Arctic Oscillation and Polar Vortex Analysis and Forecasts

December 18, 2023

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 positive and is predicted to be positive the next two weeks as pressure/geopotential height anomalies across the Arctic are currently negative and are predicted to remain mostly negative 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 remain negative across Greenland.
- This week, troughing/negative geopotential height anomalies in the North Atlantic including Greenland will force mostly ridging/positive geopotential height anomalies across Europe with the exception of regional troughing/negative geopotential height anomalies across Northern Europe but especially Scandinavia. This pattern will support widespread normal to above normal temperatures across Europe including the

United Kingdom (UK) with the exception of normal to below normal temperatures across Scandinavia the next two weeks.

- This week the predicted general across Asia is ridging/positive geopotential height anomalies across Western and Central Asia and troughing/negative geopotential height anomalies across East Asia. Then next week the pattern is predicted to become more zonal with ridging/positive geopotential height anomalies across Southern Asia and troughing/negative geopotential height anomalies across Northern Asia. This pattern favors widespread normal to above normal temperatures across Western, Northern and Southern Asia with normal to below normal temperatures across East Asia this week. However next week the normal to above normal temperatures will become even more widespread across Asia with normal to below normal temperatures becoming much more limited to mostly Eastern Siberia.
- The general predicted pattern across North America the next two weeks is troughing/negative geopotential height anomalies across Alaska and the Gulf of Alaska forcing ridging/positive geopotential height anomalies across most of North America. However next week troughing/negative geopotential height anomalies are predicted to deepen over the Eastern United States (US). This pattern favors widespread normal to above normal temperatures across North America with the exceptions of normal to below normal temperatures across Alaska the next two weeks and the Southeastern US next week.
- in the Impacts section I discuss the growing likelihood of a large polar vortex (PV) disruption and the impact on Northern Hemisphere (NH) weather.

Plain Language Summary

Cold weather persists across East Asia (see **Figures 3**) but has turned milder elsewhere across the Hemisphere (NH) continents and soon will include East Asia (see **Figures 5 & 8**). Any anticipated cold across much of the NH is looking to be pushed off into the new Year.

Still a larger PV disruption is more likely in early January that has the potential to reverse the overall mild pattern for the NH to a colder one. However, I am beginning to believe that this event will fall short of its full potential. Though I do believe some cold will show up in Northern Europe and the Eastern US in January.

Impacts

Talking about impacts, I was certainly impacted by the hurricane this morning in Boston with a falling tree just barely missing my house and me at my desk. Gusts reached 90mph in nearby Blue Hill! Hard to feel bullish about winter weather when your weather is more appropriate for Labor Day than Xmas.

I wanted to follow up with the discussion from the 4 Dec 2023 blog on snow forced cold atmospheric circulation including sudden stratospheric warmings (SSWs) and a negative NAO/AO. In that earlier blog I showed the six-step model starting with above normal snow cover

extent (SCE) across Eurasia in October and climaxing with an extended period of a negative AO with widespread cold and snow across the Northern Hemisphere (NH) continents, typically peaking in February. But this six-step model can be simplified to three steps 1) a tropospheric precursor, 2) an SSW and finally the completion of the cycle with 3) an extended period with a negative AO on average.

These three steps can be easily seen with figures I created with my former AER colleague Jason Furtado (and have previously been show in the blog). The first figure is shown in **Figure i**, which displays the composites of the AO (aka Northern Annular model or NAM) based on high minus low Eurasian October SCE. An SSW is represented by a negative AO or NAM in the stratosphere with relative high pressure in the Arctic and relative low pressure in the mid-latitudes as with the surface AO. The three steps are indicated with numbers in the plot. The tropospheric precursor period typically lasts 2-3 weeks (but can repeat) and is associated with regional cold due to high latitude blocking (most often in the Ural/Scandinavian region but can include Alaska). The second step or SSW formation is typically about 4 weeks and is often associated with relatively mild conditions due to the absence of high-latitude blocking. Finally, there is the extended negative AO or NAM period that can be up to six weeks in length (sometimes even longer) that is associated with more widespread cold across the NH continents with high latitude bocking in the Central Arctic and/or Greenland and or Alaska. This is shown for the extensive SCE scenario and negative AO but it is linear and is comparable for the low SCE positive AO scenario. This is shown in the bottom plot.

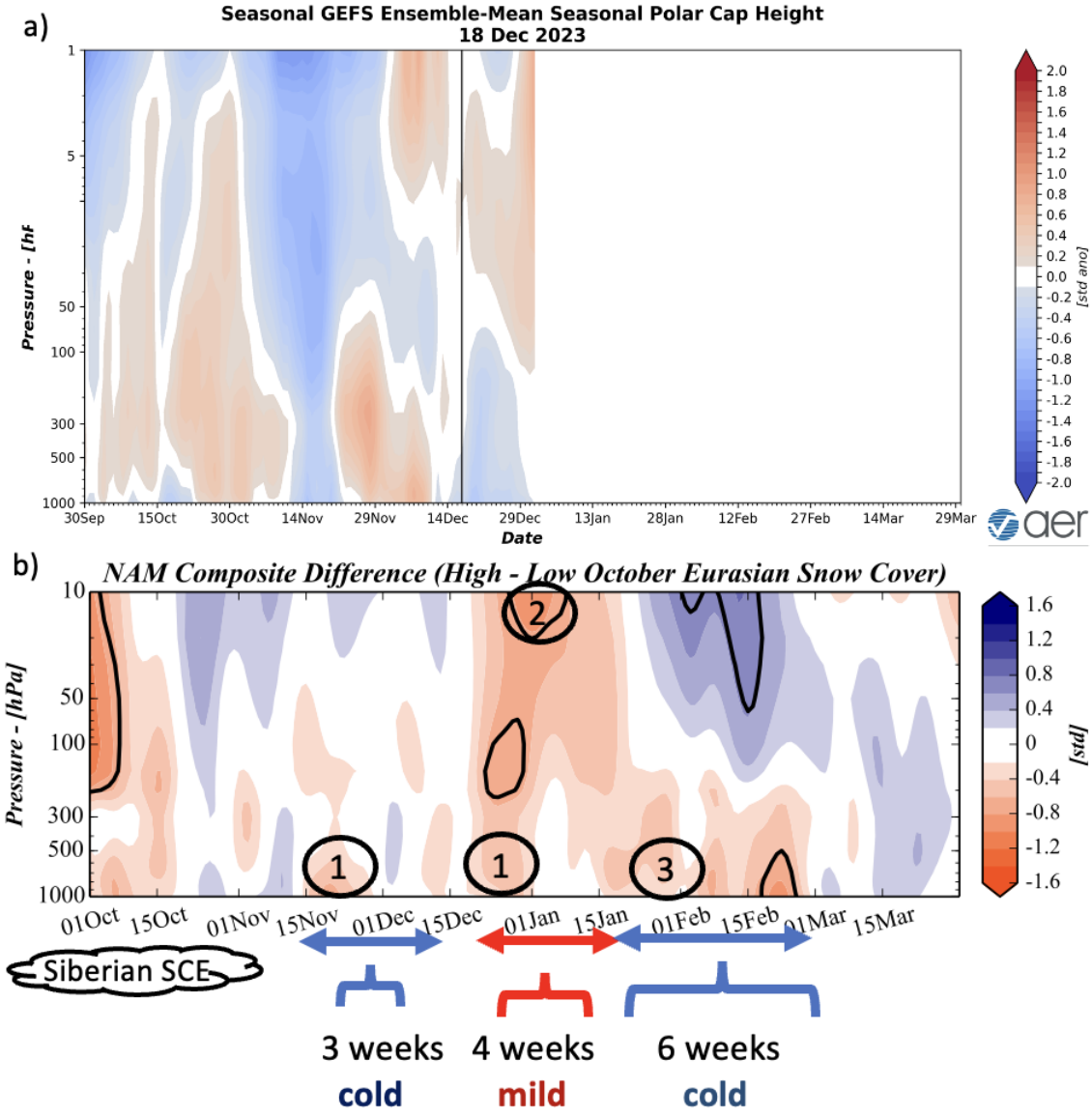

Figure i. **a)** Observed (since 1 October 2023) and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 18 December2023 GFS ensemble. **b)** Composite of NAM index for high minus low Eurasina October SCE. Also shown are the tropospheric precurosor (cold weather), the SSW (mild weather) and persistent negative surface NAM (cold weather).

On the top plot I show the polar cap geopotential height anomalies (PCHs) the same as in Figure 11 but the seasonal version for ease of comparison and comprehensiveness. The PCH anomalies is a good proxy for the NAM and for the purposes of this discussion should be considered synonymous. To first order look how nicely this year mirrors the idealized or average three step

troposphere-stratosphere-troposphere coupling derived using Eurasian SCE alone. Please keep in mind the top plot reaches up to 1 hPa and the bottom plot only to 10 hPa.

I doubt there are many boundary conditions or forcings can give you a similar composite with the possible exception of Arctic sea ice extent and Figure 2 from Kim et al. (2014) looks similar. In fact, if you composited over SSWs over the entire record, it wouldn't look the same. I know this from a paper in review that should be published soon. And out of respect for the authors that is all that I will say until it is published, and this is not the focus of the study, so I feel that I am not giving anything away.

In **Figure ii**, I show similar composites of vertical Wave Activity Flux (WAFz) derived from high minus low SCE also with the help of Jason Furtado. Once again, the idealized model based on SCE matches this year's active WAFz period. It is my opinion that SCE could not be that predictive or reflective of individual events if it was all nonsense but rather there must be a physical relationship.

