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Ray Russell's 2022-2023 Fearless Forecast

Summary of the Fearless Forecast for Winter 2022-2023

You may want to read the rationale that follows, but we'll give you the "answer" first.

- Snow totals are forecast to be 25% less than long-term average, but near the 10-year average.
- Temperatures are expected to be slightly warmer than average.
- According to the best long-range modelling, winter lovers better get their fill in the first half of the season.

Below are forecast totals for many locations in the Southern Appalachians. (Note: The forecast snowfall total includes snow/ice falling between October 2022 and May 2023.)

Table 1: Specific 2022-23 Snowfall Forecasts for Selected Locations

Location	Expected Total Snow/Ice for Winter 2022-2023
Asheville, NC	11"
Banner Elk, NC	34"
Beech Mountain, NC	70"
Boone, NC	29"
Galax, VA	17"
Hendersonville, NC	8"
Hickory, NC	4"
Independence, VA	17"
Jefferson and West Jefferson	20"
Lenoir, NC	5"
Morganton, NC	6"
Mt. Airy, NC	8"
Old Fort, NC	6"
Sparta, NC	18"
Spruce Pine, NC	18"
Sugar Mountain, NC	70"
Waynesville, NC	14"
Wilkesboro and N. Wilkesboro	6"
Wytheville, VA	20"

The coming winter is forecast to be the third La Niña winter in a row. NOAA shows ENSO Classifications for each month since 1950 at https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php. Only twice have

we had La Niña threepeats (1973-1976 and 1998-2001). Two La Niña winters in a row have happened 5 times. So, if this forecast looks a lot like the last two Fearless Forecasts, La Niña is the reason.

Background and Assessment of Last Year's Forecast

This is RaysWeather.Com's 20th Winter Fearless Forecast. Last year, we forecast total snowfall slightly above the 10-year average (but 25% less than the long-term average) and temperatures near seasonal averages. The snowfall forecast was spot on for the SW North Carolina Mountains, significantly below actual snowfall in the Foothills (which came in one big January storm), and (on average) about 25% more than actual snowfall in NW North Carolina and SW Virginia. Temperatures for the winter averaged 3 degrees above average. See Table 2. Below for details regarding the snowfall forecast compared to actual.

Table 2: Last Year's RWC Fearless Winter Snowfall Forecast

Location	Forecast	Actual	Actual - Forecast
Asheville, NC	11"	11"	0"
Banner Elk, NC	35"	29.3"	-5.7"
Beech Mountain, NC	70"	65.7	-4.3"
Boone, NC	30"	22.7"	-7.3"
Galax, VA	17"	15.9"	-1.1"
Hendersonville, NC	8"	11"	+3"
Hickory, NC	4"	10.2"	+6.2"
Independence, VA	17"	13"	-4"
Jefferson and West Jefferson	20"	16"	-4"
Lenoir, NC	5"	7.7"	+2.7
Morganton, NC	5"	8.9"	4.9"
Mt. Airy, NC	8"	9.6"	+1.6"
Old Fort, NC	5"	10.5"	+5.5"
Sparta, NC	18"	*	
Spruce Pine, NC	18"	16.9"	-1.1"
Sugar Mountain, NC	70"	56.7"	-13.3"
Waynesville, NC	14"	14.3"	+0.3"
Wilkesboro and N. Wilkesboro	6"	5.5"	-0.5"
Wytheville, VA	20"	*	

Note: Data here is from NOAA COOP and COCORAHS stations. If multiple stations exist in the area, the value here is the average of the reporting stations.

* No reliable report available.

Winter 2021-22 featured a very warm December, a cold and very snowy January, a mild February, but a little more snow for the Southern Appalachians in March and April.

As winter forecasts go, we cannot reasonably expect to produce a more accurate forecast than the 2021-22 Winter Forecast. Actually, the biggest "miss" in that forecast was average temperatures, headlined an incredibly warm December.

Fearless Forecast Rationale

ENSO Analysis

The first consideration in a Winter forecast is always the current state and forecast for the El Niño/Southern Oscillation (ENSO). ENSO is a measure of large-scale weather conditions in the Equatorial Pacific. It fluctuates between El Niño (associated with warmer than average sea surface temperatures in the Equatorial Pacific) and La Niña (associated with colder than average sea surface temperatures in the Equatorial Pacific).

