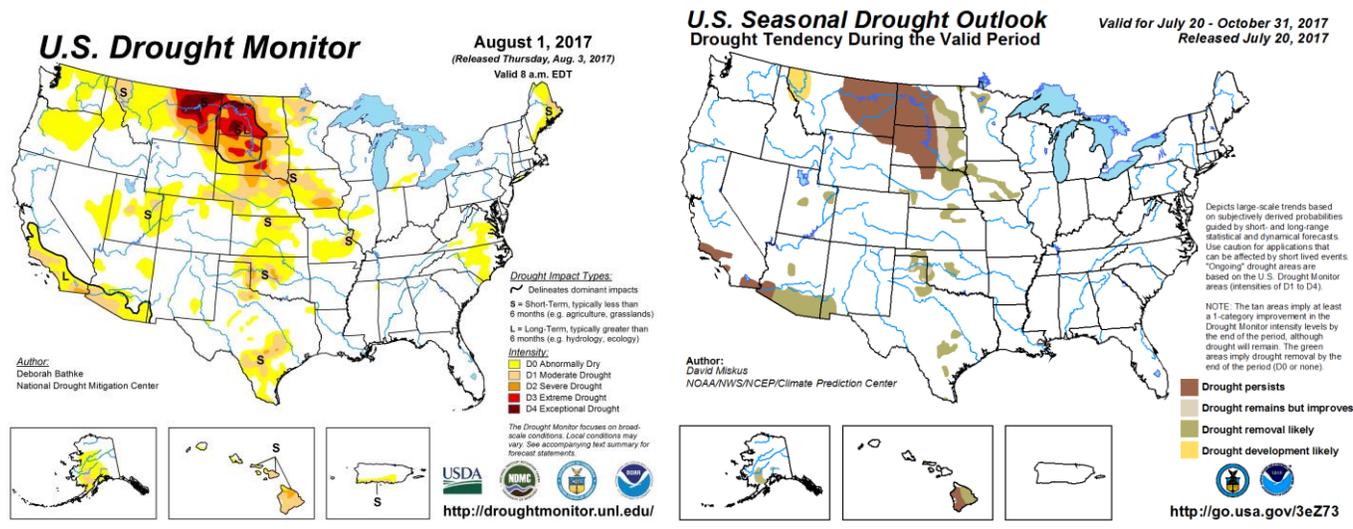
**Figure 2** – Western US January-July 2017 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Entering the months when heat accumulation is at its greatest, departures from normal for January-July are now near the 1981-2010 average in Washington and Idaho, about 10-15% above average in Oregon, and 10-20% above average in California (Figure 3). Most wine regions are now 5-20 days ahead of average, while a portion of eastern Oregon/Washington is still 2-6 days behind. Heat accumulation (GDD) amounts for four locations in Oregon continue to track above the 1981-2010 normals for this period, but remain below the values seen at this point in 2015 (see the Appendix Figure 1 for four locations in Oregon). The 2017 heat accumulation to date in the western US wine regions is similar that observed during 2006, 2009, and 2012-13.



**Figure 3** – Western US January through July 2017 growing degree-days departure from the 1981-2010 normals (image from Climate Impacts Research Consortium, University of Idaho).

**Drought Watch** – Very little change over the last 30 days in drought conditions nationwide (Figure 4). The two main areas seeing any change are the northern Great Plains and the Southern California to Southern Arizona regions. The northern Great Plains has transitioned to extreme and even exceptional drought status over the last couple of months with some indication that it will be relatively long-term. Coastal southern California and across southern Arizona are continuing to see abnormal to moderate drought that have been delineated as long-term. Scattered short-term drought exists across many areas of the rest of the country (areas in yellow in Figure 4, left panel). The seasonal drought outlook for the United States through October (Figure 4, right panel) predicts drought to persistent in the two main regions of the Northern Great Plains and California/Arizona, although monsoon flow in August/September might alleviate the conditions in portions of southern Arizona (see forecast periods). The rest of the country is forecast to be largely free from drought through the end of the summer.

