



Will It Be A White Christmas?

Effect of Temperature and Climate on Snow Accumulation in a Season



Abstract

Weather is extremely volatile, but with the ability to make accurate predictions and assess climate patterns, disastrous consequences can be avoided. Meteorology describes this scientific field of forecast of the earth's atmosphere and has continued to advance its precision over the years with cutting edge technology and increased data collection. Our goal as researchers is to explore what kind of climate events contribute to an increase or decrease in annual snowfall averages through the collection of data from the National Weather Service's National Oceanic and Atmospheric Administration (NOAA). By exploring the conditions of over ten winter seasons with the highest and lowest snowfall accumulation in recent history we hope to be able to make a prediction for this upcoming winter and decide whether it's time to break the bank with some new skis or to keep the snow pants in deep storage.

Research/Observations

Snowiest seasons	Snowfall inches	Average temperatures	ENSO
1995-96	75.6	75.3 F	Niña
2010-11	61.9	76.3	Niña
2013-14	57.4	76.15	ENSO neutral
2009-10	51.4	73.7	Niño
2014-15	50.3	73.65	Niño

Least snowiest	Snowfall inches	Average Temperatures	ENSO
2022-2023	2.3	74.75	Niña
2001-02	3.5	72.3	ENSO neutral
2019-20	4.8	76.65	ENSO neutral
1997-98	5.5	72.5	Niño
2011-12	7.4	75.6	Niña
2023-24	7.5	77.05	Niño

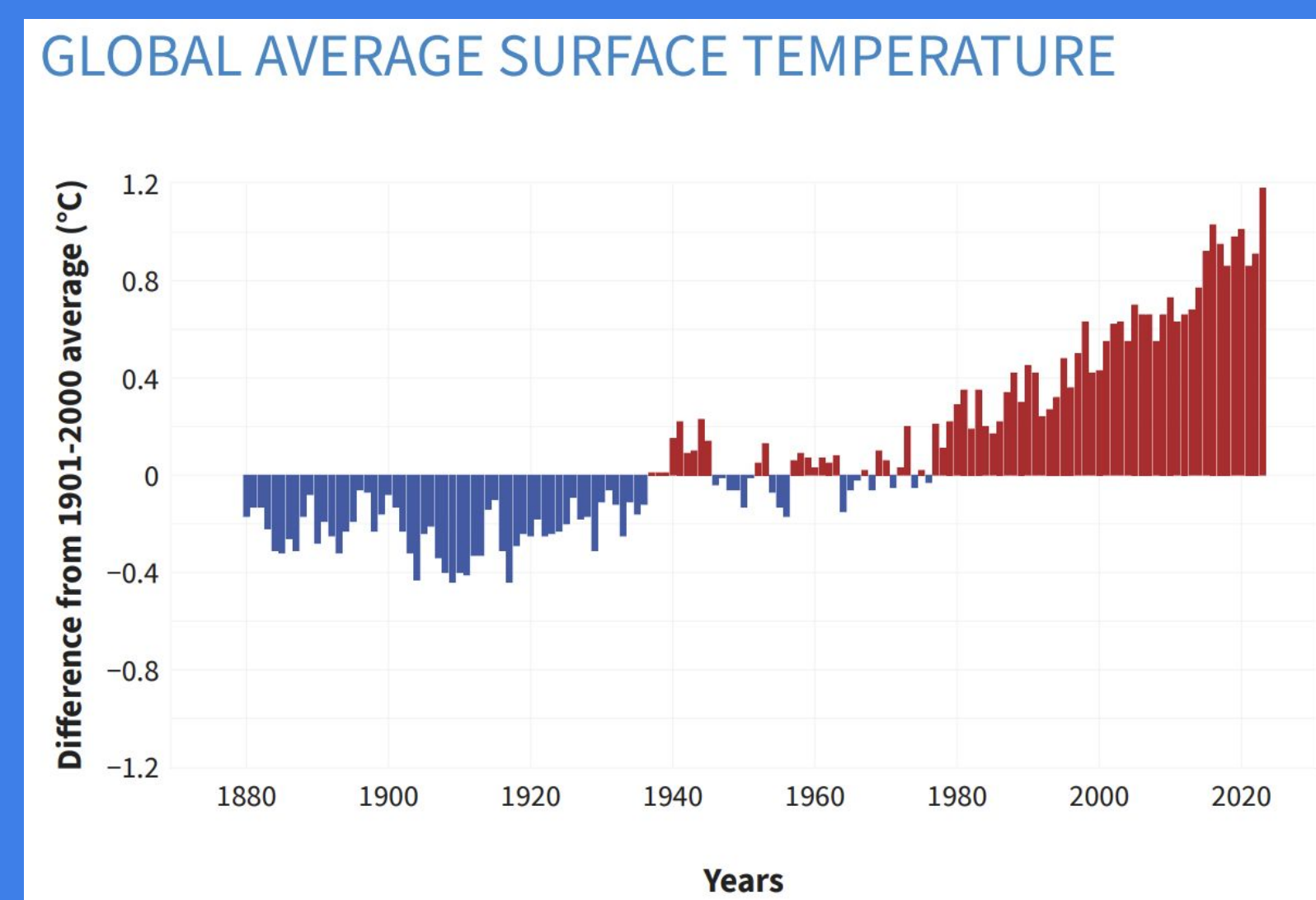
Data from the highest and lowest snowfall accumulations over the past 30 years and their climate conditions.

