Arctic Oscillation and Polar Vortex Analysis and Forecasts

January 2, 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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Summary

- The Arctic Oscillation (AO) is currently neutral and is predicted to be increasingly negative the next two weeks as pressure/geopotential height anomalies across the Arctic are currently mixed and are predicted to become increasingly positive over the next two weeks. The North Atlantic Oscillation (NAO) is currently neutral with weak and mixed pressure/geopotential height anomalies across Greenland and the NAO is predicted to trend negative the next two weeks as pressure/geopotential height anomalies become increasingly positive across Greenland.
- The next two weeks, strengthening ridging/positive geopotential height anomalies across the northern North Atlantic including Greenland will force deepening troughing/negative geopotential height anomalies across much of Europe the next two weeks with some residual ridging/positive geopotential height anomalies across Southern and Western

Europe this week only. This pattern will support this week normal to above normal temperatures across Southern and Western Europe including the United Kingdom (UK) with normal to below normal temperatures across Northern and Eastern Europe but then next week cold temperatures will spread south and west and cover much of Europe including the UK.

- The next two weeks, strengthening ridging/positive geopotential height anomalies across Greenland will force deepening troughing/negative geopotential height anomalies across Northern Asia with ridging/positive geopotential height anomalies across Central Asia. This pattern generally favors widespread normal to above normal temperatures across Southern and Eastern Asia with normal to below normal temperatures across Northern and Western Asia this week.
- The general predicted pattern across North America the next two weeks is strengthening ridging/positive geopotential height anomalies across Greenland and Alaska forcing deepening troughing/negative geopotential height anomalies across the interior of North America especially Western Canada and the United States (US) with ridging/positive geopotential height anomalies across most of Canada. This pattern favors widespread normal to above normal temperatures across North America with normal to below normal temperatures mostly limited to Northern Canada spreading south next week across Western Canada and the Western US with normal to above normal temperatures across Eastern Canada and the Eastern US.
- in the Impacts section I discuss the multiple polar vortex (PV) disruption in rapid succession and the impact on Northern Hemisphere (NH) weather.

Plain Language Summary

Colder weather is on the move across the Hemisphere (NH) continents. The coldest temperatures are found around the Baltic Sea and Northwestern Russia but will expand across much of Europe (see **Figure 6**). A relatively minor perturbation of the polar vortex (PV) where it stretches out like a rubber band to end the month will bring colder temperatures to Western Canada and the Western US (see **Figure 9**).

Really complicated what to expect but I picked January 2011 as the best analog. Some important differences from this January but please look at **Figure vi** for a rough first guess.

And I am trying my best to keeping a rallying score of the observed surface temperatures for this winter. Scandinavia and northwest Russia are the clear winners if you enjoy the cold. Alaska gets an honorable mention. See below.

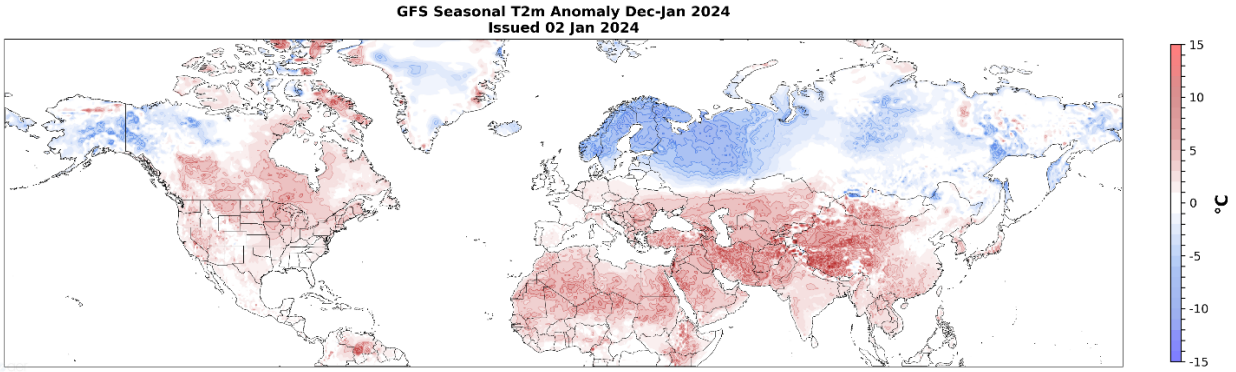

Figure. Estimate of the observed surface temperatures (°C; shading) from 1 December 2023 – 2 January 2024 based on GFS initializations and the GFS forecat from the 2 January 2024 forecast.

Impacts

First an important public service announcement (PSA). What I am about to write and describe is in my opinion and my opinion only based on my experience and not support from the research literature. I think full transparency is important.

First how about some love from those who like their winters mild not wild. My blog last week successfully prevented a PV split, i.e., the snowblower effect. Though it was not intended, and you would think by now I would know better. They advise always when taking the SATs, stick with your first answer and that apparently applies to PV predictions.

For those who want to put in the extra time, here are some papers of mine that will help better understand today's blog: Kretschmer et al. (2018), Cohen et al. (2021) and Cohen et al. (2012).

