

# Arctic Oscillation and Polar Vortex Analysis and Forecasts

*December 16, 2024*

Dr. Judah Cohen from Atmospheric and Environmental Research (AER) embarked on an experimental process of regular research, review, and analysis of the Arctic Oscillation (AO) and Polar Vortex (PV). This analysis is intended to provide researchers and practitioners real-time insights on one of North America's and Europe's leading drivers for extreme and persistent temperature patterns.

During the winter schedule the blog is updated once every week. Snow accumulation forecasts replace precipitation forecasts. Also, there is renewed emphasis on ice and snow boundary conditions and their influence on hemispheric weather. In late Spring, we transition to a spring/summer schedule, which is once every two weeks. Snow accumulation forecasts will be replaced by precipitation forecasts. Also, there will be less emphasis on ice and snow boundary conditions and their influence on hemispheric weather.

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The AO/PV blog is partially supported by NSF grant AGS: 1657748

## Summary

- The Arctic Oscillation (AO) is currently near neutral and is predicted to remain close to neutral the next two weeks as pressure/geopotential height anomalies across the Arctic are currently mixed and are predicted to remain mixed over the next two weeks. The North Atlantic Oscillation (NAO) is currently positive with negative pressure/geopotential height anomalies across Greenland and the NAO is predicted to remain positive the next two weeks as pressure/geopotential height anomalies are predicted to remain mostly negative across Greenland.
- The next two weeks troughing/negative geopotential height anomalies across Greenland will extend across Northern Europe with ridging/positive geopotential height anomalies dominating the rest of Europe. This mostly zonal pattern will support mostly normal to above normal temperatures across much of Europe including the United Kingdom (UK) with the exception of normal to below normal temperatures across northern Scandinavia the next two weeks.
- This week an omega block is predicted for Asia with ridging/positive geopotential height anomalies in Central Asia bookended by troughing/negative geopotential height anomalies across Western and Eastern Asia and then next week the pattern will transition with ridging/positive geopotential height anomalies across Western Asia while troughing/negative geopotential height anomalies will deepen across Eastern Asia. This

pattern favors widespread normal to above normal temperatures across much of Asia but especially Siberia, with regional normal to below normal temperatures across Western, Central and east Asia the next two weeks.

- Also a transitional pattern predicted across North America the next two weeks with ridging/positive geopotential height anomalies centered in Alaska, Western Canada and the Western United States (US) supporting troughing/negative geopotential height anomalies across Eastern Canada and the Eastern US this week but is predicted to flip to western troughing and eastern ridging next week and then possibly flip yet again to western ridging and eastern troughing as we approach the New Year. This pattern favors normal to below normal temperatures extending from Alaska across Western and Central Canada and the US Upper Midwest with normal to above normal temperatures across Eastern Canada and most of the US. However next week temperatures are predicted to turn milder across much of Canada and the US with normal to below normal temperatures mostly confined to the US East Coast.
- The battle continues and in the Impacts section I discuss the competing influences of a strong polar vortex (PV) and high latitude blocking on the upcoming weather in the Northern Hemisphere (NH). But the PV seems to be finally getting the upper hand. So far this winter it is all about the PV stretching and then relaxing over and over again in quick succession. That is predicted to continue or is there a last minute plot twist?

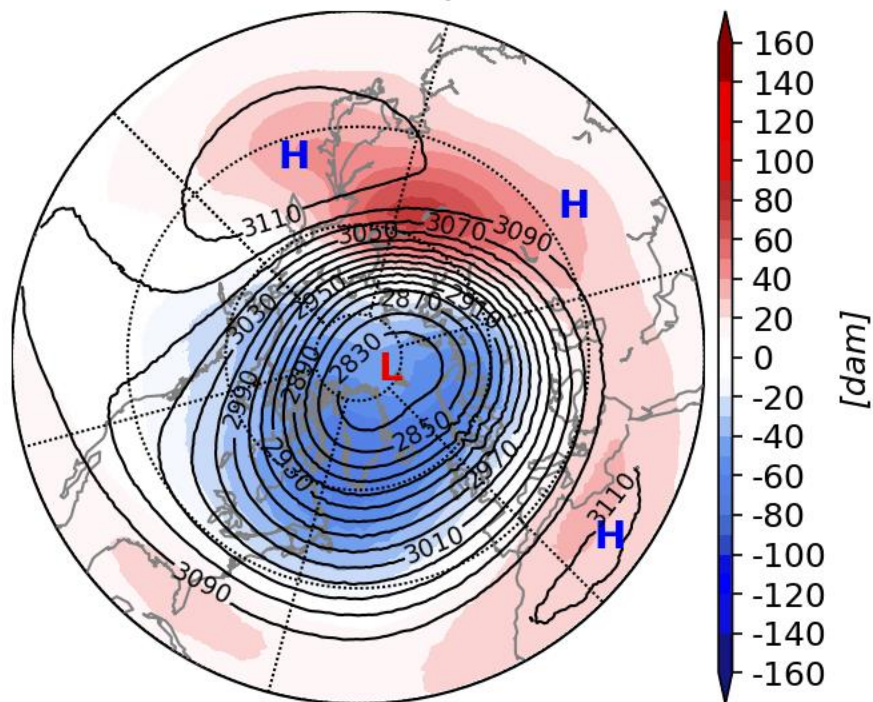
## Plain Language Summary

Three stretched polar vortices are in the books and a fourth and fifth are looking increasingly likely this week and then again heading into the New Year. They are bringing cold weather to the Eastern US and East Asia (see **Figures 3 & 9**) but nothing impressive. In between an interlude of a strong polar vortex favors a milder pattern next week. Western Europe isn't strongly influenced by stretched PVs, instead the weather is more dependent on Greenland high or low pressure. Low pressure across Greenland this week will an extended mild weather pattern (see **Figure 3, 6 and 9**). Longer term is it "lather, rinse, repeat" or is it? Some model forecasts suggest the polar vortex is finally getting off this merry go-round that could spell much milder weather for North America and maybe colder weather for Europe.

## Impacts

The atmosphere still seems to on the "lather, rinse, repeat" cycle of stretched polar vortex (PV) followed by a snap back to a strong circular PV and then repeat the whole thing over again. The interval between each stretched PV seems to be about a week or so. And as long as we stay on this same merry go-round the forecast seems fairly straightforward for the Eastern Asia and the Eastern US – cold air outbreaks first for East Asia then for the Eastern US for about five to seven days, quickly followed by a mild pattern for another five to seven days and then repeat the whole cycle all over again. This rapid change or variability in the PV can be seen in the latest PV animation (see **Figure i**). There is a bit of a deviation right at the end of the animation but more on that at the end of the discussion.

## Initialized 00Z 10 hPa HGT/HGTa 16-Dec-2024



**Figure i.** Initialized 10 mb geopotential heights (dam; contours) and temperature anomalies ( $^{\circ}\text{C}$ ; shading) across the Northern Hemisphere for 16 December 2024 and forecasted from 17 December to 31 December 2024. The forecasts are from the 00Z 16 December 2024 GFS model ensemble.

Stretched PVs don't have a strong relationship with European weather. The PV phase or mode that seems to most strongly support cold weather is a PV split and for now there are no signs of one happening any time soon. The other teleconnection pattern that brings cold weather to Europe is Greenland blocking. No sign of that until at least the New Year so therefore I think the forecast for Europe is the most straightforward relatively mild until further notice. So, for better or worse, for now Europe misses all the PV and weather melodrama.

Of course, anyone who reads the blog knows that I focus on PV variability in trying to predict the weather from days to weeks ahead. So, it is kind of a surreal circumstance where the models have come in to very good agreement through the next two weeks both in their forecasts for the PV and the weather and yet my uncertainty starting for the holiday period and beyond is very high. The forecast for East Asia and the Eastern US for the next ten days is the easy part, and I will quickly run down the PV variability and the associated expected weather.

**December 16-20.** It looks mild for much of the US as the PV becomes more circular and relaxes from the stretched PV from last week. However, the next stretched PV is already underway (see **Figure 12a**). This will start to deliver some cold air first to East Asia later this week and cold air will try to punch into the upper Midwest later this week and will wait for the weekend to fully make it to the Eastern US. Another run of the mill stretched PV but at least it is showing up in all the models and I can also observe wave reflection with this event, but barely. But given that this is a modest event the duration is less than a week.

