Office of the Washington State Climatologist

March 2022 Report and Outlook

April 8, 2022

http://www.climate.washington.edu/

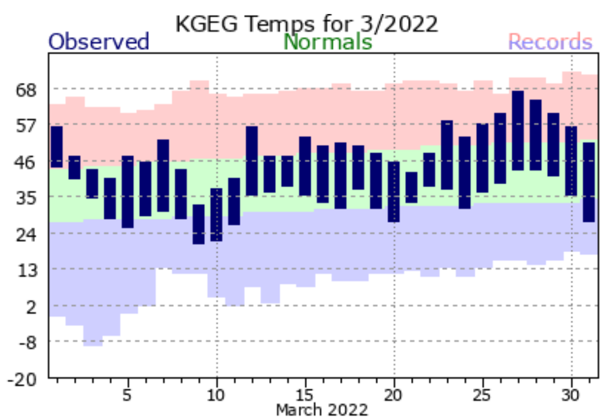
March Event Summary

Average March temperatures were near-normal to above normal throughout Washington, with above normal temperatures more common east of the Cascade Mountains. Total March precipitation was below normal for nearly the entire state, with a few exceptions in central and northern Puget Sound region.

The atmospheric river that brought heavy rain at the end of February continued to impact the state in early March. Temperatures were mild, freezing levels were high, and rain was widespread. On the 1st, a record high daily temperature was tied at Dallesport (66˚F) and set at Ephrata (63˚F). On the 3rd, a maximum daily rainfall record was set at Walla Walla (0.50").

In this Issue

Once the skies cleared from that impressive event, we entered the first of two significant dry stretches that occurred in March. As illustrated in Figure 1 at Spokane International Airport, it was relatively dry from March 4 through the 12th.



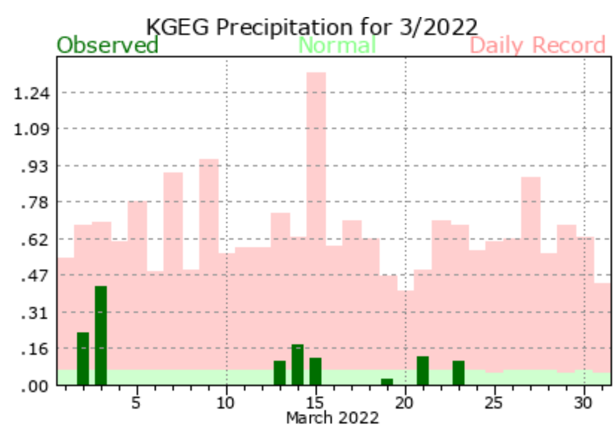


Figure 1: March 2022 daily temperature and precipitation for Spokane International Airport compared to the 1991-2020 normal (green envelope) and previous records (blue and red envelopes; NWS).

Temperatures were quite chilly during that latter part of this period, and a few daily records were set. Olympia, for example, recorded a record low daily temperature of 23°F on the 9th. On the 10th, Quillayute (22°F; tie) and Walla Walla (21°F) set record low minimum temperatures. By the 12th it became rather warm statewide; Walla Walla measured a daily high temperature of 69°F, tying the record for that day.

Precipitation returned mid-month, and our mountain snowpack responded with growth from roughly the 14th through the 21st. Figure 2 shows the snow water equivalent (SWE) at Stampede Pass with the only increase in SWE occurring mid-month. At lower elevations, Quillayute set daily maximum rainfall records on the 14th (2.09") and the 20th (1.90").

The month ended with a second extended dry period of the month, beginning around the 24th for most of the state. There were some isolated showers during this period, particularly for western WA. Nevertheless, temperatures were spring-like and Spokane, for example, saw high temperatures more typical of early May.