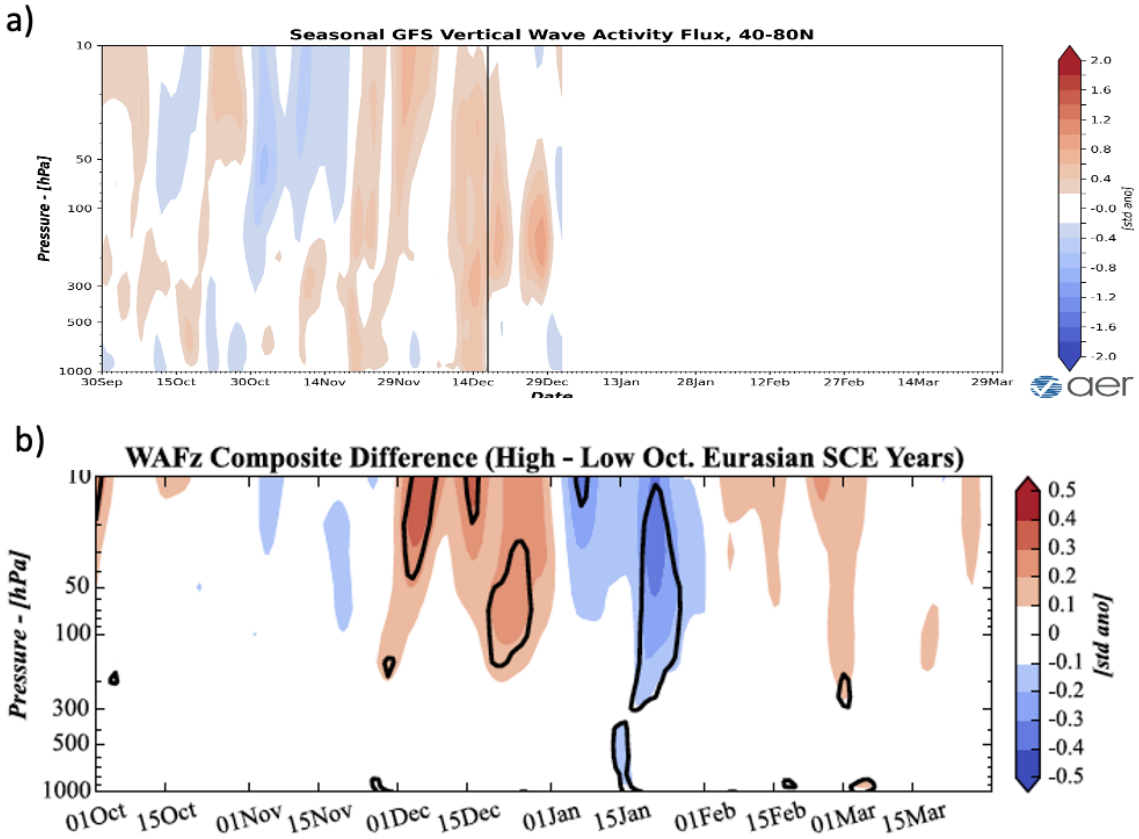

Figure ii. **a)** Observed and predicted daily vertical component of the wave activity flux (WAFz) standardized anomalies, averaged poleward of 40-80°N. The forecast is from the 00Z 18 December2023 GFS ensemble.**b)** Composite of WAFz for high minus low Eurasina October SCE.

The precursor cold brought cold to Northern Eurasia but mild conditions to North America (see **Figure iii**). But now as we enter the most active period of WAFz and the beginnings of an SSW of questionable magnitude we are entering a milder period hemispheric wide (see for example **Figures 6** & **9**). But if and when the negative AO in the stratosphere reaches the surface, cold weather should become more widespread across the NH and could potentially last well into February.

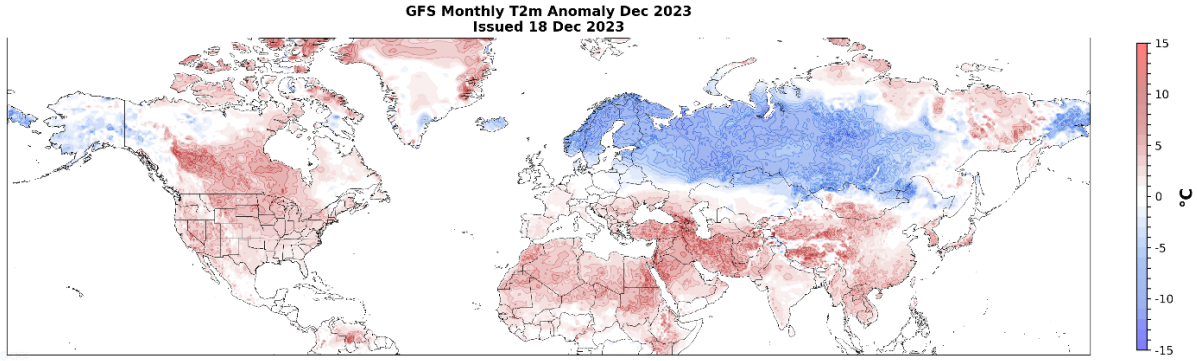

Figure iii. Estimate of the observed surface temperatures (°C; shading) from 1 – 18 December 2023 based on GFS initializations.

Two important take aways from these two plots. First my consistent forecast that an SSW was most likely in late December and early January was in large part supported by this analysis combined with the easterly quasi biennial oscillation and the positive snow advance index (SAI) this October. And this forecast is looking fairly prescient but obviously wouldn't work every winter. The other is that based on this analysis and how closely the PCH anomalies are following the NAM composites, we should expect the downward influence from the stratosphere should arrive into the troposphere in mid-January resulting in an increase in high-latitude blocking possibly including a possible negative AO/NAO. Regardless of the magnitude of the SSW, I still expect it to impact the weather across the Northern Hemisphere. But the extent and duration are very much an open question.

But here's the rub. SCE was only slightly above normal but has improved with an impressive extent in East Asia. Barents-Kara sea ice was below normal but only slightly though again I do think that the forcing has gotten somewhat stronger with time. But the weak forcing leaves the outcome at least in my mind in doubt and had larger anomalies of SCE and sea ice been observed this fall such as in 2012, I would be more confident in a major SSW (reversal of the zonal mean zonal winds at 60°N and 10hpa). In early January 2013 a major SSW was observed with long lasting impacts across the NH through March.

At a minimum a Canadian warming looks to be all but certain. I also believe that a minor SSW (rapid warming at the North Pole but no wind reversal is likely but the odds of whether the PV disruption reaches major warming criteria I put at 40/60 right now. Or in other words I feel the probability is greater that the SSW only achieves minor criteria and not major criteria. What

bothers me the most is that high-pressure ridging in the polar stratosphere forms over Canada but then seems content to just hang out and not move aggressively towards the North Pole based on the weather models predictions. But that can change. The model that seems to be the most aggressive with the SSW seems to be the ECMWF (see **Figure iv**).

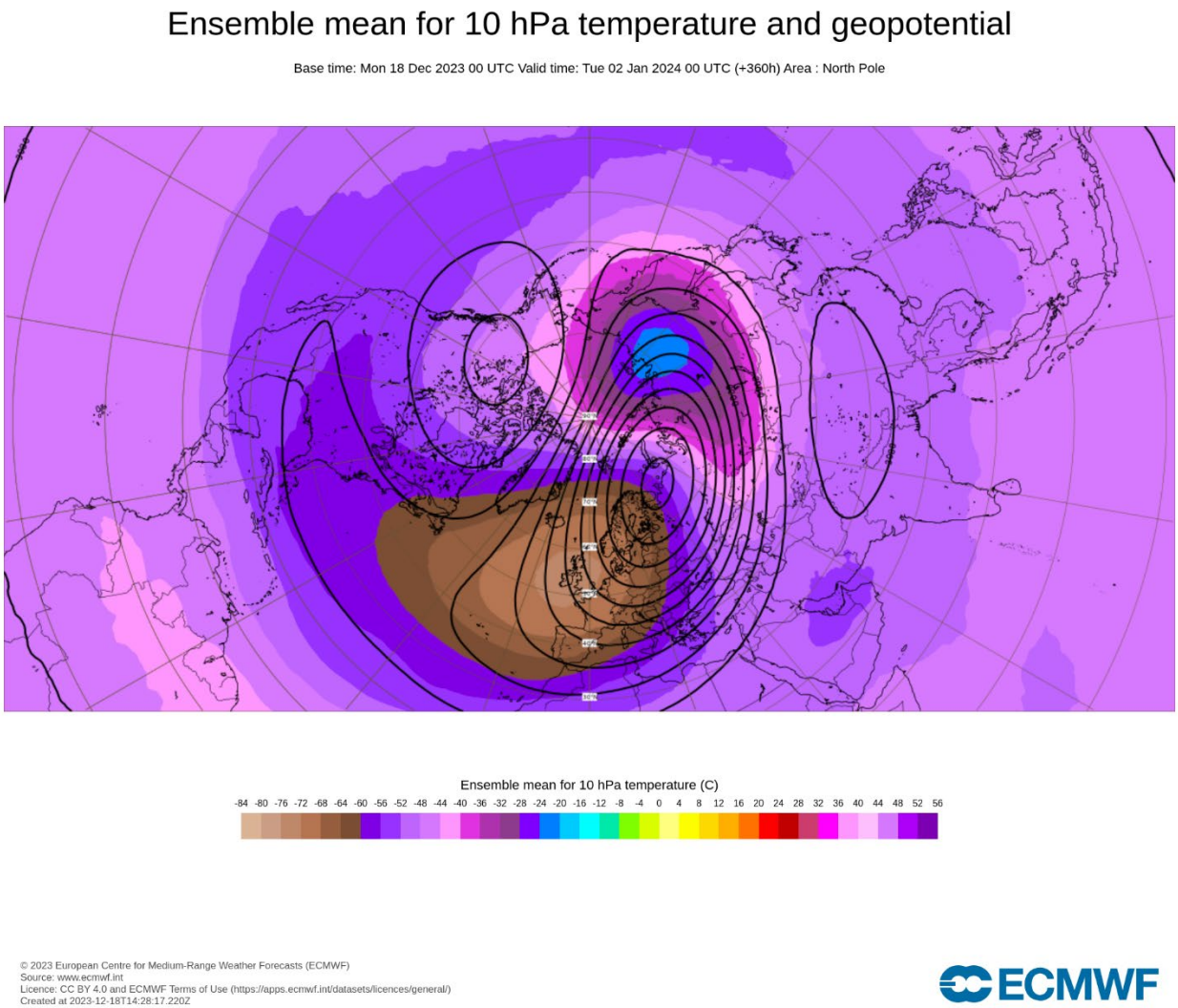

Figure iv. Chart shows 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere for 2 January 2024. Forecast from the initialized 18 December 2023 ECMWF ensemble. Plot taken from https://charts.ecmwf.int/

In addition, though the Ural blocking indeed has been a beast so far this month (see **Figure v**), it is predicted to fade quickly. I would have liked to have seen the Ural blocking persist somewhat longer but is completely gone in week two (see **Figure 8**). Seems that the forcing of an SSW may have short-circuited prematurely. Stronger Arctic forcing could have helped Ural blocking persist

for longer. But once again model forecasts struggle with Ural blocking and they could still be wrong.