Besides me, the polar vortex (PV) is certainly hard at work doing all kinds of gymnastics. Once again, if you are keeping score at home the PV has so far this winter experienced a Canadian warming, then a PV stretch back to a Canadian warming and about to enter another stretched PV. The we have a minor sudden stratospheric warming (SSW; spike in temperatures at the North Pole at 10hPa but no reversal of the zonal mean zonal winds at 60°N and 10hpa). And then finally we have another stretched PV and that is where the weather model forecasts end. But sorting out the exact impacts with so many rapidly transitioning PV disruptions with different impacts that will likely constructively and destructively interfere is challenging.

The first upcoming stretched PV will bring more seasonable temperatures to the Eastern US (see **Figure 3**) but possibly of more consequence could bring the first meaningful snowfall to parts of the Northeastern US in over two years. I am sure that it will be an emotional rollercoaster for snow starved fans in the I95 corridor from Virginia to Massachusetts, but that seems like it is with every I95 snow threat.

It seems to me to be a very interesting and complex situation because in between the PV stretch sandwich, is the minor warming. And to be honest they may not be independent and in fact are in this instance the same or stages of the same PV disruption. At least to my eye I can identify the first stretched PV, the minor warming and the second stretched PV with the energy diagnostics. But I feel it is maybe a bit too much into the weeds and I don't think materially changes the impacts to the weather, so I am not showing. Typically, when you have a stretched PV, the NAO is neutral to positive as with the first PV stretch.

So that no one should be confused, I am disappointed this PV disruption does not include a full PV split one that meets the technical requirements. But even the most dramatic and impressive looking SSW will not have a strong influence our weather unless the signal can make it bodily into the troposphere. And I have been frustrated in the past by PV disruptions doing the most amazing looking tricks in the stratosphere with little influence on the weather. So sure, this is only a minor warming and will not make anyone's list of SSWs in the research literature, but could it be the little engine that could? In **Figure i**, I present the North Atlantic regional polar cap geopotential height anomalies (PCHs) plot and it clearly shows a robust downward propagation (real or apparent, debate still not settled) including a strongly negative NAO.

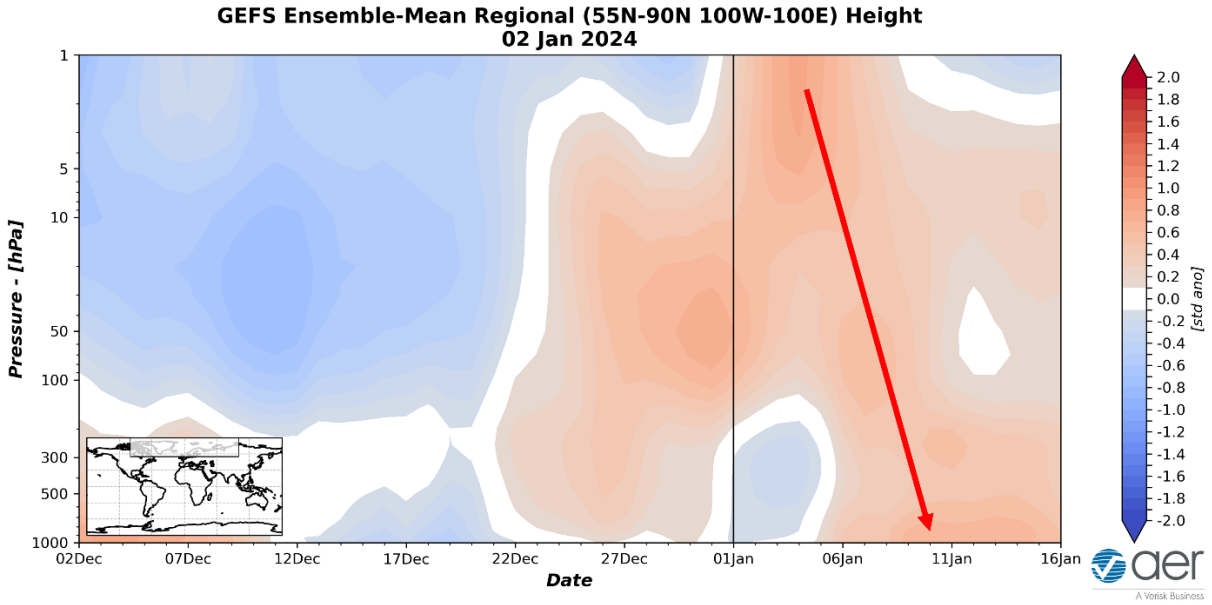

Figure i. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies for the North Atlantic sector only. The forecast is from the 00Z 2 January 2024 GFS ensemble. Also shown is red arrow to highlight downward propagation of warm/postive polar cap heights from stratosphere to the troposphere.

For example, here are two impressive major warmings, January 2019 and 2002. The NAO index in January and February 2019 was slightly positive so not the traditional tropospheric response. There was an historical Arctic outbreak into the Midwestern US in late January, but I am guessing that was a stretched PV piggybacking off the SSW (though I was not following these events as closely back then and have no support for this idea). And following the January 2002 SSW, there is no discernable downward influence based on the polar cap geopotential height anomalies (PCHs) from that winter and at the time 2001/02 was a record warm winter.