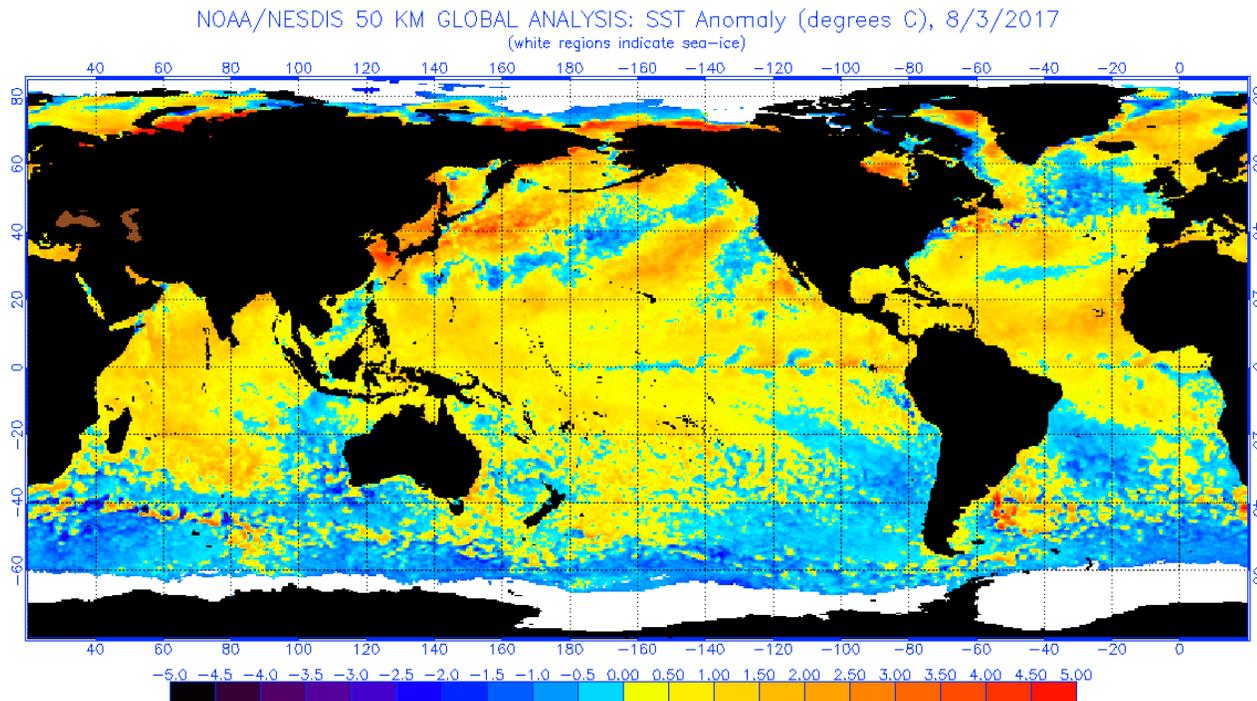


**Figure 4** – Current US Drought Monitor and seasonal drought outlook.

**ENSO Watch** – The mid-July 2017 reports all point to the tropical Pacific remaining in an ENSO-neutral state, with SSTs near the El Niño threshold in the east-central tropical Pacific but the atmosphere maintaining ENSO-neutral patterns. The collection of latest ENSO prediction models indicates ENSO-neutral as the most likely condition during summer through fall and into winter with chances for El Niño development at about 35-40%. As was seen during the last update, many indicators continue to show little or no increase in tropical sea surface temperatures (SST) for several months now (Figure 5), suggesting El Niño development has stalled for now and nearly all models indicate that if El Niño does form, it is likely to be weak. My assessment continues from the last few months, with the majority of the evidence pointing to the tropical Pacific remaining close to neutral conditions where the equatorial sea surface temperatures (SSTs) are near average to slightly above average across the central and east-central Pacific (Figure 5). As mentioned previously, neutral conditions tend to mean that there is little tropical influence in mid-latitude weather. Statistically, neutral conditions in the tropics would slightly favor the next few months to be warm and dry across the southern half of the US; wet and cool the further north one goes into Canada (see forecast periods below). If El Niño conditions do develop by summer or early fall, we will likely see some transition to overall warmer and moister conditions in the Tropical Pacific sector. These conditions can bring stronger monsoonal flow in the southwest and overall warm the western US slightly, but need to be considered along with the North Pacific conditions (see below). There is some indication of monsoonal flow into ASO, but it is relatively weak at this point.

