NEW YORK METRO WEATHER

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Winter Forecast 2015-2016

Primary Methodologies and Variables of Examination

- El Nino Southern Oscillation (ENSO)
- Arctic Oscillation (AO)
- East Pacific Oscillation (EPO)
- Pacific Decadal Oscillation (PDO)
- North Atlantic Oscillation (NAO)
- Siberian/Eurasian Snow cover and Stratospheric Warming
- Pacific Decadal Oscillation (PDO)
- Sea Surface Temperature Anomalies (SSTA)

Explanation of Variables

Over the past several months, our forecasters have monitored the above variables (plus others) and the trends in their behavior. We will be utilizing the above variables and indices, as well as their abbreviations, throughout the winter forecast. These variables reflect the atmospheric circulation patterns for certain geographical areas. For example, the AO refers to patterns within the Arctic Circle. The NAO refers to pattern characteristics in the North Atlantic, the PNA in the western part of North America, the PDO in the Pacific Ocean, and the EPO in the Northern and Eastern Pacific Ocean.

Typically, negative AO, NAO and EPO values correlate to enhanced high latitude blocking and high pressure to our north while lower pressure areas and troughs usually form underneath that high latitude ridging in the middle latitudes. In contrast, positive AO, NAO and EPO values generally yield lower pressure and less blocking to our north, while higher pressure and more ridging tends to build into the middle latitudes. There are exceptions to the rule, but generally the negative state of the above listed indices yields colder, more snowy weather in our area during the winter months.

Seasonal Forecasting Brief

Seasonal forecasting is one of the most misunderstood aspects of meteorology. Not only is it a difficult task for the meteorologists themselves, but it is often difficult for readers and public viewers to understand the nature of the forecast. The root of the problem lies in the fact that seasonal forecasting is based on many different methods -- all of which have tremendous variability and low percentage verification. Seasonal forecasting begins with an analysis of current conditions and atmospheric circulations, similar to any daily forecast. Beyond this point, forecasters use variables such as sea surface temperature anomalies, analogs, and comparative methodology.

Some forecasters have detailed the mentality very well when they have stated that long term forecasting is very much about "What can go wrong" as opposed to "How will my forecast be correct". Our job as meteorologists is to detail the aspects that have formed the foundation for our forecast, express our concerns and confidence in all aspects, and deliver the ideas which we have formulated as a result of our research and work in attempting to understand the patterns evolution over the next several months.

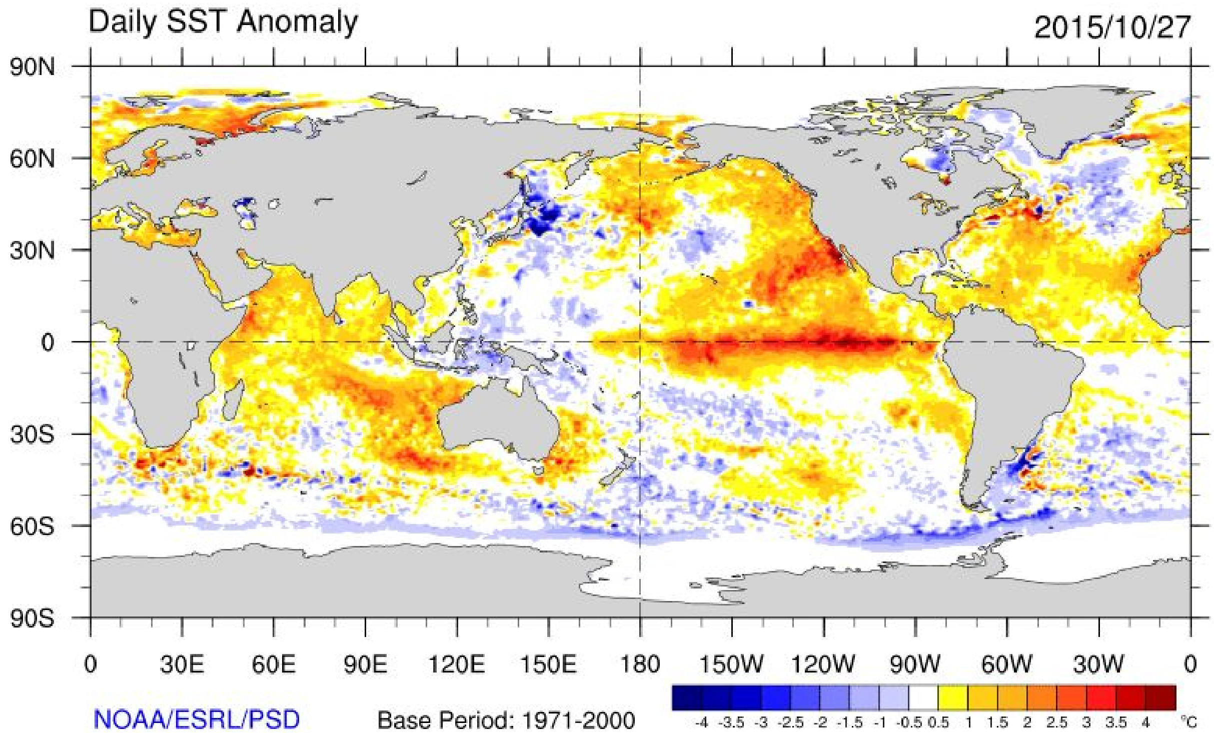
We will begin by highlighting several variables which we have researched. Each variable will be listed with a conclusion and prediction on its state during the winter, as well as the methodology and reasoning behind that forecast.

El Nino Southern Oscillation (ENSO)

Prediction: High likelihood Strong El Nino, uncertain winter trend

Much has been made over the past several months in regard to the Strong El Nino, which has developed in the tropical Pacific. Some forecasts even went far enough to call for a record breaking "super El-Nino", or the strongest ever, which to this point has not yet occurred. Still, the global sea surface temperature configuration presents a few very notable areas.

First, and most obvious, is the area of much above normal temperature anomalies in the tropical Pacific. This is, by numbers and definition, a "Strong" El Nino. The Multivariate Enso Index, or MEI, has indicated El Nino conditions since the month of March 2015. In addition to strengthening over the summer, the MEI numbers show a peak in September of 2015 with a value of 2.5. This is the second highest MEI Value for the month of September on record.

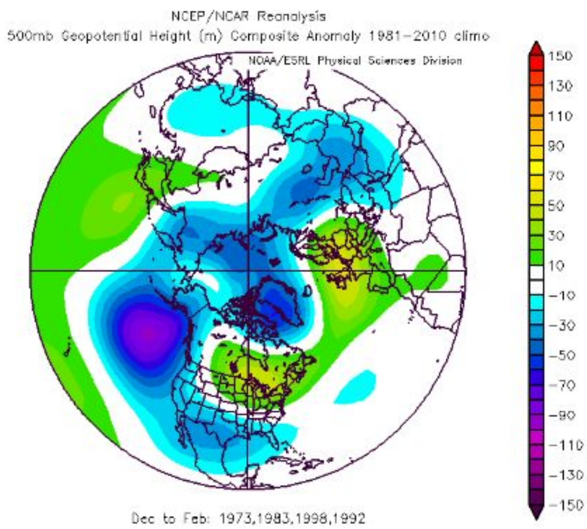


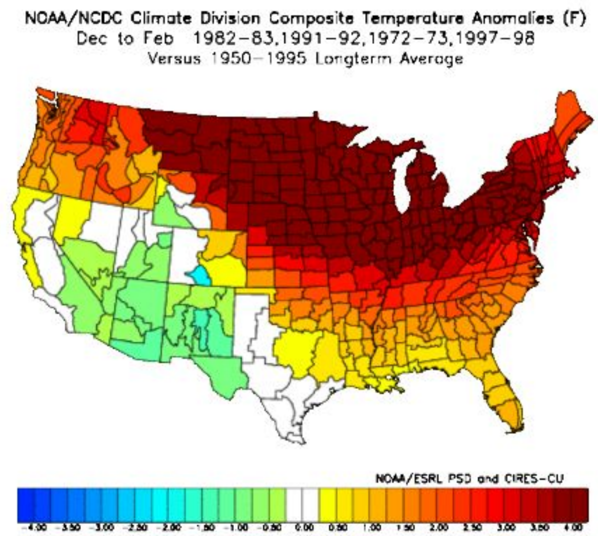
The location of the warmest waters within the tropical Pacific is also a point of significant interest for long range forecasts. Classically, Western-based El Ninos and Eastern-based El Ninos produce wildly different patterns across the globe, and particularly across North America. A western "based" El Nino is signified by the warmest Sea Surface Temperature anomalies being located near the dateline, while an eastern based El Nino is the opposite -- with the warmest Sea Surface Temperature anomalies to the East of the dateline and nearer to South America.