On the other hand, a minor warming occurred in 2014/15 and at least in my opinion it had a large impact on our weather (here in Boston the most wicked impact evah!). Again, not on anyone's list and I am glad that I included it in my plot of PV splits last week. It may look like a PV split but technically it is not. Instead, I am fairly convinced it was a more extreme stretched PV. And in certain ways yes and in other ways no, the upcoming PV disruption could be considered analogous with this PV disruption. We may yet observe two PV centers (most models are predicting that and see **Figure ii** from the latest ECMWF forecast) but it should be considered as a more extreme stretched PV. But there is a very notable exceptions between the two events. Following the 2015 PV disruption there was no discernable downward propagation and the NAO in January and February 2015 was high as a kite and as a consequence, not surprisingly, much of Northern Europe and Asia were warm following the minor warming. From **Figures i** and **11** a robust downward propagation is predicted and a strongly negative NAO. January 2024 could easily be one of the top four most negative NAOs of the past 25 years. The number of January negative NAOs is surprisingly low given the many major warmings over the past twenty-five years in either late December or January.

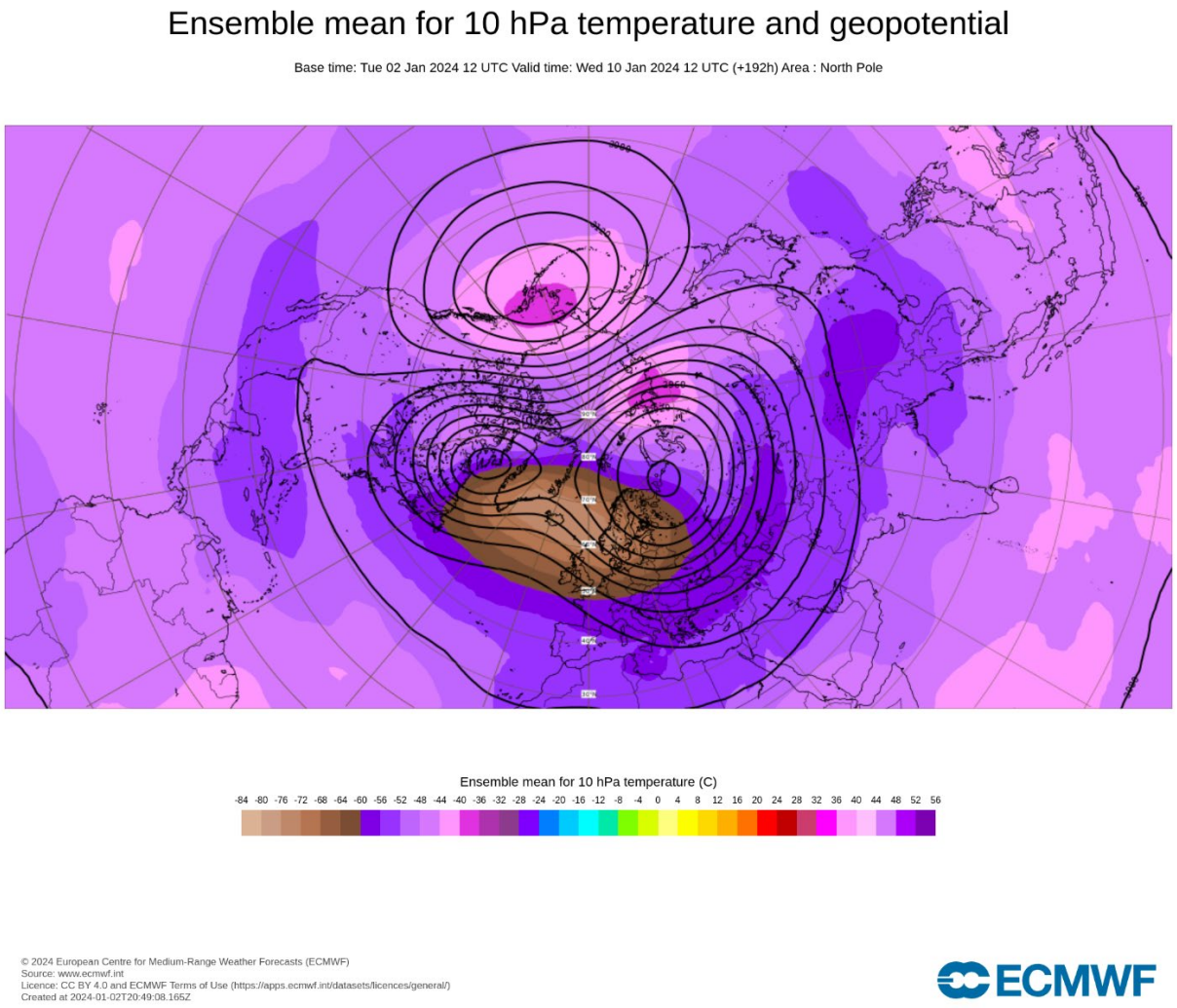

Figure ii. Chart shows 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere for 10 January 2024. Forecast from the initialized 2 January 2024 ECMWF 12Z ensemble. Plot taken from https://charts.ecmwf.int/

So, if you have read the blog in previous winters, hopefully you are familiar that the high-latitude blocking or ridging of high pressure that accompanies stretched PVs is Alaskan blocking while the high-latitude blocking or ridging of high pressure that accompanies SSWs is Greenland blocking. Also keep in mind that the tropospheric response to PV stretching is relatively short and to SSWs is relatively long (this is very important!). In the 1-5 day forecast period we have the downward influence from a stretched PV (see **Figure iii** and **13a)** and Alaskan (really Beaufort Sea) blocking (see **Figure 2**). In the 6-10 day forecast period we have the beginnings of the downward influence from the SSW (see **Figure 13a)** and Iceland but transitions to Greenland blocking (see **Figure 5**). (Side tangent- by the way the downward influence from the SSW is accelerated compared to what is shown in the literature, could minor warmings elicit a faster tropospheric response? I have no idea.) Finally, in the 11-15 day forecast period we have the

maturing of the tropospheric response from the SSW and the downward influence from the second stretched PV (see **Figure 13b**) and **13b**and a return of Alaskan blocking (see **Figure 8**). This results in the unusual situation where the tropospheric response to the minor SSW is ongoing i.e., Greenland blocking, which is in addition to the tropospheric response to the stretched PV, i.e., Alaskan blocking (see **Figure 8**).