See the October 10 Sea Surface Temperature Anomaly graphic (Figure 1) below. Note the blue shades stretching from the west coast of South America to almost Papua New Guinea. That's a clear signal of La Niña. For comparison, I included an October SST graphic from the last two years below.

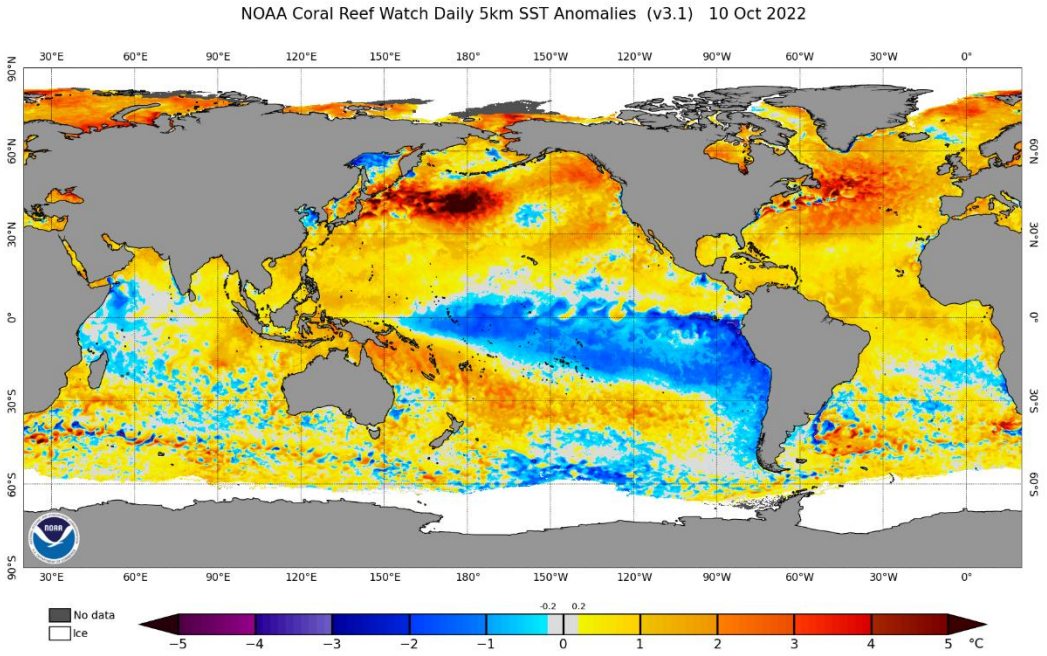

Figure 1: Sea Surface Temperature Anomaly 10/10/2022 (https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/index.html)

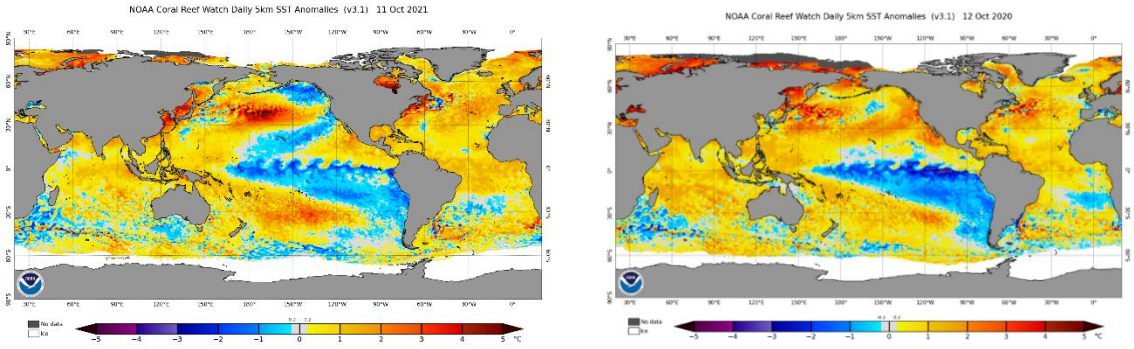

Figure 2: Sea surface temperature anomalies in October 2021 (left) and October 2020 (right).