Results/Conclusions

It seems a big winter awaits! NOAA has put out an advisory for this upcoming winter to be La Niña but transition towards ENSO-neutral most likely in January-March 2026 (61% chance). This point in the cycle results in a very active storm pattern, because the shift from southern La Niña jetstream towards northern El Niño jetstream puts NY right on the path of very cold air and an increased number of storms. While storm track is important, keeping cool air in place for long periods is what really leads to snow and is determined further by strong negative NAO of which we are currently experiencing and NOAA currently has a 7 day forecast with a mean average of -0.2625 Mbp.

Intro/Hypothesis

As New Yorkers the one thing we've all noticed is the decreased snowfall in winters past. But, what factors have contributed to the loss of those magical winters, and are they gone forever or will there be a chance the city's covered by this Christmas? Climate change and rising global temperatures have played large factors in snowfall and provide reason to believe NYC's 'snow-season' will shrink. While the thought of less frigid winter months may sound enticing, the larger consideration is that the many storms that typically would have brought snow are becoming too warm, and producing rain instead.

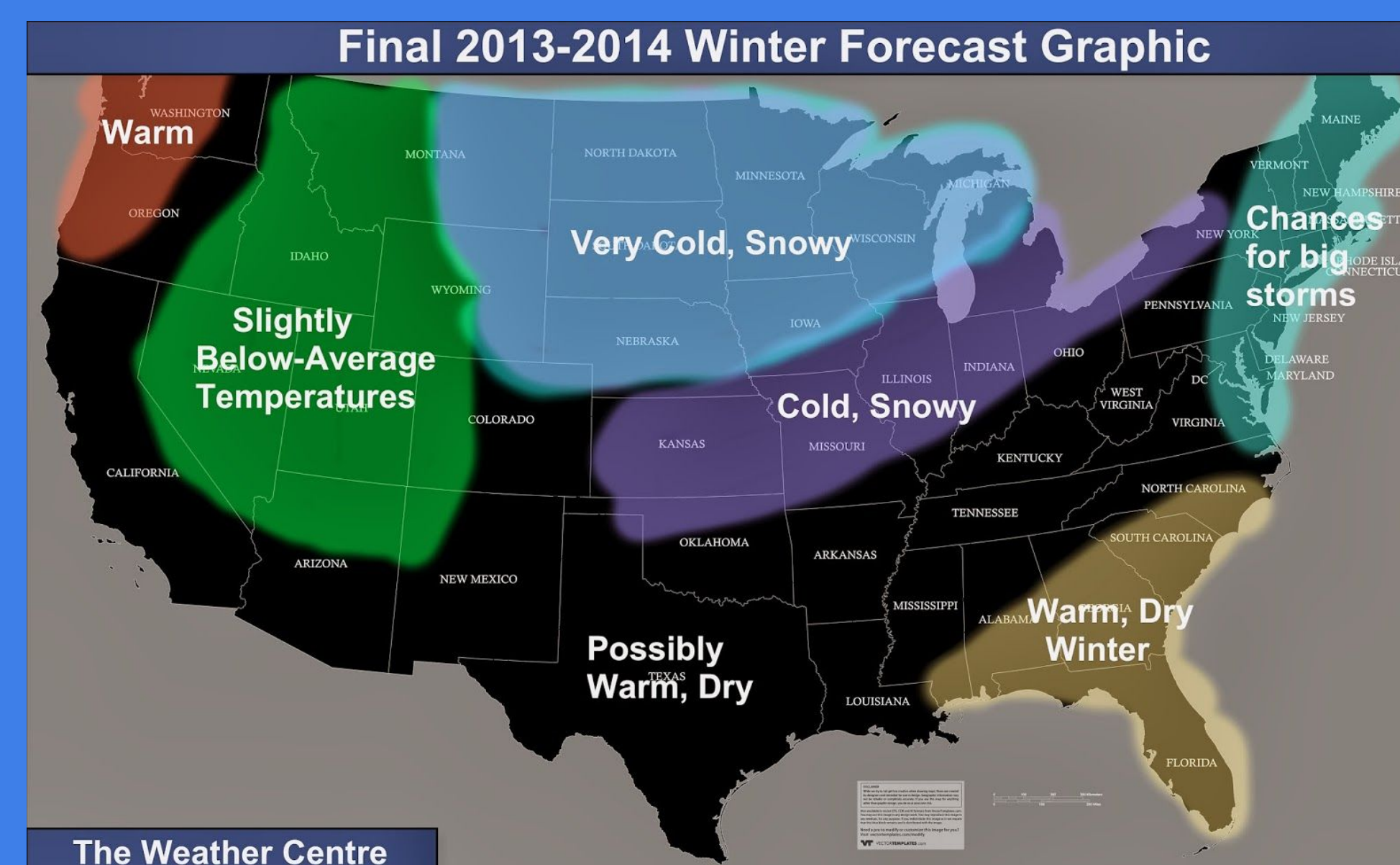