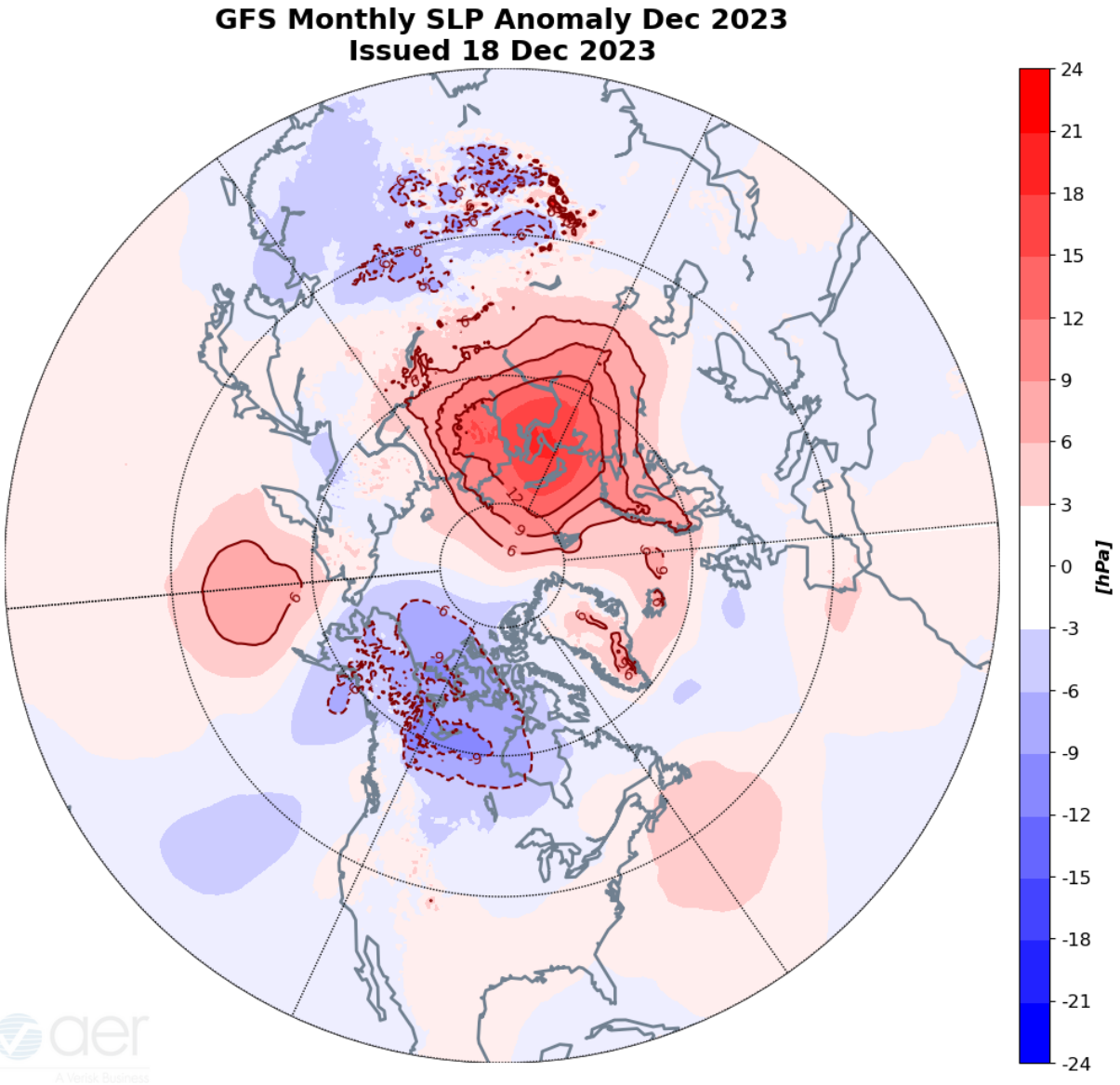

Figure v. Chart shows observed sea level pressure anomalies (hPa shading) for the Northern Hemisphere 1 – 18 December 2023 based on GFS initializations.

The strung-out appearance of the PV is what typically occurs before a PV split rather than a more compact PV during displacement. I think the potential is there for a PV split but so far not really showing up in the model forecasts.

It is my experience that the regions of precursor cold are different than the focus of the cold during the extended negative AO period but there are always exceptions. One great but painful

example for me is winter 2005/06. It was cold in the Eastern US in December with the precursor cold but then the cold transferred to Eurasia in January coinciding with a major SSW never to return to the Eastern US. And ironically in January 2006 a tree fell on my car at work during a summer like squall in January. And today a tree fell on my property narrowly missing my house. So maybe history doesn't repeat itself, but it often rhymes (Mark Twain).

Based on the PV forecasts I feel that Northern Eurasia including Northern Europe are at the highest risk of seeing the return of cold as early as the first or second week of January. I expect to see a mid-tropospheric reflection of the PV center over Northern Eurasia.

As far as North America, I think the overall mild pattern continues with an important caveat, the pattern seems to highlight a greater risk for a snowstorm more than cold temperatures for the Eastern US. The models are teasing us with the same thought. It is important to keep in mind that an SSW does create a favorable background for wave reflection or a stretched PV with easterly winds in the polar stratosphere at least regionally. The latest wave diagnostics are showing wave reflection (see **Figure vi**) so something to monitor. That scenario is likely the fastest mechanism to deliver unseasonable cold to the Eastern US in January.

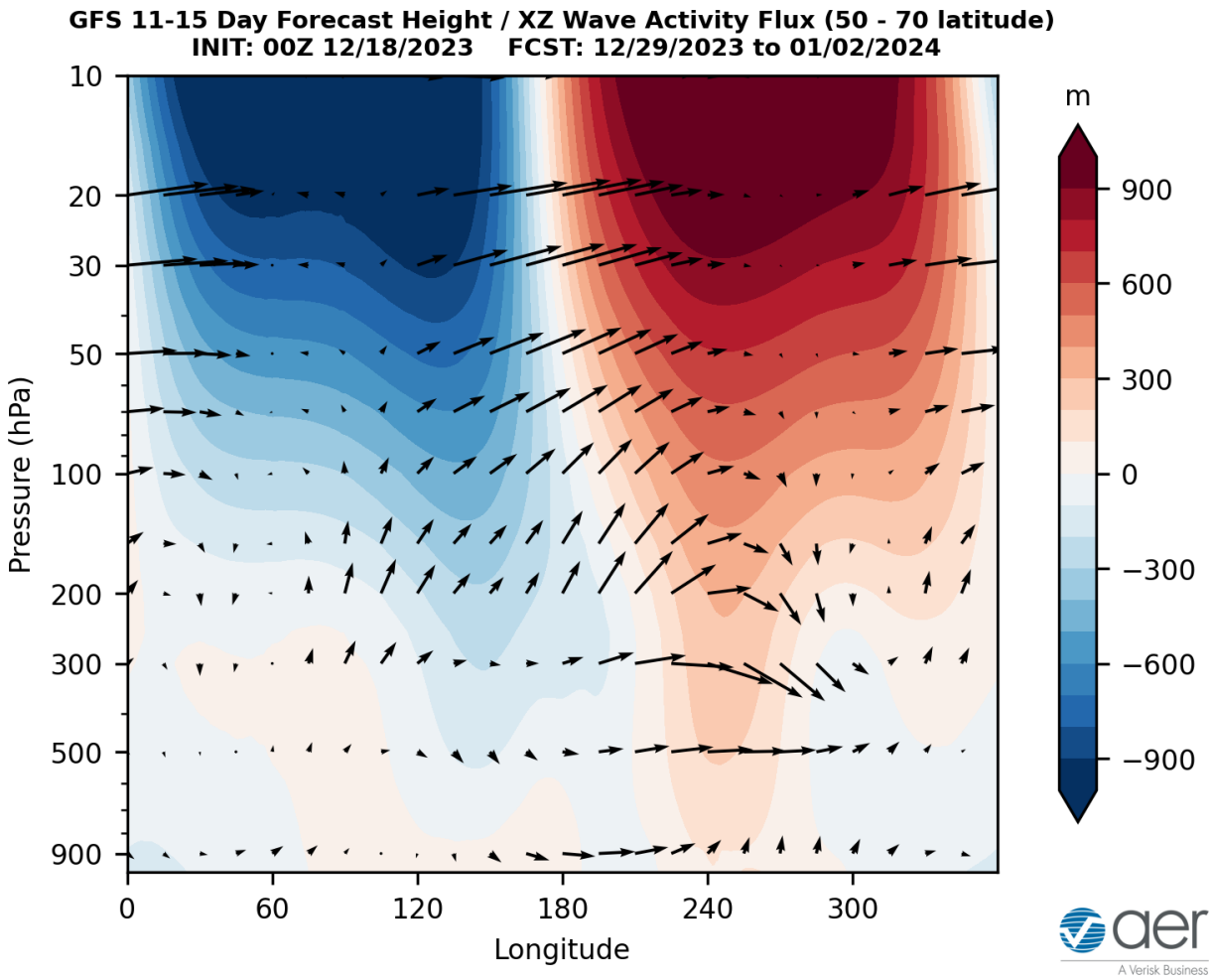

Figure vi. Longitude-height cross section of geopotential eddy height anomalies (shading) and wave activity flux (vectors) forecasted for 28 December 2023 – 2 January 2024. The forecasts are from the 00z 18 December 2023 GFS ensemble.

I am sure most who read the blog know that I love snow, cold is more of a means to an end. So right now, I am not too excited about the remainder of the winter. On the upside though, I am liking more and more our winter forecast posted last month on the blog, but I am rooting for it to be wrong.

Near-Term

This week

The AO is predicted to be positive this week **(Figure 1**) with widespread negative 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 period as well.

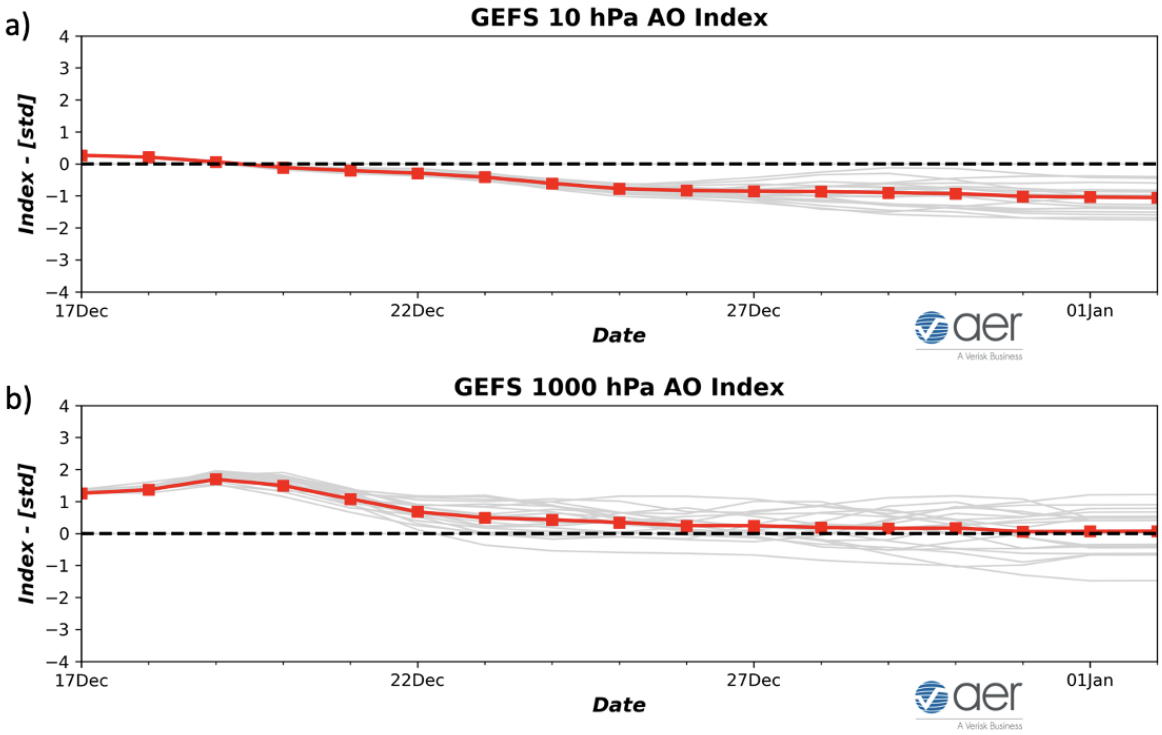

Figure 1. (a) The predicted daily-mean AO at 1000 hPa from the 00Z 18 December 2023 GFS ensemble. (b)The predicted daily-mean near-surface AO from the 00Z 18 December 2023 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble-mean AO index given by the red line with squares.