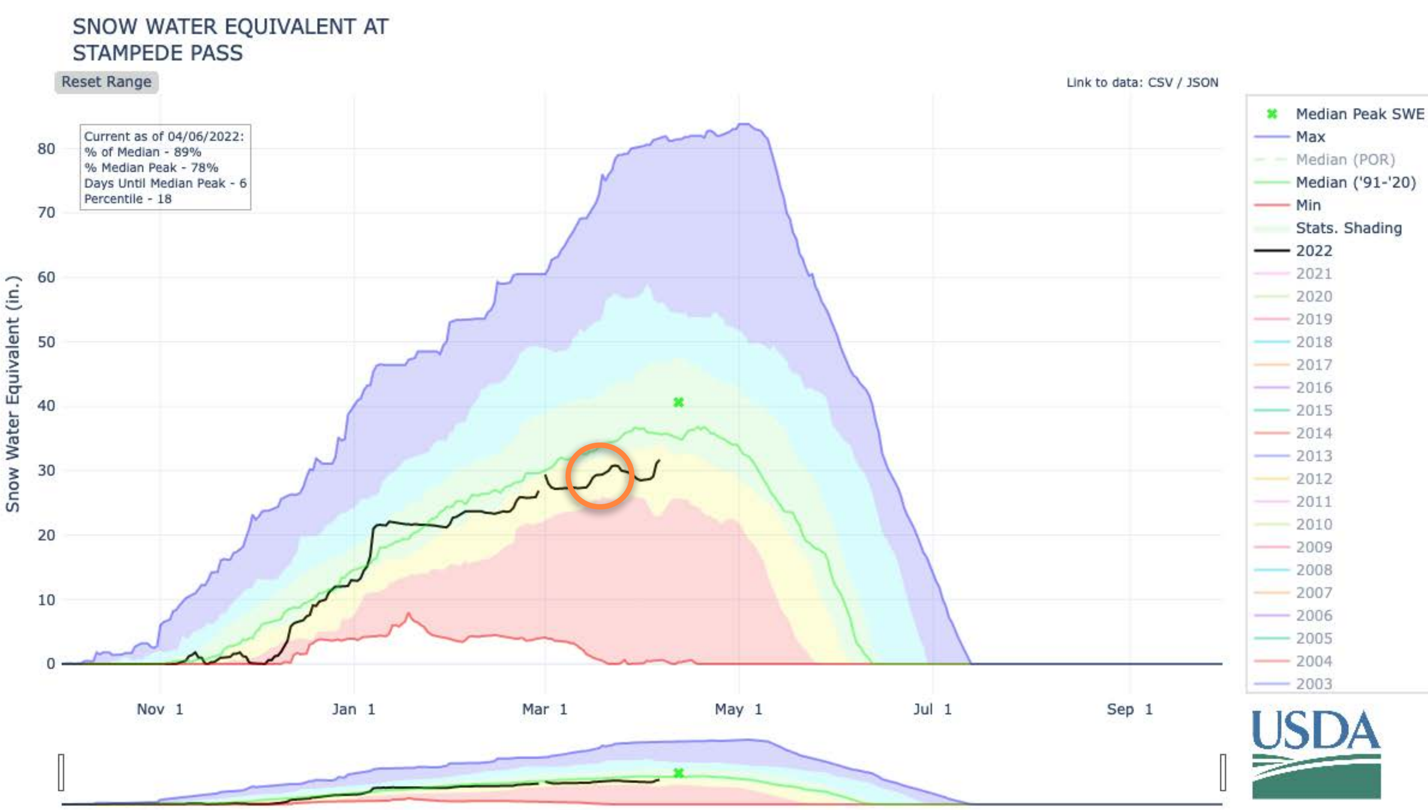


Figure 2: Snow water equivalent (SWE) at Stampede Pass for the 2021-22 snow season (black line) compared to the 1991-2020 median (green envelope) and the rest of the historical record at that station (NRCS). The period of SWE growth in March is highlighted by the orange circle.

Snowpack and Drought Summary

Lack of March precipitation was bad news for WA mountain snowpack, and the warmer than normal mountain temperatures made it worse. Basin average SWE percent of median from NRCS as of April 1 (Figure 3), when the amount of water stored in our mountain snow typically peaks, shows below-median SWE for much of the state. The Central Puget Sound and Lower Columbia basins are the only ones with near-normal SWE (91 and 90% of median, respectively). Most of the other basins fall between 74 and 88% of median. Of more concern are the Lower Snake-Walla Walla and Upper Yakima, both below the statewide drought criteria of 75% of normal at 67 and 63% of normal, respectively. The Lower Yakima and Klickitat fared even worse, with only 39% of median SWE. Despite the lower than usual snowpack in the Yakima watershed, the Yakima Bureau of Reclamation's April water supply forecast is for 94% of normal April-September water supply for junior irrigators based on adequate water storage in their reservoirs.

Despite the favorable forecast for Yakima irrigated systems, it is likely that the state drought declaration made in July 2021 will be extended for at least some portions of eastern WA before it's set to expire on June 1, 2022.