The current El Nino, while still a fluid situation with changing temperature anomalies across the Tropical Pacific, features the warmest relative temperature anomalies in the Central El Nino region -- and slightly east of the Dateline as well. This particular El Nino, currently, does not necessarily fall into a West or East based El Nino definition.

Commonalities among Strong El Ninos

While each El Nino event has been different, as aforementioned, there are commonalities that develop among these events with the general global circulations and resulting surface conditions.



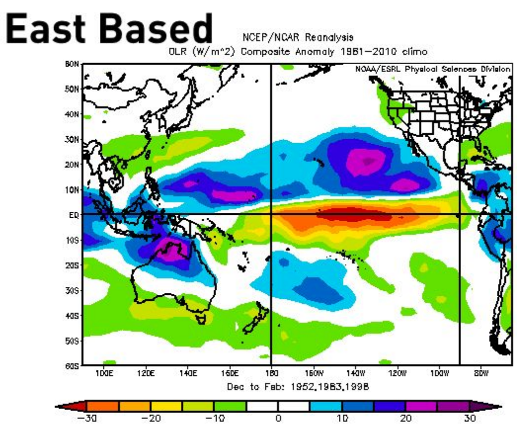


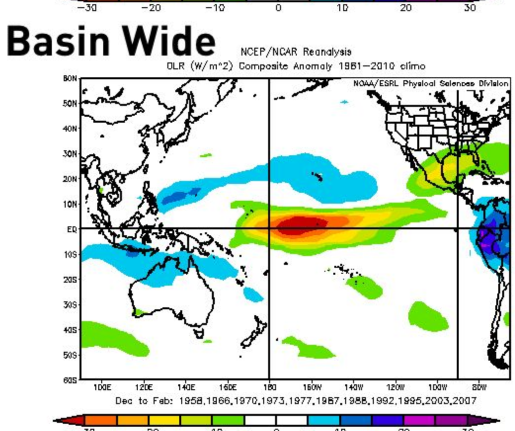
The global pattern during strong El Ninos in winter, as seen on the left side of the above image, features several notable features. First, a large trough of lower pressure in the Gulf of Alaska, with lower than normal heights extending southeastward toward the Southwestern United States. This promotes the advection of mild, Pacific air into the Continental United States. Above normal heights develop over Southeast Canada and New England. Not surprisingly, against the 1950-1995 long term temperature average, the winter composite temperature anomalies during Strong El Nino events is almost 3 full degrees above average throughout the North/Eastern ⅓ of the US.

That being said, while these Strong El Nino analogs are useful and necessary for long range forecasting, the current El Nino event varies significantly both with its spatial extent across the Tropical Pacific, and the surrounding patterns in both the Pacific and Atlantic.

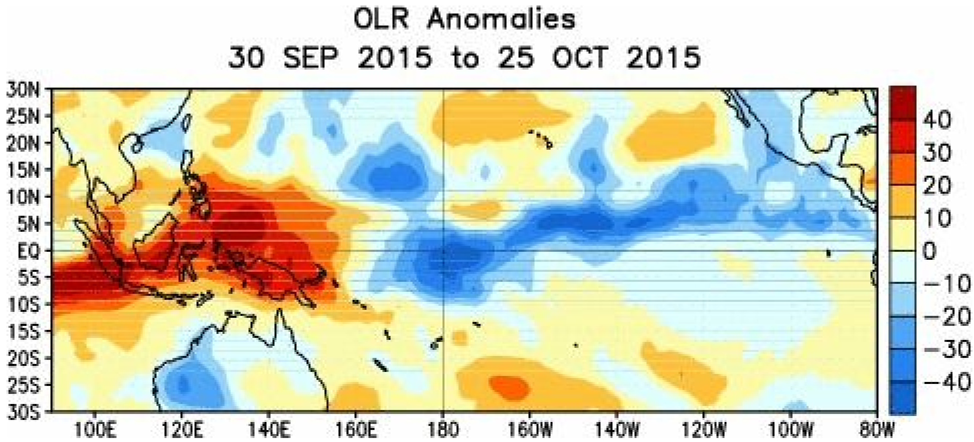
Of particularly interesting El Nino debate is that of a “Modoki” El Nino. A Modoki El Nino, features a central based warm anomaly with negative anomalies on the western and eastern sides of the Tropical Pacific. Historically, Modoki El Nino’s have been precursors to some prolific winters -- not all, but some. That being said, the current El Nino does not match the Modoki composite. Nevertheless, cooling of ENSO region 1.2 could allow this El Nino to be more favorable for cold and snow than other strong El Ninos, but we are not expecting this to align like a Modoki anytime soon.

One of the most important aspects of El Ninos is the location of tropical forcing. In the tropics, particularly warm water enhances lift and generates convection, which can majorly alter the orientation of troughs and ridges. In Strong El Ninos, there is a lot of tropical convection, since there is more warm water than usual. In east-based El Ninos, a lot of this convection is spread out and oriented to the east, and in basin-wide El Ninos, this convection is centered further west, closer to the Dateline. (Image below courtesy of OH Weather/americanwx forums)