La Niña is expected to hold through the winter then fade to neutral conditions in the Spring. See Figure 3 for current ENSO modeling (negative values indicate La Niña and positive values indicate El Nino.)

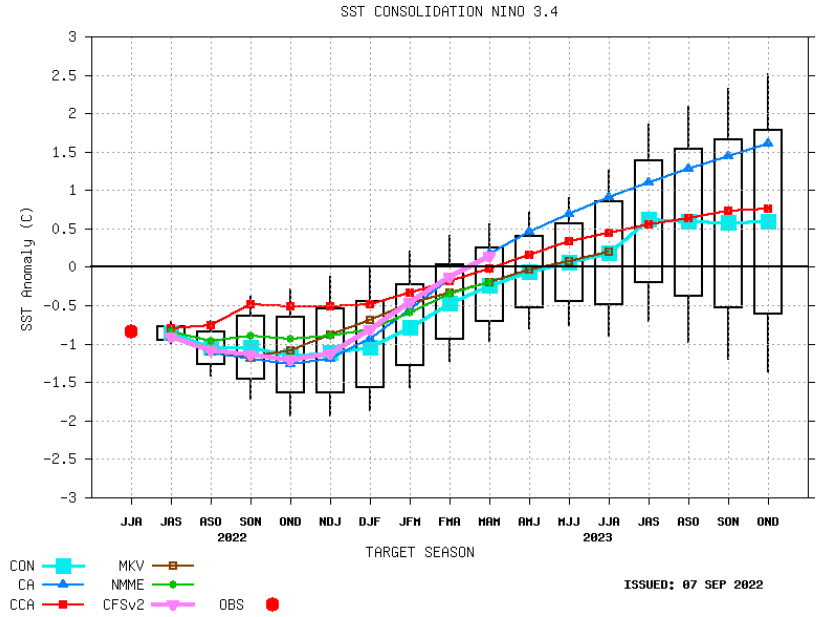

Figure 3: Forecast for ENSO (from https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-sst_table)

Astute readers at this point might say, “Wait a minute! You mean the winter snowfall forecast is based on another forecast. That sounds mighty risky.” To which I reply, “Yes, it is risky. That’s not the only reason you shouldn’t put too much stock in any winter forecast including this one.”

Figure 4 shows snow data from Boone, NC. You see seasonal snow data for 63 years classified by ENSO type (Strong El Niño through Strong La Niña). The graph also shows the long-term average and a 10-year moving average. Note that moderate La Niña conditions generally have slightly less than average snow and strong La Niña conditions have much less snow.

I’ll call out one important point in this table (among many). The standard deviation in this data is 20.0. You will remember from your statistics class (and I’m sure everyone had a statistics class and remember it well 😊), that 68% of the data falls within one standard deviation of the mean (assuming a normal distribution). To which you exclaim, “Wait a minute! You mean that 32% of winters in Boone have more than 58” of snow or less than 18” of snow. And you are trying to forecast this?!” To which I say, “Yes. Yet another reason not to put too much stock in any winter forecast.”

