Weather and Climate Summary and Forecast

Summer 2016

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May 2016 continued the warm trend for portions of the west, while providing some relief for others. The month ended up warmer than average from northern California throughout much of Oregon, Washington and Idaho where temperatures 2-5°F above normal were observed (Figure 1). Central to Southern California and into the Great Basin and the desert SW were average to cooler than average largely due to cloud cover and moisture that has lingered from the fading El Niño in the tropical Pacific. In terms of precipitation, most of the coastal to intermountain valleys in California, Oregon and Washington all remained dry, while much of the Sierra Nevada mountains and portions of the desert SW into the Rockies were much wetter than normal (Figure 1). For the rest of the US, Texas and much of the southeast were much wetter than average in May, while much of the eastern third of the country was near normal to drier than normal (not shown). Temperatures across the rest of the US in May were largely normal to slightly cooler than normal with the exception of the PNW, Great Lakes and northern New England which were warmer than normal (not shown).

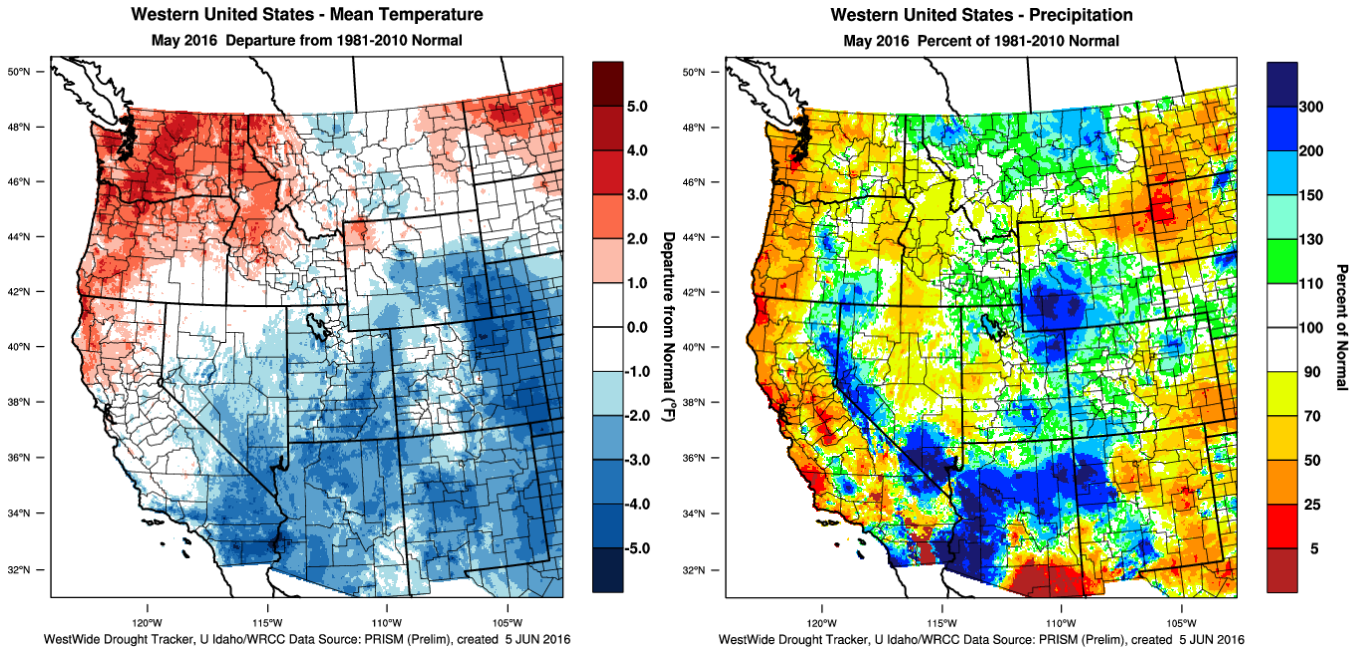

Figure 1 – Western US May 2016 temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

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 1-4°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 (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 Gulf Coast states, while portions of the eastern US have been drier than average so far this year (not shown).