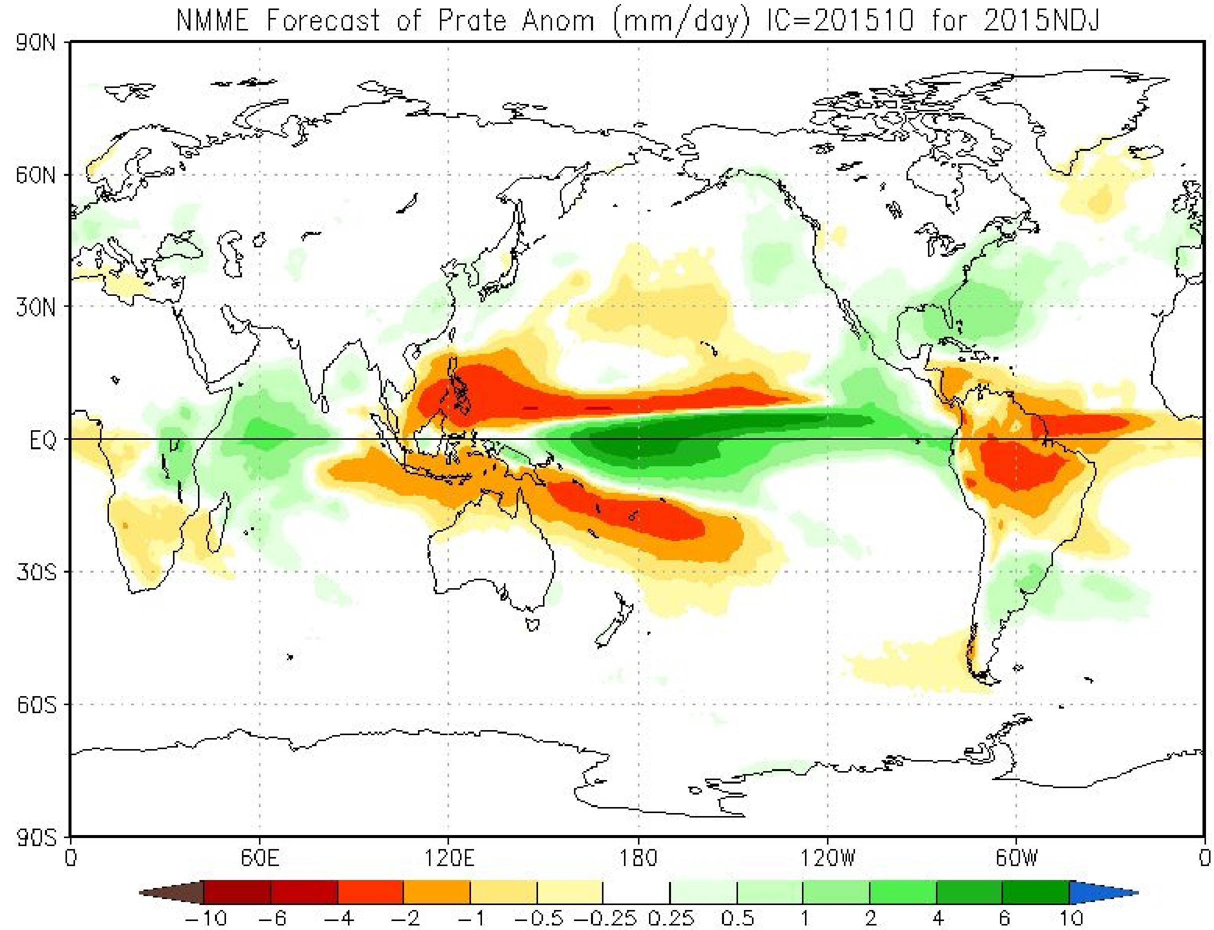


Despite the fact that this is a basin-wide El Nino, it is so strong in strength that it may exhibit behavior similar to east-based Ninos. Let's take a look at how the convection has been behaving thus far:

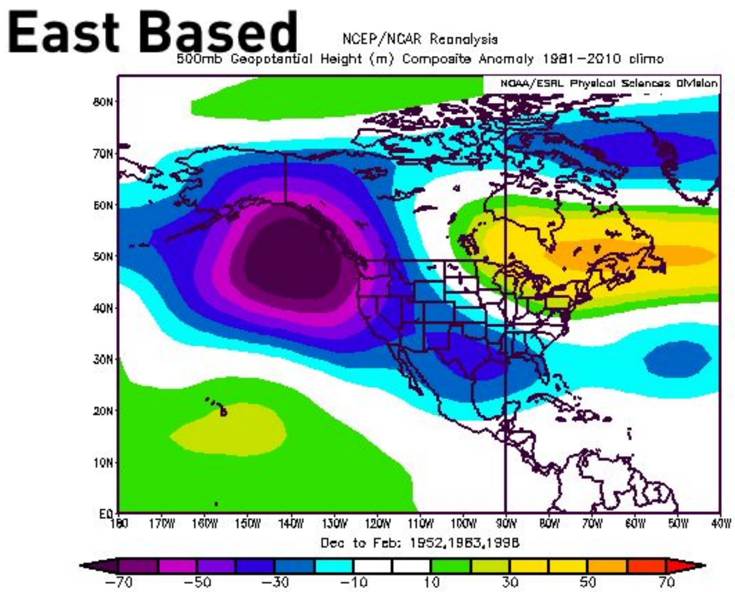


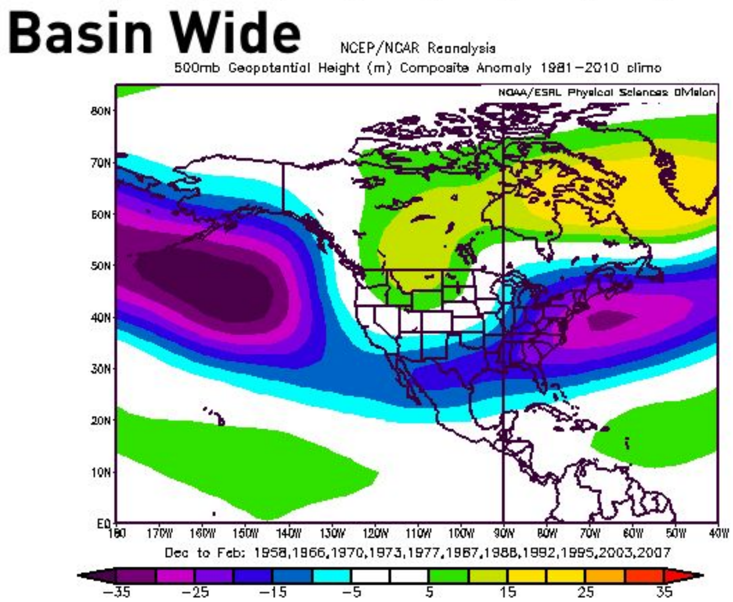
OLR is outgoing longwave radiation, and the more clouds and convection there is, the lower the OLR, since clouds and convection will block the radiation from escaping back into space. Thus, negative OLR is a good indicator of where the convection and tropical forcing is. As we can see, the forcing has been behaving kind somewhat like a hybrid of the east-based and basin-wide events, with a core of convection centered near the Dateline, but also elongated convection stretching further east. If we use a different metric for convection, such as divergence aloft (the deepest convection creates lift which then diverges near the top of the Troposphere), it also shows deep convection elongated eastward along the El Nino regions. This means that although this El Nino is a basin-wide event, it is exhibiting some behaviors of an east-based event.

It will be important to see where this forcing tracks as the winter progresses. One of our more reliable pieces of forecast guidance displays this forcing by using mm of precip per day, as convection tends to lead to a heavier rate of rainfall.



