Wx Watcher

Fall 2020

Volume I-2

Inside This Issue:

Editors/Authors:
National Weather Service Office Gray

Meteorologist in Charge (MIC):
Hendricus Lulofs

Science and Operations Officer (SOO):
Justin Arnott

Warning Coordination Meteorologist (WCM):
Donald Dumont

Get the latest forecast at:
www.weather.gov/gray

To subscribe, email:
gyx.vwxobs@noaa.gov

A New(ish) Face in Our Office

By Maura Casey, Meteorologist

Hi! My name is Maura Casey and I have been a forecaster at the Gray, Maine office since August of 2019. I came here from the National Weather Service in Charleston, West Virginia after 3+ years where I got my start in the agency. I am originally from the Metro Detroit area of Michigan, so I come with a passion for winter weather, an acceptance of the cold, and a distaste for heat and humidity. I graduated with my Meteorology degree from Central Michigan University in 2013 (Fire Up Chips!), focusing my efforts on winter weather and heavy snowfall forecasting. I then went on to Michigan State University (Go Green!) where I studied hydroclimatology and hydrology as a graduate student and researcher. My passion for winter weather started many years ago; as a young skier I paid close attention to weather patterns so I could be informed before hitting the slopes... and as a student I of course loved snow days. That curiosity, combined with my love of math and science, blossomed into my dream career - I wanted to be a National Weather Service forecaster since I was in middle school, and here I am.

In my free time, I enjoy downhill skiing, hiking, watching hockey, cooking, and craft beer. With these interests I'm very happy to have landed in beautiful Portland, Maine. I do a lot of exploring around northern New England both as a meteorologist getting to know the area I forecast for and as a perpetually curious adventurer. If you see me on a trail or at the top of a mountain taking a temperature, dew point, or wind measurement with my Kestrel hand-held weather meter... don't be shy, say hi!

Northern New England Summer 2020: Very Warm and Dry

By William Watson, Meteorologist

It is not much of a secret: Summer 2020 was very warm and dry in northern New England. A dry spell that began in mid-May lasted through June, and with the exception of a few wet days at the end of June and the end of July, conditions remained dry and drought developed over much of northern New England by late June. In addition, one of our climate sites experienced its warmest summer on record. Let's look at some of the more notable records from our longest-running climate sites for summer 2020:

-Portland had its warmest summer on record at an average temperature of 70.3 degrees, 3.6 degrees above normal and breaking the old record of 68.9 degrees from 2018 and 2016. Temperature records for Portland began in 1941. July 2020 was also the warmest overall month on record at Portland. Finally, the low temperature of 78 degrees on July 27 was the warmest low temperature on record at Portland.

-Concord had its fourth warmest summer on record at 70.7 degrees, 2.9 degrees above normal; the three warmest summers on record all occurred in the 1870s. Temperature records at Concord began in 1868. July 2020 was also the third warmest overall month on record at Concord.

-Both Portland (13, third most) and Concord (24, fifth most) saw top 10 numbers of days of 90+ degree high temperatures. While Concord saw its seventh most number of days with 60+ degree low temperatures, Portland saw a record number of days of both 70+ degree and 65+ degree low temperatures.

According to the US Drought Monitor, abnormally dry conditions developed in portions of our region in late May and moderate drought conditions developed in late June. After some improvement in July and early August, drought conditions began to spread again and also worsen for many areas in the last half of August and into September. As of this writing, the entire region is still experiencing moderate to extreme drought conditions that are forecast to continue into the fall.

2020 Hurricane Season Review

By Michael Clair, Meteorologist

So what were the conditions that led to the initial development of drought conditions in late June? To put it in some perspective, from May 16 to June 27, Portland received only 0.38 inches of rainfall, almost an inch less than the previous lowest amount for that period of 1.32 inches in 1899. Similarly, Concord received only 0.28 inches of rainfall over the same period, more than half an inch less than the previous lowest amount of 0.89 inches from 1964. These are not official records, but hopefully it puts a perspective on how dry that 5-6 week period was for our region and why we entered a drought around the end of that period.

The year 2020 will be remembered for many reasons, including having an extremely active Atlantic hurricane season. The season included a record shattering 30 named storms (so far), including 13 hurricanes, and 6 major hurricanes. The tracks of these storms are shown in Figure 1. The season also featured 12 named storms making landfall in the US, 6 of which were hurricanes. The rest of the article will discuss the records broken during the season, break down the US landfalls, discuss other notable storms, and see how the season ended up compared to the seasonal forecast. Data and information on the storms are derived from archived data from the National Hurricane Center (NHC).