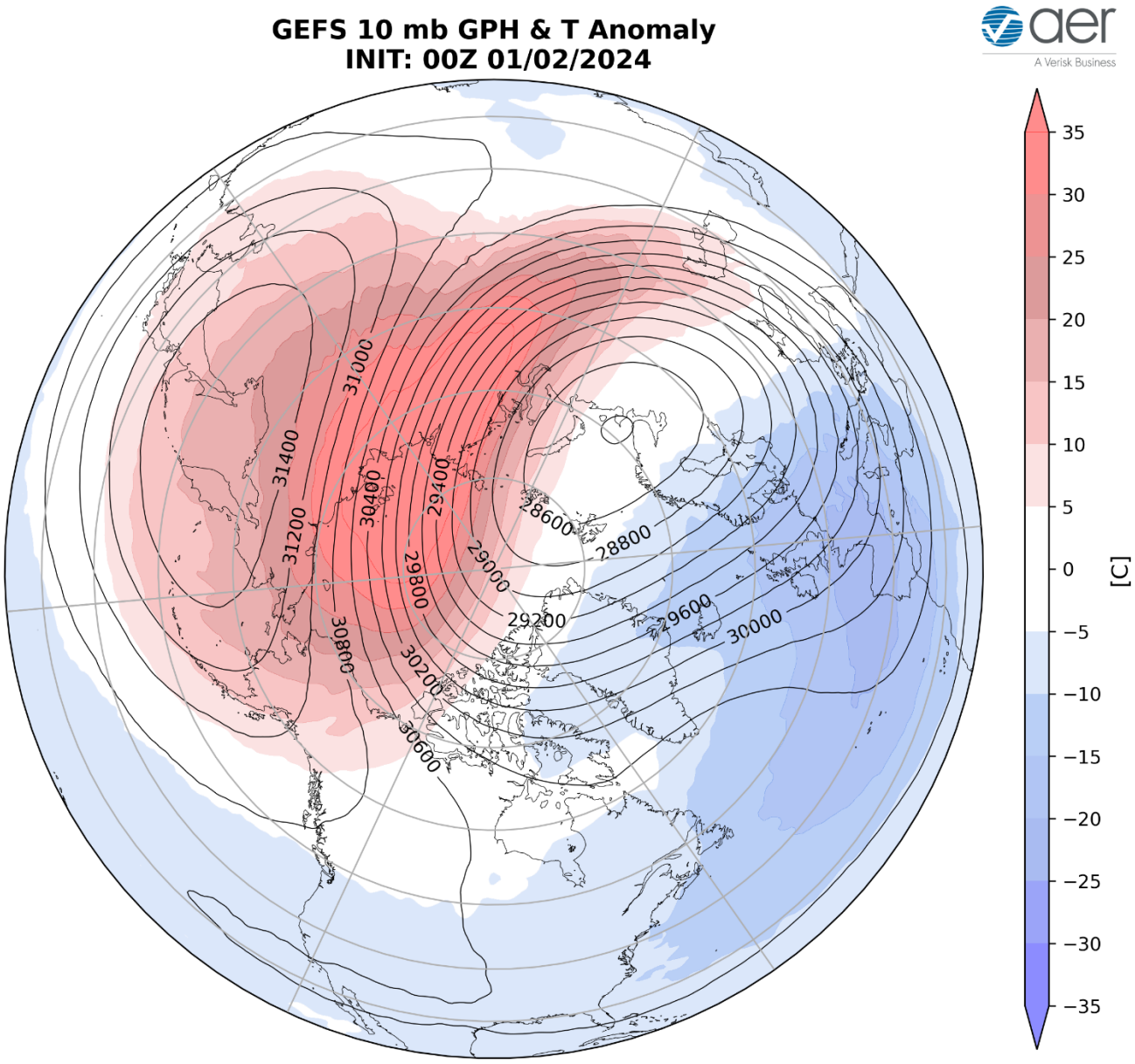

Figure iii. Initialized 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere for 2 January 2024. The forecasts are from the 00Z 2 January 2024 GFS model ensemble.

Thus, because we have the overlapping minor warming and stretched PV we have both simultaneous Alaskan and Greenland blocking rather than one without the other. And temperature-wise it is looking likely that we could observe simultaneous relatively cold temperatures in the US and in Europe, a rare feat in my experience. I often say that where the polar vortex goes so goes the cold air. Currently the PV center is over northwestern Eurasia (see **Figure iii**) and so are the coldest relative temperatures of the NH (see **Figure iv**).