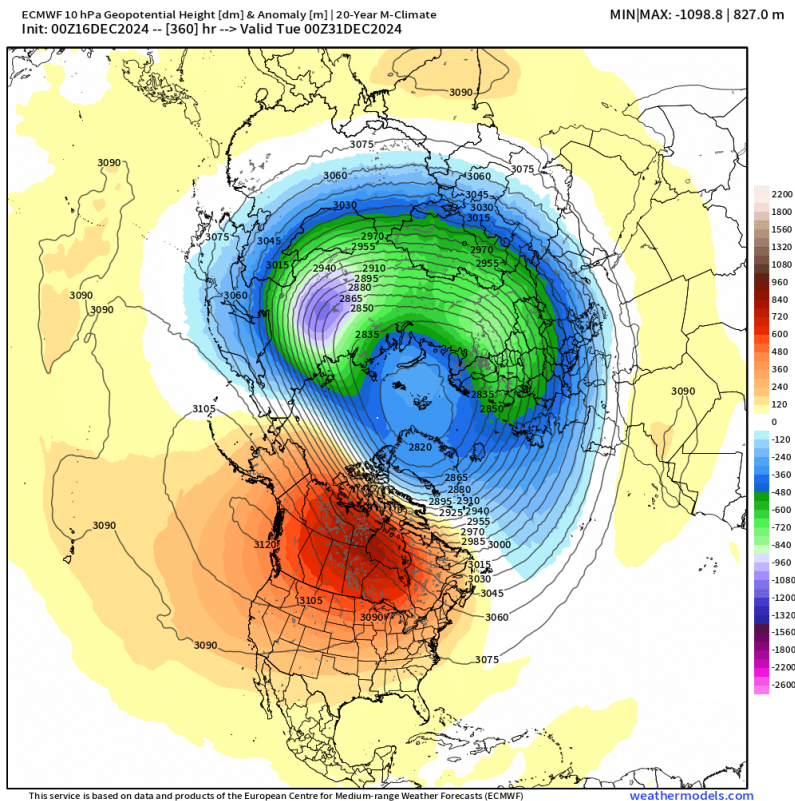
**December 21-25.** Looks cold in the Eastern US as the latest in a series of stretched PVs winds down. It starts to turn mild in East Asia and for much of the US. Cold hangs on longest along the US East Coast. Looks like the core of the cold are December 22, 23 and 24 right before the all-important holiday season. Here all the drama is – will it be white, wet or dry.

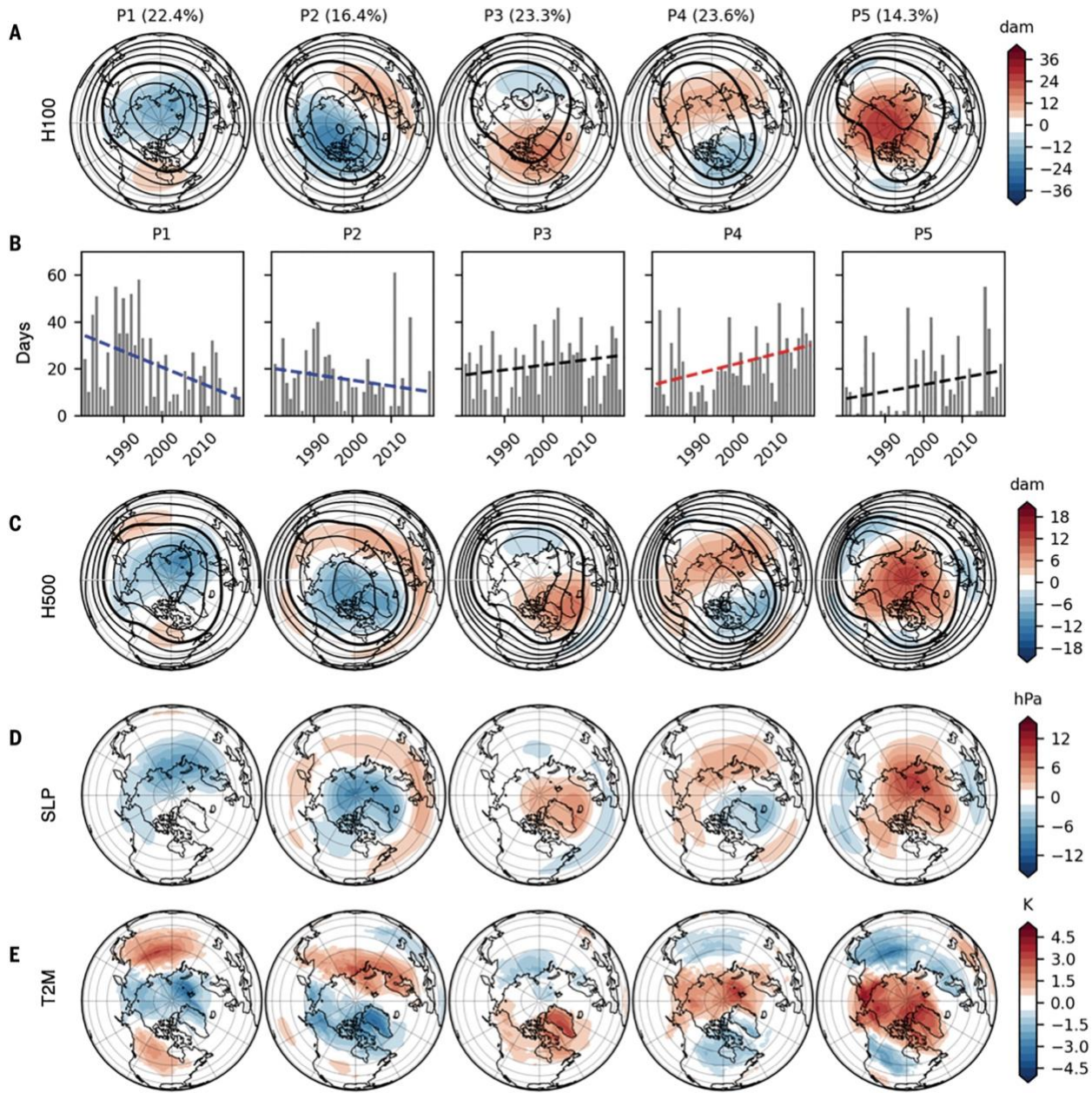
**December 26-30.** Mild yet again in the Eastern US and East Asia as the PV relaxes from the stretched PV and becomes more circular in shape. It could be quite mild in the Eastern US as the models predicting probably near record warmth and ridging over Hudson Bay. This very much reminds me of last winter (at least I think that it was last winter but maybe it was two winters ago?) with the lack of sea ice in Hudson Bay contributing to the higher probability of ridging and warm temperatures that truly prevents any meaningful cold air in Eastern North America. In my opinion a good possibility low sea ice in Hudson Bay is again playing a role in this winter with low sea ice acting as resistance to a more durable troughing in the Eastern US and sustained cold temperatures. But cold air will begin entering East Asia signaling the next round of cold weather for East Asia and the Eastern US.

**The New Year's period.** The models are now in good agreement that another stretched PV will occur around this time, fifth of the season if it does occur, but once again this event looks underwhelming (see **Figure 12b**). The past week or so, I did think that this could be a bigger event, and I am seeing less evidence of that in recent model runs. For a bigger event more persistent and stronger Ural blocking is needed and currently the models are yet again predicting only transient Ural blocking and want to move the core of the blocking into Siberia that both helps to strengthen the PV and gives me little confidence in sustained cold in the Eastern US (see **Figures 5 and 8**). All three models, the GFS, Canadian and the European all look like they want to reload the pattern that delivers cold into the Eastern US at the end of their runs. I did think that based on the predicted stretched PV for the holiday period, the cold could arrive earlier than what the models are predicting. The European is consistently predicting the cold to return to the Eastern US after January 6, 2025. If nothing else the European model consistency is impressive, now we shall see it really knows something. The GFS is showing the cold returning either later in the month or not at all. But given the warmth across North America and especially in the Hudson Bay region, I am not expecting the cold to arrive in the Eastern US not until New Year's Day the earliest and probably not until a few days after but still a little earlier than what the models are suggesting. Looks like the Canadian model agrees with my timing of the return of the cold air to the Eastern US right around New Year's. This forecast is based on ensemble model forecasts.

Now to the drama associated with the stretched PV predicted at the very end of the year thanks to the operational forecasts. The ensemble forecasts from all three major models look

very similar with a modest stretched PV. The GFS operational first predicted then did not and is now back on the Canadian warming train (see **Figure i**) and now the latest European is also predicting a Canadian warming (see **Figure ii**). Since the operational models so far on an island to itself, I think that solution is unlikely but still needs to be at least considered as a growing possibility.