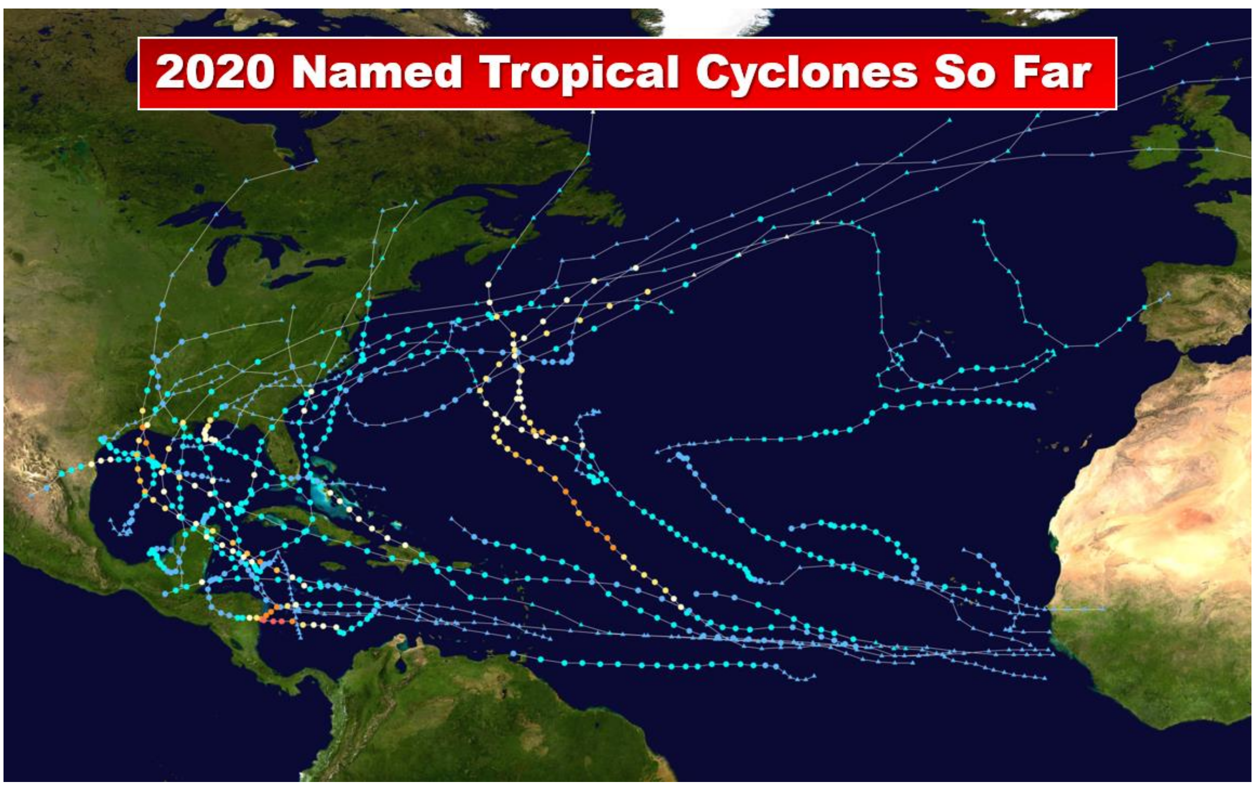

Figure 1: 2020 tracks of named Atlantic tropical cyclones so far. Image adapted from https://upload.wikimedia.org/wikipedia/commons/3/3c/2020_Atlantic_hurricane_season_summary_map.png.

Seasonal Summary: As mentioned, there were 30 named storms this season. This beat 2005 for the title of most named systems in a season. Since only 21 letters of the English alphabet are used for the list of hurricane names, this meant that the Greek alphabet was used for storm names once the original list was used up. This is only the second season the Greek alphabet was needed, with the other being 2005. The list of names, and the ones that were used, are shown in Figure 2. Hurricane season runs from June 1st through November 30th, but any storm that develops through the end of the year will be part of this year's season, so it is still possible there will be more named systems.

Figure 2: List of 2020 Tropical Cyclone storm names, with those that have been used crossed out.