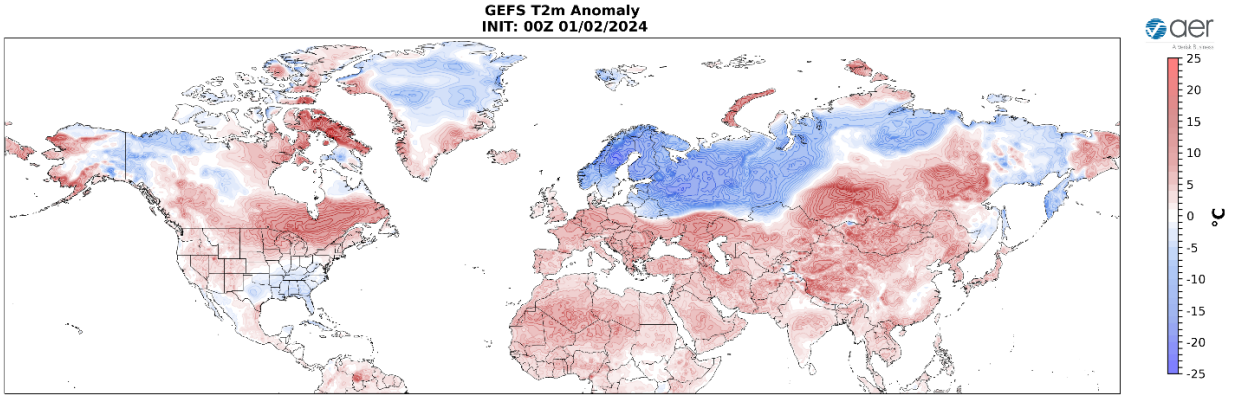

Figure iv. Initialized surface temperature anomalies (°C; shading) across the Northern Hemisphere for 2 January 2024. The forecasts are from the 00Z 2 January 2024 GFS model ensemble.

But then mid-month we have the second stretched PV of the year (see **Figure 13b**) and that should help deepen the cold air over North America. But based on what I am seeing from the model forecasts as far as the orientation of the stretching and where the lowest heights are located, it does suggest to me that the coldest temperatures relative to normal will be focused in western North America and not eastern North America. I can't believe that I am writing this because I was convinced El Niño, and a strong one at that, would favor colder temperatures in the Eastern US. So, we will have to monitor how this all plays out.

Typically, the impacts from stretched PVs can last about a week and maybe up to two weeks for the most extreme cases. The impacts from a major warming can be much longer up to two months and sometimes even a little longer (in 2013 the impacts pretty much covered all of January, February and March). Finally, it is my experience that tropospheric forced only high-latitude blocking lasts on the order of three weeks. So how long can the cold pattern in Europe and North America last? As short as one week and as long as two months. Without a robust PV split I am discounting for now a pattern persisting for two months. Based on the stretched PV, it could be as short as a week. But I am leaning against just a week duration and instead favoring closer to three weeks based on the typical persistence of high latitude blocking. But I will be watching the behavior of the PV closely for adjustments.

There are three possible scenarios following a stretched PV: 1) a rapidly strengthening PV (e.g., 2019/2020), a strengthening PV that repeatedly stretches (e.g., 2021/22) and 3) an SSW (e.g., 2022/23). For now, I least favor scenario three and most favor scenario two. But if scenario one does materialize winter could pretty much be over by the end of January, except for Scandinavia the new ice box of the NH.

There are three Januarys characterized by negative NAO, 2010, 2011, and 2021 since 2000. January 2010 was sandwiched in between two SSWS (one minor and one major) so I don't see that as a good analog. January 2021 was characterized by the longest major SSW that I can recall so I don't see that as a good analog either. Instead, January 2011 had a minor warming and a stretched PV (see **Figure v**). Looking at the 500 hPa geopotential heights you can also see Greenland blocking and Alaskan blocking (see **Figure v**), similar to what is predicted this January.

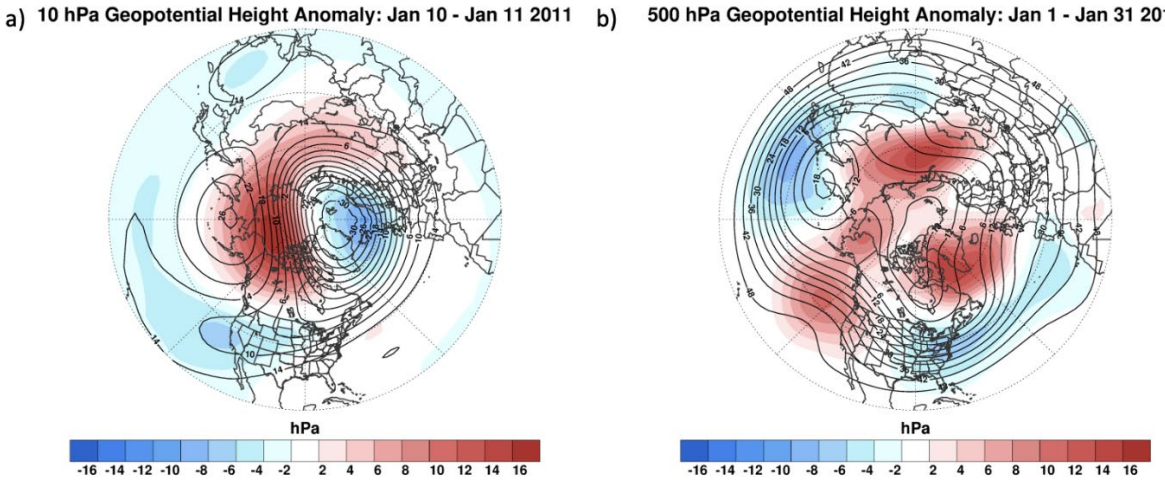

Figure v. Observed 10hPa geopotential heights (contouring) and anomalies (shading) for a) 10 – 11 January 2011, b) Observed 500hPa geopotential heights (contouring) and anomalies (shading) for January 2011.