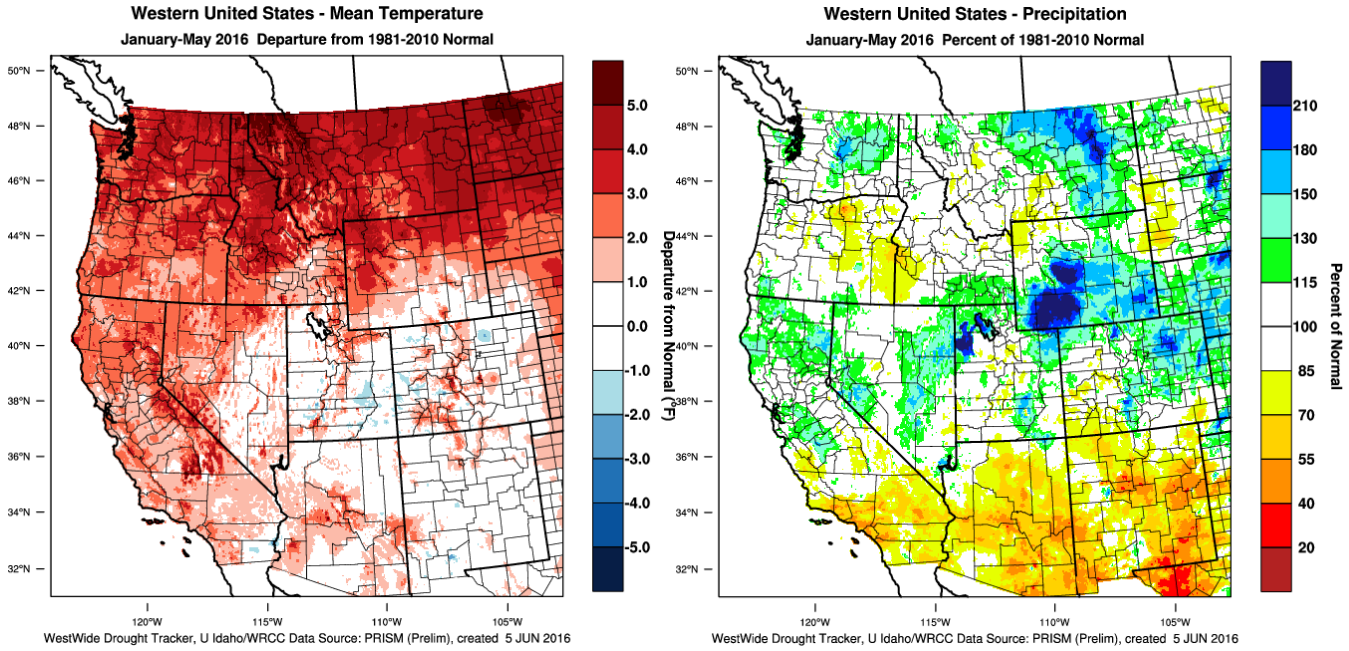

Figure 2 – Western US year to date (January through May 2016) temperature departure from normal (left) and percent of normal precipitation (right; images from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

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). March through May accumulations are running 100-200 units higher than the 1981-2010 normals throughout much of the western wine regions, with the exception of a portion of the North Coast and south-central coast in California. GDD accumulations are running roughly 15-25 days ahead of average and continue to outpace the last two warm years (2014 and 2015) (see the Appendix Figure 1 for four locations in Oregon).