**North Pacific Watch** – Fairly dramatic change from last month ... the wide band of cooler than average ocean temperatures in the Gulf of Alaska and North Pacific have warmed and decreased in extent across the majority of the ocean (Figure 5). While a small band remains cooler than average, the bulk of the region has flipped to being 1-4°F warmer than average (note figure is in °C). The latest August-September-October (ASO) ensemble forecast for SST predicts the North Pacific to continue to warm north of 45° with the cooler than average band south of 45° warming slightly. This change bolsters the dynamics that would indicate a warmer than average ASO for the western US (see

90-day forecast below). Combined with no other climate variability components evident at this time, the Tropics and North Pacific are displaying conditions that would indicate that the warm and seasonably dry 30 and 90 day forecasts for the west are likely to hold (below and in Appendix Figure 2).



**Figure 5** – Global sea surface temperatures (°C) for the period ending August 3, 2017 (image from NOAA/NESDIS).

#### Forecast Periods:

**6-10 Day (valid August 10-14):** The current heat wave in the western US appears to be holding through this forecast period, albeit not as extreme as the first few days of the month. Some fluctuation in onshore vs offshore flow will give short-term relief, but the majority of the western US is forecast to stay much above normal (5-15 degrees), although smoke from fires through the west, including Canada, might tamp down the temperatures a couple of degrees. For the rest of the US, temperatures are forecast to be lower than normal due to unseasonably cold air dropping down from Canada. This is a fairly common flip-flop pattern ... when the west is hot, the east is not. In terms of precipitation, the PNW, northern Rockies, and Plains are forecast to see drier than normal conditions through mid-month. Central Oregon south into California, the desert southwest, and the Great Basin are forecast to see some potential rains from monsoonal flow. How far north this gets and how much it brings is the great unknown. Areas east from the Gulf Coast to New England are likely to be wetter than average during this period.

**8-14 Day (valid August 12-19):** Overall forecast for this period continues warm, although moderates to closer to seasonal in most areas in the western US. The only exception is the inland PNW, which will likely stay more above normal than other areas. The rest of the country will likely continue the cooler than average conditions through mid-month. The precipitation forecast for the western US during this period points to a relatively dry period, although there is a slight indication for conditions to develop that are favorable for some rain in western Oregon and Washington at the very end of the forecast period. Too early to tell how much and the spatial extent as these systems break down this time of year. The Gulf Coast to New England are likely to continue to be wetter than average during this period.