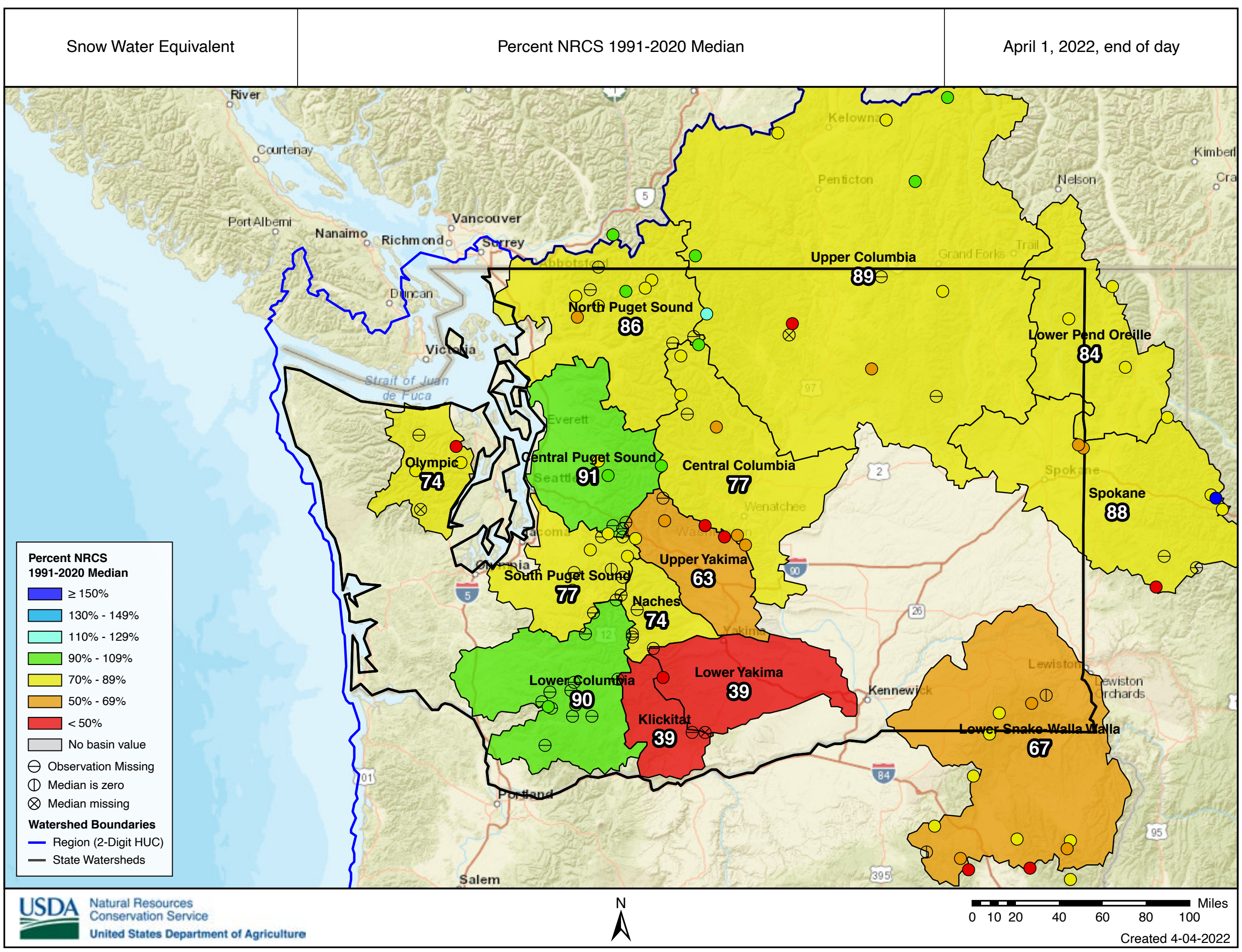


Figure 3: Snowpack (in terms of snow water equivalent) percent of median for WA as of April 1, 2022. The median is based on the 1991-2020 period (NRCS).

The continued dry conditions have prompted drought degradations to be made on the U.S. Drought Monitor (Figure 4). More specifically, "severe drought" or "extreme drought" were expanded in parts of Okanogan, Stevens, Ferry, Douglas, Grant, Adams, and Franklin counties since the last edition of our newsletter in early March.