But there are important differences especially Ural blocking in 2011 instead of Ural troughing in 2024. The troughing in North America is shifted east in 2011 relative to forecasts in 2024 (the irony based on ENSO!). Looking at the surface temperature anomalies from January 2011 (see **Figure vi**), I think Europe can be colder as well as western North America while Siberia and the Eastern US could be warmer.

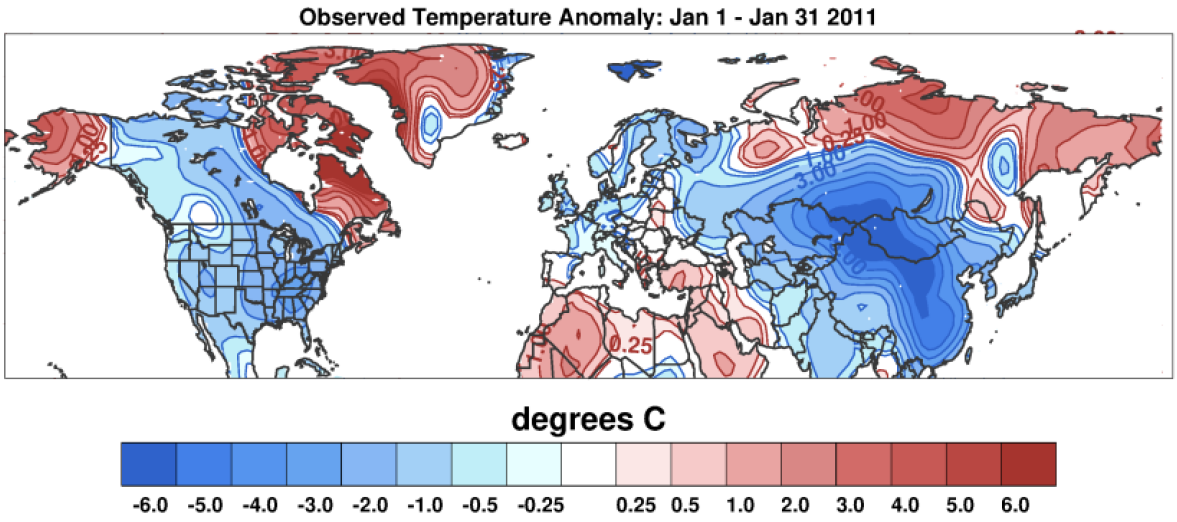

Figure vi. Observed surface temperature anomalies (°C; shading) for January 2011. The observed temperatures are from the NCEP/NCAR reanalysis.

Finally, the PV went record strong following the stretched PV. Right now, I am not favoring that same scenario but could easily happen. Trying to not wishcast here because as I said above, that could break the back of winter 2024.

Near-Term

This week

The AO is predicted to be 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 increased positive geopotential height anomalies across Greenland (**Figure 2**), the NAO is predicted to be negative this period.