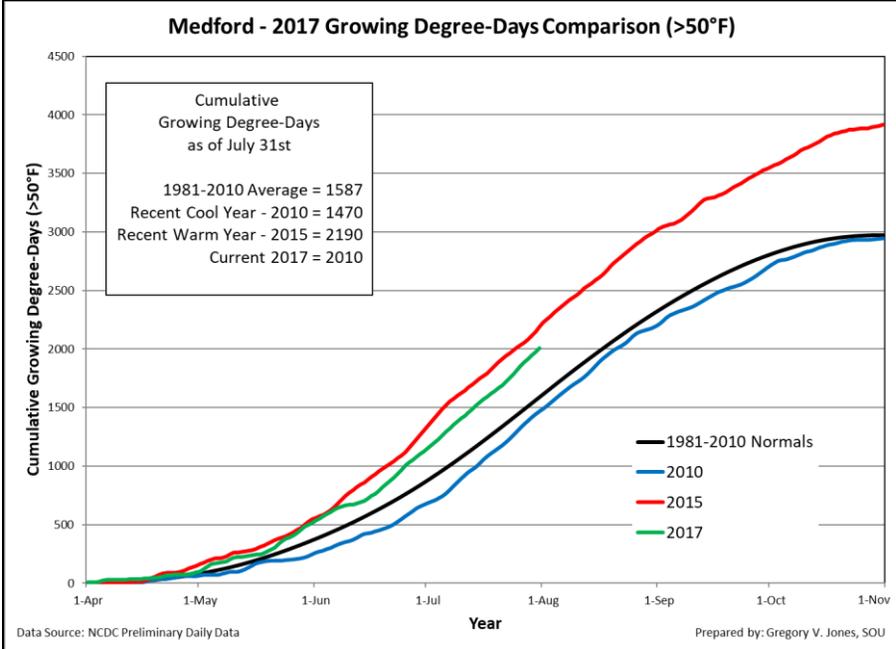
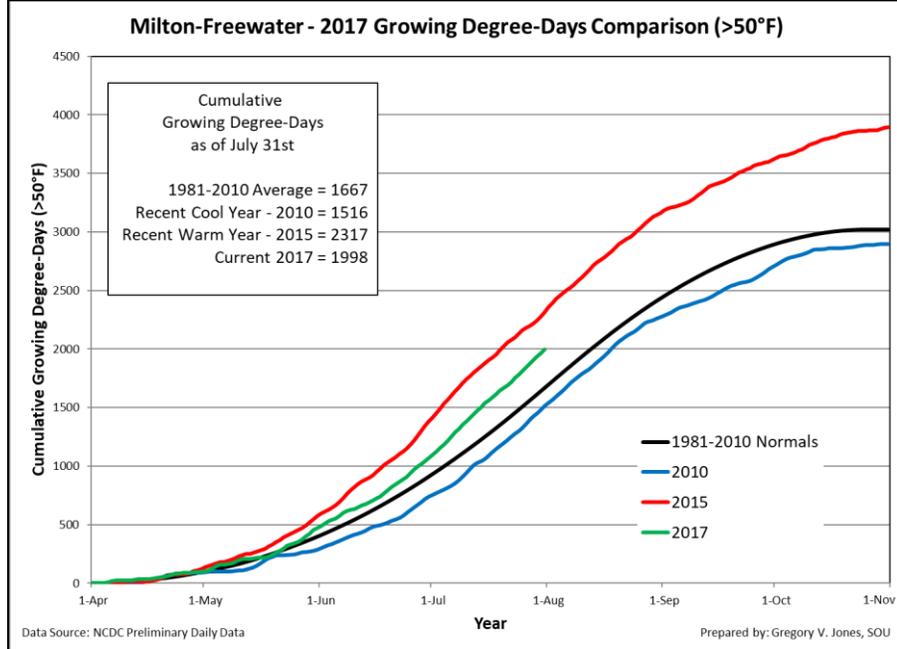
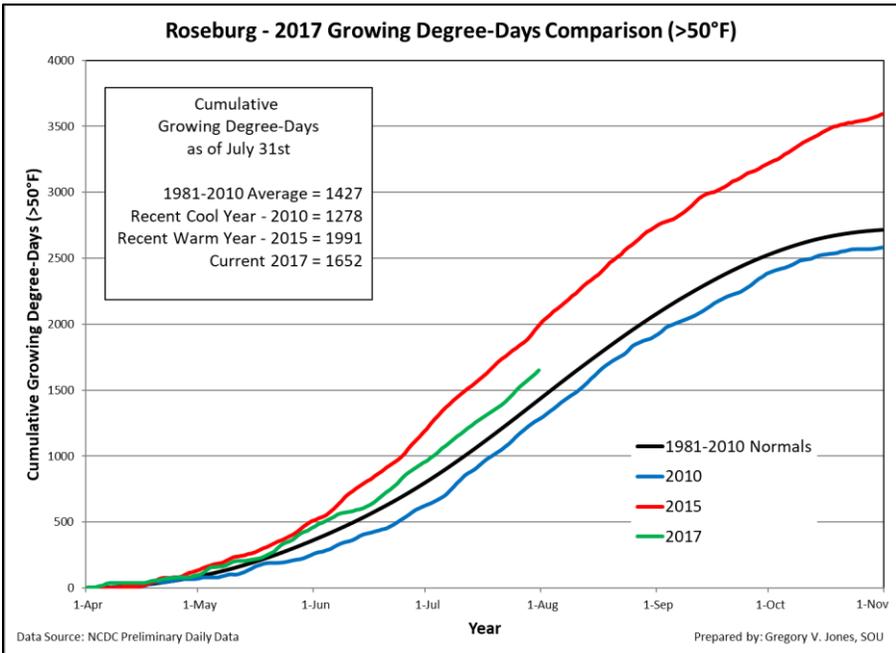
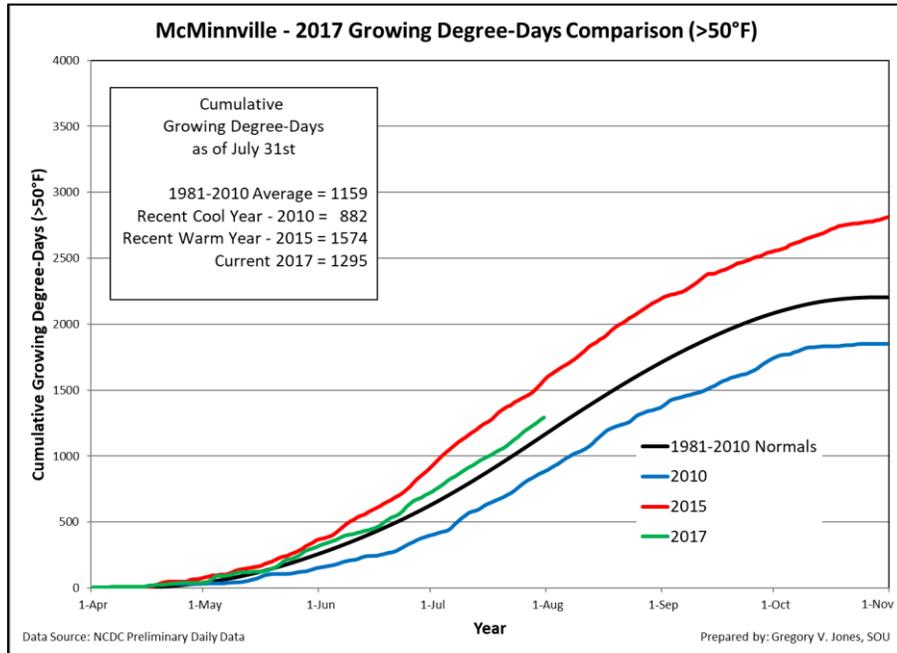
**30 Day (valid August 1-31):** The month of August is highly likely to end up above normal for the west coast and extending across the northern Rockies (see Appendix Figure 2). The Plains and portions of the Midwest are likely to end up on the cool side for August, while much of the Ohio River valley, southeast and eastern seaboard have an