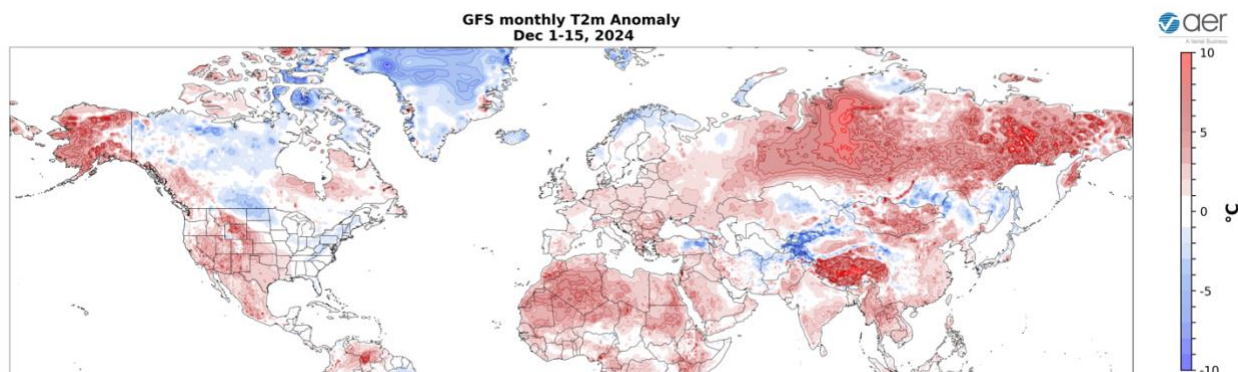




**Figure iii.** (A) 100-hPa geopotential height composites (contours in 20-dam intervals, anomalies shaded, and 1580-dam contour bolded) for pattern days P1–P5. Percent of days assigned to the pattern is indicated in parentheses. (B) Yearly frequency of (left to right) P1–P5 pattern days (grey bars), with dashed lines showing linear trend (blue if statistically significant negative trend, red if significant positive trend, and black otherwise). Statistical significance is at the 0.05 level, as determined by the Wald test with t-distribution of the test statistic. Composites for (left to right) P1–P5 pattern days of (C) 500-hPa geopotential heights (in decameters, with anomalies shaded and 540-dam contour bolded), (D) mean sea-level pressure anomalies (hPa), and (E) 2-m surface temperature anomalies (K). Monthly data are for the years 1980 through 2020. Plot taken from [Cohen et al. 2021 in Science](#).

Longer term – looking to January. With the transient Ural blocking in one day and out the next, seems to me expect more of the same weather across the Northern Hemisphere until further notice. Plenty of variability/volatility and large rapid swings in temperature that result in near seasonable temperatures for the Eastern US. If the Ural blocking can become more persistent, then the argument for cold (even if eventually) grows stronger for both East Asia and I think eventually the Eastern US and even Europe. If on the other hand the Ural blocking becomes more persistent Siberian blocking, then the argument for overall mild month of January grows stronger and maybe makes any turn to meaningful and impactful cold in the Eastern US and East Asia nearly impossible for this winter. For Europe we need to watch for Greenland blocking. If we do get a Canadian warming maybe that brings with it Greenland blocking and colder weather for Northern Europe consistent with a negative NAO.

However, two things are biasing my opinion milder for the Eastern US and even East Asia for the month of January. First overall it has been very mild in Siberia this month (see **Figure iv**) and the models are not predicting a change in that situation.



**Figure iv.** Observed surface temperature anomalies ( $^{\circ}\text{C}$ ; shading) from 1 Dec to 15 Dec 2024. The forecast is from the initialized GFS ensemble. Climatology used is 1991-2020.

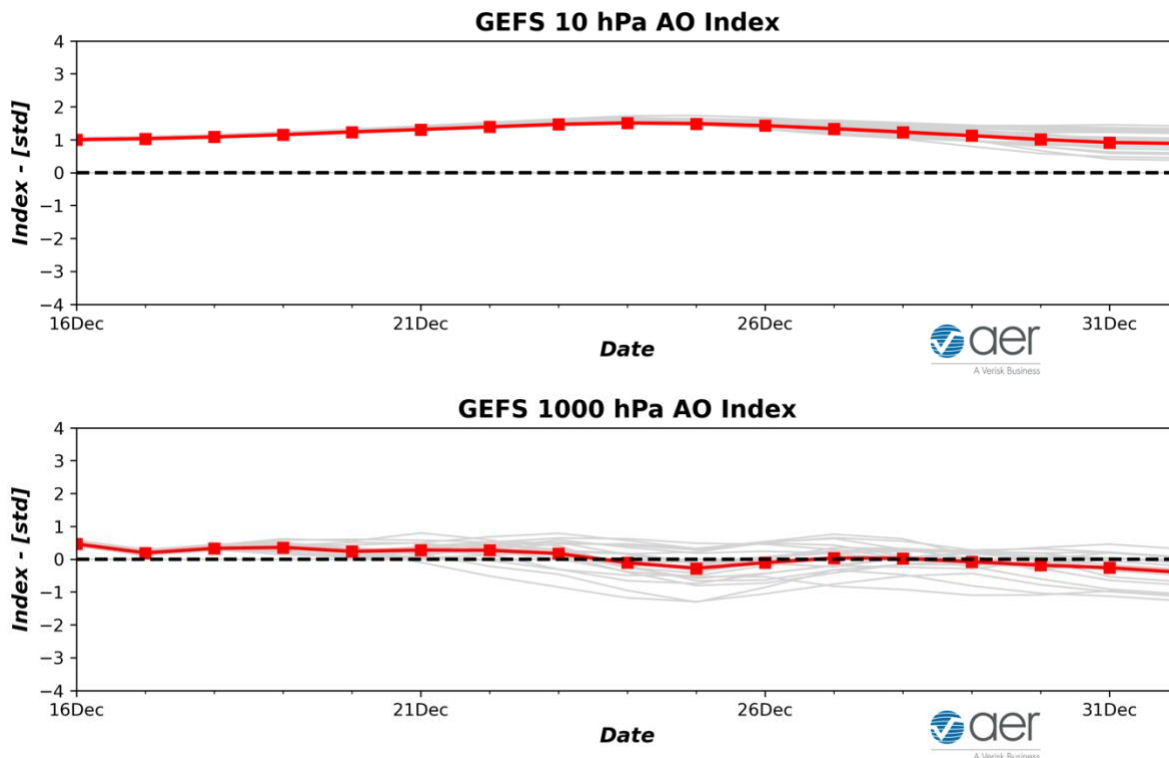
Second, I have been discussing the battle between the overall strong PV and the surprisingly tenacious high latitude blocking. If one can impose its will on the other, that will likely determine the overall characteristic of the winter. While for the past month the two have been at a draw or stalemate, over the past several days the strong PV has started to exert its dominance while high latitude blocking looks for now to be on life support as seen from polar cap geopotential height anomalies (PCHs) in **Figure 11**. Clearly the blue team of cold/negative PCHs is starting to dominate the whole field and not just the stratosphere. The diagnostic unfortunately is highly variable even from day to day so this can certainly change and will eventually. But for now, the trend has been for the strong polar vortex to extend its dominance into the troposphere more and more.

Lots of uncertainty and lots of holiday drama with the polar vortex and the weather and should make for interesting following during the holidays. Could there be more holiday gifts in the form of an early public release of the blog for well-behaved readers?

## Near-Term

### This week

The AO is predicted to be near neutral this week (**Figure 1**) with mixed geopotential height anomalies across the Arctic and with mixed geopotential height anomalies across the mid-latitudes of the NH (**Figure 2**). With predicted negative geopotential height anomalies across Greenland (**Figure 2**), the NAO is predicted to be positive this week.