Landfalling Storms and Discussion: 12 of these storms made landfall in the US, which was a record, and beat the previous record of 9 landfalling storms, set in 1916. Of the 12 storms, 6 of them were hurricanes at landfall, which ties the record for most landfalling hurricanes. This record is shared with the years 1985 and 1886 as well. The first landfall of the season was Tropical Storm Bertha, which made landfall near Charleston, SC on May 27th. The next was Tropical Storm Cristobal, which made landfall in southeast Louisiana on June 7th. Our longest break from landfalls for the season was ended by Tropical Storm Fay, which made landfall in southern New Jersey on July 10th. After making landfall, the center of Fay traveled northward through Upstate New York, just west of the border with Massachusetts and Vermont. The first hurricane of the season, Hurricane Hanna, then made landfall as a category 1 storm on July 25th in South Texas. We did not have to wait long for another one through, as Hurricane Isaias made landfall near the North Carolina/South Carolina border as a category 1 storm on August 4th. Isaias then tracked northeastward through the Mid-Atlantic as a tropical storm before passing through western Vermont as a post-tropical cyclone. Tropical Storm Marco then made landfall on August 24th in southeast Louisiana. Only days later on August 27th, Hurricane Laura came roaring ashore in southwest Louisiana as a category 4 hurricane, packing sustained winds of 150mph. It was the strongest storm to impact the US this year. Hurricane Sally then made landfall as a category 2 storm on the Alabama Shore on September 16th. Less than a week later Tropical Storm Beta made landfall on the Central Texas coastline on September 22nd. Then on October 9th, Hurricane Delta made landfall as a category 2 storm in southwest Louisiana, a mere 10 miles away from where Hurricane Laura had made landfall six weeks earlier. On October 28th, Louisiana would endure its fifth landfalling system of the season when Hurricane Zeta plowed ashore as a high end category 2 hurricane in the southeast part of the state. The remnants of Zeta then brought the first snowfall of the season to parts of southern New Hampshire and Massachusetts on October 30th. Then, a little less than a week after making landfall as a category 4 hurricane in Nicaragua, Tropical Storm Eta made landfall in the Florida Keys on November 9th after a landfall in Cuba a day earlier. Eta then made a second US landfall as a Tropical Storm near Cedar Key on November 11th.

With so many US landfalls, an interesting statistic came out of this hurricane season. Every single coastal county along the Atlantic Ocean and Gulf of Mexico at some point was under either a Tropical Storm or Hurricane Watch or Warning, except Wakulla County and Jefferson County in Florida. The watches and warnings that were issued this season are shown in Figure 3.

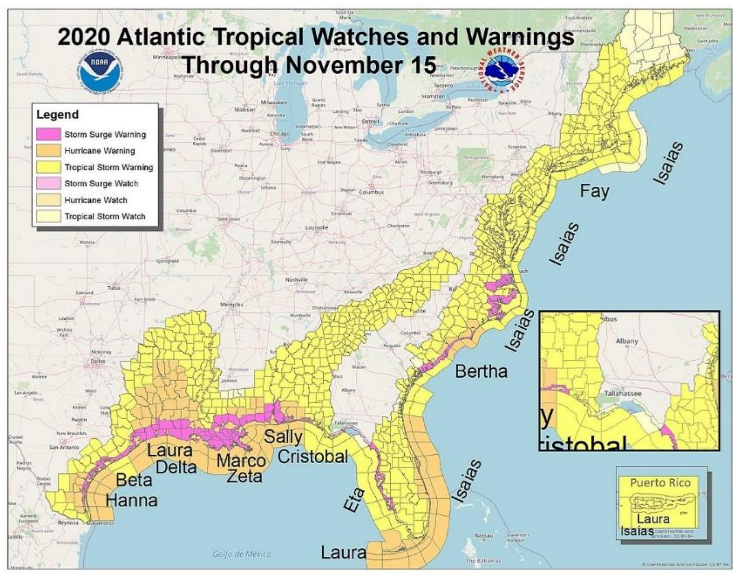

Figure 3: Map of watches and warning issued during the 2020 Hurricane Season. Image courtesy of NWS Corpus Christi.

There were several other storms and record breakers throughout the season. Most notable was Hurricane Iota, which was the strongest storm of the season, reaching Category 5 strength on November 16th. This also made it only the second hurricane on record to reach Category 5 strength in the month of November. The other was the 1932 Cuba Hurricane. Iota then made landfall as a high end Category 4 hurricane in Nicaragua only 15 miles from where Hurricane Eta had made landfall two weeks earlier.

Figure 4: NOAA's NHC 2020 Atlantic Hurricane Season forecast and August 6th update.

Hurricane Outlook Verification: An important part of forecasting is verifying how a forecast turned out, so how did the 2020 seasonal forecast turn out? Back in May, the National Hurricane Center (NHC) had made their preseason projection for the 2020 Atlantic Hurricane season, shown in Figure 4. They were projecting an above average season, with little chance of the season ending up below average. The historical average for a season features 12 named storms, 6 of which become hurricanes, and 3 of those that become major hurricanes, which are storms that strengthen to category 3 or stronger. From May the NHC was projecting an above average season. By early August the NHC had increased their forecasted number of storms up to 19-25, calling for an "Extremely Active Season".