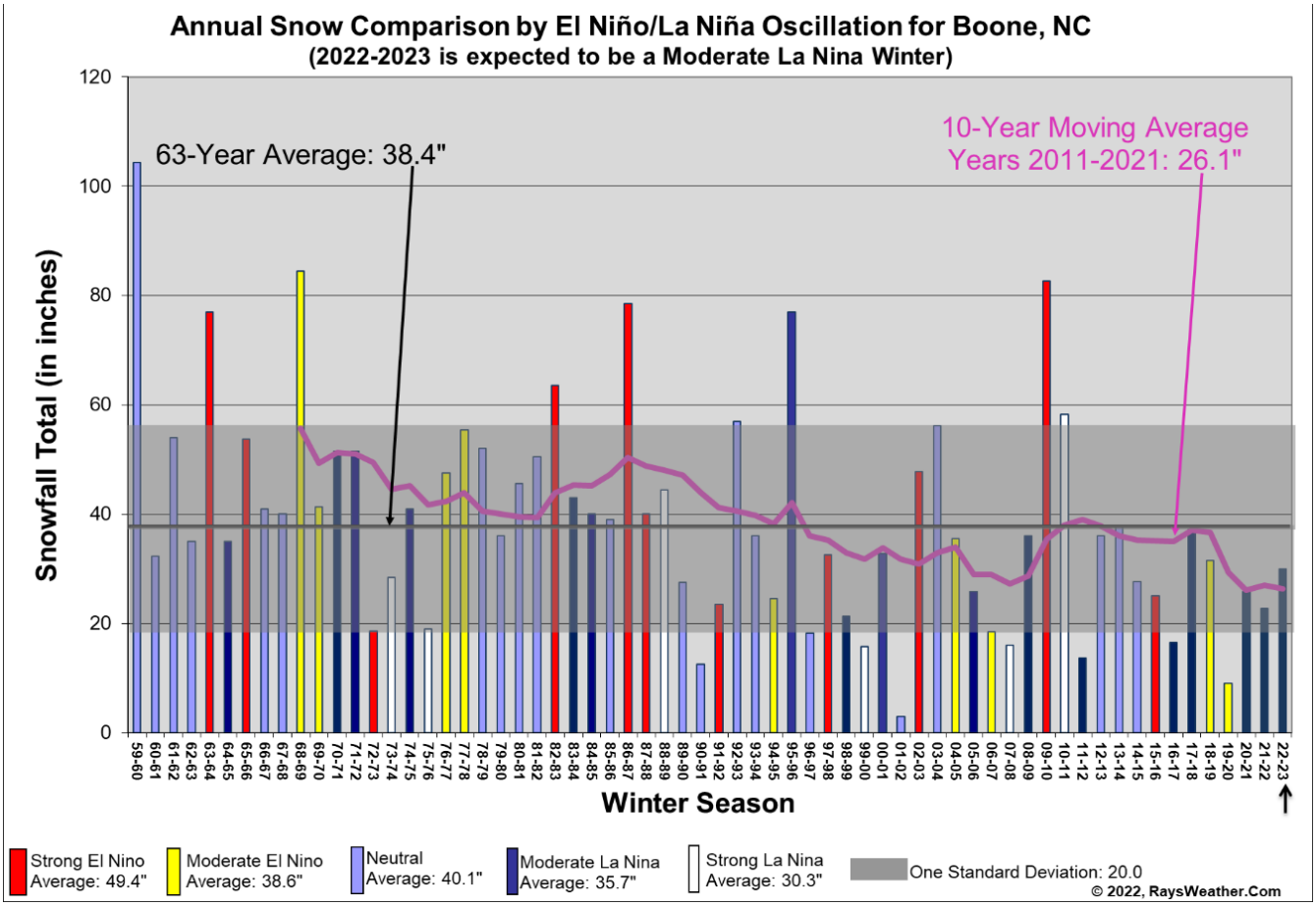

Figure 4: Total Winter Snowfall in Boone, NC, Classified by ENSO (ENSO classifications derived from www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml)

Not all La Niñas are created equally. Based on predicted ENSO conditions for 2022-23 and SSTs across the Pacific and Atlantic in the Northern Hemisphere, we identified 7 “Best Fit” winters for the coming season. These Best Fit winters are: 1964-65, 1970-71, 1971-72, 1995-96, 2011-12, 2020-21, and 2021-22.

Figure 5 compares: Best Fit Winter temperatures with Other Moderate La Niña Winters, and All Other Winters month by month. It’s difficult to distinguish the Best Fit winters from other winters except for the slight tendency to be slightly warmer.

We also analyzed the Best Fit winters compared to other Moderate La Niña winters and all other winters by monthly snowfall. See Figure 6 below. Again, the lines are similar except for the propensity for a little more snow in January.