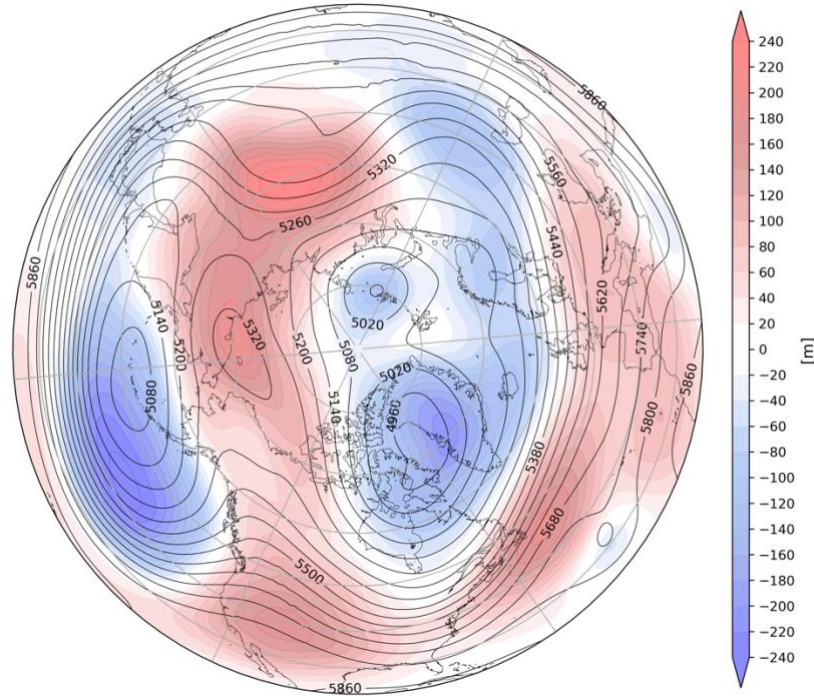


**Figure 1.** a) The predicted daily-mean AO at 10 hPa from the 00Z 16 December 2024 GFS ensemble. b) The predicted daily-mean AO at 1000 hPa from the 00Z 16 December 2024 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble mean AO index given by the red line with squares.

This week, troughing/negative geopotential height anomalies across Greenland will extend across Northern Europe with ridging/positive geopotential height anomalies across Central and Southern Europe (**Figures 2**). This pattern will favor normal to above normal temperatures across most of Europe including the UK with normal to below normal temperatures limited to northern Scandinavia (**Figure 3**). This week an omega block is predicted for Asia with ridging/positive geopotential height anomalies in Central Asia sandwiched by troughing/negative geopotential height anomalies across Western and Eastern Asia (**Figure 2**). This pattern favors normal to above normal temperatures widespread across much of Asia but especially Siberia with normal to below normal temperatures limited to parts of Western, Central and Eastern Asia (**Figure 3**).



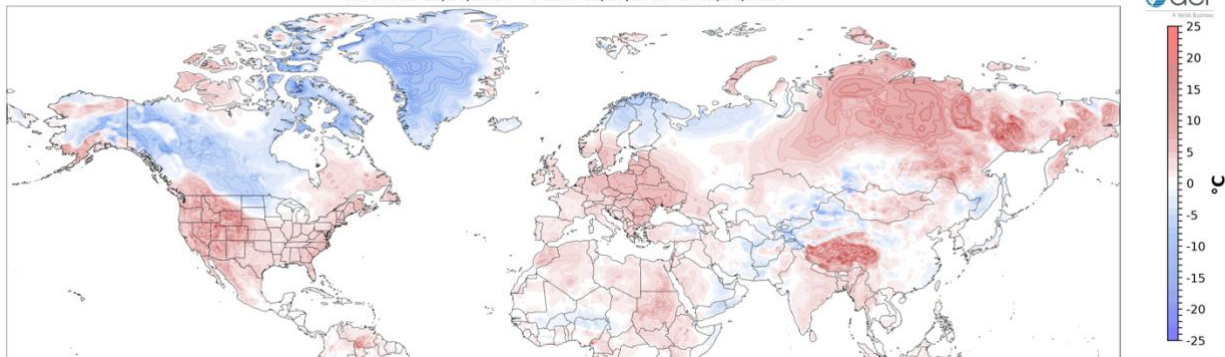
GEFS 1-5 Day Forecast 500 hPa Anomaly  
INIT: 00Z 12/16/2024 FCST: 12/17/2024 to 12/21/2024



**Figure 2.** Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 17 Dec to 21 Dec 2024. The forecasts are from the 00Z 16 December 2024 GFS ensemble.

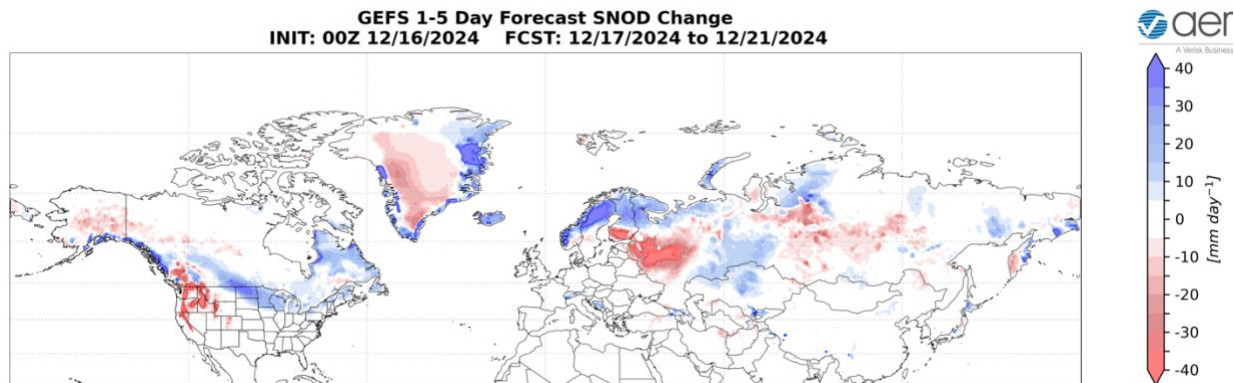
This week ridging/positive geopotential height anomalies across Alaska, Western Canada and the Western US will force troughing/negative geopotential height anomalies across Central Canada and the Eastern US. (**Figure 2**). This pattern will favor the flow of normal to below normal temperatures from Alaska into Western and Central Canada, and the into the US Upper Midwest with normal to above normal temperatures across Eastern Canada and most of the US (**Figure 3**).

GEFS 1-5 Day Forecast T2m Anomaly  
INIT: 00Z 12/16/2024 FCST: 12/17/2024 to 12/21/2024



**Figure 3.** Forecasted surface temperature anomalies (°C; shading) from 17 Dec to 21 Dec 2024. The forecast is from the 00Z 16 December 2024 GFS ensemble.

Trouching and/or cold temperatures will support new snowfall across Scandinavia, the Alps, the Balkans, the Urals, parts of Siberia and the while warm temperatures will support snowmelt in Baltic Sea region, Western Russia and parts of Siberia this week (**Figure 4**). Trouching and/or cold temperatures will support new snowfall across southern Alaska, the Canadian Prairies and the US Upper Midwest while warm temperatures will support snowmelt in central Alaska, Southwestern Canada and the higher elevations of the Western US this week (**Figure 4**).

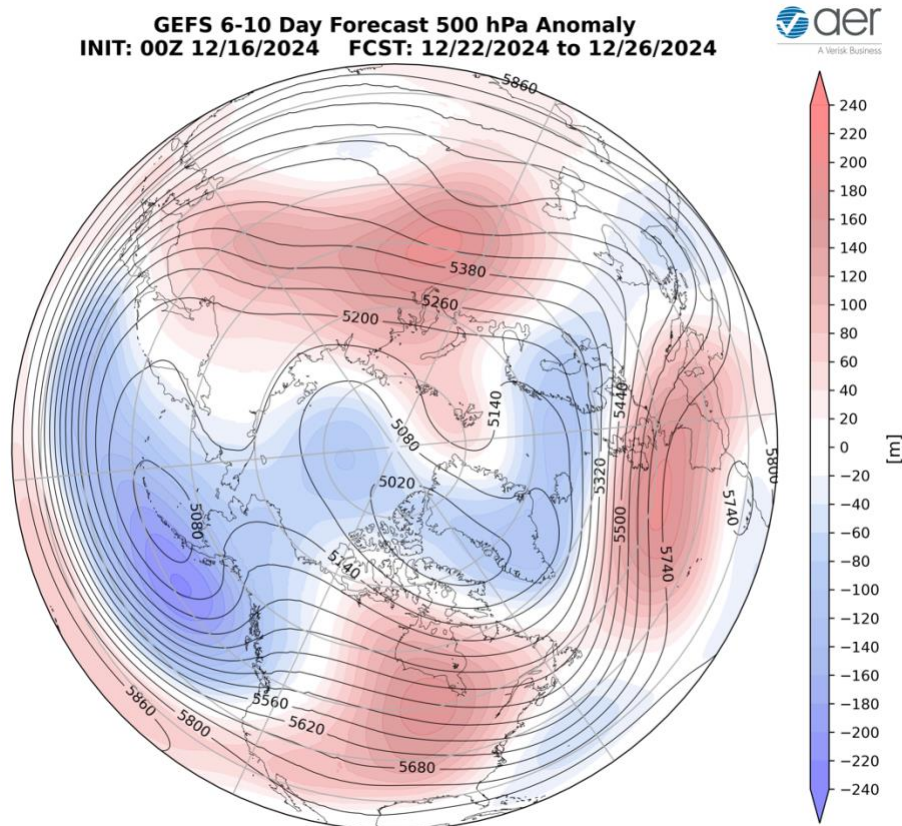


**Figure 4.** Forecasted snow depth changes (mm/day; shading) from 17 Dec to 21 Dec 2024. The forecast is from the 00Z 16 December 2024 GFS ensemble.