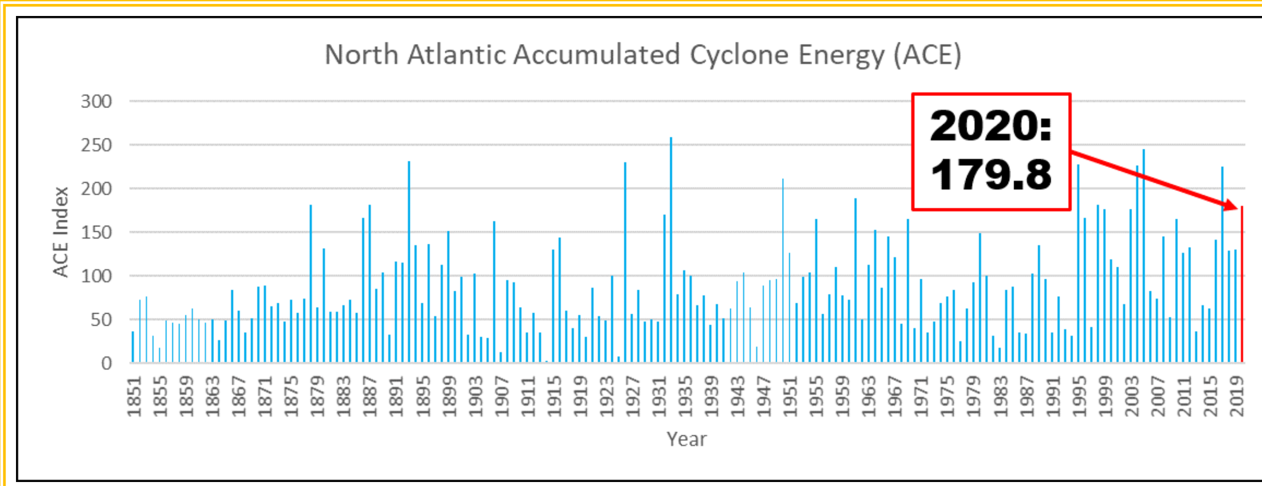

Figure 5: Historic ACE Index by year. Data courtesy of Colorado State University.

From well before the season began, there were strong signals that the season would be an active one, which certainly came to fruition. Another metric used to measure the severity of a season is what is known as the Accumulated Cyclone Energy (ACE) Index. The ACE index is a summation of how much energy each Tropical Cyclone produced during the season. The ACE index is compiled by comparing the wind speeds in a system to the size of a system. Larger and stronger storms that have a long lifetime yield the highest amount of ACE "points". In terms of the ACE Index, so far 2020 has been the 13th most active season on record. The seasonal comparison is shown in Figure 5. Hurricane Teddy had the highest ACE Index this season, generating 27.8 ACE points. Teddy also had the 4th largest tropical storm force wind field on record.

Winter Outlook 2020-2021

By Derek Schroeter, Meteorologist

Each winter is different here in New England, but more often than not dominant weather patterns emerge that leave impressions of the severity of the seaon. A key player in the development of dominant weather patterns for the upcoming winter is the state of sea surface temperatures (SST) in the equatorial Pacific Ocean. Currently, La Niña conditions are present and confidence is high that moderate to strong La Niña will persist through winter. La Niña refers to the periodic cooling of SSTs in the equatorial Pacific between the International Date Line and the west coast of South America, which can be seen in figure 6. Additional players that can contribute to dominant weather patterns will be SST anomalies off the East Coast as well as teleconnections such as the Pacific North American (PNA) pattern.