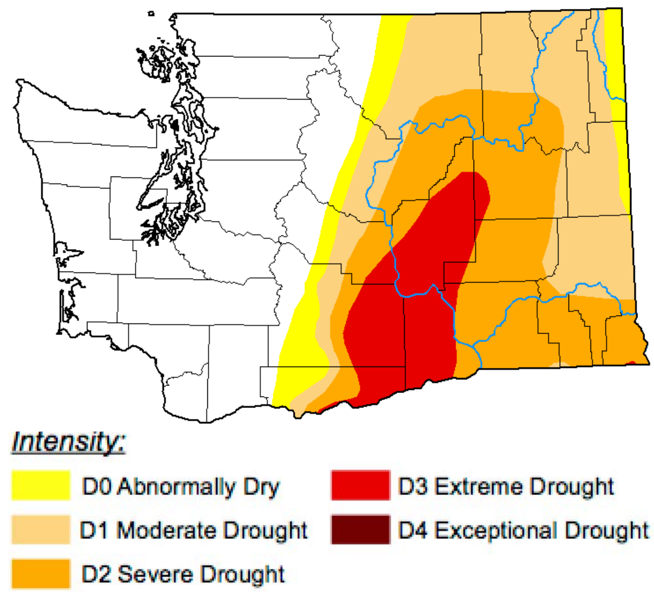


Figure 4: The April 7, 2022 edition of the U.S. Drought Monitor.

Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) Corner

Last month, we asked the readers of this newsletter to help us recruit new members to the Washington CoCoRaHS network in the spirit of CoCoRaHS March Madness 2022. We did, in fact, see an uptick in the number of folks who joined us last month – a hearty welcome to fifteen new observers! Unfortunately, though, we were beat out by Minnesota. Perhaps we'll get it next year - and we did top the other states in the PNW (Figure 5)! Don't let the end of March Madness stop you from joining the CoCoRaHS network – science does not wait for human-made holidays. For more information, visit the CoCoRaHS website.

Members of the Washington CoCoRaHS network recorded 11,028 observations over the month of March (111% of February number of observations). 62% of those observations recorded some amount of precipitation, a marked increase from February's 47%. Interestingly, the same observer in Quinault, WA that recorded the state's highest one-day total for the month of February takes home the same title for the month of March, with 5.36" recorded on the day after their February record: 3/1/2022. As the month continued, lots of folks mentioned snow melting and spring appearing in their condition monitoring reports. Said one observer from Okanogan County: "We are quickly transitioning from 'mud season' to 'dust season.'"

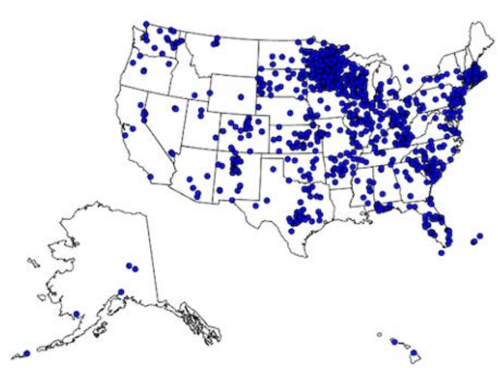


Figure 5: New CoCoRaHS observers in March 2022.

Climate Classification of Washington State

Written by: Haley Staudmeyer

Any Washingtonian can tell you that different areas of the state experience vastly different climates. But what terms can we use to describe those climates? Where are the boundaries between one climate and another? What metrics can be used to quantify climatological differences? It is useful for scientists across the globe to share a common language to answer these questions; this way, any region's climate can be accurately described and understood in just a few succinct terms. Let's dive into this language and how it describes Washington State.

The Köppen-Geiger climate classification system, designed by Wladimir Köppen in 1884 and later improved upon by Rudolf Geiger, is the most popular method by which climates are categorized (see Belda et al. 2014). It assigns an area a two- or three-letter code, which acts as shorthand for a lengthier description of its climate. The first letter of the code assigns an area to one of five main groups: *A* (tropical), *B* (dry), *C* (temperate), *D* (continental), and *E* (polar). These groups are assigned based on certain temperature and precipitation thresholds. For example, for an area to be classified as *tropical*, every month of the year must have an average temperature of at least 18 °C (64.4°F) and experience significant precipitation. The following one or two letters in the code assign a temperature subgroup and/or a precipitation subgroup based on more granular climatic thresholds. As examples, *w* indicates a climate that experiences a relatively dry winter, and *c* indicates a relatively cold summer.