Global surface temperatures have been on the rise over the past 50 years. Higher than average temperatures are not prime conditions for snowfall.

It should be noted that global temperatures play an important role, but other factors such as climate patterns are arguably more significant in annual snowfall predictions. One of the most studied, the El Niño-Southern Oscillation (ENSO) cycle, describes a recurring climate pattern that involves the periodic warming and cooling of the central and eastern tropical Pacific Ocean surface waters. When mixed with negative conditions of North Atlantic Oscillation (NAO), which compares the relative strength of semi-permanent high and low pressure patterns in the North Atlantic Ocean, stronger cold-air outbreaks and increased storminess in the eastern U.S are what result.

We believe, in accordance to our research, that this upcoming winter will exhibit a very high snowfall total due to our current point in the ENSO cycle, NAO average, and comparisons to past winters with similar conditions.

Final 2013-2014 Winter Forecast Graphic

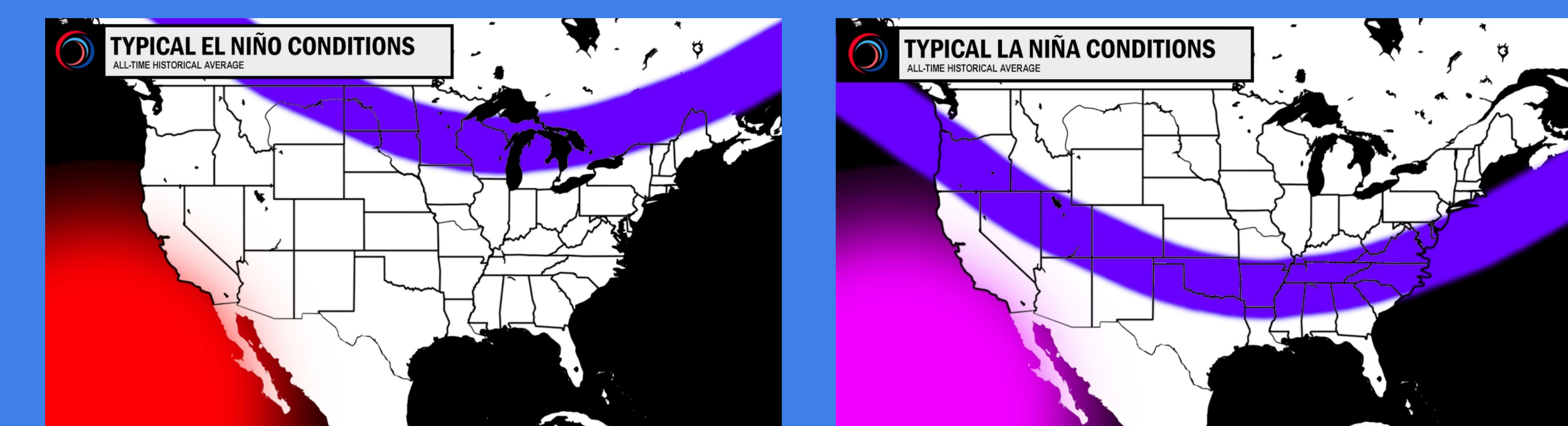


Winter forecasts for the 2013/2014 season were ENSO neutral conditions resulting in neither Niño nor Niña being dominant and unpredictable winter conditions with typically higher than average snowfall.