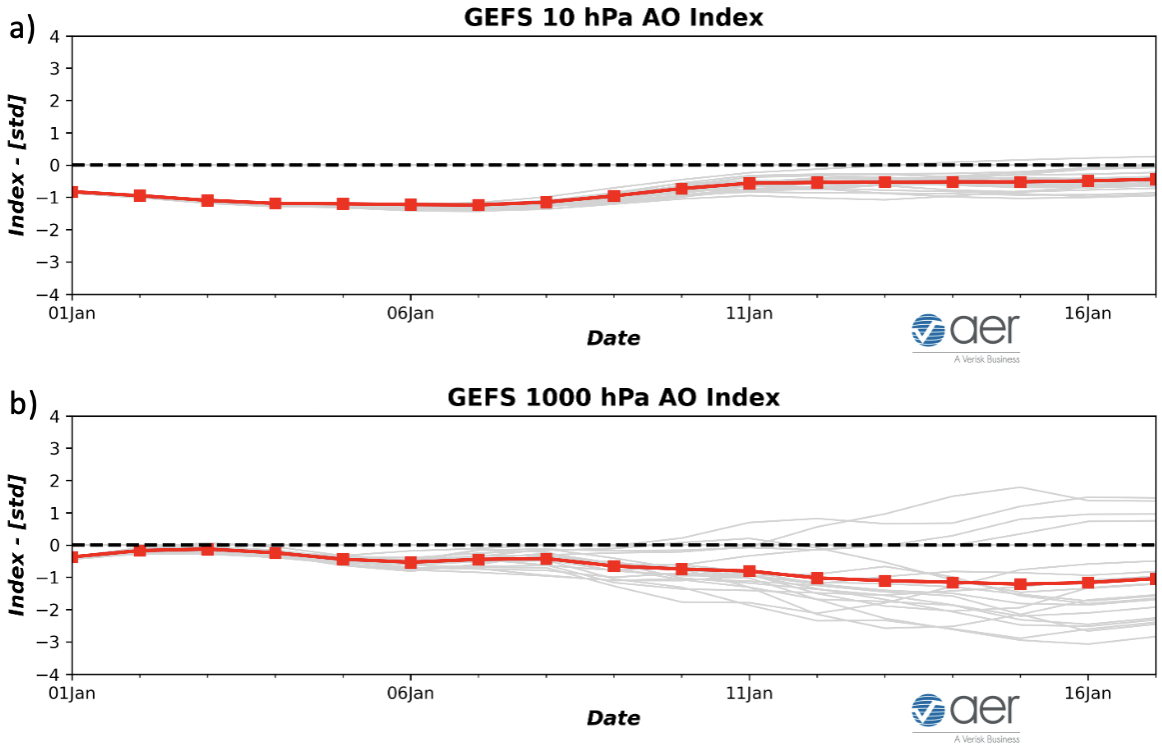

Figure 1. (a) The predicted daily-mean AO at 1000 hPa from the 00Z 2 January 2024 GFS ensemble. (b)The predicted daily-mean near-surface AO from the 00Z 2 January 2024 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble-mean AO index given by the red line with squares.

Strengthening ridging/positive geopotential height anomalies centered near Iceland will force deepening troughing/negative geopotential height anomalies across Northern and Eastern Europe with some residual ridging/positive geopotential height anomalies across Southern and Western Europe this week (**Figures 2).** The pattern favors normal to above normal temperatures across Southern and Western Europe including the UK with normal to below normal temperatures across Northern and Eastern Europe (**Figure 3**). Predicted strengthening ridging/positive geopotential height anomalies centered near Iceland will force deepening troughing/negative geopotential height anomalies across Northern Asia with more ridging/positive geopotential height anomalies across Southern Asia this period (**Figure 2**). This pattern favors widespread normal to above normal temperatures across much of Asia with normal to below normal temperatures mostly limited to Northwestern Russia and Siberia **(Figure 3**).

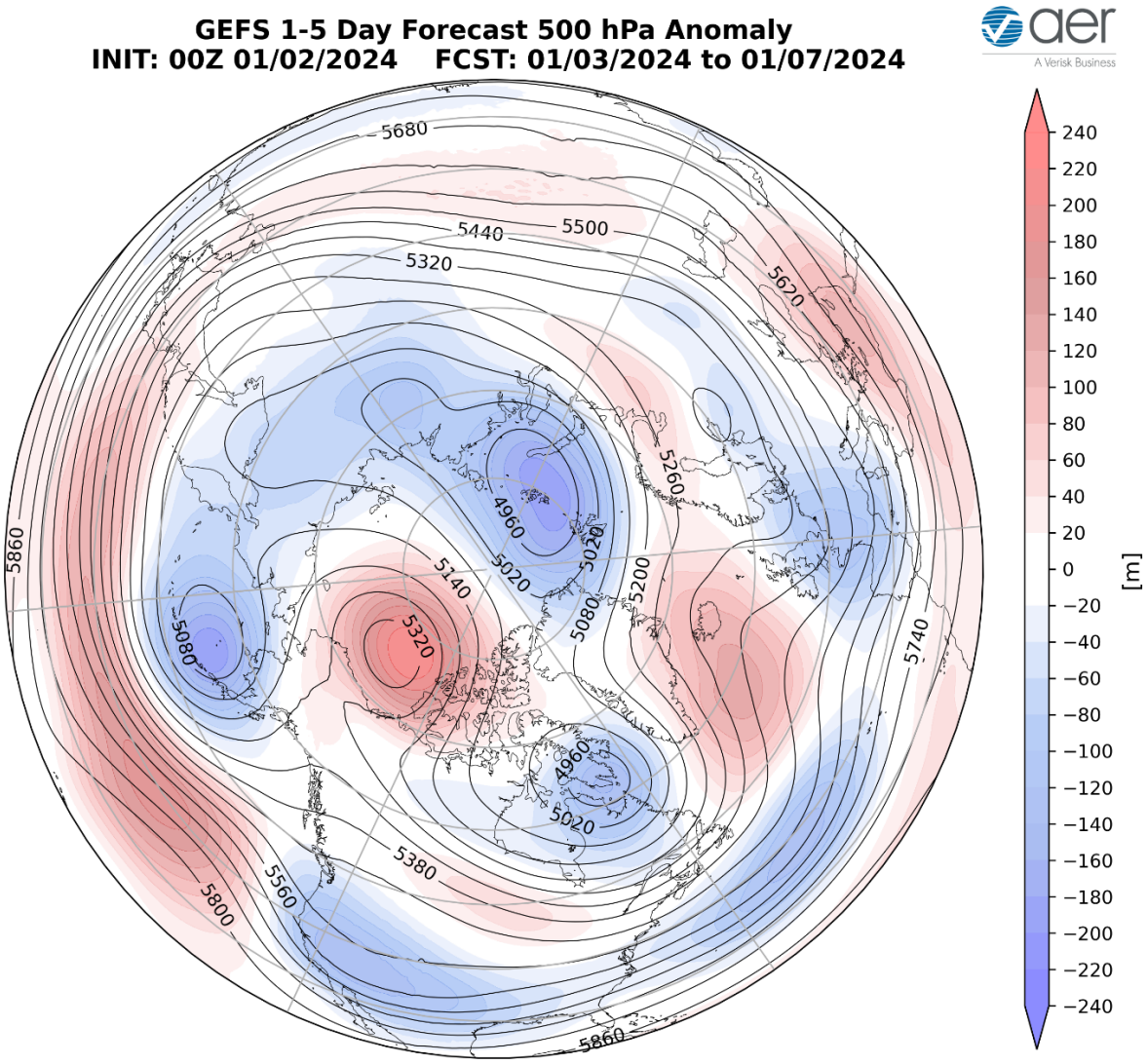

Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 3 – 7 January 2024. The forecasts are from the 00z 2 January 2024 GFS ensemble.