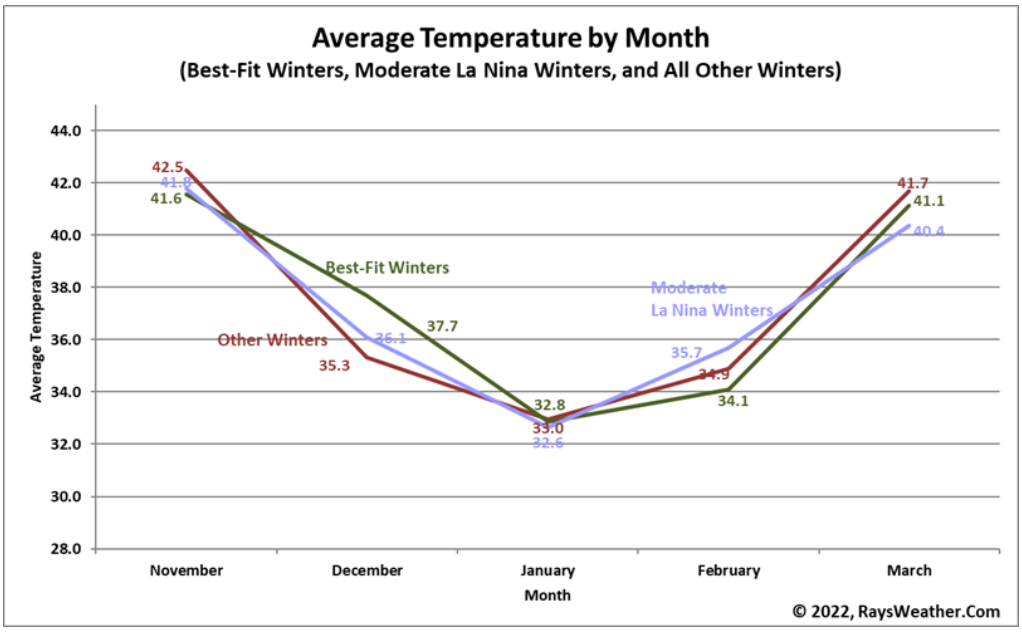

Figure 5: Monthly Average Temperatures for our Best-Fit Winters (1964-65, 1970-71, 1971-72, 1995-96, 2011-12, 2020-21, 2021-22) compared with Moderate La Nina Winters and All Other Winters. Temperature data is from Boone, NC.