## Near-Mid Term

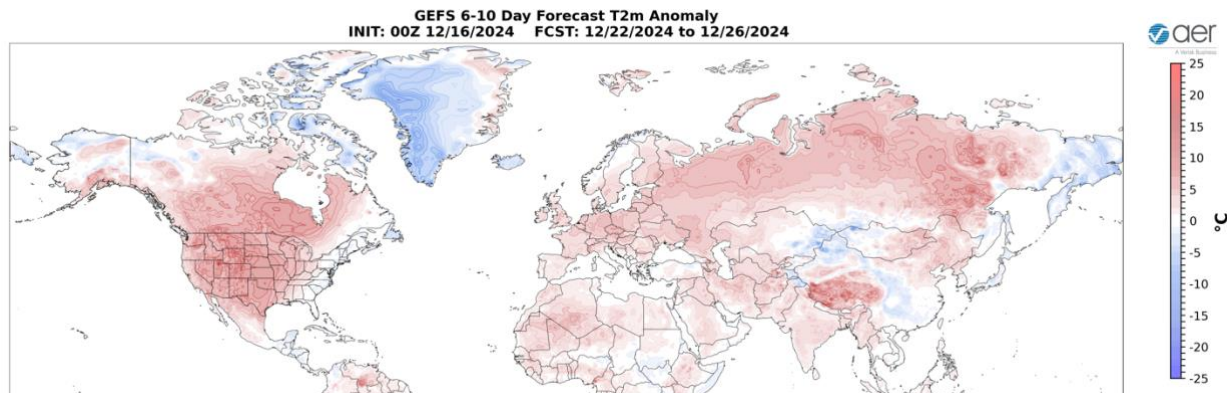
### Next week

With geopotential height anomalies remaining mostly mixed across the Arctic and with mixed geopotential height anomalies across the mid-latitudes this period (**Figure 5**), the AO will likely be near neutral this period (**Figure 1**). With predicted negative pressure/geopotential height anomalies across Greenland (**Figure 5**), the NAO will likely be positive this period.



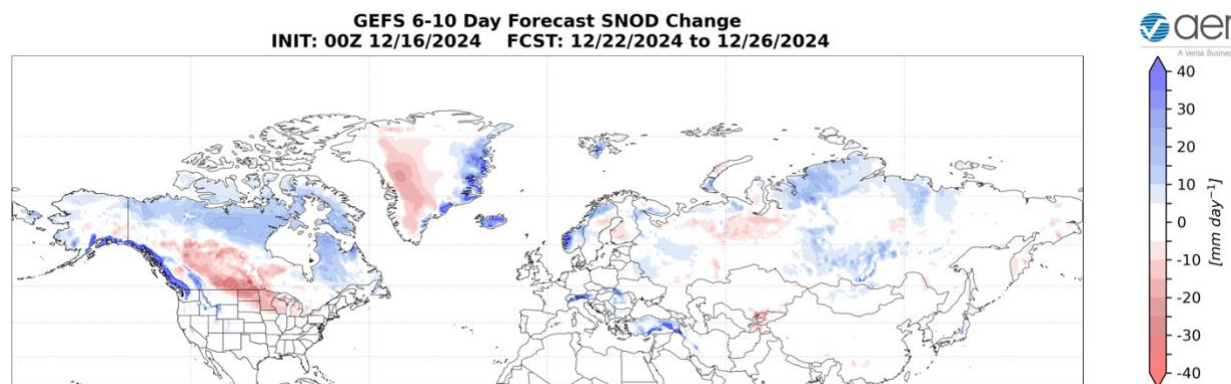
**Figure 5.** Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 22 Dec to 26 Dec 2024. The forecasts are from the 00Z 16 December 2024 GFS ensemble.

Predicted troughing/negative geopotential height anomalies across Greenland will extend across Northern Europe with ridging/positive geopotential height anomalies across Western and Southern Europe this period (**Figure 5**). This mostly zonal pattern will favor normal to above normal temperatures across much of Europe including the UK with normal to below normal temperatures limited to Northern Scandinavia this period (**Figure 6**). The predicted pattern across Asia is ridging/positive geopotential height anomalies across Western Asia centered near the Urals forcing deepening troughing/negative geopotential height anomalies across Eastern Asia (**Figure 5**). This pattern favors widespread normal to above normal temperatures across Asia but especially Siberia with normal to below normal temperatures limited to parts of Central and Eastern Asia (**Figure 6**).



**Figure 6.** Forecasted surface temperature anomalies ( $^{\circ}\text{C}$ ; shading) from 22 Dec to 26 Dec 2024. The forecast is from the 00Z 16 December 2024 GFS ensemble.

The transient pattern continues across North America with troughing/negative geopotential height anomalies predicted across Alaska, Western Canada and the Western US with ridging/positive geopotential height anomalies across eastern Canada and the Eastern US this period (**Figure 5**). This pattern will favor widespread normal to above normal temperatures across much of North America with normal to below normal temperatures limited to parts Alaska, Northwestern Canada and the US East Coast (**Figure 6**).



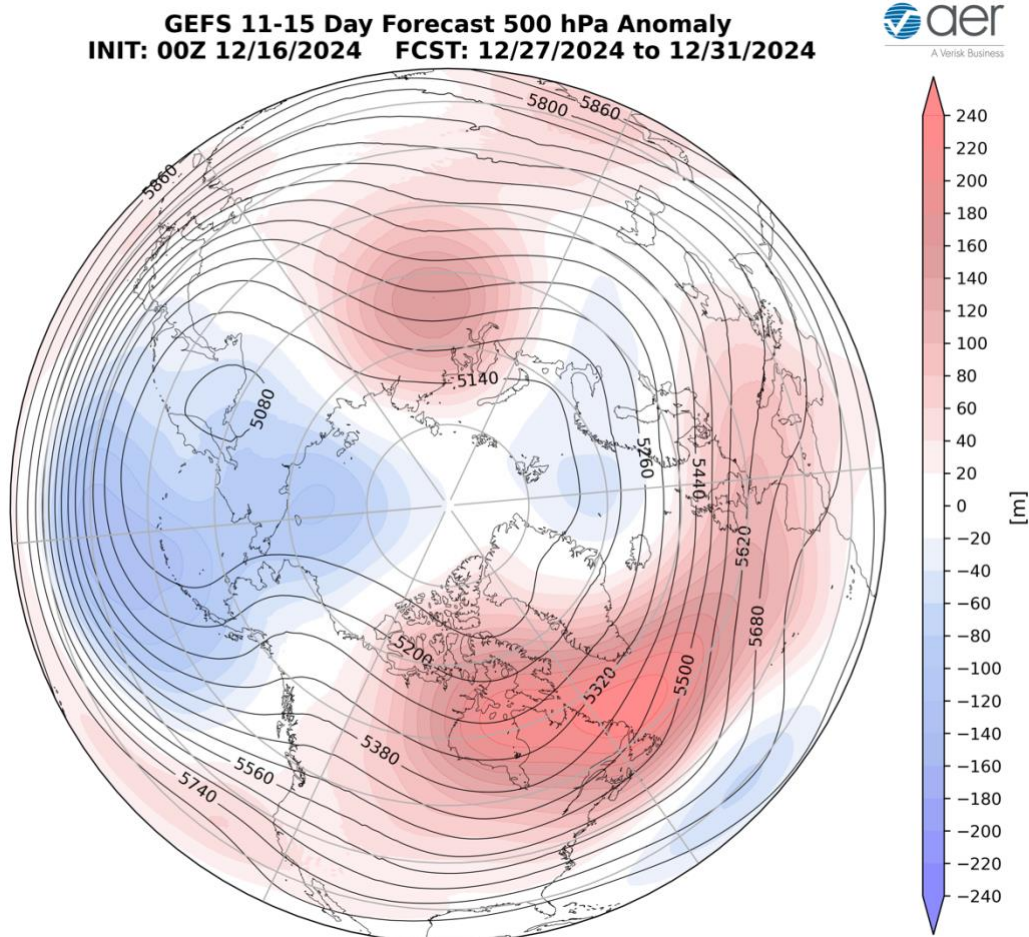
**Figure 7.** Forecasted snow depth changes ( $\text{mm}/\text{day}$ ; shading) from 22 Dec to 26 Dec 2024. The forecast is from the 00Z 16 December 2024 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Scandinavia, the Alps, Turkey and Western Siberia while warm temperatures will support snowmelt in the Baltic Sea region and Western Russia this period (**Figure 7**). Troughing and/or cold temperatures will support new snowfall across southern Alaska, the West Coast mountains of Canada, Northern and Eastern Canada and the Northwestern US while warm temperatures will support snowmelt in Southcentral Canada and the US Northern Plains this period (**Figure 7**).