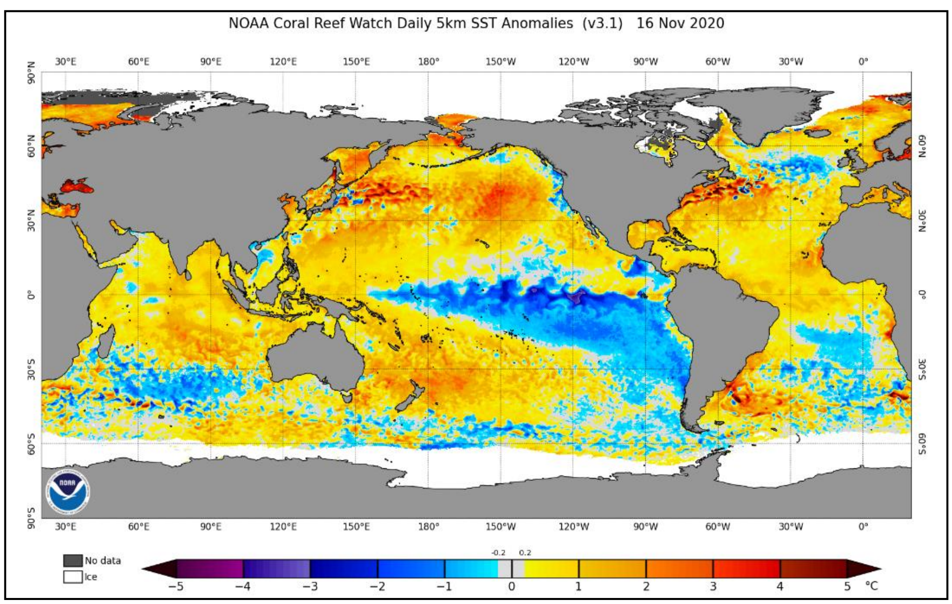

Figure 6: Sea surface temperature anomalies showing La Niña conditons in the Pacific and well above normal anomalies off the East Coast.

La Niña events generally occur every 3 to 5 years, and on occasion can persist through consecutive winters. La Niña represents the cool phase of the El

Niño/Southern Oscillation (ENSO) cycle. This past winter weak El Niño conditions were present and over the course of this summer SSTs cooled and are now about -1.0°C from normal. Sea surface temperatures anomalies are expected to continue to cool through into December and bottom out near -1.5°C, putting this La Niña event near the threshold of a moderate to strong event.La Niña conditions can drive winter weather patterns across North America through the atmospheric response to the orientaion of SST anomalies. The importance of these SST is that they dictate the prefered location for peristent large areas of thunderstorms in the tropics. During La Niña events, tropical thunderstorm activity is prefered over warmest waters over the western Pacific and Indonesia with suppressed thunderstorm activity in the central and east Pacific. Peristent thundertsorm activity in this part of the Pacific leads to the development of a blocking high pressure sytem in the north Pacific. This blocking high pressure system generally leads to a suppressed Subtropical Jet Stream with the Polar Jet Stream largely influencing winter weather patterns across North America.

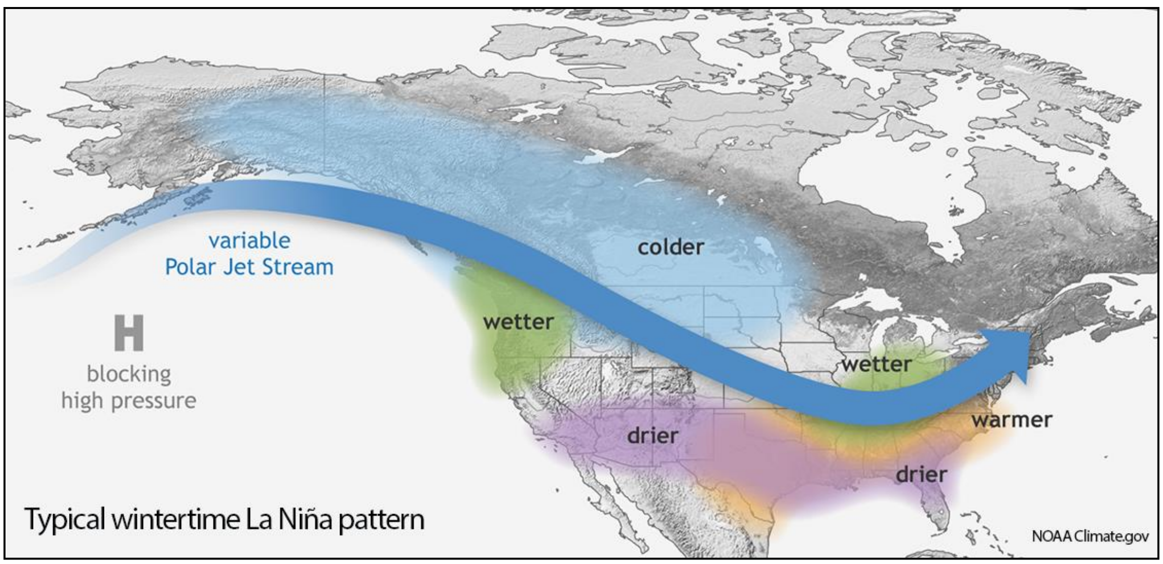

Figure 7: Typical wintertime La Niña pattern with a dominant Polar Jet Stream aimed directly at northern New England.