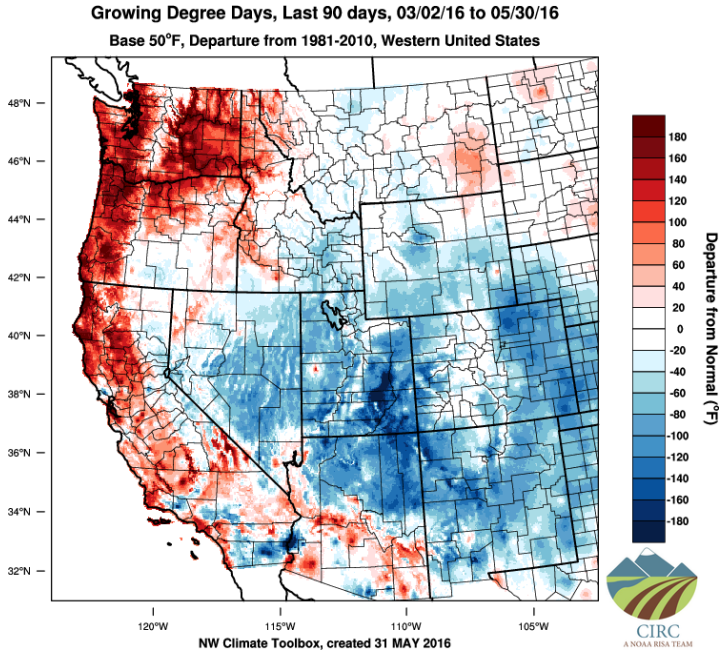

Figure 3 – Western US March through May 2016 growing degree-days departure from the 1981-2010 normals (image from WestWide Drought Tracker, Western Region Climate Center; University of Idaho).

Drought Watch – western US drought conditions have lessened in some areas from the extremes of the last few years. However, conditions have not changed much since the first of the year 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 Arizona, California and Nevada will likely persist through the end of August and beyond, while drought development is likely into eastern Oregon and much of Washington.

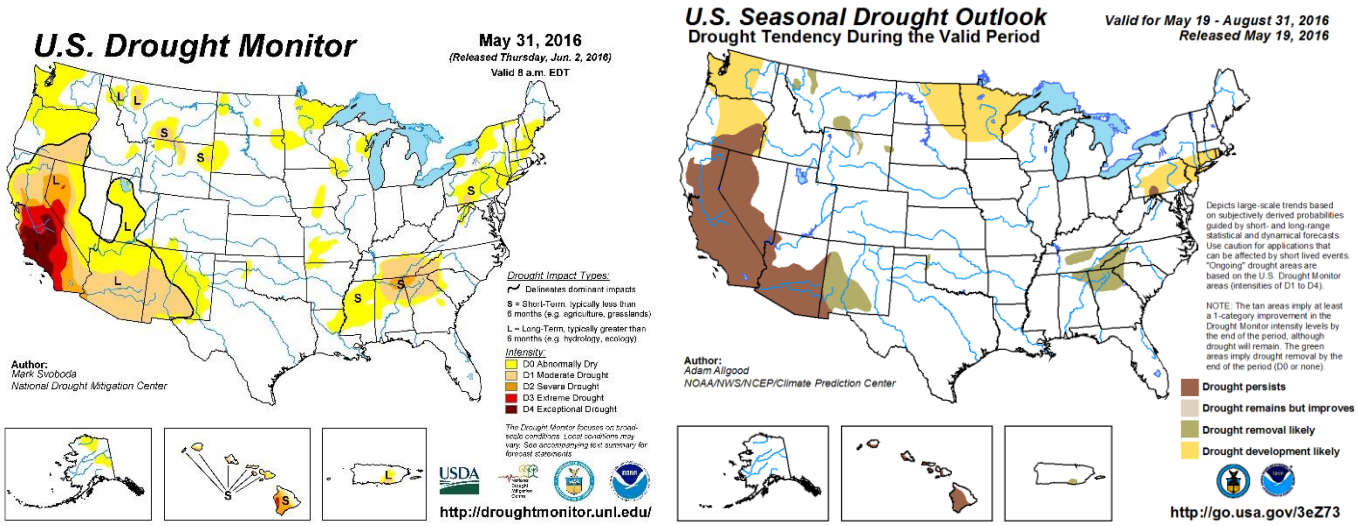

Figure 4 – Current US Drought Monitor and seasonal drought outlook.

El Niño Watch – El Niño conditions are essentially over in the tropical Pacific with cool surface waters emerging across the equator toward the central Pacific. Prediction models are in agreement that this El Niño will continue to weaken and that La Niña development is extremely likely by fall. However, even with this weakening we have seen some lingering El Niño effects in the western US with more cloud cover and higher humidity levels in the southwestern US and into the Great Basin. 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 – 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 continue to decline 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 warmer coastal waters along the west coast should help bolster a warmer than average growing season, especially higher minimum temperatures, but the cooler pool of water might be indicative of a slowing of this effect. Long range forecasts are typically driven by conditions in the North Pacific and the state of El Niño 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.