## Mid Term

### Week Two

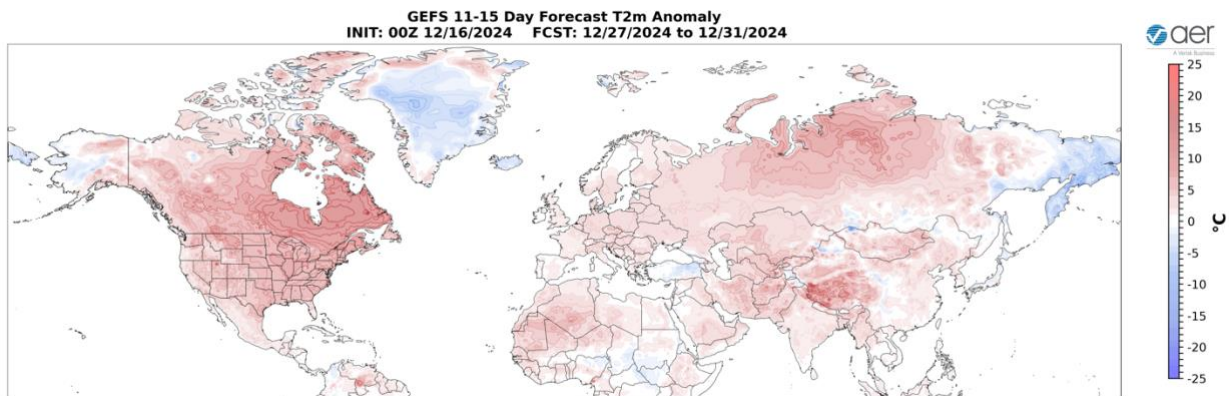
With predicted mostly mixed geopotential height anomalies across the Arctic and mixed geopotential height anomalies across the mid-latitudes this period (**Figure 8**), the AO will likely remain near neutral yet again this period (**Figure 1**). With predicted weak and mixed pressure/geopotential height anomalies across Greenland (**Figure 8**), the NAO will likely remain positive to relatively close to neutral this period.



**Figure 8.** Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 27 Dec to 31 Dec 2024. The forecasts are from the 00Z 16 December 2024 GFS ensemble.

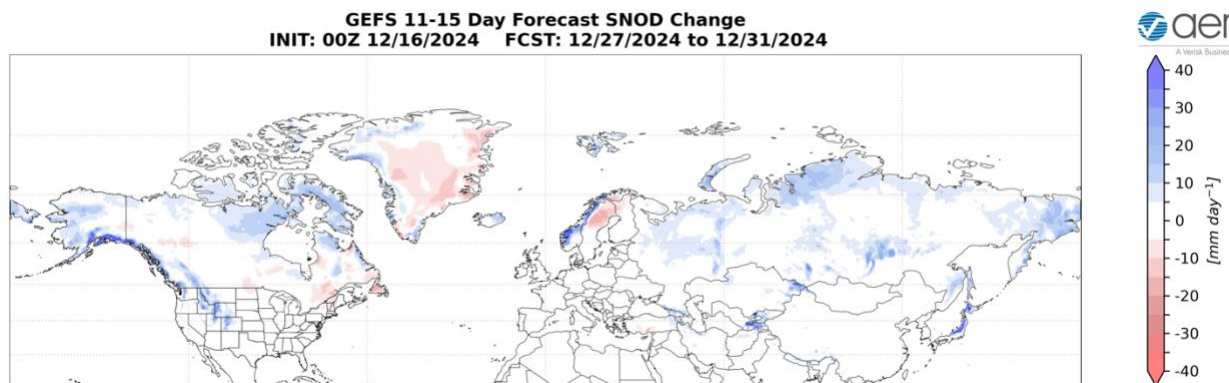
Persistent but weakening troughing/negative geopotential height anomalies across Greenland is predicted to continue to extend across Northern Europe with ridging/positive geopotential height anomalies persisting across Western and Southern Europe (**Figure 8**). This pattern should favor widespread normal to above normal temperatures across much of Europe including the UK this period (**Figures 9**). The pattern across Asia is predicted to continue to transition this period with ridging/positive geopotential height anomalies centered on the Urals sliding east into Western Siberia forcing troughing/negative geopotential height anomalies across East Asia this period (**Figure 8**). The predicted pattern favors widespread normal to above normal temperatures

widespread across much of Asia with normal to below normal temperatures limited to parts of Central and East Asia this period (**Figure 9**).



**Figure 9.** Forecasted surface temperature anomalies ( $^{\circ}\text{C}$ ; shading) from 27 Dec to 31 Dec 2024. The forecast is from the 00Z 16 December 2024 GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to try to build once again across Alaska, Western Canada and the Western US supporting developing troughing/negative geopotential height anomalies across Eastern Canada and the Eastern US this period (**Figure 8**). As this is a period of transition, widespread warmth from the previous period will continue with normal to above normal temperatures across much of Canada and the US with normal to below normal temperatures mostly limited western Alaska this period (**Figure 9**).



**Figure 10.** Forecasted snow depth changes (mm/day; shading) from 27 Dec to 31 Dec 2024. The forecast is from the 00Z 16 December 2024 GFS ensemble.

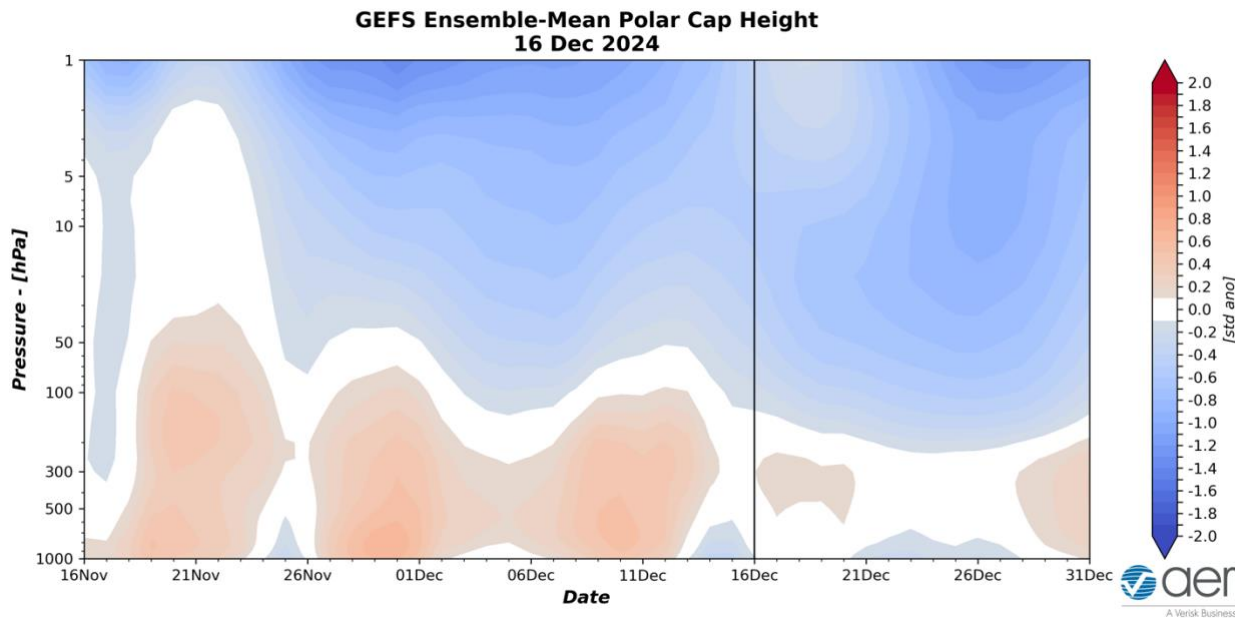
Troughing and/or cold temperatures will support new snowfall across Norway, and scattered across Northern Asia while warm temperatures will support snowmelt in Scandinavia this period (**Figure 10**). Troughing and/or cold temperatures will support new snowfall across western Alaska, the west coast mountains of Canada, Northeastern Canada and US Rockies while warm

temperatures will support snowmelt in the Canadian Maritimes and New England this period (Figure 10).