Troughing/negative geopotential height anomalies across the North Atlantic Arctic including Greenland will support ridging/positive geopotential height anomalies across much of Europe with the exception of troughing/negative geopotential height anomalies across Northern Europe this week (**Figures 2). T**he pattern favors widespread normal to above normal temperatures across Europe including the UK with the exception of normal to below normal temperatures across Scandinavia mostly due to low heights (**Figure 3**). Ridging/positive geopotential height anomalies are predicted across Western and Central Asia with troughing/negative geopotential height anomalies across Eastern Asia this period (**Figure 2**). This pattern favors widespread normal to above normal temperatures across much of Western, Northern and Southern Asia with normal to below normal temperatures across East Asia **(Figure 3**).

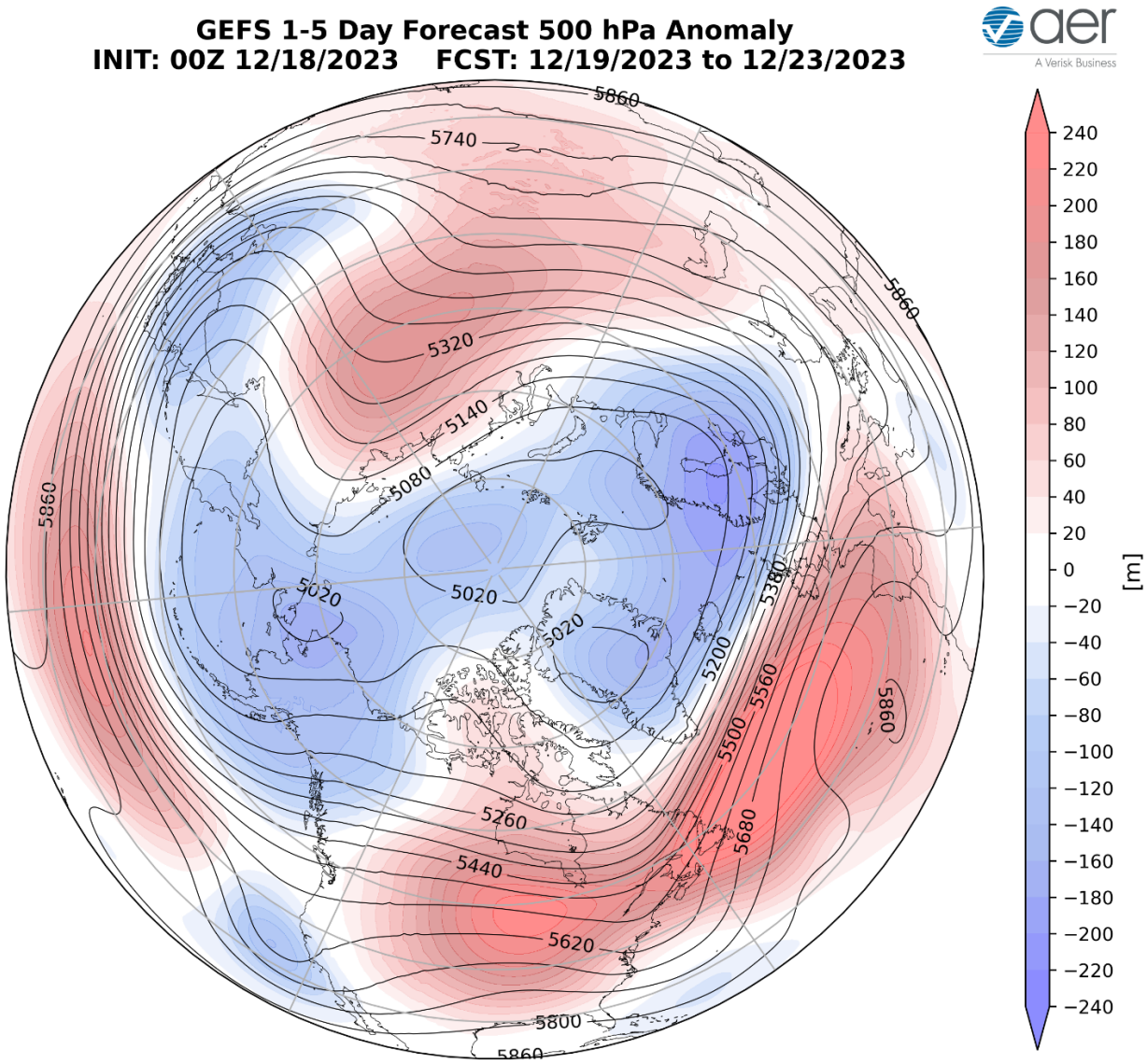

Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 19 December – 23 December 2023. The forecasts are from the 00z 18 December 2023 GFS ensemble.

The pattern this week across North America is troughing/negative geopotential height anomalies across Alaska and the Gulf of Alaska forcing across ridging/positive geopotential height anomalies across Canada and the US with the exception of more troughing in Baffin Bay **(Figure 2).** This pattern will favor normal to above normal temperatures across much of Canada and the US with normal to below normal temperatures limited to Alaska and far northwestern Canada **(Figure 3).**

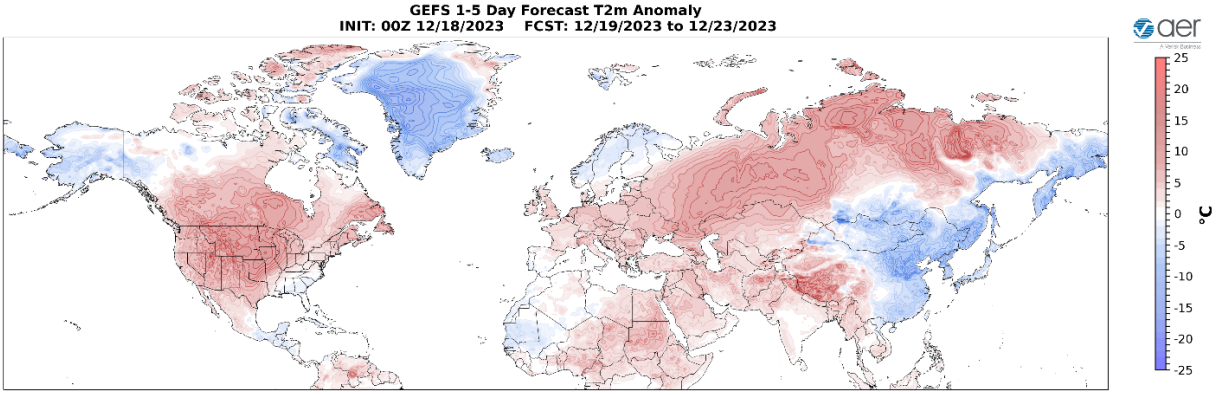

Figure 3. Forecasted surface temperature anomalies (°C; shading) from 19 December – 23 December 2023. The forecast is from the 00Z 18 December 2023 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Scandinavia, the Alps, Siberia and Japan while mild temperatures will support snowmelt across Finland and Western Russia this week (**Figure 4**). Troughing and/or cold temperatures will support new snowfall across Southern Alaska and Canada while mild temperatures will support snowmelt across Southwestern Canada, the US Rockies and Ontario this week (**Figure 4**).

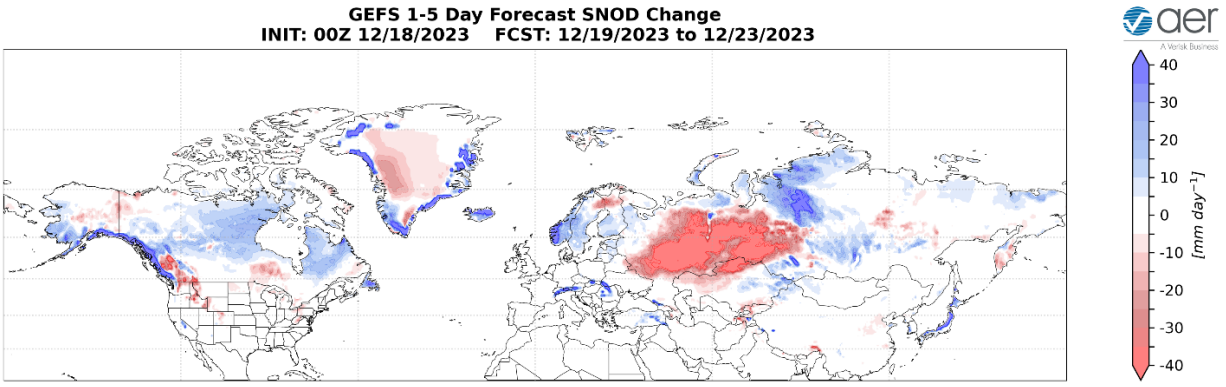

Figure 4. Forecasted snow depth changes (mm/day; shading) from 19 December – 23 December 2023. The forecast is from the 00Z 18 December 2023 GFS ensemble.

Near-Mid Term

Next week

With mostly negative geopotential height anomalies across the Arctic and with mixed geopotential height anomalies across the mid-latitudes this period (**Figure 5**), the AO should remain positive this period (**Figure 1**). With predicted negative pressure/geopotential height anomalies across Greenland (**Figure 5**), the NAO will also remain positive this period as well.