The typical wintertime pattern associated with La Niña is shown in figure 7. During La Niña winters the Polar Jet brings increased storm activity to Pacific Northwest with colder than normal conditions to the northern Plains. East of the Rockies the Polar Jet dips southward towards the Ohio Valley and then turns northward towards northern New England. This setup generally brings above normal precipitation to the Great Lakes region with warmer than normal temperatures across the Mid-Atlantic region. The position of the Polar Jet in figure 7 will be important for our area this winter as subtle shifts to the south and east will lead to storms that bring primarily snow, while subtle shifts to the north and west will bring storms that bring mixed precipitation and rain.

The position of the Jet Stream over northern New England can also be modulated by atmospheric teleconnections, such as the Pacific North American Pattern (PNA), Arctic Oscillation (AO), and North Atlantic Oscillation (NAO). During La Niña events the PNA tends to be in its negative phase, which correspnds to a trough of low pressure in the West and ridge of high pressure over the southeast U.S. Figure 8 shows mid-atmospheric flow and surface temperature relationships with respect to the PNA. During the negative phase of the PNA the cool colors represent troughs of low pressure and cooler than normal temperatures while the warm colors represent ridges of high pressure and above normal temperatures. As can be seen from the left graphic in figure 8, when the PNA is negative a ridge of high pressure tends to develop over

the Southeast and expands northward into New England. This ridge of high pressure may become amplified this winter with the help of the well above normal SSTs off the East Coast as seen in figure 6. Under this set-up low pressure systems will have a tendancy to track to our west allowing for warm air to be pulled into our area leading to storms changing from snow to mix/rain. The westward storm track may be mitigated this winter during times when the AO and NAO are in their negative phase. The negative phase of the AO, and particularly the NAO, lead to upstream blocking that acts to shunt low pressure sytems to our southeast increasing the likelihood of low pressure systems bringing more snow than mix/rain.

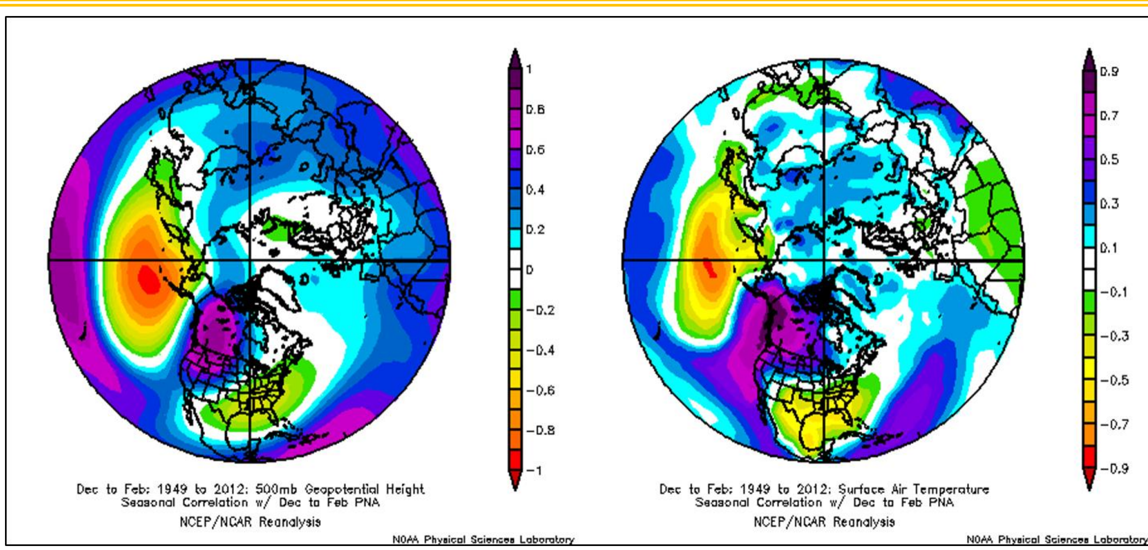

Figure 8: Atmospheric and temperature relationships with the Pacific North American (PNA) pattern. The left shows mid-level atmospheric flow and the right shows surface temperature. During the negative phase of the PNA the cool colors correspond to troughs of low pressure and below normal temperatures, while the warm colors represent ridges of high pressure and above normal temperatures.