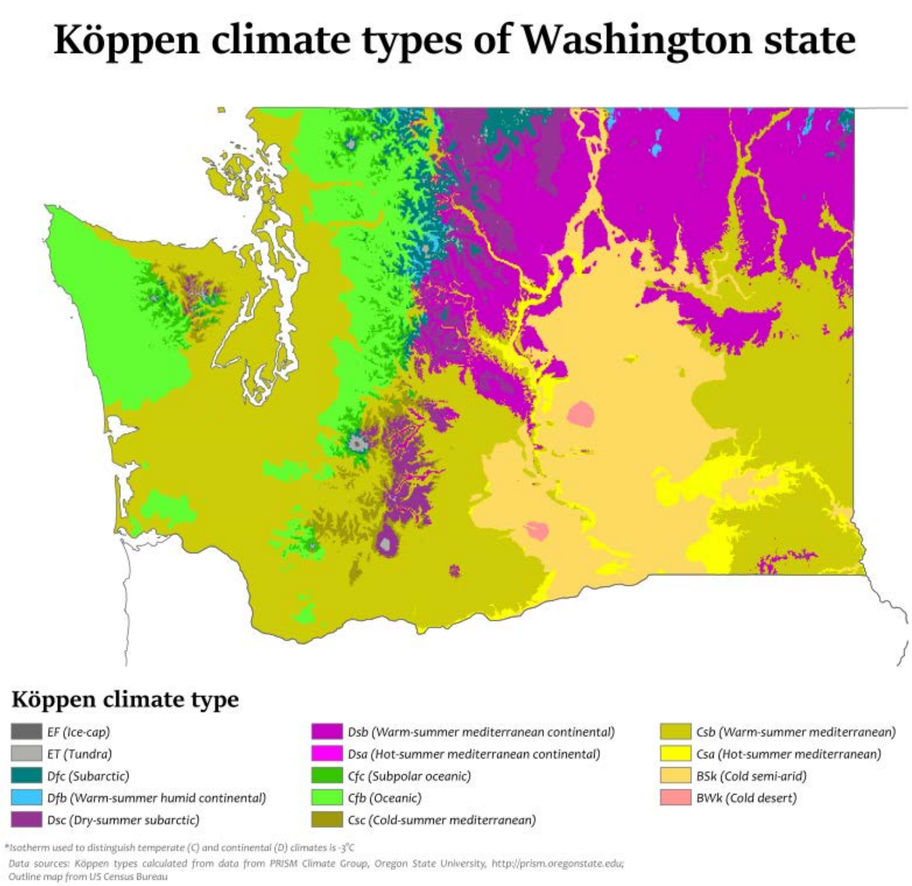


Figure 6: Köppen-Geiger climate types for Washington. Map created by Adam Peterson (Wikimedia) based on the PRISM high resolution 1981-2010 climate normals.

There are enough groups and subgroups within the Köppen-Geiger system that describing each of them in detail is beyond the scope of this article. Surprisingly, even when only considering those found of Washington State, there are still too many to cover in great detail here. Figure 6 shows a map labeling Köppen-Geiger climate types across the state. Fourteen different climates can be found in the state, spanning each of the five main groups except tropical.

Compare this map of Washington State to that of the entire country (Figure 7). East of the Rocky Mountains, the country is dominated by just three climate types. Entire states can be subsumed by a single climate type. States west of the Rockies exhibit more diversity in climate, but even California, for all its area, cannot boast more climate types than Washington.

Most of Washington state is defined as either *temperate (C)* or *continental (D)*. Both groups indicate a climate with more seasonality than tropical or polar regions. *Continental* climates experience at least one month out of the year where average temperatures reach below freezing; *temperate* climates do not. *Mediterranean* climates occupy the largest portion of Washington, and they are characterized by mild winters and dry summers. The *oceanic* climates found on the Olympic Peninsula and on the west slopes of the Cascade Mountains feature more mild summers. Central-eastern Washington is defined as *dry*, but also earns the label *cold*, as it is not quite as hot as other arid regions of the world.

Somewhat confusingly, many of the *oceanic* regions of Washington aren't found on the coast, and the state's *mediterranean* regions are all very far from the Mediterranean Sea. Additionally, the criteria used to define each climate group and subgroup is not universally agreed upon, meaning that some regions can be feasibly assigned multiple climate types. This makes the Köppen-Geiger climate classification system difficult for the non-specialist to use, even if one works up the nerve to unscramble its cryptic two- or three-letter codes. Climatologists have no shortage of gripes with the system, too. It relies heavily on averages and does not account for many important defining features of climates, such as cloud cover or intensity of precipitation.