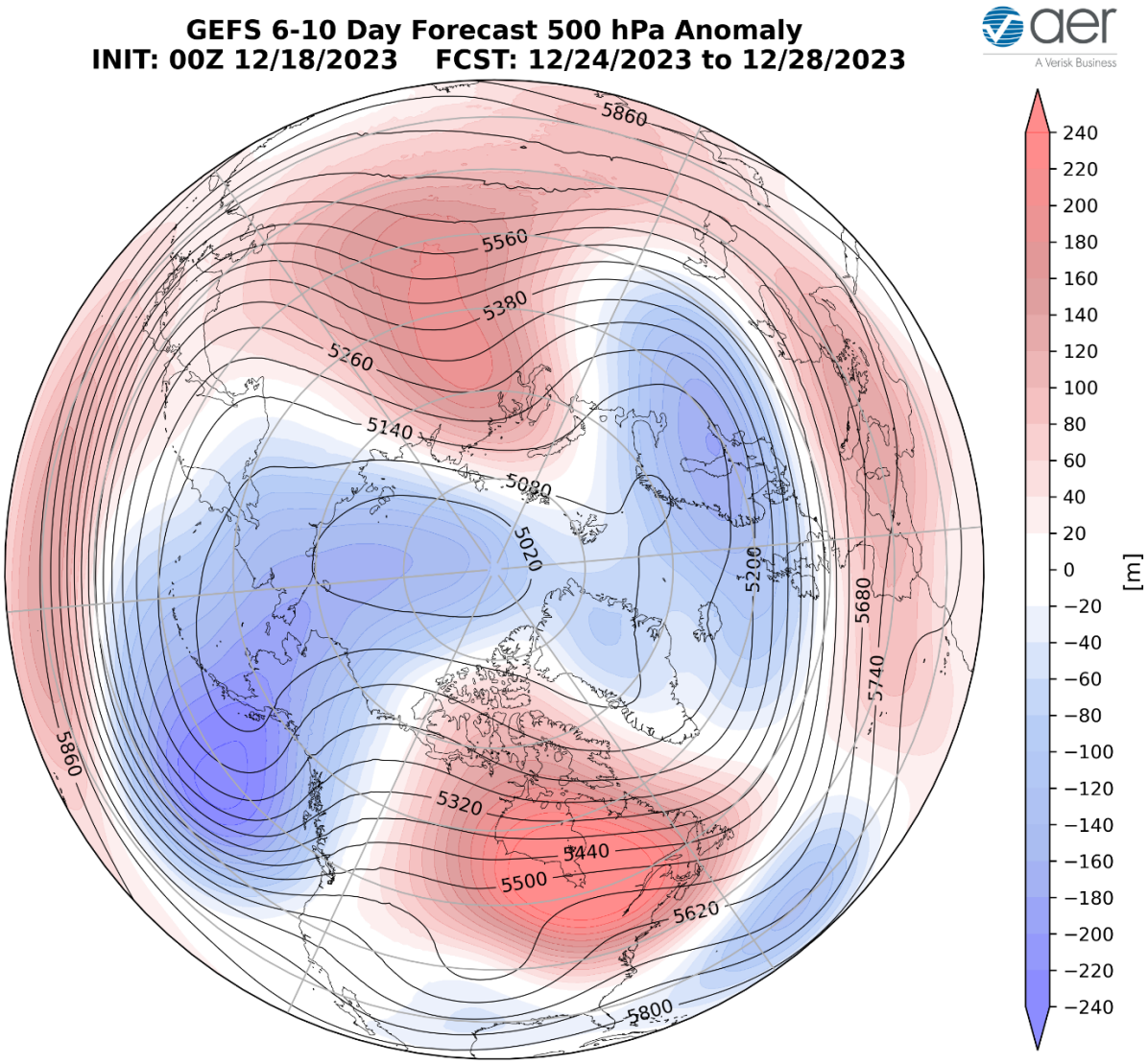

Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 24 – 28 December 2023. The forecasts are from the 00z 18 December 2023 GFS ensemble.

Persistent troughing/negative geopotential height anomalies across the North Atlantic, Greenland and Northern Europe will support widespread ridging/positive geopotential height anomalies across the remainder of Europe this period (**Figure 5**). The zonal pattern will favor widespread normal to above normal temperatures across Northern and Eastern Europe including the UK the exception of normal to below normal temperatures across Scandinavia due to low heights (**Figures 6**). Ridging/positive geopotential height anomalies will persist across Western and Central Asia with troughing/negative geopotential height anomalies limited to Northeastern Asia this period (**Figure 5**). This pattern favors widespread normal to above normal temperatures across much of Asia including Siberia with normal to below normal temperatures limited to Eastern Siberia and coastal China, Korea and Japan this period (**Figure 6**).

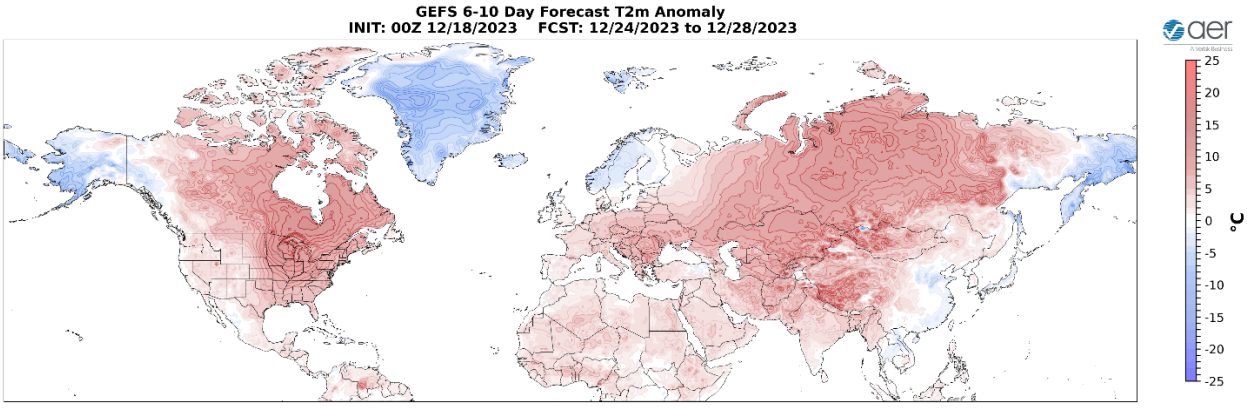

Figure 6. Forecasted surface temperature anomalies (°C; shading) from 24 – 28 December 2023. The forecasts are from the 00z 18 December GFS ensemble.

The predicted general pattern across North America this period is troughing/negative geopotential height anomalies across Alaska and the Gulf of Alaska forcing ridging/positive geopotential height anomalies across much of North America with the exception of more troughing in the Southcentral US (**Figure 5**). This pattern favors widespread normal to above normal temperatures across much of Canada and the US with normal to below normal temperatures limited to Alaska and Northwestern Canada (**Figure 6**).

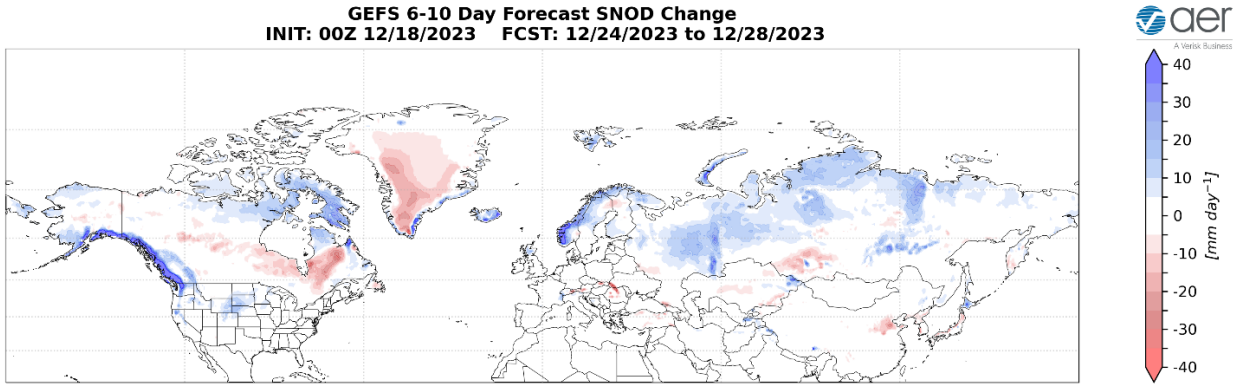

Figure 7. Forecasted snow depth changes (mm/day; shading) from 24 – 28 December 2023. The forecast is from the 00Z 18 December 2023 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Norway and Northern Asia while mild temperatures will support snowmelt in Central Asia and Eastern China this period (**Figure 7**). Troughing and/or cold temperatures will support new snowfall across southern Alaska, the West Coast of Canada, Northeastern Canada and the higher elevations of the Western US while mild temperatures will support snowmelt in in Southern Canada this period (**Figure 7**).

Mid Term

Week Two

\With persistent negative geopotential height anomalies across the Arctic and mixed geopotential height anomalies across the mid-latitudes this period (**Figure 8**), the AO should remain positive this period (**Figure 1**). With predicted negative pressure/geopotential height anomalies across Greenland (**Figure 8**), the NAO should remain positive as well this period.

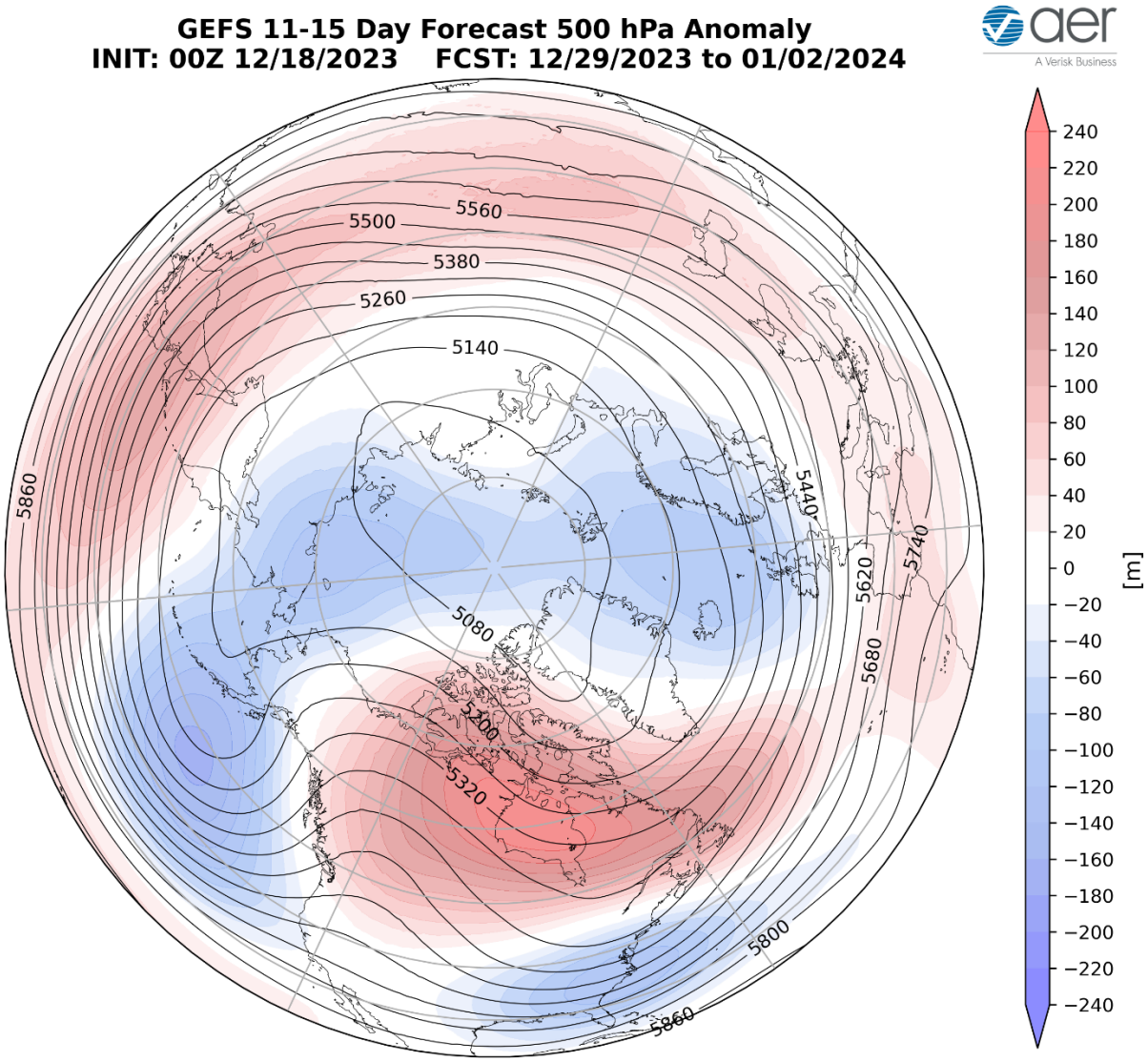

Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 28 December 2023 – 2 January 2024. The forecasts are from the 00z 18 December 2023 GFS ensemble.