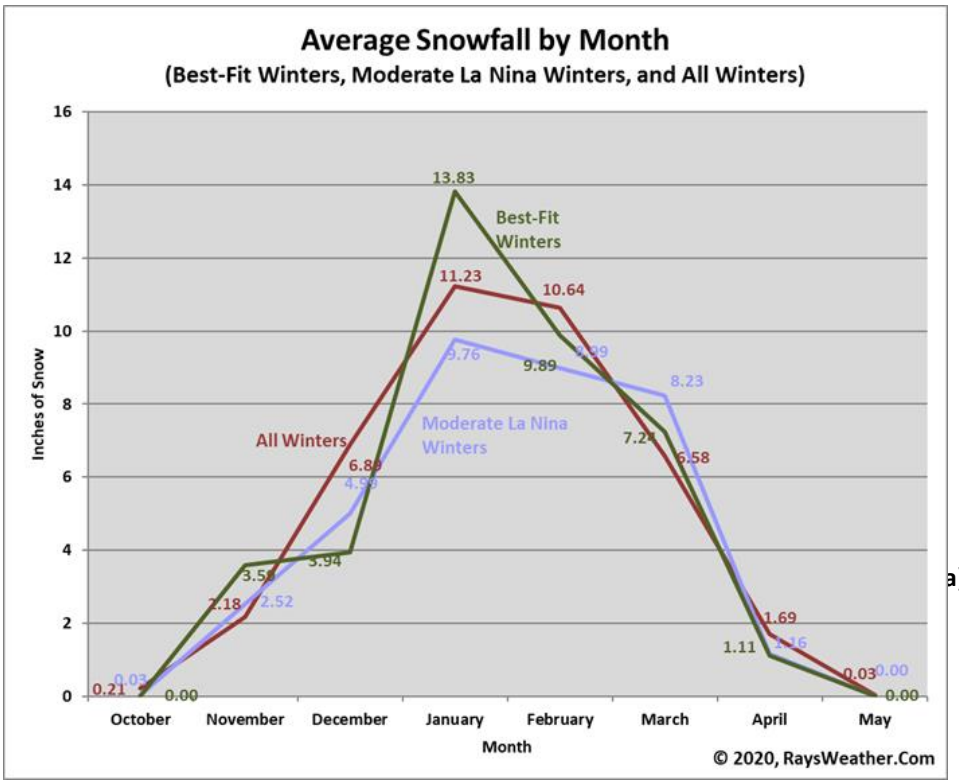

Figure 6. Best Fit winters compared to other Moderate La Niña winters and all other winters by Monthly Snowfall.

The winter pattern associated with La Niña Winters is shown in Figure 7 below. On average, La Niña winters feature a dominate jet stream flow through Alaska, Western Canada, and into the Great Plains. Lows tend to track through the Ohio Valley. That pattern should put us in line for a few NW Flow snow

events. A moderate La Niña should also allow for Gulf and Atlantic moisture to get involved a few times this winter.

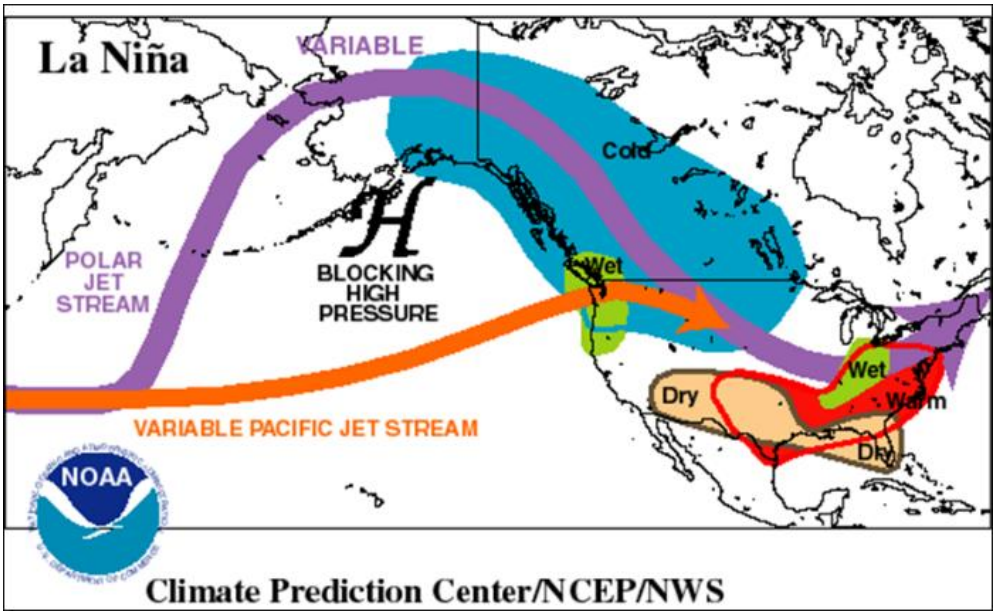

Figure 7. Typical La Niña winter pattern.

Figure 8 shows the latest NOAA Climate Prediction Center seasonal model forecast for December through February. It generally reflects our thinking.

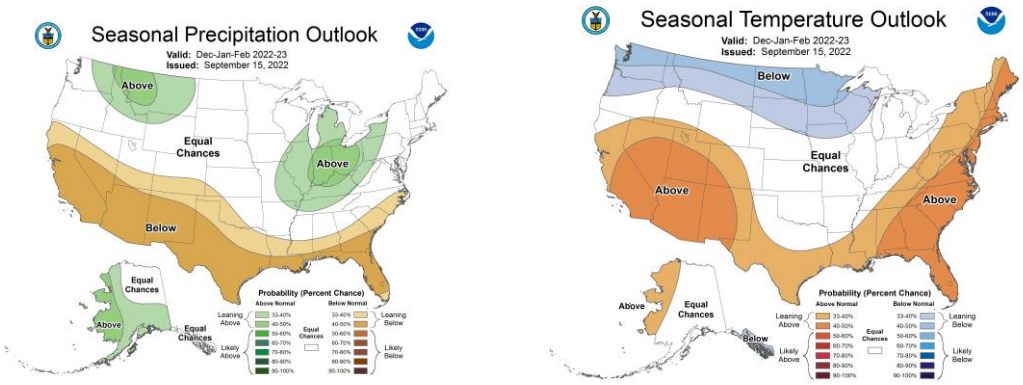

Figure 8 Latest NOAA Winter Forecast Probabilities
(from www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=3)