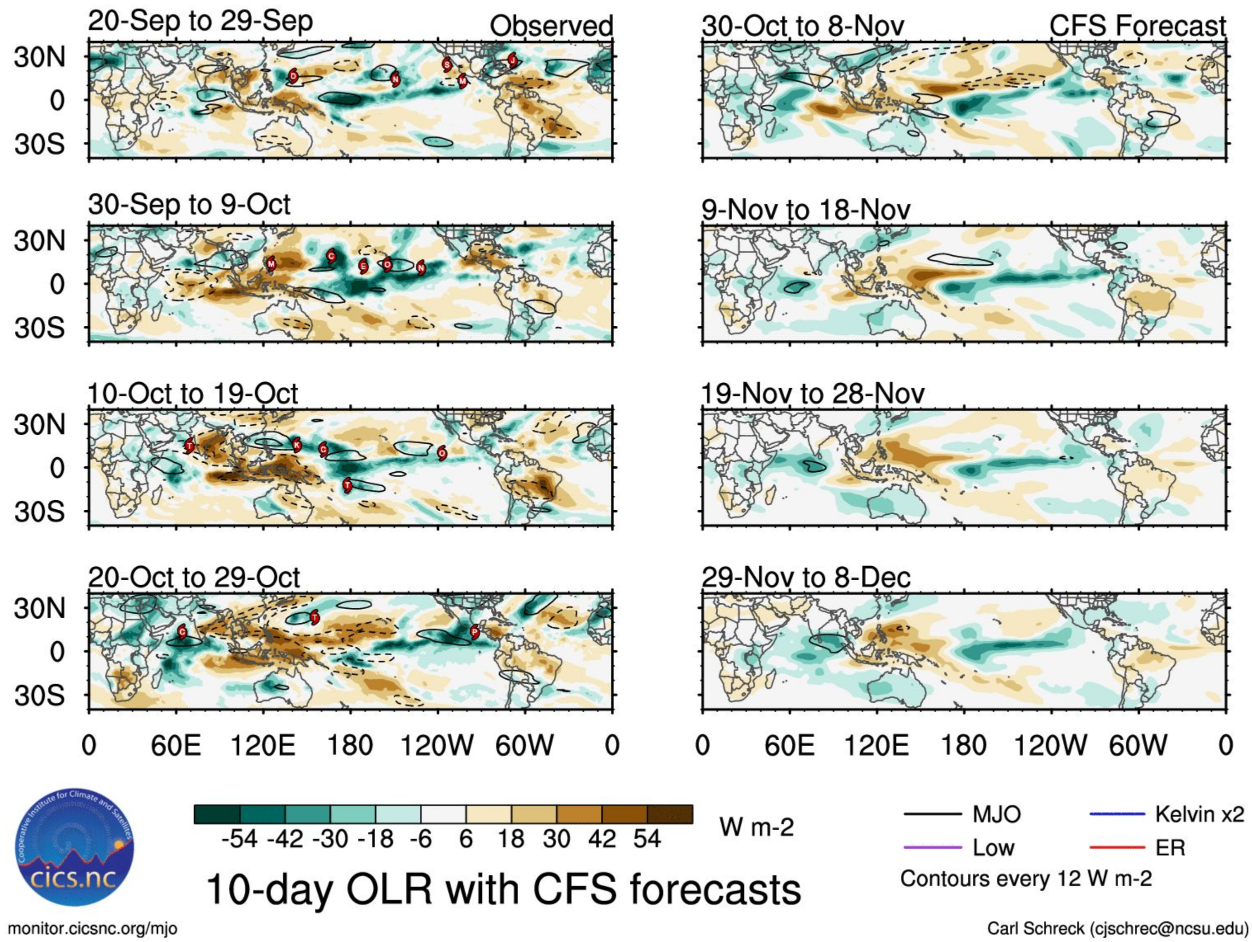
This model shows more forcing centered around the Dateline, which is typical for basin-wide events, though it still does show some elongation, similar to the east-based events. That being said, this projection is more similar to the basin-wide events than the east-based events. The following 500mb patterns result from these types of El Ninos: (Image below also courtesy of OH Weather on Americanwx -- might need to get his name)





The basin-wide events keep the Gulf of Alaska low further southwest, which prevents Pacific air from overwhelming the pattern. It also creates more ridging in the West, more ridging near Greenland, and thus a trough in the East; an overall favorable look for cold and snow. The east-based events cut off any source of cold air.

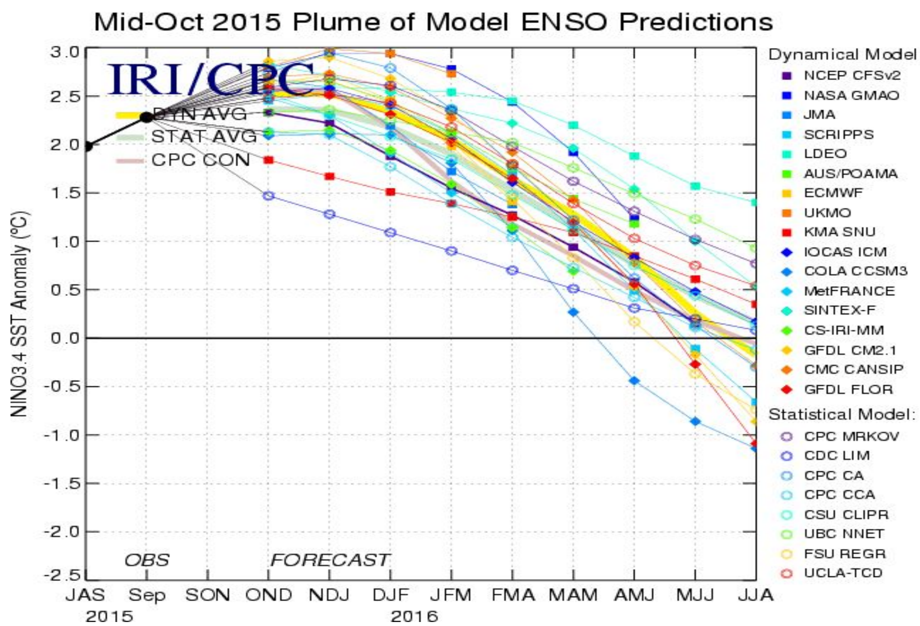
Near-term projections of the forcing indicate an east-based regime through early December:



This gives further credence to the fact that December will be a very warm month in the East. Considering the forecast for the forcing does take it further west towards the Dateline in the long range, that means we could have basin-wide forcing for the second half of the winter, meaning January is a transition month from above average temperatures to below average temperatures as the forcing sets up closer to the Dateline, and February would be cold and snowy.

The exact behavior of the El Nino's peak intensity is also extremely important. Of the 5 strongest El Ninos, each has had a "double peak" of intensity, where warm temperature anomalies maximize, plateau, and then maximize again before weakening. The strong El Nino's which featured warm/generally snowless winters in the Northeast US both featured "double peaks" from the late Autumn into the early to mid Winter months, with the El Nino remaining within the threshold of "Strong" by definition through the month of January.

An initial or secondary peak of a very strong El Nino in the winter months makes establishing a colder or snowier than normal pattern across the Eastern United States very difficult. It is unclear whether an initial peak has already occurred, or if a secondary peak will occur shortly, but most short to medium range ENSO forecast models now show a slow cooling trend in the Tropical Pacific through the winter months. **Exactly when this occurs will be of critical importance.** (Graphic below shows ENSO forecasts through the next several months).



Adding credence to the idea of slow weakening is the location of tropical forcing. The stronger El Nino events of 1982-1983 and 1997-1998, while not necessarily holding many common characteristics, both featured mid-winter anomaly peaks. These were both sustained by East-based temperature anomalies (not present this year). The East Based temperature anomalies makes El Nino conditions more sustainable -- the East Based forcing is a byproduct of a stronger El Nino equilibrium being established against the stronger trade winds.

Mid to late winter temperature composites among El Ninos that weakened to near

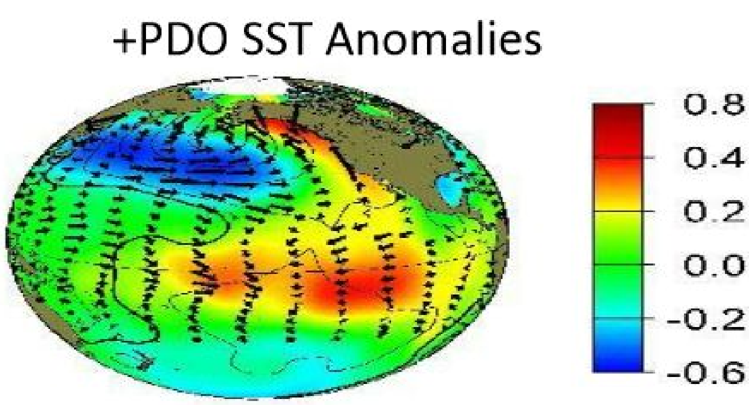
Moderate levels during the winter months (prior to roughly mid January) feature a colder, snowier second half of winter in much of the Eastern United States.