Other climate classification systems (such as the Trewartha system) exist, yet in spite of its flaws, the Köppen-Geiger system remains the most popular by far. Of course, by its very nature, a perfect climate classification system cannot exist. Obtaining information about a region's climate in a nutshell requires glossing over its finer details. For a newsletter focused on the state of Washington, though, a suitable alternative may exist. Regular readers of this newsletter may recall a series of highlights summarizing the various climate divisions of Washington State as assigned by NOAA. For considerations restricted to a single state, NOAA's climate divisions are theoretically more useful than the Köppen-Geiger system, as they can be more accurate without creating too many terms to keep track of. In practice, though, finding information on any given climate division's characteristics is fairly difficult – hence, OWSC's effort to document all of Washington's. Additionally, climate divisions are

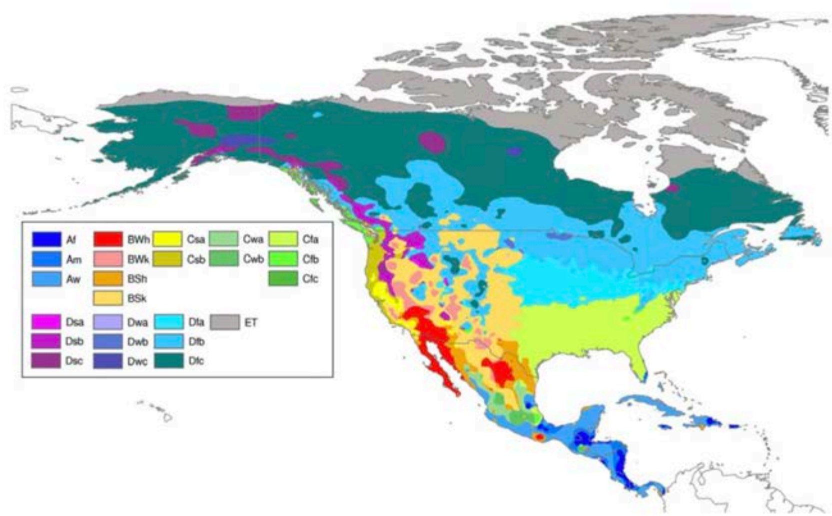


Figure 7: Köppen-Geiger climate types of North America from Peel et al. 2007.

not defined outside of the United States, making them ill-suited as tools for global climate comparisons.

The OWSC does not employ a professional graphic designer, so we have done our best to overlay NOAA's climate divisions onto the map of Washington's Köppen-Geiger climate types in Figure 3. Though we cannot guarantee the figure's accuracy along the borders of divisions, the comparison yields interesting results. The boundaries of some climate divisions, like 9 (Northeastern) and 10 (Palouse Blue Mountains) slot together easily with their Köppen-Geiger counterparts. Other climate divisions further subdivide regions that share the same Köppen-Geiger climate type, such as 2 (NE Olympic-San Juan) and 3 (Puget Sound Lowlands). Comparing the similar figures from our analyses of these two climate divisions reveals significant differences between them. This is perhaps one example where the greater specificity of climate divisions may be preferable.

However, other climate divisions in the state, such as 5 (Cascade Mountains W), encompass many different Köppen-Geiger climate types. Much of including this region into a broad-brush climate division is due to the lack of station data in the higher terrain, so the mountain microclimates are undoubtedly smoothed over in the climate division breakdowns. There is also the problem that average temperature and precipitation are changing due to human-driven climate change. It may be easier to change a particular weather station's Köppen-Geiger code than to redefine entire climate division boundaries in the coming years. All this to say, there may still be some reasons to prefer the Köppen-Geiger system, even on a statewide scale.

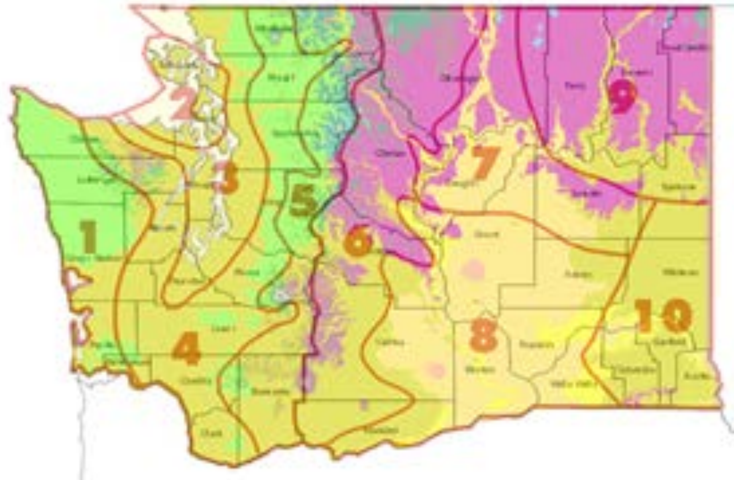


Figure 8: NOAA's Washington climate divisions overlaid onto the Köppen-Geiger map of Washington from Figure 6.