The main takeaways from the analysis of ENSO forecast for the coming winter are:

1. Snowfall not far from the 10-year average.
2. Slightly above average temperatures.

Long Range Modeling

You might wonder, based on the data in my charts, why NOAA is forecasting warmer than average temperatures. The answer is found in the best long-range modeling this year. Below is the latest and most reliable long-range models. These latest results were published just two days before the release of our forecast.

Figure 9 shows forecast average temperatures from several long-range models: JMA, ECMWF, UKMet, and a combined product averaging the previous three. Don't worry about the details, but yellow, orange, red, and crimson mean warmer, warm, very warm. To be honest, I do not understand why they forecast a warmer winter in the Southern and Eastern U. S., but that level of consensus should get any forecaster's attention. And it will move the Fearless Forecast from a neutral stance on temperatures to warmer. The month-by-month forecast results tend to favor cooler than average temperatures before January and warmer than average temperatures after January.

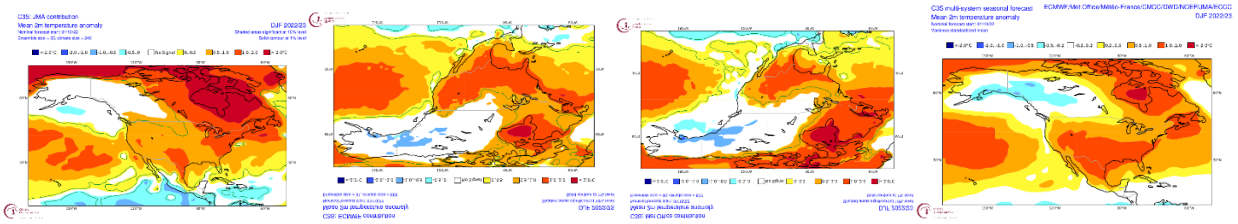

Figure 9. Long-Range Temperature Modeling for Winter from JMA, EMCWF, UKMet, and a combined product. Images from https://climate.copernicus.eu/.

Takeaway: I really don't know how much weight to put on these model results, but all that "red and orange" pushes a wise forecaster to "warmer". I'll also lean on the idea of cooler early relative to average and warmer later.

Climate Change

Climate change is real. If you are interested in a good source of scientific data and analysis on the subject, see http://climate.nasa.gov/evidence/. Figures 10 and 11 show broad measures of climate change effects. Figure 10 shows the extent of Artic Ice. As of this latest report, the Artic has the 5th least ice extent on record. Figure 11 shows yearly average temperature in North America. Temperatures continue to gradually rise across the country overall. The warmest seven years have all been since 2015; the top three being 2016, 2019 and 2020. However, the effects of climate change are not linear or uniform in either time or from region to region. Our cool Fall thus far attests to non-uniformity of the phenomena.

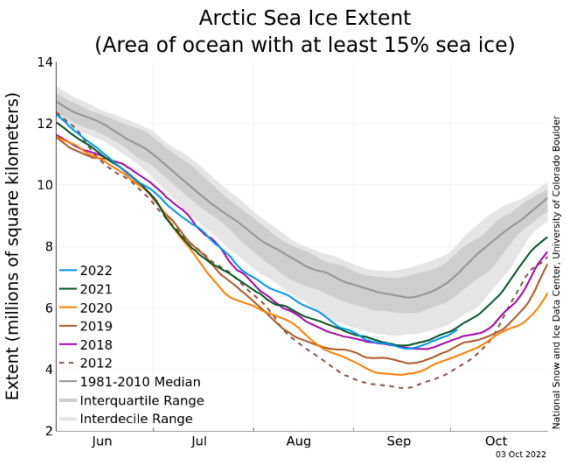

Figure 10: Extent of Arctic Ice (from nsidc.org/arcticseaicenews/)