Confidence in the forecast for El Nino conditions moving forward is quite low. However, the impacts of when (and where) the El Nino forcing and sea surface temperature anomalies peak will be tremendous on global circulations. Monitoring conditions over the next several weeks will prove critical to increasing confidence toward either a slower progression of a pattern change (and warmer winter) -- or a faster progression, with a weakening El Nino, and a colder second half of the winter months in the Northeast US.

Pacific Decadal Oscillation (PDO)

Prediction: Positive

One consistent feature over the past two winters was an area of anomalously warm water in the Northeast Pacific, hugging the west coast of North America, with cooler anomalies extending west from the Central Gulf of Alaska. These warmer anomalies, as mentioned above, often hug the Western Coast of the United states from California northward to parts of Southwestern Canada. This is a textbook +PDO composite.



This has aided/juxtaposed with an -EPO ridge moving poleward, which helped to dislodge extremely cold air into the United States. At a basic meteorological level, warmer SST's mean more lift, which expands the vertical column of air, increasing geopotential heights and causing more ridging. This is the very basic meteorology behind what seems to be a correlation between the Northeast Pacific warm water anomaly and the pattern we have seen.

Historic composites for a +PDO which is sustained over multiple years with values over 1 (this +PDO has been sustained since September of 2014) show a Gulf of Alaska low pressure system -- farther west , south of the Aleutian Islands -- with ridging from the West Coast of the United States into Western Canada and the higher latitudes, poleward. These composites match the general -EPO pattern we have experienced in the past few years which, at times, has dislodged arctic air further south into the CONUS.

Confidence is high that the PDO will average strongly positive throughout this winter, promoting the occasional development of West Coast USA/Canada ridge and high latitude ridging into the poles.

East Pacific Oscillation (EPO)

Prediction: Volatile, averaging slightly positive in the means, negative later in the winter

One of the main reasons why the past two winters were so cold was due to a large amount of -EPO ridging, which stretched from the Northeast Pacific all the way up the Poles, and dislodged Arctic air into the United States. The general idea was that a pool of abnormally warm water in the Northeast Pacific helped to promote ridging along the West Coast into British Columbia. However, this general form of thinking may not be the only reason why that ridging developed.

The SSTA to atmospheric correlations are much more sound in the tropics, where there is much more heat and convection, and thus more latent heat release in the atmosphere to truly alter the ridging and troughing orientation. This is why El Nino is so important -- it is a tropics-based index and thus has a strong impact on weather patterns upstream and downstream. This is also why perhaps the SSTs in the the North Pacific are overrated, because even if they are warmer than average, they are still cold, and simply being anomalously warm (or slightly less cold) is not going to induce convection to consistently cause a ridge in the Northeast Pacific.

This implies that there is not necessarily a correlation between the Northeast Pacific SSTs and the -EPO pattern that we have seen, and it may not be that important of a factor this winter.

That doesn't mean that these SSTs don't matter at all. Oftentimes, warmer SSTs can still help to sustain or accelerate a feedback process that had already been started in the tropics, even if it did not drive the bus to start the process in the first place. In the winter of 1972-1973, we had a strong El Nino, but an overall chilly Pacific, and the El Nino forcing was halted. It's hard to believe that's merely a coincidence, and seems to prove that the SSTs mean something.

The "cause/effect" debate comes into focus at this point, when considering all of the factors, and it seems that the ridging may be more of an effect of the surrounding environment. Ridging in an area favors warmer SSTs, but also helps to sustain and accelerate feedback processes. With this in mind, it becomes important to weight the El Nino's tendency to eat away at these warm pools -- as well as the fact that the one this year remains very much in tact.

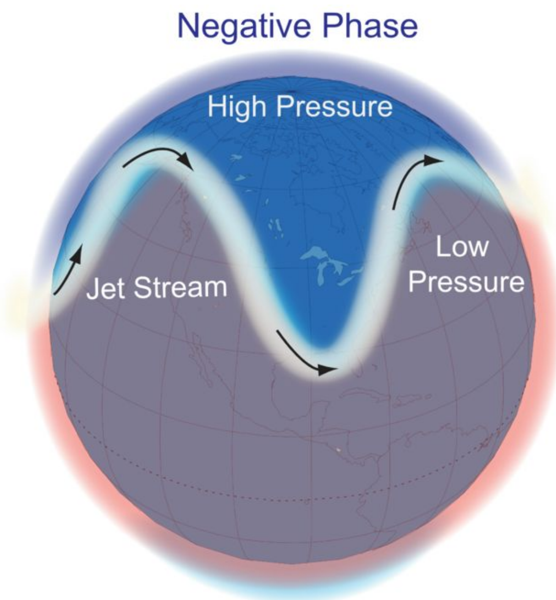
With a bit of a pendulum swing occurring, as multiple atmospheric processes fight for "control" of the pattern, it appears likely that the EPO will be quite volatile this winter. The general idea is that a positive start to the EPO modality is likely in December -- with more volatile conditions by January and February. Similar to other indices, and owing to the location and intensity of tropical forcing, we are expecting the EPO to take on a more consistently negative modality by the end of January and February.

While the effects of the EPO are well documented, it remains to be seen how strongly it will fluctuate in either direction. The strength of the EPO on either side of its fluctuations will obviously have major impacts on exactly how much it affects the weather in North America. Monitoring the state of SSTA's and the overall progression of the EPO through November and early December will prove critical in determining how and when it will affect our weather.

Arctic Oscillation (AO)

Prediction: Positive, trending negative through the winter

The state of the Arctic Oscillation has again been a major talking point amongst forecasters and meteorologists alike during the Summer and Autumn months this year. Dissimilar to last year, AO forecasts are much more uncertain this year. Despite the strong El Nino in place, the Arctic Oscillation may be a significant factor in this winter's temperature behavior. The negative phase of the AO features a global mid and upper level atmospheric pattern that is very conducive to not only cold air, but snow, in our area of the world:



July of 2015 featured the second most negative Arctic Oscillation on record, second only to 2009, with a number of -1.108. Research of data from the top 15 most negative AO July's on record reveal a strong correlation between a negative AO in July and a negative AO modality in the following winter. In fact, 14 of those 15 most negative AO July's featured a negative AO modality in the winter that followed.

The graph below shows the AO modality in July, the numbered data of the AO Value on the left, and the same data for the average DJF (winter) period following that July.

Year	**July AO**	**Following DJF AO**
2009	-1.356	-3.422
2015	-1.108	----
1962	-0.927	-0.914
1968	-0.836	-2.288
1950	-0.802	-0.804
1958	-0.684	-0.385
2000	-0.649	-1.312
1957	-0.646	-0.946
1980	-0.622	-0.168

1960	-0.619	-0.409
1978	-0.604	-1.303
1971	-0.578	0.265
1972	-0.553	1.08
1993	-0.511	-0.418
1965	-0.510	-1.502
1977	-0.492	-1.2

While the July → DJF AO correlation isn't perfect, the 15 most negative AO July correlation is quite remarkable, as pictured (And colored) above.