The predicted pattern for Europe this period is ongoing zonal flow pattern with troughing/negative geopotential height anomalies across Northern Europe and ridging/positive geopotential height anomalies across Southern Europe this period (**Figure 8**). This pattern should favor normal to above normal temperatures across most of Europe including the UK with normal to below normal temperatures limited to Scandinavia this period (**Figures 9**). The zonal flow originally in Europe is predicted to make its way completely across Asia as well with ridging/positive geopotential height anomalies across Southern Asia and troughing/negative geopotential height anomalies across Northern Asia this period (**Figure 8**). The predicted pattern favors widespread normal to above normal temperatures widespread across Asia with the exception of normal to below normal temperatures across Eastern Siberia this period (**Figure 9**).

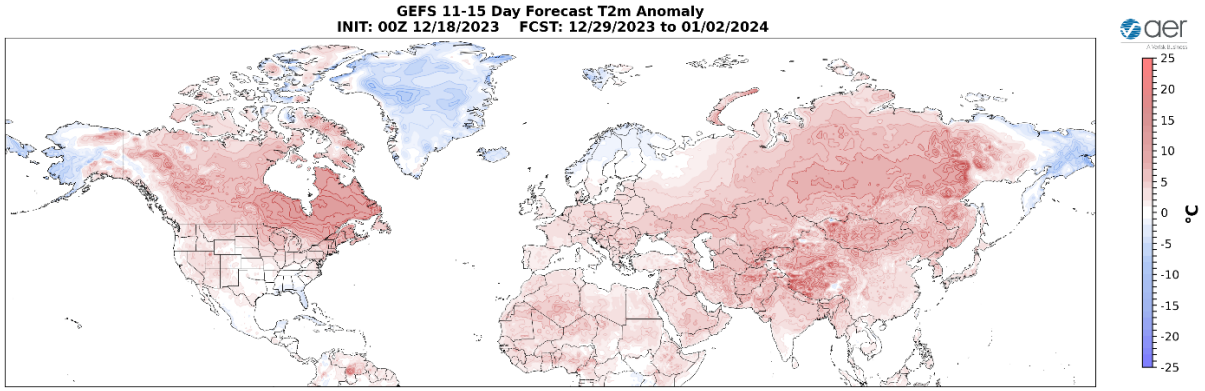

Figure 9. Forecasted surface temperature anomalies (°C; shading) from 29 December 2023 – 2 January 2024. The forecasts are from the 00z 18 December 2023 GFS ensemble.

Persistent troughing/negative geopotential height anomalies in the Gulf of Alaska will continue to force ridging/positive geopotential height anomalies across much of Canada and the Western US with deepening troughing/negative geopotential height anomalies in the Eastern US this period (**Figure 8**). This pattern favors widespread normal to above normal temperatures across much of Canada and the US with normal to below normal temperatures limited to Alaska and the Southeastern US (**Figure 9**).

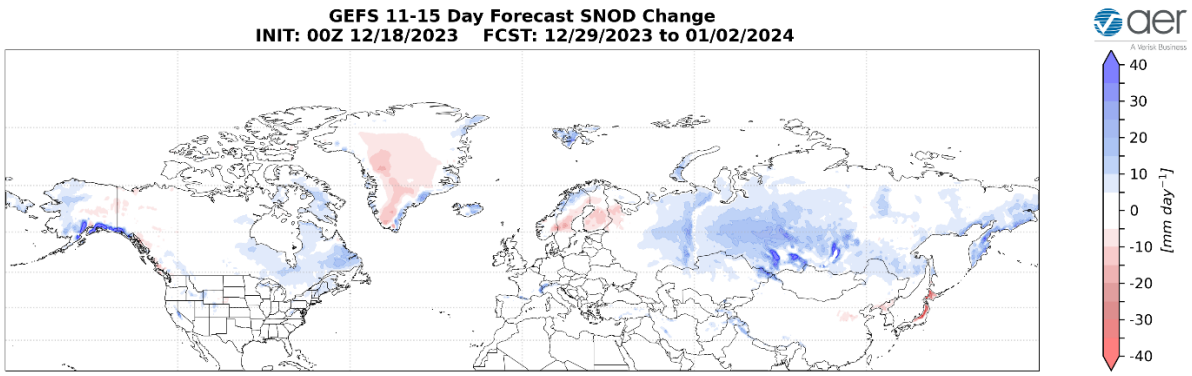

Figure 10. Forecasted snow depth changes (mm/day; shading) from 28 December 2023 – 2 January 2024. The forecast is from the 00Z 18 December 2023 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Norway and Siberia while mild temperatures will support snowmelt around the Baltic Sea and Japan this period (**Figure 10**). Troughing and/or cold temperatures will support new snowfall across western Alaska and Northeastern Canada and the higher elevations of the Western US. Mild temperatures will support snowmelt in eastern Alaska this period (**Figure 10**).

Longer Term

30–day

The latest plot of the polar cap geopotential height anomalies (PCHs) currently shows cold/negative PCHs in the troposphere with near normal PCHs in the stratosphere (**Figure 11**). However, next week PCHs in the stratosphere are predicted to become increasingly warm/positive associated with another Canadian warming and then a sudden stratospheric warming (**Figure 11**).

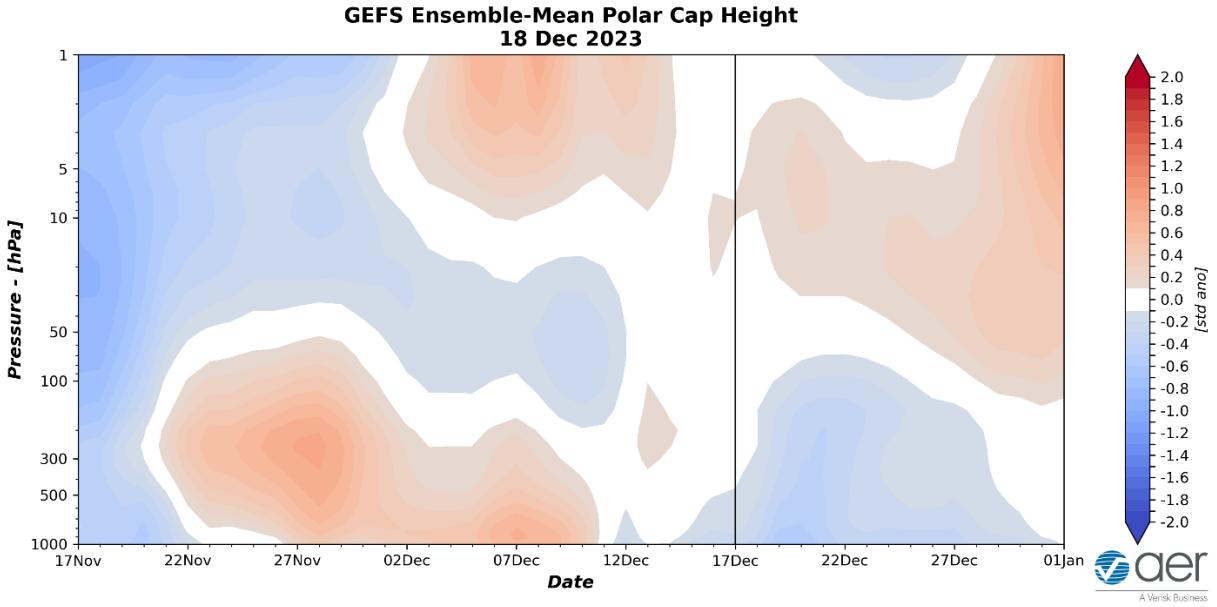

Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 18 December2023 GFS ensemble.

The predicted neutral to cold/negative PCHs in the lower troposphere for the next two weeks (**Figure 11**) are consistent with the predicted positive surface AO the next two weeks (**Figure 1**).

Also shown in **Figure 1** is the stratospheric AO. The stratospheric AO is currently near neutral and is predicted to dip negative the next two weeks. This is consistent with increasingly warm/positive stratospheric PCHs. The forecast of warming PCHs likely signals an increasing likelihood of at least the beginnings of a sudden stratospheric warming in late December.

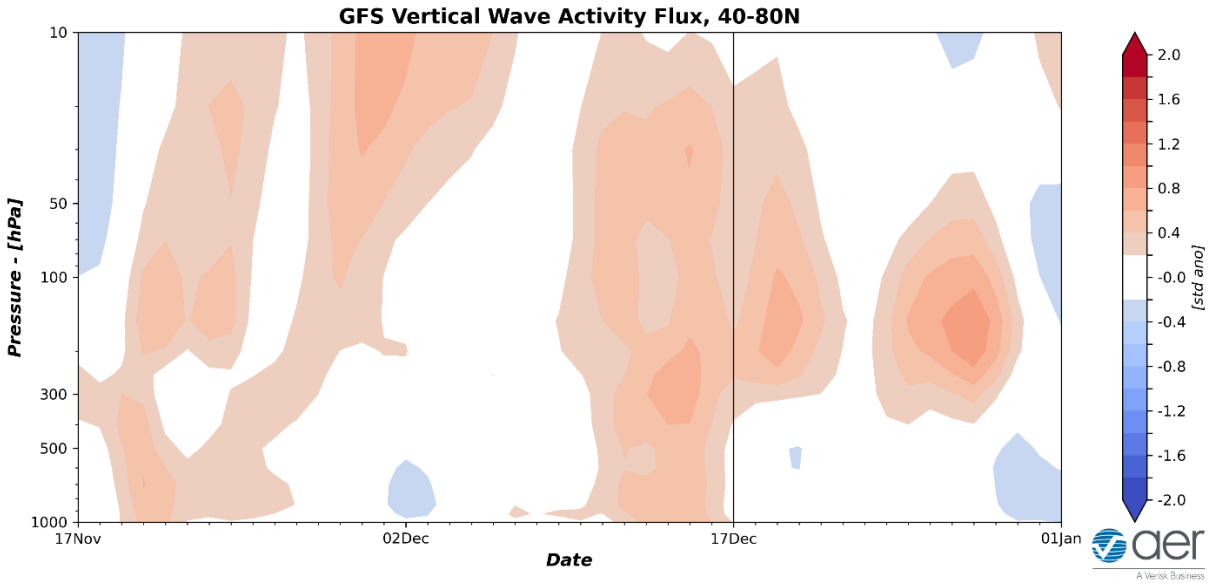

Figure 12. Observed and predicted daily vertical component of the wave activity flux (WAFz) standardized anomalies, averaged poleward of 40-80°N. The forecast is from the 00Z 18 December2023 GFS ensemble.