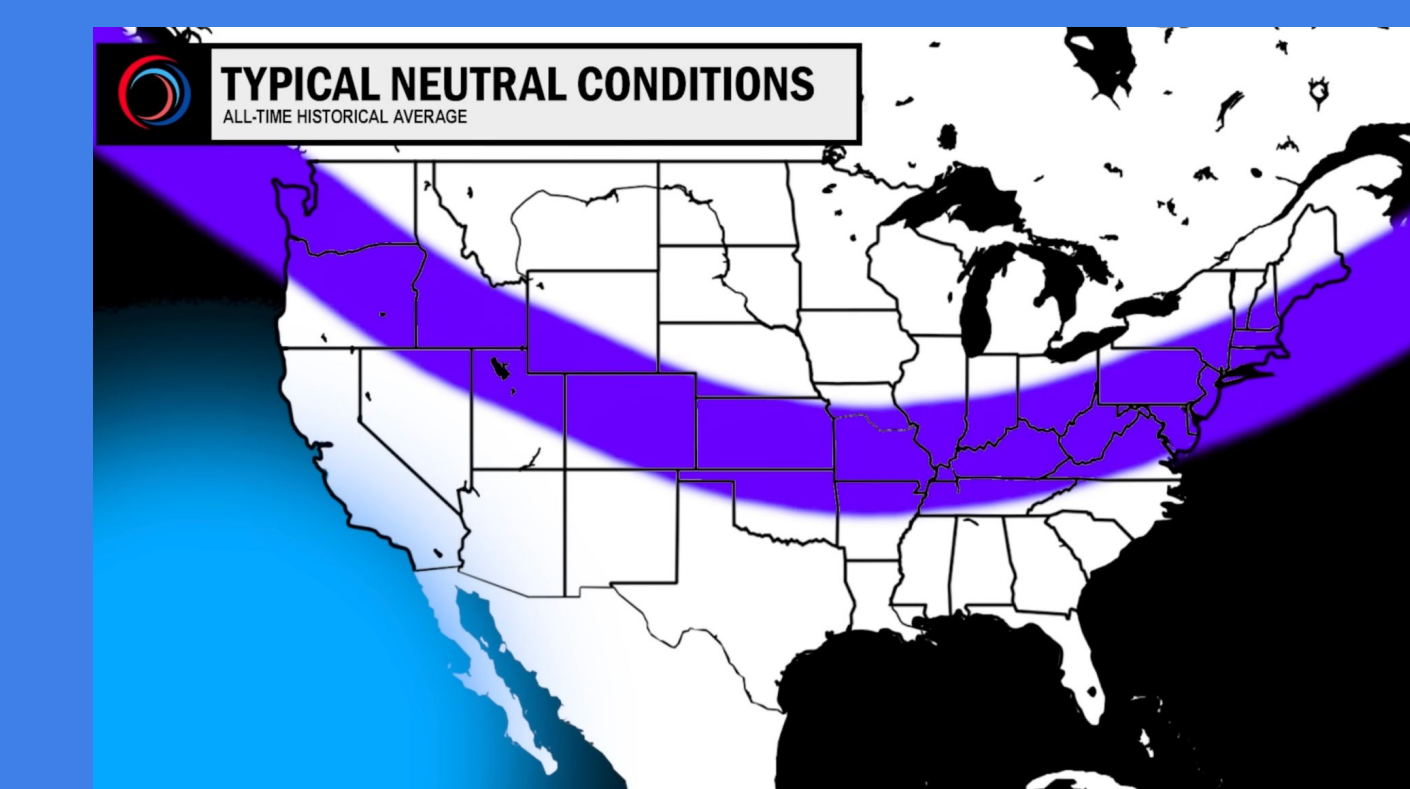
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NYC Hazard Mitigation Plan. "Winter Weather — Hazard Profiles." NYCHazardMitigation.com



Warm temp pushes jet stream upward vs cold trump bringing jet stream down



Neutral temp results in central jetstream aimed towards NYC

Limitations/Future studies

While our hypothesis points towards a heavy winter snowfall there are still many constantly changing variables that make weather predictions extremely difficult and could lead to differing results. Even with storm tracks headed in our direction via the Pacific Jet Stream this doesn't infer a definitive number or size to said storms. The ENSO cycle could proceed at a slower rate leading to less dramatic events and shifts in weather patterns. The NAO could lean further towards a positive average resulting in a faster, more northern jet stream that keeps cold air locked in the Arctic.

In order to be able to more precisely identify possibilities of snow accumulation for any given winter, individual storm systems must be more closely observed. This close storm watch in conjunction with constant re-analysis of NAO and ENSO climate factors would give the most up to date forecasts. In our research we considered broader effects on snowfall that we could observe and quantify in recent history to compare to this season's conditions, so, many things are still subject to change on a day-to-day level. Regardless, the evidence we've collected makes a strong argument for a chilly next few months so bundle up!