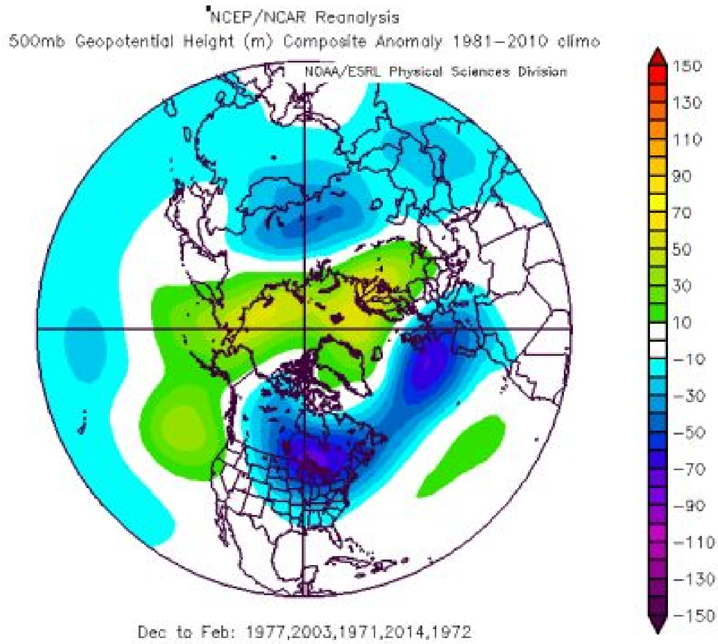
Siberian/Eurasian Snow Cover

In addition to the many discussed changes, the global mid level circulation pattern has brought the return of above average Siberian/Eurasian snow cover. Negative height anomalies present in Eurasia have driven snow cover numbers upward to above average levels, with snow cover extending southward of typical regions for this time of year. While the snow cover number is not yet as impressive as last year -- it is trending upward each day and, most notably, medium range forecast models show a pattern conducive for a continued increase in snow cover to above normal levels through November.

The byproducts of this snow cover can be best described as "innumerable". Above normal snow cover in the discussed area -- with the present upper level height pattern -- has preceded many -AO winters in the past.

The research regarding Eurasian snow cover in October and preceding a -AO winter was developed by Judah Cohen. He notes that both snow cover extent (SCE) and snow advance (SAI -- 'I' for Index) strongly correlate to a -AO winter. What's important to note is that the SAI is actually a stronger predictor on its own than the SCE.

The following composite chart shows the 500mb geopotential height anomalies averaged for the 5 winters of highest preceding October Eurasian snow cover. Notably, extremely cold air makes its movement into Southern Canada and much of the Northern ⅓ of the United States while ridging builds in the high latitudes.



The composite chart for the 5 lowest Siberian/Eurasian October snow cover years show a nearly opposite pattern in the following DJF months, with troughing over the higher latitudes and higher than normal heights over North America.

Over the next few weeks, monitoring the progression of Eurasian snow cover will be critical, as will the final numbers for October. The Eurasian snow cover preceding the winter of 2014-2015 notably jumped out to historic levels but then dropped rapidly into November. The behavior of these trends through November are critically important.

Another interesting tidbit about last winter was that this correlation did not work so well. One of the reasons may have been because of the drop in November, but another reason is because there are a lot of variables to consider after the enhanced heat flux from the snow cover. There are other things that need to happen in order to finish the connection between snow cover and a -AO and -NAO, which is often triggered by features other than the snow cover itself. This is why forecasting the AO and NAO can be so challenging. That being said, the El Nino progression can at least somewhat help support the AO trending negative as the winter goes on, and the snow cover can still play a role.

So, we expect significant variability within the AO over the next month or two. We anticipate that the AO will begin in a positive modality through November and possibly much of December. We then anticipate a drop toward a negative modality in January, February in March, with a negative AO on average for the winter. The AO may drop quite low at times particularly in February, bringing the potential for colder than normal patterns in the Northeast United States.

North Atlantic Oscillation (NAO)

Prediction: Positive, trending negative mid to late winter

The North Atlantic Oscillation, or NAO, is one of the more well known indexes for predicting colder and snowier patterns in the Northeast United States. Most notably, its negative phase generally entails higher than normal heights from the Northwest Atlantic, into Greenland, and extending into North-Central Canada and the poles.

The positive phase of the NAO, on the contrary, features lower than normal heights over the Northwest Atlantic into Greenland and North Central Canada. Historically, a positive NAO features warmer and less snowy conditions across the Northeast US, while a negative NAO features colder and snowier conditions (on a very basic meteorological level).

Extensive research conducted by Al Marino suggests a strengthening correlation between North Pacific Sea Level Pressure numbers in October and the NAO modality in the following winter. In El Nino years, this correlation seems to be strengthened and may be a tip-off to the location of tropical forcing and the effects it has on global circulations.

NP SLP --> NAO Indicator during +ENSO Winters

Year	OCT NP SLP	DJFM NAO
2009	1011.60	-1.93
1963	1012.91	-1.80
1968	1011.06	-1.78
1976	1012.91	-1.39
1957	1011.62	-1.31
1969	1010.92	-0.94
1977	1012.11	-0.84
1965	1012.45	-0.80
1986	1011.78	-0.64
1951	1012.44	-0.41
1953	1011.09	-0.37
2002	1010.98	-0.27

Sea Level Pressure Threshold: +/= NAO > 1013 mb > -NAO

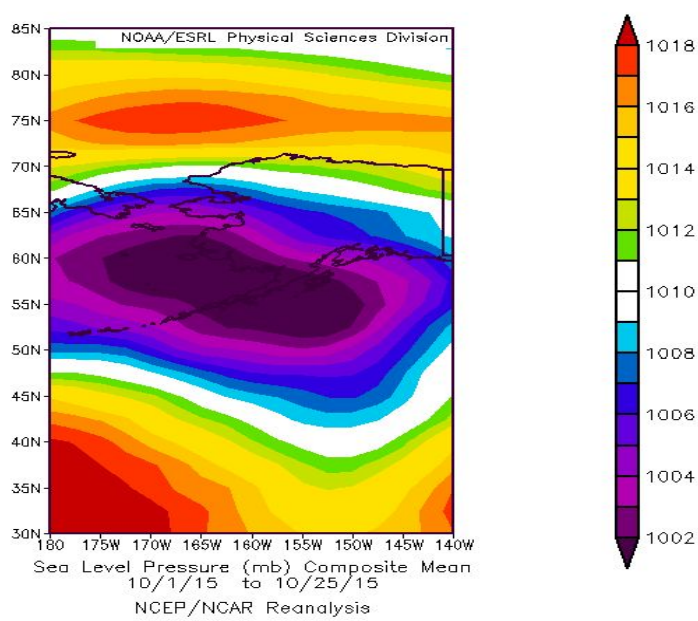
Uses older Oceanic Nino Index (1971-2000) base period, not rolling base periods (New ONI).

Year	OCT NP SLP	DJFM NAO
1997	1014.02	-0.27
2004	1013.21	-0.14
1972	1015.21	0.02
1987	1013.42	0.18
1991	1014.16	0.24
2006	1014.86	0.26
1982	1015.87	0.61
1994	1013.46	1.03

North Pacific Sea-Level Pressure is area-weighted between 65N-30N & 160E-140W

The correlation suggests that at a threshold of 1013mb average North Pacific Sea Level Pressure -- the NAO modality can be predicted with reasonable accuracy. Winters with North Pacific SLP values under 1013mb (left side of above image) feature a large amount of negative NAO modalities. The correlation seems to strengthen as the October North Pacific SLP numbers trend lower.

Conversely, October North Pacific SLP numbers over 1013mb feature a large amount of positive NAO modalities in the winters that follow.



While an official number is not yet available, it appears that the current October will end with North Pacific SLP numbers below 1013mb. The composite mean SLP from October 1st to October 25th, 2015 features numbers below 1010mb throughout much of the Northern Pacific.

An active mid level jet stream, with lower than normal atmospheric pressure, is expected to continue across the North Pacific over the next few days, leading to increased confidence that the number will finish below 1013mb for October 2015.

With a North Atlantic cold pool continuing this Autumn, the potential exists for an NAO to develop during this winter season. But its modality is not likely to be predominantly negative until the middle part of the winter, when the stratospheric pattern and global circulations begin to change -- as a result of westerly moving tropical forcing and the aforementioned global circulation changes that are anticipated. At this time, we favor a positive NAO modality to begin the winter from November into December. During the month of January, a gradually changing NAO (and AO) state is anticipated, with a negative modality developing through February.