Vertical Wave Activity Flux (WAFz) from the troposphere to the stratosphere or poleward heat transport in the stratosphere has become more active since mid-November (**Figure 12**). This has resulted in the in brief and minor PV disruptions (**Figure 12**) and the return of the stratospheric AO to neutral (**Figure 1**). Over the next two weeks the WAFz is predicted to become even more active (**Figure 12**), which should result in the commencement of a sudden stratospheric warming.

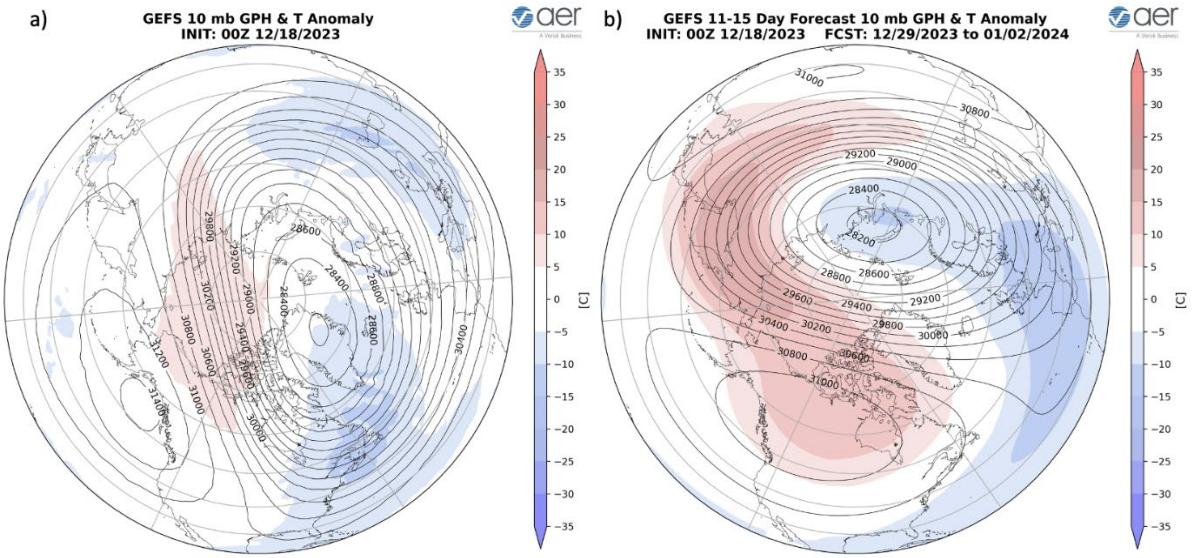

Figure 13. (a) Initialized 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere for 18 December 2023 . (b)

Same as (a) except forecasted averaged from 28 December 2023 – 2 January 2024. The forecasts are from the 00Z 18 December 2023 GFS model ensemble.

Currently the polar vortex (PV) is elongated in shape with the PV center shifted south of the North Pole in the direction of Greenland (**Figure 13a**). This elongated PV configuration is predicted oriented along an axis from Siberia to Central Canada. Across North America a ridge is centered near Alaska with the strongest warming aimed at Northern Canada. Though this stretched PV configuration favors colder temperatures east of the Rockies, warm temperatures continue to dominate across North America. But cold temperatures are observed across East Asia as common with stretched PVs. Next week the PV center slides towards Eurasia with an elongated shape but now oriented from Siberia towards Europe> also warming in the polar stratosphere is aimed at Northern Canada characteristic of a Canadian warming (**Figure 13b**). Though with time the warming should become more directed towards the North Pole.

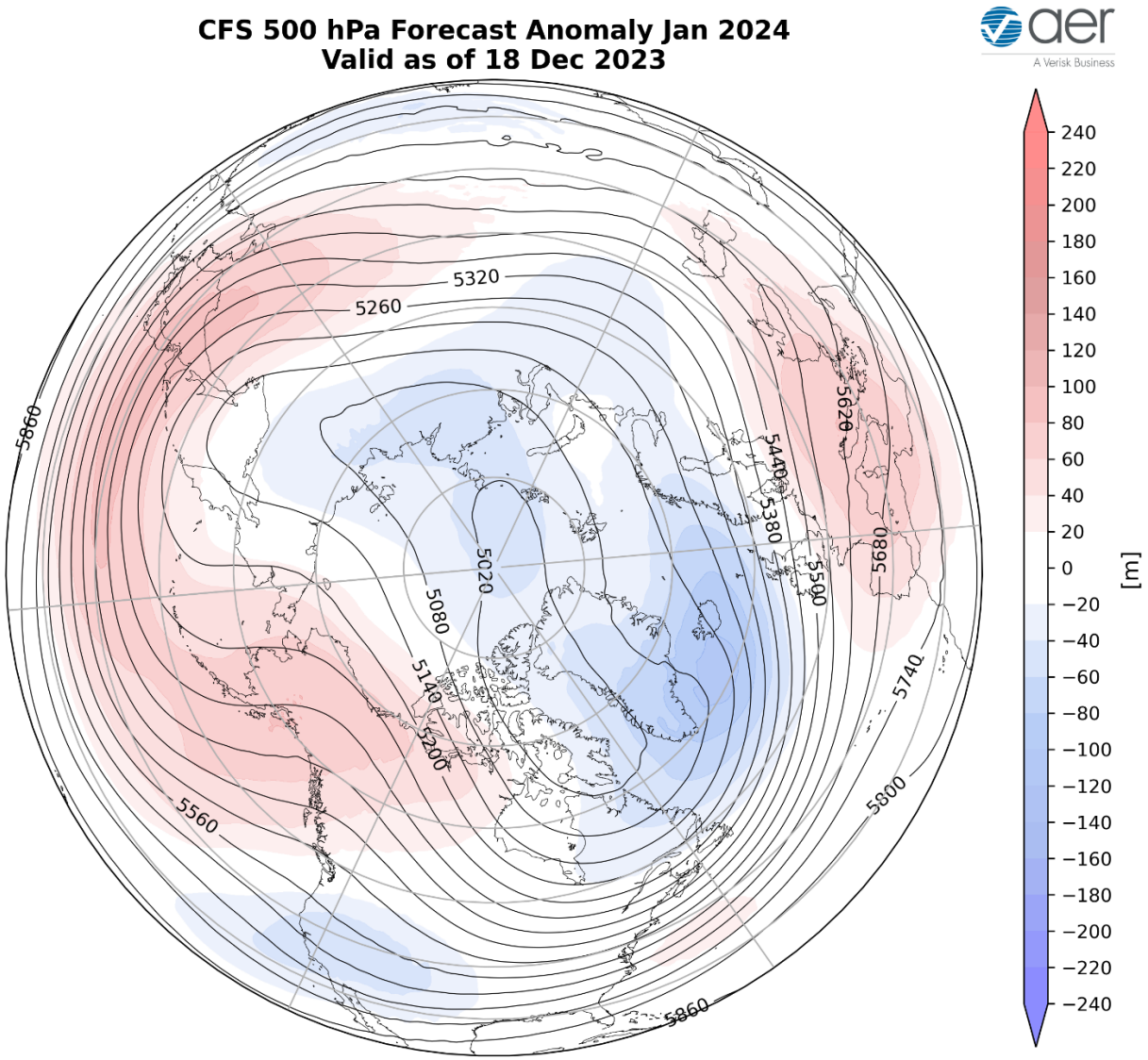

Figure 14. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for January 2024. The forecasts are from the 00Z 18 December 2023 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 14**) and surface temperatures for January (**Figure 15**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging across Southern Europe, Eastern Siberia, Alaska and Western Canada with troughing in Northern Europe, the Urals, the Laptev Sea, Siberia, Northeast Asia, the Western US and eastern North America (**Figure 14).** This pattern is consistent with a stretched PV in January. Regardless this pattern favors seasonable to relatively warm temperatures across much of Europe, Southern and Central Asia, Eastern Siberia, Alaska and Western Canada with seasonable to relatively cold temperatures across Scandinavia, Siberia, Northeast Asia, Eastern Canada and much of the US (**Figure 15**)**.**

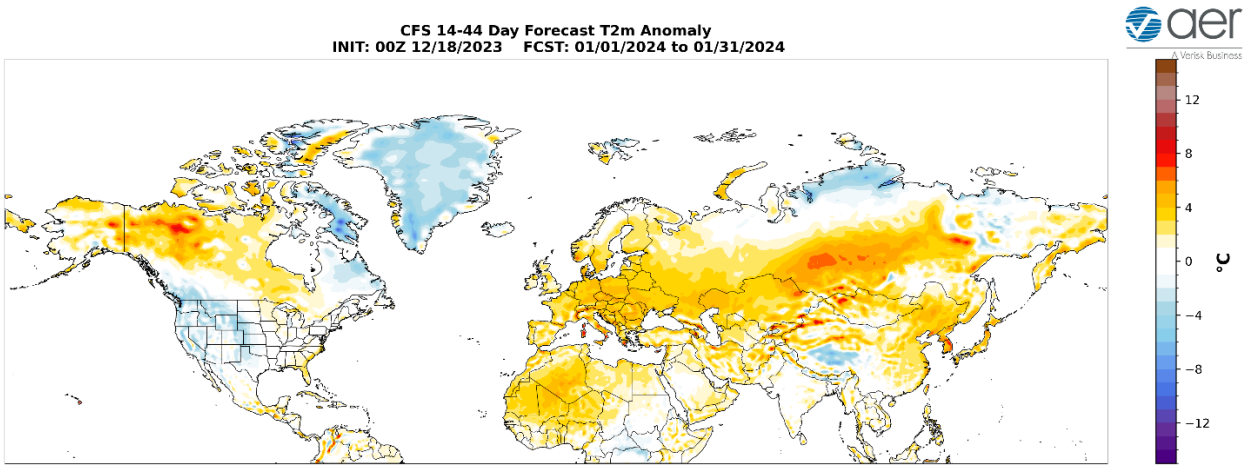

Figure 15. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for January 2024. The forecasts are from the 00Z 18 December 2023 CFS.