equal chance of slightly above, normal, or slightly below normal temperatures. Extreme northern New England and Florida will likely stay above normal. The precipitation forecast for August remains dry in the upper PNW and northern Rockies, while the rest of the west is forecast to have an equal chance of slightly dry to slightly wet. As mentioned often here, nevertheless, seasonally this would still mean quite dry. Monsoon flow has the potential to keep part of the southwest wetter than average and Gulf of Mexico moisture will likely keep the Gulf states wetter than average (see Appendix Figure 2).

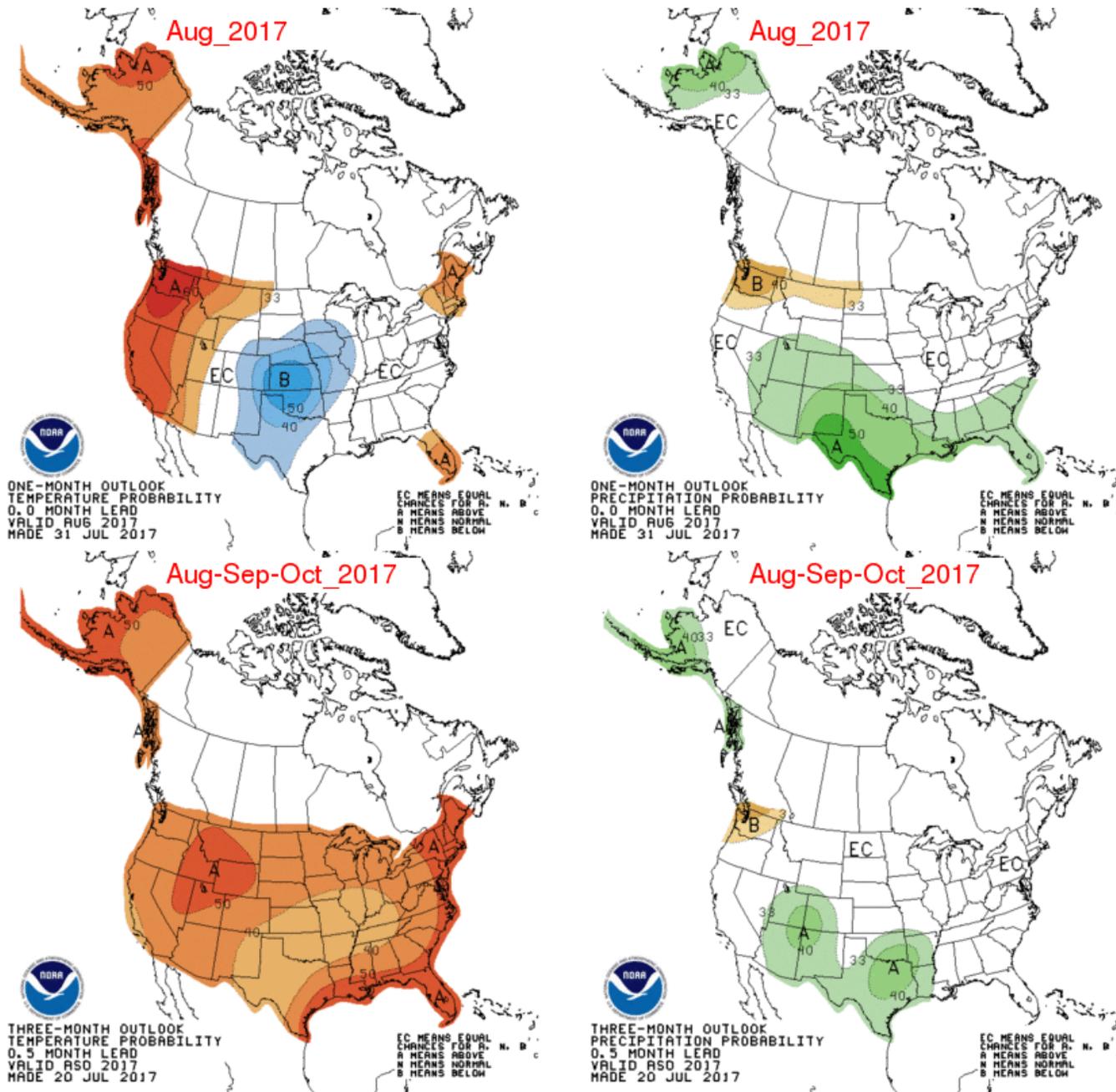
**90 Day (valid August-September-October):** The current three-month (ASO) forecast from the CPC continues to show the country with an above average chance of being warmer than normal with the northern Rockies, Gulf Coast and eastern seaboard up into New England likely seeing the warmest conditions (NOAA's Climate Prediction Center, see Appendix Figure 2). I am continuing my overall viewpoint that the 90-day forecast for the western US wine regions will hold to normal to moderately warmer than normal summer into fall temperatures. This is bolstered by the slight warming in the North Pacific (Figure 5). The ASO precipitation forecast has no clear signal in the short to long-term drivers of rainfall heading into the last months of summer and the start of fall (low pressure out of the North Pacific, monsoons, tropical storms, hurricanes, etc.). There is some indication that western Washington and some of the PNW will stay drier than normal into the fall. There is also some evidence that monsoonal flow will bring moisture to the Four Corners region and that Gulf moisture will give Texas a wet three-month period. However, the rest of the country has an equal chance of being slightly above average, normal, or slightly below average precipitation for this three-month period (see Appendix Figure 2). For the western US, I see all evidence pointing to seasonally dry conditions that will likely give way to a fairly normal start to the fall rainy season.

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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 (2017) 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 August (top panel) and August, September, and October (bottom panel) (Climate Prediction Center, climate.gov).