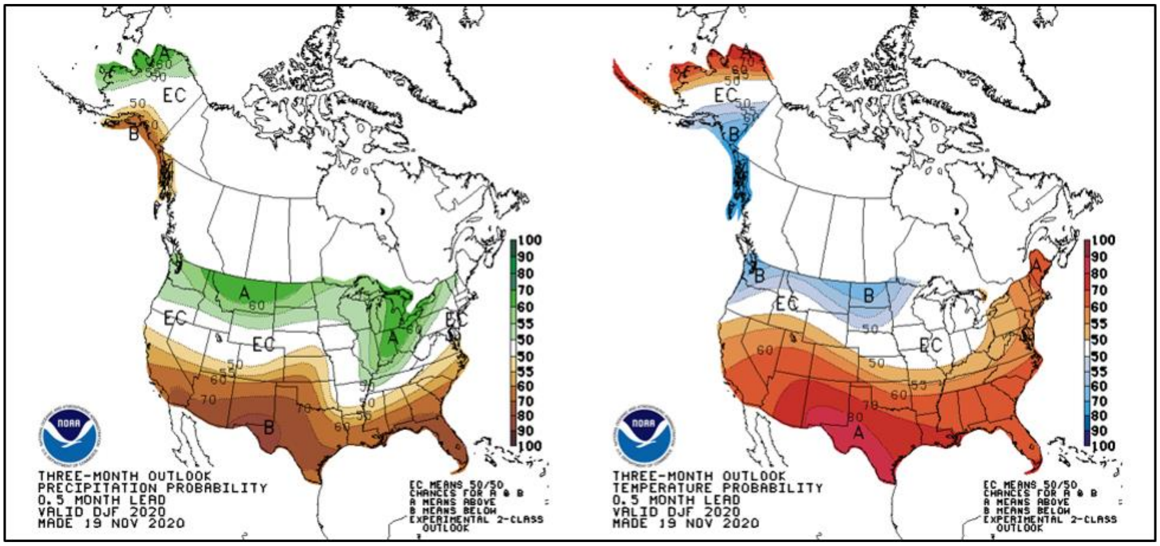

Figure 9: Winter seasonal outlook from the Climate Prediction Center (CPC). Odds favor above normal precipitation from the Great Lakes into western New England with near normal (equal chances) precipitation for much of our forecast area and above normal temperatures for all of New England.

The Climate Prediction Center's (CPC) winter outlook shown in figure 9 largely resembles the typical wintertime La Niña pattern. Odds favor wetter than normal conditons across the northern tier of the US extending into western New England while temperatures are favored to run above normal in New England. The signal for above normal temperatures comes from the prefered ridge over the Southeast and the above normal SSTs off the East Coast. It is important to note that while temperatures are favored to be above average it does not mean that snowfall will be below average with our cold climate in New England. In fact, figure 10 shows snowfall anomalies during La Niña winters with northern New England averaging above normal snowfall. Further analysis shows that when looking seasonal snowfall in Rangeley, ME, with a period of record back to 1968-1969, the top five snowiest winters there were all during La Niña events. These same winters however, produced more variable seasonal snowfall south of the mountains indicative of a storm track that brings low pressure system that are snow producers in the mountains with rain/mix the closer one gets to the coast. While climatology

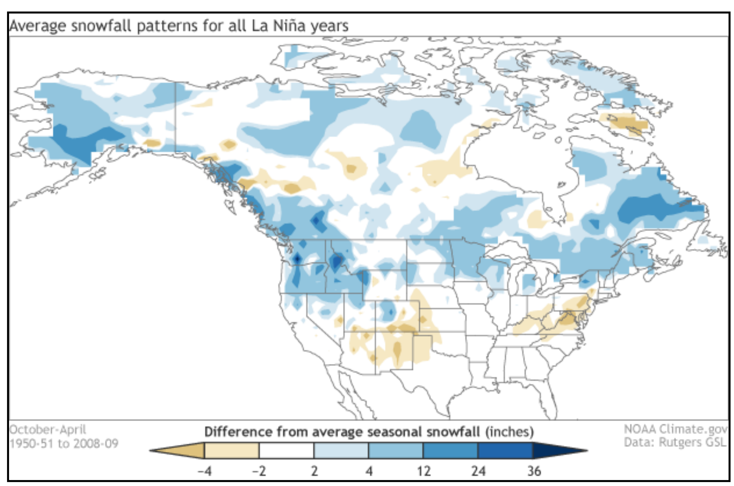

Figure 10: Average snowfall patterns during La Niña winters showing a tendancy for above normal snowfall in the mountains of our forecast area and normal snowfall closer to the coast.

suggests that La Niña winters bring above normal snowfall to the mountains, it should be noted that some La Niña winters have brought well below normal snowfall to New England such as the winters of 1988-1989 and 2011-2012. The most recent La Niña event in 2017-2018 is also noteworthy for large month to month variability. During this winter, December was much colder than normal with above normal snowfall with a significant thaw in February when temperatures rose into the 60s, followed by a cold march with several nor'easters. For this upcoming winter expectations are for temperatures to run above normal while the mountains have a good chance of seeing above normal snowfall.