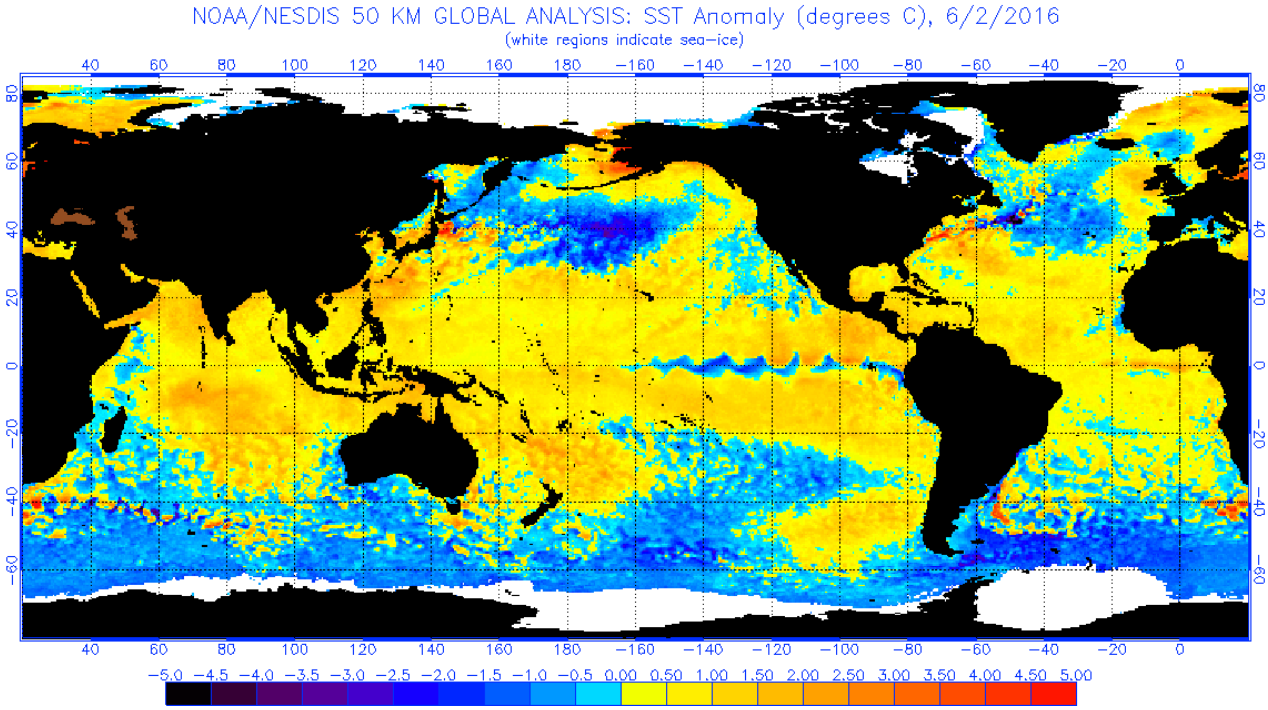

Figure 4 – Global sea surface temperatures (°C) for the period ending June 2, 2016 (image from NOAA/NESDIS).

Forecast Periods:

6-10 Day: The short term forecast points to a cool down in the west from the record breaking high temperatures of the last week. A break down in the ridge should allow for on shore flow and one or two frontal passages out of the Gulf of Alaska. The result is that temperatures during this period are forecast to be cooler than normal across the PNW, but warmer than normal in most of California and across through most of the eastern half of the country. The precipitation forecast for this period shows an above normal likelihood across the PNW and into the northern Rockies. California and into the southwest is forecast to see normal to drier than normal conditions during this period.

8-14 Day: Similar to the 6-10 day forecast with the overall pattern dominated by a cool down in the PNW and warmer than average conditions throughout California and the vast majority of the rest of the country. Precipitation forecasts into the middle of June tilt the odds to a slightly wetter than normal northern Oregon and western Washington, while northern California, the Great Basin and the Rockies are forecast to see drier than average conditions.