## Longer Term

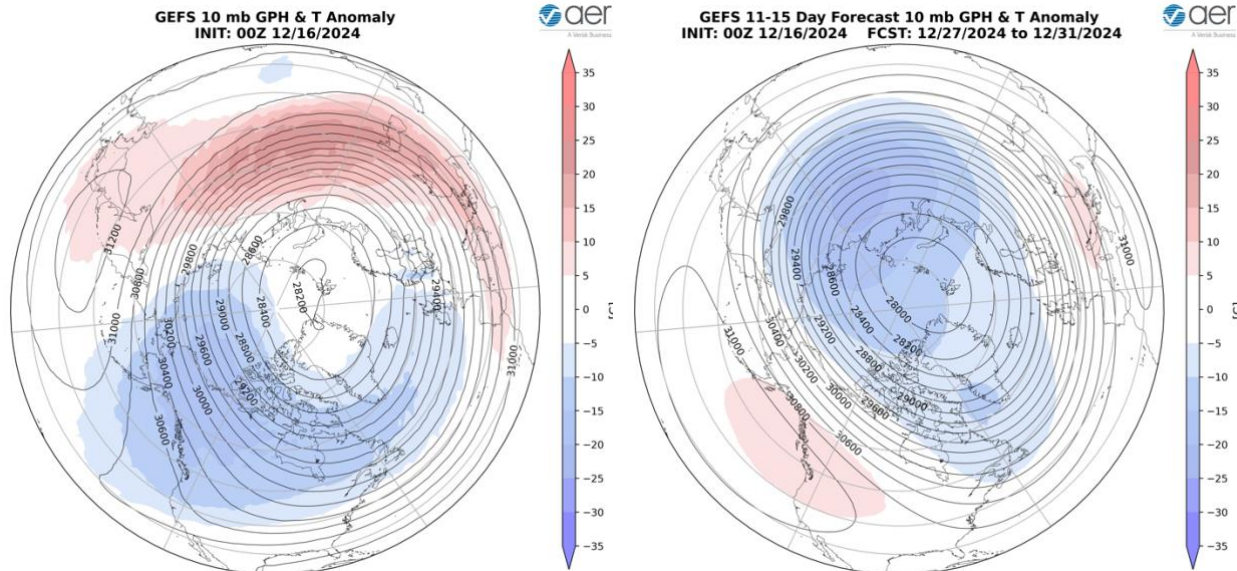
### 30-day

The latest plot of the polar cap geopotential height anomalies (PCHs) currently shows normal to warm/positive PCHs in the troposphere, albeit very weak with cold/negative PCHs in the stratosphere (Figure 11). The cold/negative PCHs from the stratosphere are predicted to descend all the way to the surface next week but only briefly. Then the contrast between cold/negative PCHs in the stratosphere and warm/positive PCHs are predicted in the troposphere is predicted to return for the holiday period (Figure 11). For now, this suggests that the stratosphere and troposphere are mostly uncoupled but does look like the strong PV is increasingly coupling to the troposphere.



**Figure 11.** Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 16 December 2024 GFS ensemble.

The predicted alternating warm/positive followed and cold/negative PCHs but overall staying weak in the lower troposphere the next two weeks (Figure 11) are consistent with the predicted near neutral surface AO the next two weeks (Figure 1). Still waiting to see if the cold/negative PCHs in the stratosphere could couple to the surface for a longer duration or whether the warm/positive PCHs in the troposphere could force a larger polar vortex disruption. But over the past week, the cold/negative PCHs are starting to dominate.

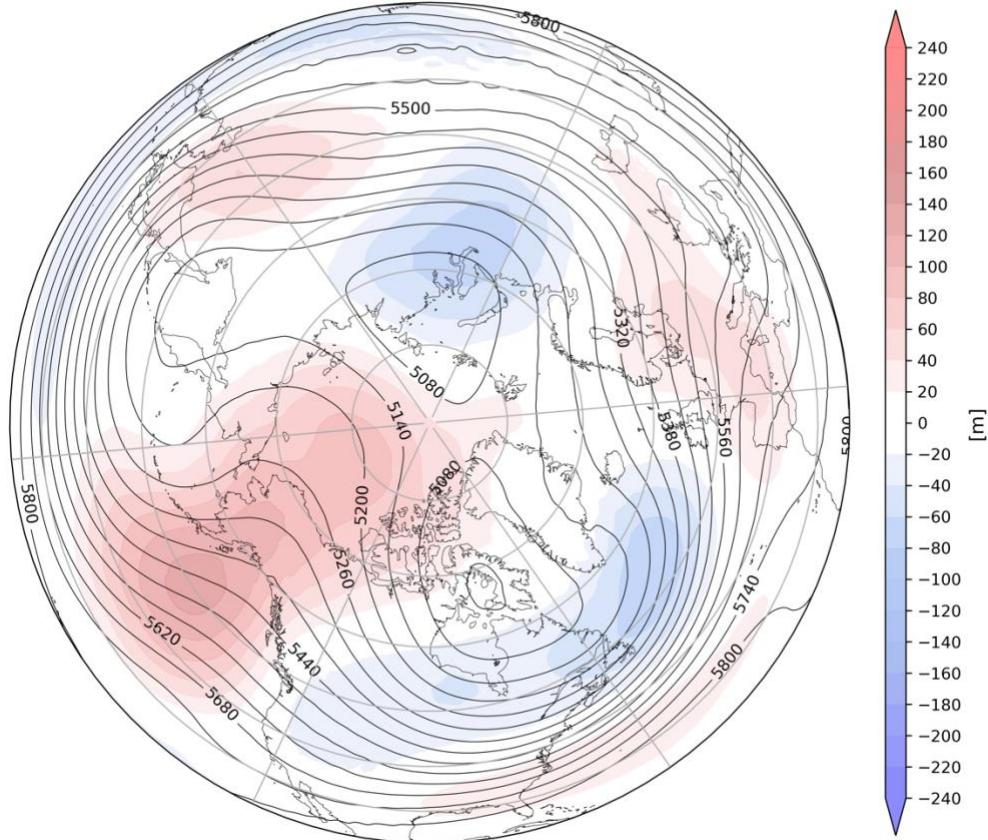


**Figure 12.** (a) Initialized 10 mb geopotential heights (dam; contours) and temperature anomalies ( $^{\circ}\text{C}$ ; shading) across the Northern Hemisphere for 16 December 2024. (b) Same as (a) except forecasted averaged from 27 Dec to 31 Dec 2024. The forecasts are from the 00Z 16 December 2024 GFS model ensemble.

This week the polar vortex (PV) is predicted to be elongated in shape with the PV center near the Svalbard with relatively cold temperatures extending from Asia to Western Canada with warm temperatures centered over Asia (**Figure 12a**). This is consistent with a stretched PV configuration. This is related to the cold air outbreak first in East Asia and then out of Canada to the US later this week. This is what I believe is the fourth stretched PV in rapid succession of the season. Then, at the very end of December the PV center is predicted to remain near Svalbard and once again become more elongated in shape with relatively cold temperatures extending from Asia towards Canada in the polar stratosphere (**Figure 12b**). This is consistent with yet another stretched PV (for those keeping score at home, the fifth of the season). However, some model runs are predicting a Canadian warming instead. This is a minority of the models but if this verifies would favor a warm pattern across much of North America but could result in colder temperatures across northern Eurasia. The stratospheric AO in **Figure 1** this week continues to show that despite the repeated stretched PVs overall the PV remains strong, and any cold air outbreaks should remain brief with each individual stretched PV event.