Our biggest takeaway from this discussion is an understanding of how complicated and varied the climates of Washington State are. We at OWSC try to stay on our toes in accounting for all the intricacies of Washington's many climates in our various projects. It also serves as a reminder as to just how diverse the state is in other ways – after all, a region's climate can determine its vegetation and wildlife, agriculture, available jobs, civil necessities, and more. What strikes you the most from this analysis? As always, feel free to email/tweet/Facebook us your feedback (climate@atmos.washington.edu; @WAStateClimate).

References

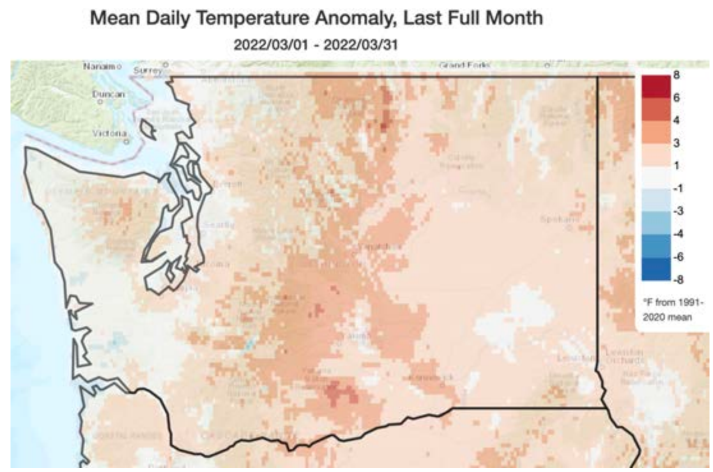
Peel, M.C., B.L. Finlayson, and T.A. McMahon, 2007: Updated world map of the Köppen-Geiger climate classification, Hydol. Earth Syst. Sci., 11, 1633-1644.

Belda, M., E. Holtanová, T. Halenka, J. Kalvová, 2014: Climate classification revisited: from Köppen to Trewartha, Clim Res, 59, 1-13.

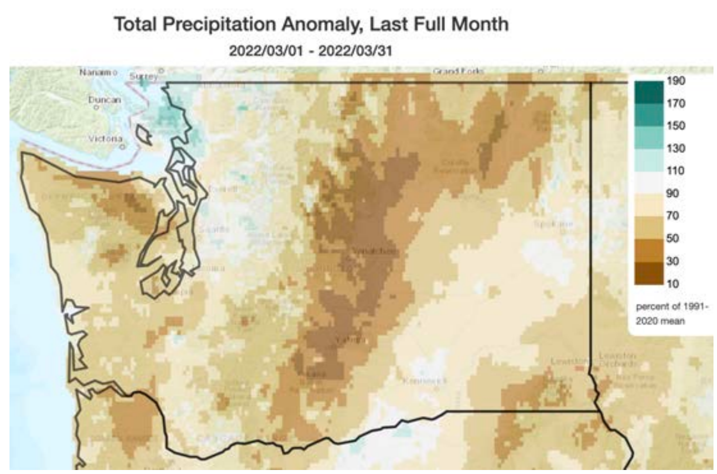
Climate Summary

Due to some incorrect data that has yet to be removed from the Regional Climate Center monthly maps, we are highlighting the monthly anomalies from the Climate Toolbox here. Average March temperatures were near-normal to above normal statewide, with larger anomalies (+3.0-4.0°F) just east of the Cascade Mountains. For example, Pasco and Hanford were 3.9 and 3.3°F above normal, respectively (Table 1). Temperatures in parts of the Puget Sound region, such as Seattle and Bellingham, were much closer to normal, with several stations (Table 1) within 1°F and many others within 2°F of the long-term average.

March precipitation was below normal for nearly the entire state. Areas just east of the Cascade crest measured between only 10 to 50% of normal precipitation. Wenatchee, for example, received a meager 21% of normal precipitation, while Ephrata and Spokane were slightly more fortunate with 61 and 69% of normal, respectively. Total March precipitation was below normal in western WA as well, though the percentages of normal were not quite as low, with much of the area receiving between 70 and 90% of normal precipitation. Some locations in the central and northern Puget Sound region had near-normal precipitation, such as Bellingham (99% of normal), with the San Juan Islands representing a statewide exception with slightly above normal precipitation.



March temperature (°F) departure from normal relative to the 1991-2020 normal (Climate Toolbox).



March total precipitation percent of 1991-2020 normal (Climate Toolbox).