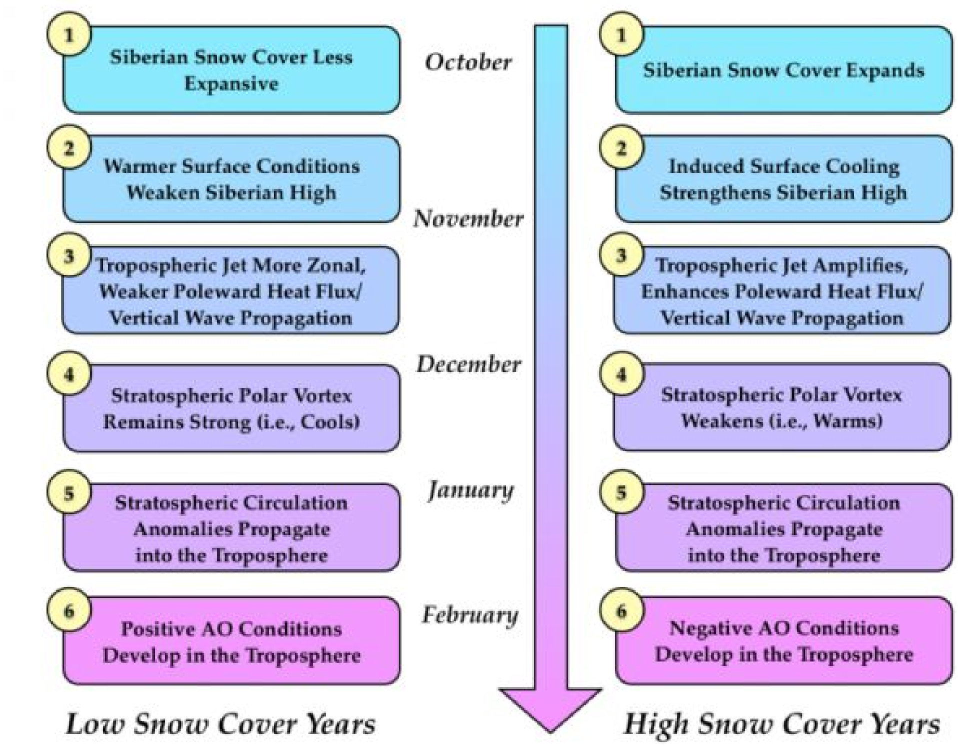
Stratospheric Warming Event

November monitoring

One of the factors behind the significance of Eurasian/Siberian snow cover in Autumn is the eventual evolution of a stratospheric warming event during the mid winter months.

Forecasting the stratosphere can be extremely fickle at times. But a major stratospheric warming event can often be the first signal of a pattern change, which could obviously produce varying weather conditions in our local area depending on where the stratospheric warming occurs.

Stratospheric warming disrupts, and sometimes splits the stratospheric polar vortex, resulting in widespread global circulation changes from the top of the stratosphere into the atmosphere.



Eurasian snow cover can help induce heat flux into the lower stratosphere during the late Autumn and early Winter months -- and above normal snow cover in Eurasia and Siberia has historically enhanced the chances of that occurring.

The above flowchart details the process -- which begins with above normal snow cover and ends with warming in the stratosphere that eventually has major impacts on the global pattern.

Quasi Biennial Oscillation (QBO)

Prediction: Consistently positive

The QBO is a quasi-periodic oscillation of the equatorial zonal winds between easterlies and westerlies in the tropical stratosphere. The mean period of the QBO is 12 to 25 months. In simpler terms, the QBO as measured is the mechanism to move warmer air in the stratosphere from the regions near the tropics to the regions nearer to the pole.

Extensive research on the state of the QBO and its relationship to high latitude blocking has raised the eyebrow of many meteorologists in the past 5-7 years. Essentially, research shows that QBO values of +10 or more, or -10 or more can provide clues as to whether or not high latitude blocking will develop in the forthcoming winter. Typically, a positive QBO tends to promote a deeper, more profound polar vortex through the stratosphere. Global circulations tend to keep this polar vortex circulation nearer to the poles. A negative QBO tends to support a more mobile polar vortex with an anomalous wave break pattern and the potential for pieces of this vortex to move farther south.

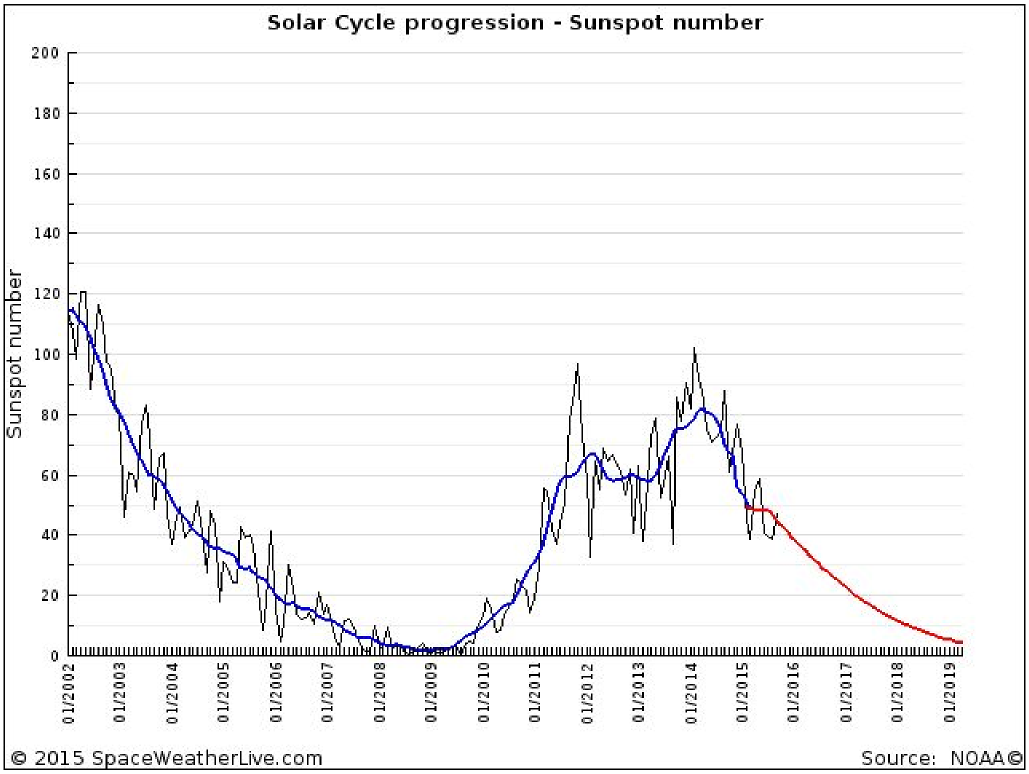
This winter, the QBO is very likely to average +10 or more -- as the QBO flipped during the late summer months and has been positive for several months now. The modality is likely to maintain positive through the winter months.

There have been five +QBO/Moderate or Strong El Nino events in the past. These are: 1957-1958, 1982-1983, 1987-1988, 2006-2007, and 1963-1964. One commonality among these winters was the presence of a Gulf of Alaska low in an unfavorable spot during the month of December, retrograding to a more typical +PDO position by January and February, with increasing high latitude blocking and a colder pattern over the Eastern US.

Solar Activity

Prediction: Trending lower off relative maximum

Solar activity and radio flux activity has long been linked to effects on the stratospheric polar vortex and general atmospheric pattern throughout the globe. On a very basic meteorological level, lower solar activity, or minimums, have been linked to a higher likelihood of high latitude blocking. Periods of higher solar activity have been linked to a tighter stratospheric vortex and less high latitude blocking. This, historically, is especially true when low solar activity periods are juxtaposed with a -QBO.