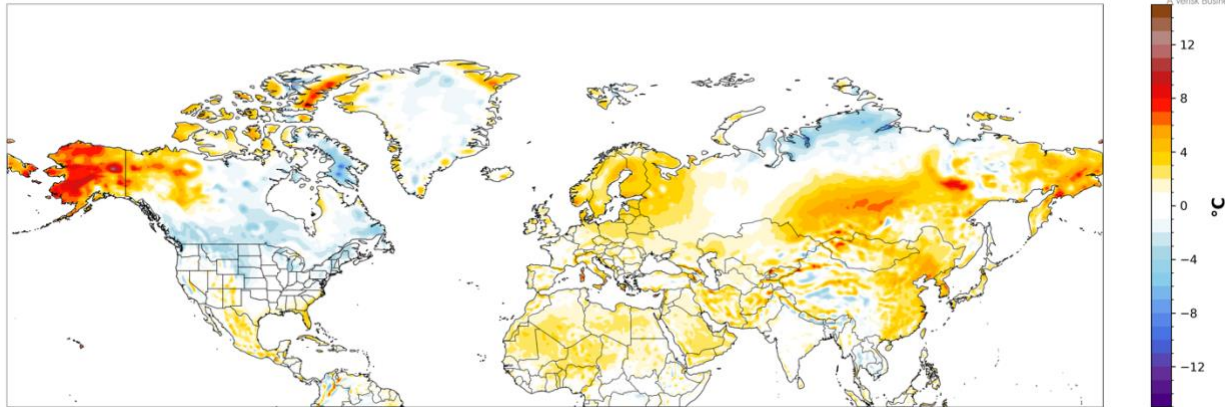
CFS 500 hPa Forecast Anomaly Jan 2025  
Valid as of 16 Dec 2024



**Figure 13.** Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for January 2025. The forecasts are from the 00Z 16 December 2024 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 13**) and surface temperatures for January (**Figure 14**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging across Europe, Western China, from the Gulf of Alaska extending into Alaska and the Beaufort Sea and the Southeastern US with troughing across Southeastern Europe and the eastern Mediterranean, the Urals, Northeast Asia extending to the Dateline, much of Canada and the Central US (**Figure 13**). This pattern favors seasonable to relatively warm temperatures across much of Europe, Southern Asia, much of Siberia, Alaska, Northwestern Canada and the Southeastern US with seasonable to relatively cold temperatures across the Urals and Northern Siberia, Central and Eastern Canada and the Northern US (**Figure 14**).

CFS 16-46 Day Forecast T2m Anomaly  
INIT: 00Z 12/16/2024 FCST: 01/01/2025 to 01/31/2025

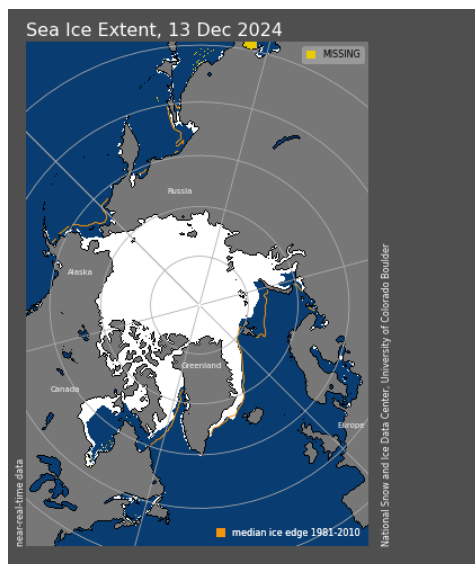


**Figure 14.** Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for January 2025. The forecasts are from the 00Z 16 December 2024.

## Boundary Forcings

### Arctic Sea Ice

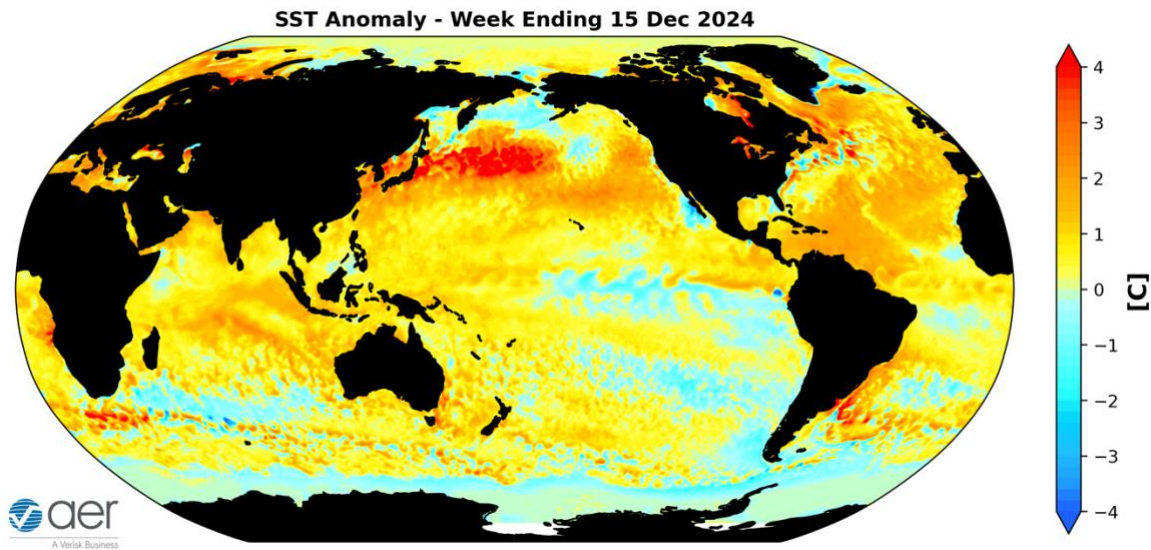
Sea ice growth continues relatively slowly with a larger negative anomaly in the North Atlantic sector compared to the North Pacific sector (see **Figure 15**). This is important because it is the lack of sea ice in the Barents-Kara Seas that favors a weak PV and colder temperatures across the interior of the NH continents. This resulted in the updated temperature forecast being colder than the initial forecast. The other region where sea ice is below normal is around Greenland and into Hudson Bay. I do wonder if low sea ice extent in Hudson Bay is contributing to atmospheric ridging and warming over eastern North America.



**Figure 15.** Observed Arctic sea ice extent on 13 December 2024 (white). Orange line show climatological extent of sea ice based on the years 1981-2010. Image from the National Snow and Ice Data Center (NSIDC). URL <https://nsidc.org/sea-ice-today>.

## SSTs/El Niño/Southern Oscillation

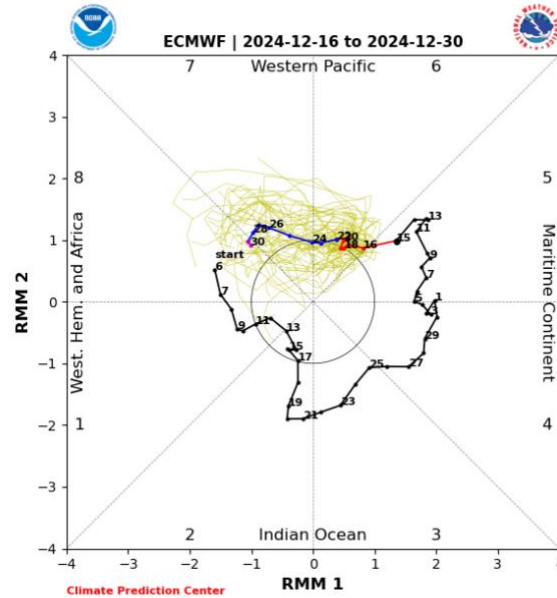
Equatorial Pacific sea surface temperatures (SSTs) anomalies are below normal, between the Dateline and the South America coast, indicating that a La Niña event is emerging (**Figure 16**) and weak La Niña conditions are expected through the winter. Observed SSTs across the NH remain well above normal especially in the central North Pacific centered on the Dateline and the western North Pacific, much of the North Atlantic and offshore of the Canadian Maritimes though below normal SSTs exist regionally especially in the South Pacific. I do wonder if the warmer SSTs this year relative to recent years along the west coast of North America is favoring the cold air further to the east this winter compared to the past decade.



**Figure 16.** The latest daily-mean global SST anomalies (ending 15 Dec 2024). Data from NOAA OI High-Resolution dataset. Source <https://psl.noaa.gov/map/clim/sst.shtml>

## Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is currently in in phase six (**Figure 17**). The forecasts are for the MJO to slowly make its way into phase seven and then phase eight. Phase six favors ridging in across the US and troughing in the Sea of Okhotsk. Phase eight favors high latitude blocking across Northern Canada an troughing in the US. Therefore, it seems that the MJO may be having some influence on North American weather the next couple of weeks but not a strong influence. But admittedly this is outside of my expertise.



**Figure 17.** Past and forecast values of the MJO index. Forecast values from the 00Z 16 December 2024 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model 'spread' is denoted by the gray shading. Sector numbers indicate the phase of the MJO, with geographical labels indicating where anomalous convection occurs during that phase. Image source <https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/ecmf.shtml>

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We appreciate your taking the time to read the public Arctic Oscillation blog from Dr. Judah Cohen and the AER Seasonal Forecasting team.

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