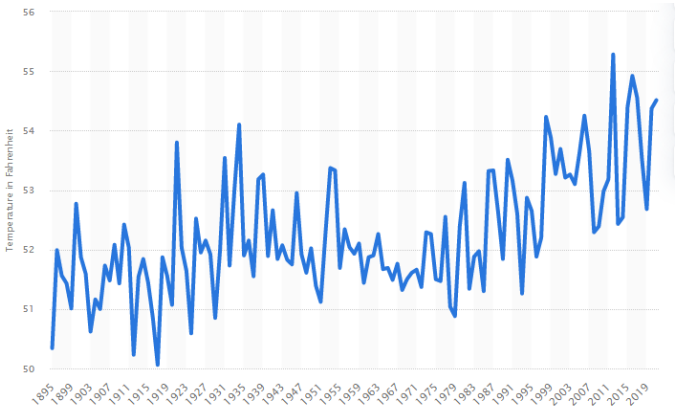

Figure 11: Avg Yearly Temp. North America (1895 to 2021)
(from statista.com/statistics/500472/annual-average-temperature-in-the-us)

Figure 12 shows a 10-year sliding average of seasonal snowfall for Boone NC. Our 10-year average total winter snowfall is currently almost half what it was in the mid to late 1980s. Climate change effects do not preclude a cold and snowy winter. As a case in point, 2009-10 was one of the snowiest on record in NW NC.

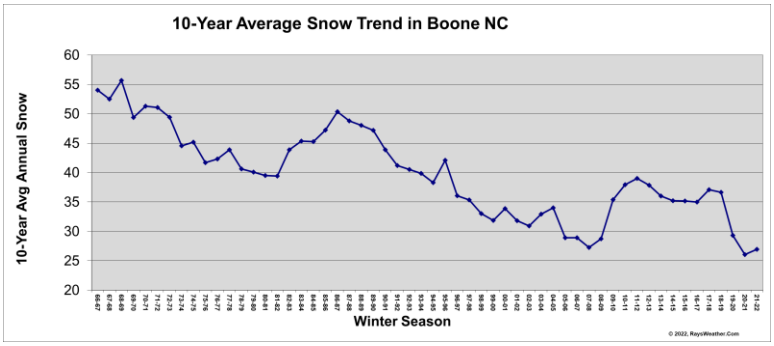

Figure 12: 10-Year Average Seasonal Snow in Boone, NC

Takeaway: Any prudent seasonal forecast must lean toward warmer and less snow compared to long-term averages because of climate change.

The North Atlantic Oscillation and Arctic Oscillation Wildcards

Every year, the North Atlantic Oscillation (NAO) and the Arctic Oscillation (AO) are the biggest wildcards for long-range winter forecasts in the Eastern U. S. The NAO index is based on the pressure difference between the Icelandic low and Azores high. The Arctic Oscillation describes the state of atmospheric circulation over the Arctic. (See climate.ncsu.edu/climate/patterns/nao for details.) These indicators tend to move together and have an enormous impact on winter weather. Both a negative NAO and negative AO generally correlate to cold and snow in the Eastern U. S. I know of no reliable tool for long-range phases for these indices.

However, two factors give us caution regarding climate change and the NAO/AO:

1. Some evidence exists that warmer than average sea surface temperatures in the Gulf of Alaska and off the NE U. S. Coast (as exists currently) tend to promote negative AO and negative NAO.
2. Evidence also exists that warming at the poles has increased the likelihood for a negative NAO and negative AO during the winter.

Either of these factors could result in colder air reaching the Eastern U. S. at times this winter.

Summary

So… the coming winter may be similar to the last two winters.

- Overall temperatures are forecast to be slightly warmer than average.
- Total snowfall is forecast to be 25% less than the long-term average but near the 10-year average.
- Generally, the first half of winter will be colder than the second half.

Whatever the weather brings, we hope you have a safe, healthy, and happy winter.