Arctic sea ice extent

Arctic sea ice extent returned to growing more normally this week. I continue to expect that the negative sea ice anomalies will become more focused in the North Atlantic sector, and that is looking more likely. Blocking in the Barents-Kara sea region is critical ffor weakening the PV that favorable for widespread and meaningful cold in Northern Eurasia and eastern North America, whihc can persist for weeks. Outside the Arctic the sea ice is well below normal in Hudson Bay and could be contributing to above normal temperatures in Eastern Canada. But the ice has finally made good progress this week.

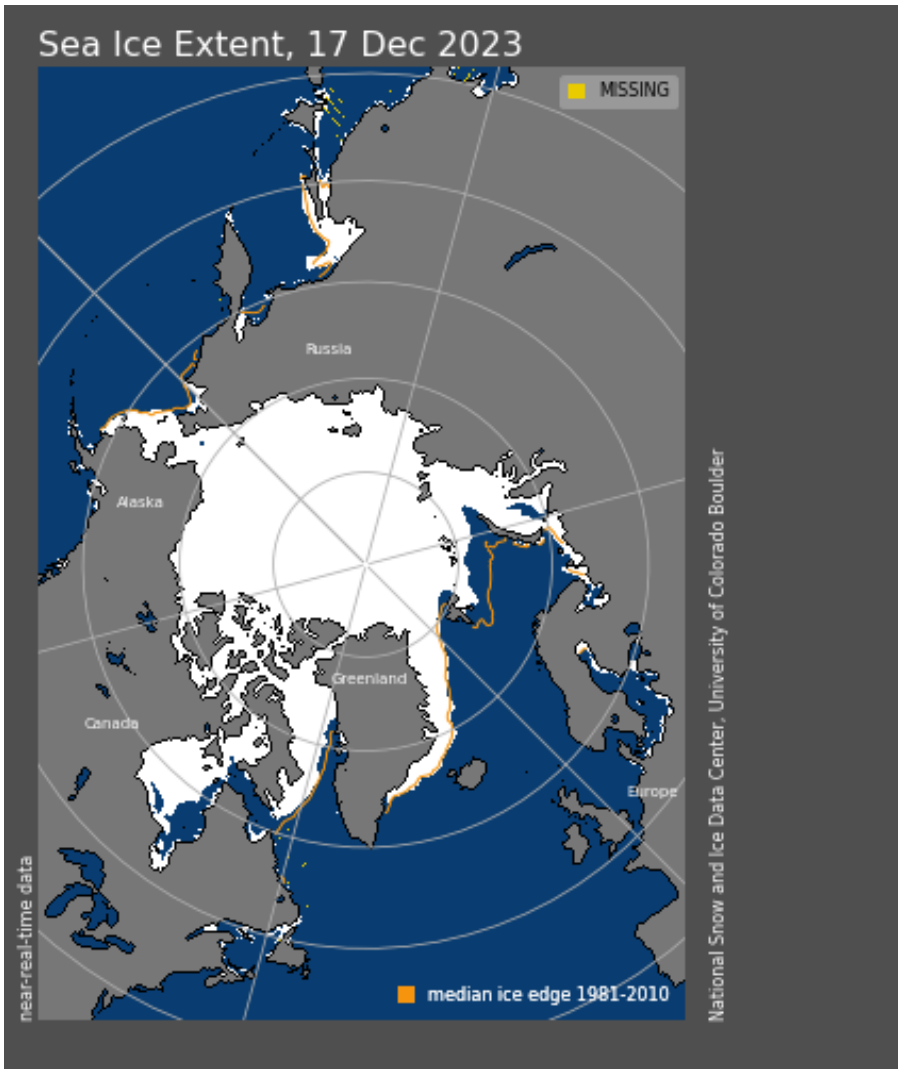

Figure 16. Observed Arctic sea ice extent on 10 December 2023 (white). Orange line shows climatological extent of sea ice based on the years 1981-2010. Image courtesy of National Snow and Ice Data Center (NSIDC). Snow and Ice Data Center (NSIDC).

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies are well above normal, especially along the South America coast, indicating that anEl Niño is pertty much a sure thing (**Figure 17)** and El Niño conditions are expected through the winter. Observed SSTs across the NH remain well above normal especially in the central North Pacific (west of recent years), the western North Pacific, the eastern North Atlantic and offshore of eastern North America though below normal SSTs exist regionally especially in the South and North Pacific and the North Atlantic.

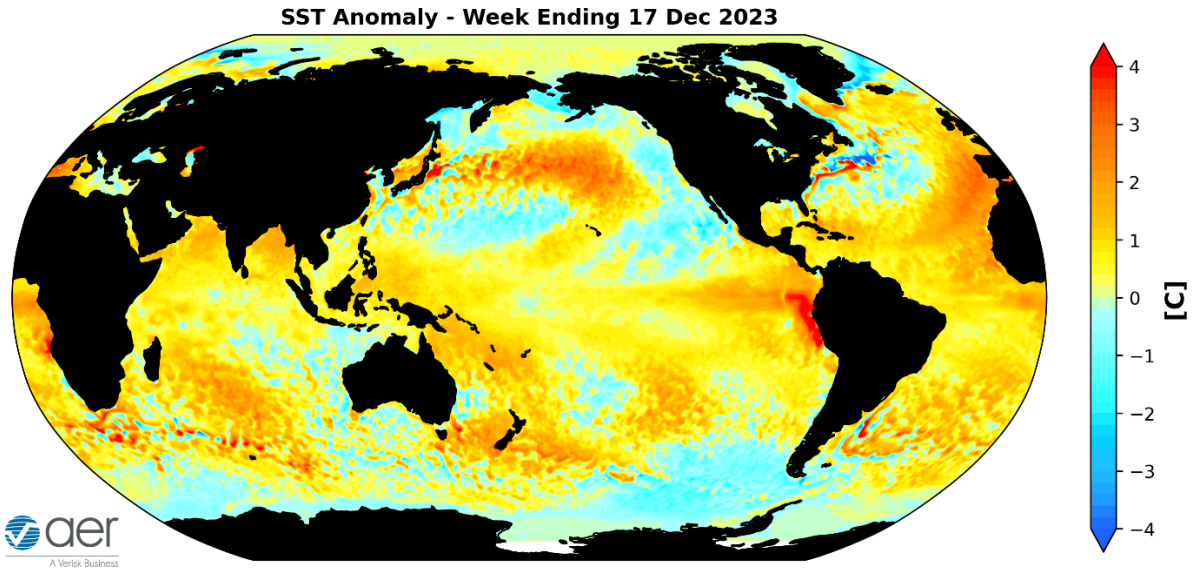

Figure 17. The latest weekly-mean global SST anomalies (ending 17 December 2023). Data from NOAA OI High-Resolution dataset.

Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is in phase seven (**Figure 1**). The forecasts are for the MJO to weaken where no phase is favored and thenemerge in phase one. Phases seven through one favor ridging near Alaska and troughing in the US and then eventually just the Western US. Therefore it seems that the MJO could be having some limited influence on North American weather the next two weeks. But admittedly this is outside of my expertise.

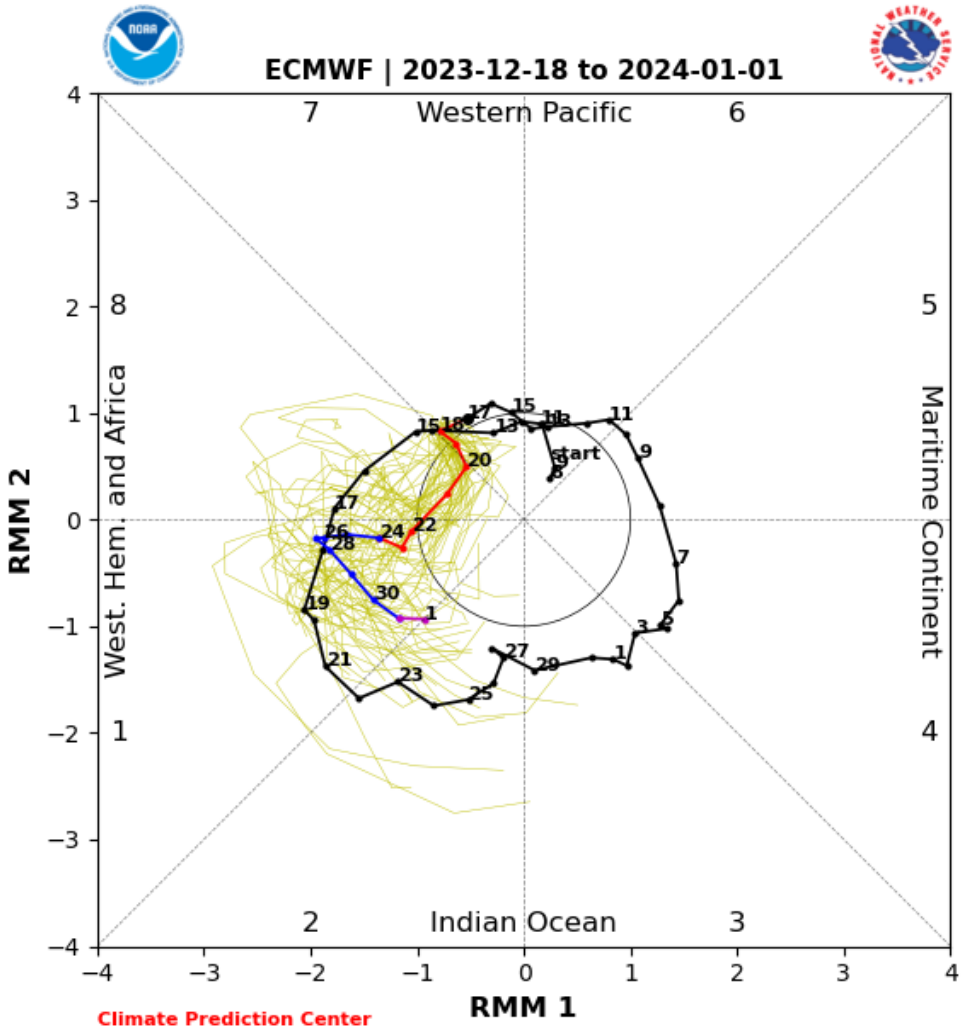

Figure 18. Past and forecast values of the MJO index. Forecast values from the 00Z 18 December 2023 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model "spread" is denoted by the gray shading. Sector numbers indicate 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/clivar_wh.shtml

Get Detailed Seasonal Weather Intelligence with sCast

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

Dr. Cohen’s detailed monthly seasonal forecast, sCast, is also available for purchase. sCast provides a monthly 30-60-90-180-day outlook into temperature and precipitation, solar flux and wind anomalies across the globe, and regional population weighted cooling and heating degree forecasts for the US.

Our sCast principal engineer, Karl Pfeiffer, can help you use sCast and other AER seasonal forecast products to deliver important, long-lead time weather intelligence to your business. Please reach out to Karl today!