30 Day: Once the short term cool down ends mid-month (see above), the forecast through the rest of the month of June calls for warmer than average conditions through the western US with the PNW having the greatest chance of much warmer than average conditions. Precipitation during June is forecasted to have 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: The June-July-August (JJA) forecast continues the 30 day June forecast as given above. Most of the continental United States is facing 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 June outlook, with the west forecasted to have an equal chance to be slightly above average, normal, or slightly below average. 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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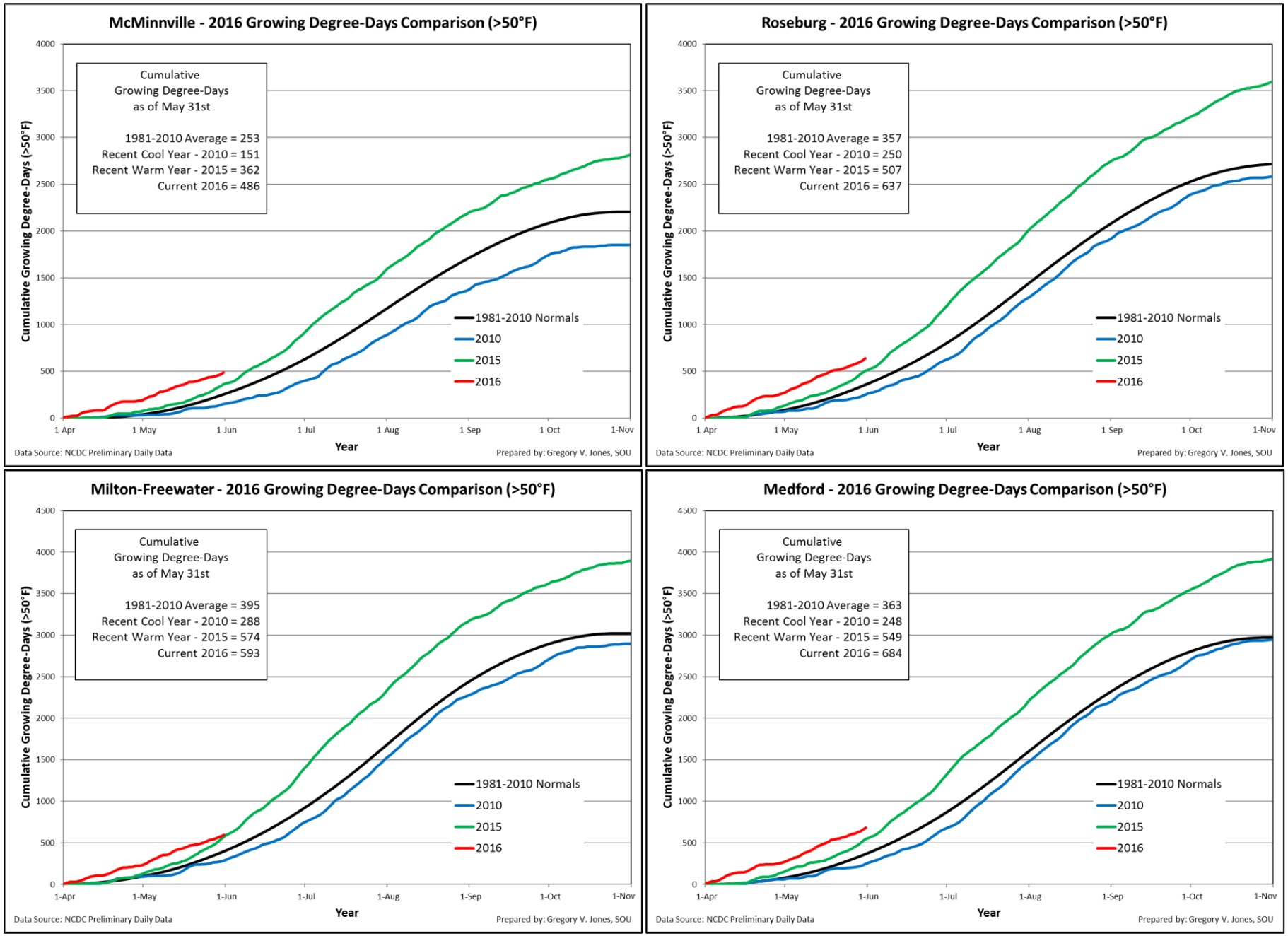
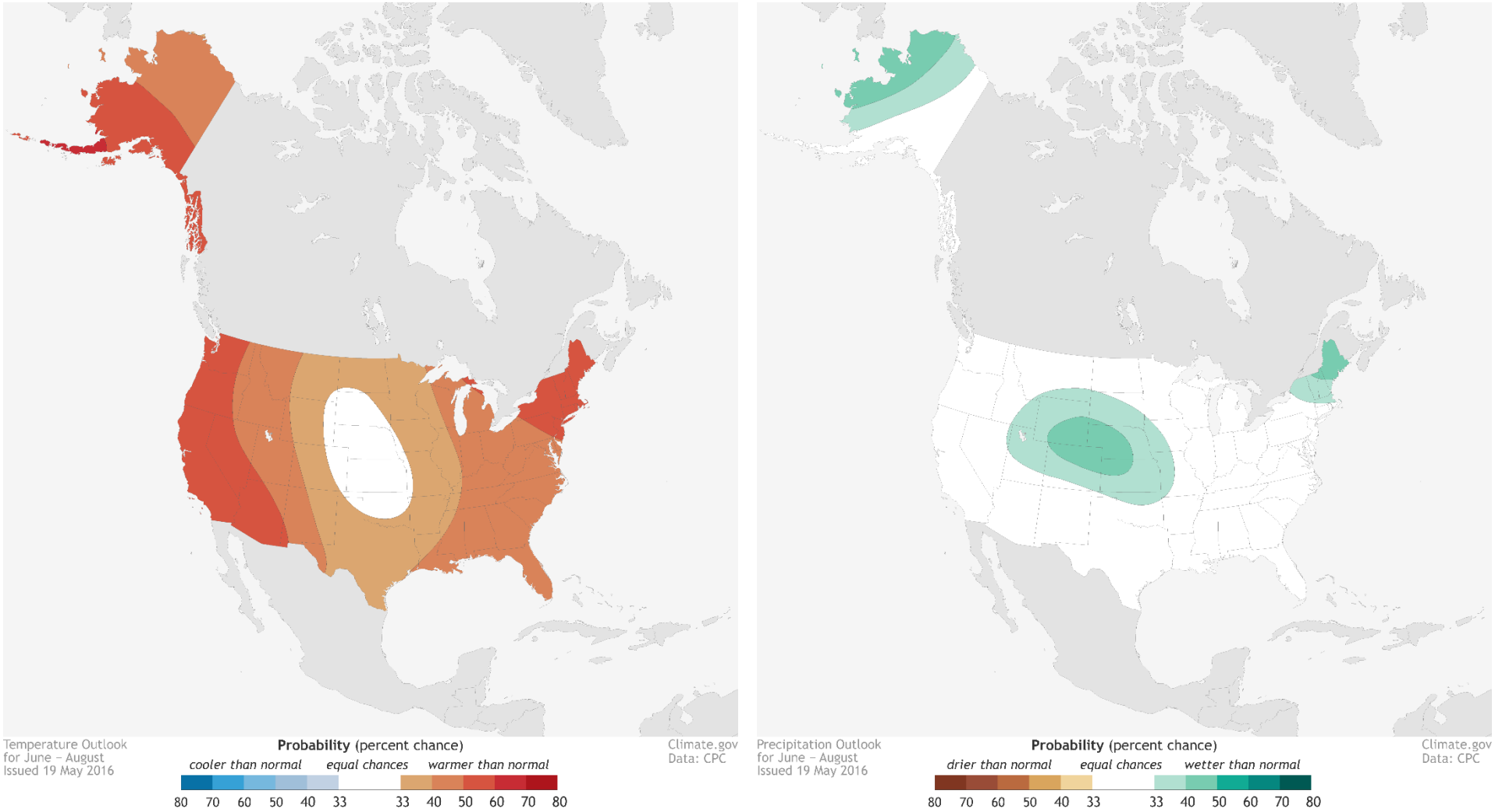


Appendix Figure 1 – Cumulative growing degree-days (base 50°F, no upper cut-off) for McMinnville, Roseburg, Milton-Freewater, and Medford, Oregon. Comparisons between the current year (2015) and a recent cool year (2010), a recent warm year (2015) and the 1981-2010 climate normals are shown (NCDC preliminary daily data).



Appendix Figure 2 – Temperature (left panel) and precipitation (right panel) outlooks for June, July and August (Climate Prediction Center, climate.gov).