A Refresher on Measuring Snow

By Michael Clair, Meteorologist

A few spots have seen a bit of snow so far this fall, but before the heavy stuff really comes down we thought it would be beneficial to do a brief seasonal review on the proper techniques, as well as the importance of these techniques, on measuring snowfall and snow depth. In order for the data quality to be consistent for various locations, a set of guidelines and procedures have been adopted at CoCoRaHS. There are four main measurements that are taken for snow. They are…

1. Measuring freshly fallen snow.
2. Taking the water equivalent of the fresh snow.
3. Measuring the total snow depth.
4. Taking the liquid equivalent of the total snow depth.

Procedures for taking these four measurements are discussed below.

Before the flakes start flying, you should place your snowboard outside. The board should be at least 16" x 16" in size, and painted white to minimize heat absorption and extra snow melt. Place the board in an open area, and if possible in an area where minimal drifting occurs. When it snows, measure the amount on this board at your usual measuring time. If possible, take the snow measurement right after the snow stops falling to minimize any settling of the snow. If this is not possible, don't worry, the normal measuring time is still fine. Report the snowfall to the nearest tenth of an inch. Clear the board off after each measurement, and place it on top of the snow. If there is any blowing or drifting of the snow, it is important to take multiple measurements. It's best to take at least three measurements that are representative of the area, being careful to avoid drifts or man-made snow piles, as well as areas where most of the snow was blown away. It will be necessary to make these measurements off of the snow board. Then, take the average of the measurements, and report the average as the snowfall total.

Another aspect of taking snowfall measurements is taking the water equivalent of the snow. The proper procedure for doing this is to remove the funnel and the inner tube from your four inch rain gauge, and allow the snow to fall into the outside cylinder. If snow accumulates on the upper rim of the cylinder, press straight down on the snow with a spatula, or similar tool, so that the snow suspended above the inner cylinder falls in, and that suspended over the outside of the cylinder falls to the ground. Then, take the cylinder inside, measure a certain amount of warm water in the inner cylinder, write this amount down, and pour the warm water into the snow in the outer cylinder. Let the snow melt, and then measure the amount of water from the melted snow and added water. Subtract the amount of warm water added, and you have the amount of water that is in the snowfall to the nearest hundredth of an inch.

If the snow that is in the cylinder does not appear representative to the amount of snow that actually fell, empty the cylinder, and press the open end down onto your snowboard, put your spatula, or similar tool, on the open end at the bottom of the snow, and flip it over so the snow falls and stays in the cylinder. You can then proceed with the melting procedure described above.

The most common daily measurement taken is the snow depth measurement. This is the amount of snow on the ground, whether it snowed in the previous 24 hours or not. This measurement should be calculated by taking multiple measurements (at least three) and then taking the average of the measurements. It should be reported to the nearest half inch. There will be times, especially after periods of melting, that there will be bare spots. These spots are important, and account for a measurement of zero. If roughly half the area has no snow, then half of the values going into the calculation should be zero.

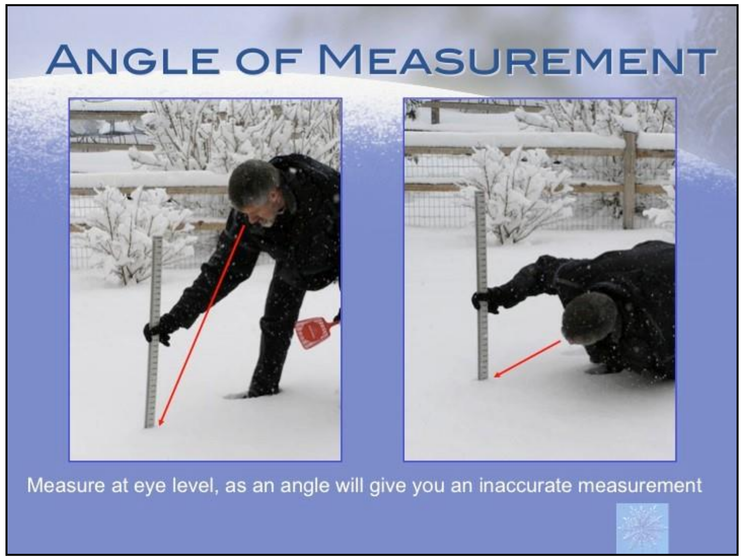

Photo Credit: weather.gov

The final measurement of discussion is the snow depth water equivalent. Taking this measurement is optional, but is extremely useful information. This is done by pressing your outer cylinder into the snowpack in a place that has the same depth as your average snow depth. Then, take it inside and proceed how you normally would for taking the snow water equivalent for a new snowfall.

For questions, comments, or suggestions contact us at gyx.vwxobs@noaa.gov