Both sunspot numbers and radio flux numbers are on a downward trend from a relative maximum over the past two years. The last solar minimum came in 2009-2010 (juxtaposed with -QBO, with a subsequent prolific high latitude block during the winter months), and current projections suggest that we will continue heading toward another solar minimum in a few years time.

While the effects of solar activity are not significantly weighted in the forecast, they are considered. As a whole, solar activity is not expected to impact the winter forecast very dramatically this year, without the presence of a relative maximum or relative minimum. But weaker solar activity and a less "stubborn" stratospheric vortex, along with the plethora of factors mentioned above, lends some credence to the idea that the second half of winter could feature a period of high latitude blocking.

This is further supported by recent research done by Anthony Masiello (@antmasiello on Twitter). Given the lack of a strong solar signal and some complications in the feedback effects of snow cover (it's important, yes, but how much does it really drive a -AO and -NAO?), forecasting the NAO and the potential for blocking is more complicated than usual. Thus, it's important to try and study other correlators, and what Anthony did portrays a realistic picture. A weakened polar vortex leads to more blocking, and a stronger one (climatology) leads to less blocking. The strength and position of a high pressure in Eastern Europe may correlate to the strength of the polar vortex. If the High is positioned in a certain spot, it may be able to halter the strength of the polar vortex, which may eventually allow the NAO to go negative sometime in January.

Summary, Variables and Uncertainties

The Winter of 2015-2016 features much more uncertainty and variability than last winter's forecast. Even today, there are a multitude of factors still developing, which will have significant impacts on the atmospheric evolution in the upcoming months. These intricate features, details, and pattern drivers are all still changing and developing each day -- leading to a low confidence forecast moving forward.

That being said, the general idea is that the winter will begin with a classic Strong El Nino atmospheric pattern. There is minimal support for high latitude atmospheric blocking through the months of November and December. With a trough developing in the Northeast Pacific, the pattern is expected to be generally warm and active throughout much of the United States.

During the middle of the winter, an accumulation and conglomeration of guidance suggests the global circulations will begin to change, with a retrogression of the Gulf of Alaska troughing, and introduction of high latitude blocking. This will promote the potential for an increasing amount of cold air shots, with the potential for snowfall increasing as the winter continues as well.

The most wintry month almost certainly looks to be February, when the development of high latitude blocking and a more favorable global pattern as a whole will promote the potential for colder than normal air. A continually active Subtropical Jet Stream will bring the potential for snowfall -- which could be prolific especially if this blocking does develop.

Uncertainties

- The strength and peak of the El Nino. The location of warmest anomalies and tropical forcing, as well as the timing of the El Nino's peak over the next few months, will have major implications on the weather pattern across the globe.
- Retrogression of the Gulf of Alaska lower heights and trough. The evolution of this feature will be critical to a changing pattern in the second half of the winter.
- High latitude blocking development during the second half of the winter. The lack of a strong solar signal makes NAO and AO forecasting more challenging, despite the fact that El Nino progression does favor blocking to develop in February.
- A major player in the above uncertainties, the presence of a stratospheric polar vortex and/or a stratospheric warming event.

Perhaps more of a tidbit than an uncertainty is the MJO (Madden Julian Oscillation). It was not mentioned in the body of the outlook -- as usually a strong El Nino weakens the MJO's significance, as they are both tropical forcing oscillations. The MJO consists of "waves" of convection in the tropics that start in the Indian Ocean and propagate eastward in the Equatorial Pacific, and their location is classified in different phases. The different phases can have different impacts on the Global Weather pattern -- it is somewhat like an intraseasonal ENSO.

While it is expected to primarily be weak, we do have very warm water in the Indian Ocean, which is where MJO waves originate. Not coincidentally, we have had a very strong MJO pulse over the past few days and this is expected to continue into November. Currently, it's somewhat counteracting the El Nino forcing, as a very La Nina-like pattern with a massive Southeast US Ridge and an RNA (westward PNA) developing. **If** MJO waves keep developing of this strength, it could be an indicator that typical El Nino forcing is not dominating the pattern, which would present many uncertainties with the weather pattern going forward.

Conclusions and Predictions

December Temperature Anomalies: +1 to +3 F (Above Normal)
January Temperature Anomalies: +1 to +2 F (Slightly above normal, variable)
February Temperature Anomalies: -1 to - 3 F (Below Normal)

December Precipitation Anomalies: Above Normal
January Precipitation Anomalies: Above Normal
February Precipitation Anomalies: Above Normal

NYC Winter Snowfall: Slightly Above Normal
Interior NJ/NY Snowfall: Above Normal
Coastal NJ/NY Snowfall: Near Normal

December Highlights: A volatile, but warmer than normal start to the winter is anticipated during the month of December. Without any support from high latitude blocking in the AO or NAO regions, the general atmospheric pattern is expected to support the advection of mild Pacific air into the United States. Multiple storm systems are expected to impact the area -- with some wintry impacts possible, but generally below normal snowfall and temperatures averaging 1 to 3 degrees above normal.

January Highlights: Of all winter months, January is likely the most uncertain at the present time. Much of this month's characteristics will depend on the aforementioned uncertainties. Regardless, the month is expected to begin similarly to December. A gradual decrease in mild, Pacific air is expected as the month continues. Toward the second half of the month, a general retrogression of the Gulf of Alaska trough/upper level low will support more ridging on the West Coast of the United States. This will promote shots of colder air, with the potential for wintry weather increasing toward the latter half of the month.

February Highlights: Significant uncertainty still remains in regards to the atmospheric evolution during the latter half of this winter. Generally, however, February is expected to be the most wintry month of the three. With the likelihood of high latitude blocking increasing, and a more negative trend in the modality of the AO and NAO indices, colder than normal weather is favored. In addition, an active subtropical jet is expected to continue with above normal precipitation expected. Should all of these factors fall into place, it certainly is possible that a few significant snowfall events would occur, with the potential for one or two “bigger” winter weather events.

Overall Highlights and General Expectations:

The past two winters have featured colder than normal temperatures with above normal snowfall. In addition, they have both featured periods of extremely cold, arctic air with outbreaks of below normal temperatures and periods of widespread/consistent snowfall. This winter, especially early on, is very likely to feel like a significant departure from that trend.

The presence of a strong El Nino, unabated in the first month or so of winter, is expected to keep things rather mild -- and chances for snowfall or very cold air will be limited. This pattern is expected to continue through December. Uncertainties then arise in regards to exactly how, and when, the pattern will change.

Gradually, the winter is expected to become more notable as we move toward the New Year. At that time, the atmospheric pattern evolution will support a more active and colder northern jet stream, with a continuation of moisture in the southern jet stream. As this pattern change occurs, wintry weather will become increasingly possible later in January toward February with periods of colder than normal air. Colder and snowier conditions may last into March if high latitude blocking does develop.

As a whole, this winter is likely to be best characterized as “more volatile” than the previous two winters. This does not mean that winter conditions will be more extreme. Instead, it signifies that after a warm start, winter is likely to enter a roller-coaster ride with warmer and colder than normal conditions, and wintry precipitation threats. Eventually, it appears that we will settle into a colder than normal pattern with opportunities for wintry weather before winter ends.

The 2015-2016 Winter Forecast was a collaborated effort between the forecasters at New York Metro Weather, from John Homenuk, Doug Simonian, and Miguel Pierre. This forecast was compiled over a period of two months and features various sourced images. The image credits are included either on the images themselves, or within text above or below the image.