Station	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	45.5	44.1	1.4	3.07	5.68	54
Seattle WFO	47.3	46.6	0.7	3.15	3.86	82
SeaTac AP	46.9	47.1	-0.2	3.32	4.17	80
Quillayute	44.5	43.9	0.6	10.03	11.78	85
Hoquiam	47.6	45.8	1.8	5.43	7.74	70
Bellingham AP	45.9	45.1	0.8	3.34	3.36	99
Vancouver AP	48.5	47.2	1.3	2.76	3.95	70
Eastern Washington						
Spokane AP	42.5	40.0	2.5	1.26	1.83	69
Wenatchee	45.5	43.1	2.4	0.15	0.73	21
Omak	43.9	41.8	2.1	0.61	1.06	58
Pullman AP	41.6	41.1	0.5	1.50	1.95	77
Ephrata	45.5	42.9	2.6	0.43	0.70	61
Pasco AP	49.7	45.8	3.9	0.60	0.69	87
Hanford	49.5	46.2	3.3	0.15	0.55	27

Table 1: March 2022 climate summaries for locations around Washington with a climate normal baseline of 1991-2020.

Climate Outlook

La Niña conditions are present in the Pacific Ocean and a "La Niña Advisory" remains in effect, according to the Climate Prediction Center (CPC). Over the last 4 weeks, below average sea surface temperatures (SSTs) have persisted in most of the eastern and central equatorial Pacific Ocean, with a positive trend in SST beginning to emerge in the east. SSTs have been above average in the western equatorial Pacific Ocean as well as right off the coast of South America. The odds are slightly higher for La Niña conditions to continue into summer (53% chance during the June-August season), but it isn't expected to have much of an impact on our weather by that point. later in the year, there is a 40-50% chance of La Niña or ENSO-neutral conditions.

The CPC outlook for April (Figure 9) shows 50-60% chances of below normal temperatures for northwestern Washington and 40-50% chances of the below normal temperatures for the rest of the state. Eastern and south-central Washington show 33-40% chances of above average precipitation for the month, while the rest of the state exhibits 40-50% chances of above average precipitation.

The three-month outlook for April-May-June (AMJ) shown in Figure 10 indicated the expectation of below normal temperatures statewide, with chances of below normal temperatures between 40 and 50% in most of the state and chances between 33 and 40% for the southeastern corner of the state. There are equal chances of below average, near-average, or above average precipitation for the entire state, with areas just south of Washington more likely to see dry conditions.

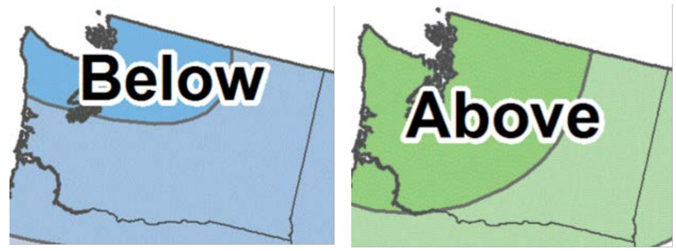
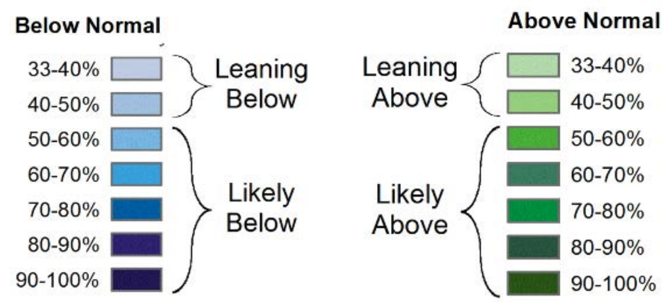


Figure 9: April outlook for temperature (left) and precipitation (right).



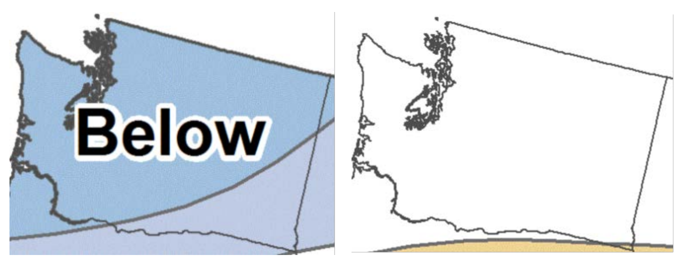


Figure 10: April-May-June outlook for temperature (left) and precipitation (right) (Climate Prediction Center).