The pattern this week across North America is ridging/positive geopotential height anomalies across the Beaufort Sea and Alaska forcing troughing/negative geopotential height anomalies across Eastern Canada and the Western US with regional ridging/positive geopotential height anomalies across the US-Canada border **(Figure 2).** This pattern will favor normal to above normal temperatures across Alaska, Southern Canada and the Northern US with normal to below normal temperatures across Northern Canada and the Southern and Western US **(Figure 3).**

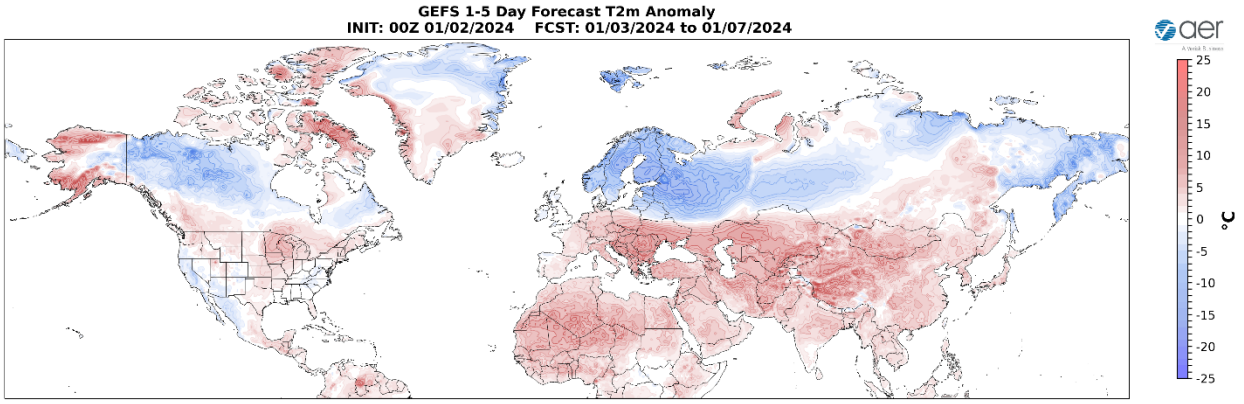

Figure 3. Forecasted surface temperature anomalies (°C; shading) from 3 – 7 January 2024. The forecast is from the 00Z 2 January 2024 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across the Pyrenees, the Alps, the Baltic States and Northern Asia while mild temperatures will support snowmelt across Sweden, Northwestern Russia and Southeastern Siberia this week (**Figure 4**). Troughing and/or cold temperatures will support new snowfall across Southern Alaska, Western, Southern and Eastern Canada, the high elevations of the Western US and the Northeastern US while mild temperatures will support snowmelt across Alaska this week (**Figure 4**).

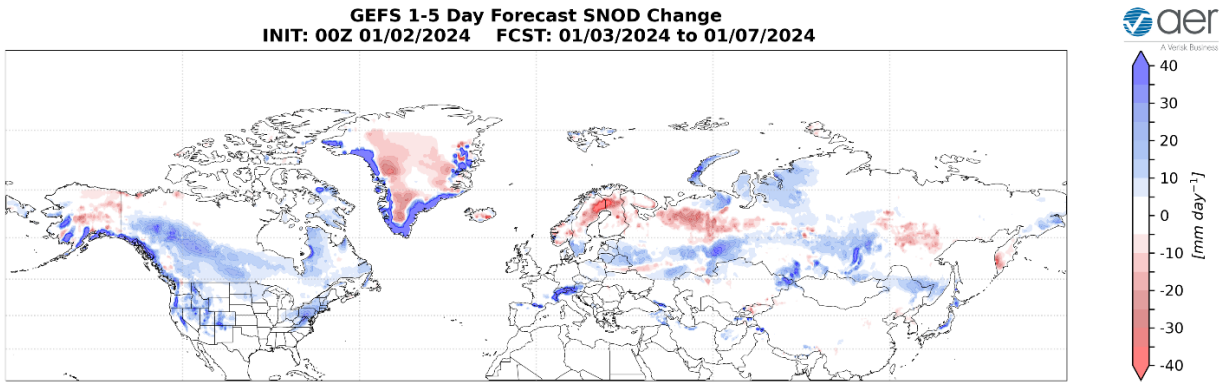

Figure 4. Forecasted snow depth changes (mm/day; shading) from 3 – 7 January 2024. The forecast is from the 00Z 2 January 2024 GFS ensemble.

Near-Mid Term

Next week

With mostly positive geopotential height anomalies across the Arctic and with mixed geopotential height anomalies across the mid-latitudes this period (**Figure 5**), the AO should turn

negative this period (**Figure 1**). With predicted positive pressure/geopotential height anomalies across Greenland (**Figure 5**), the NAO will also be negative this period.

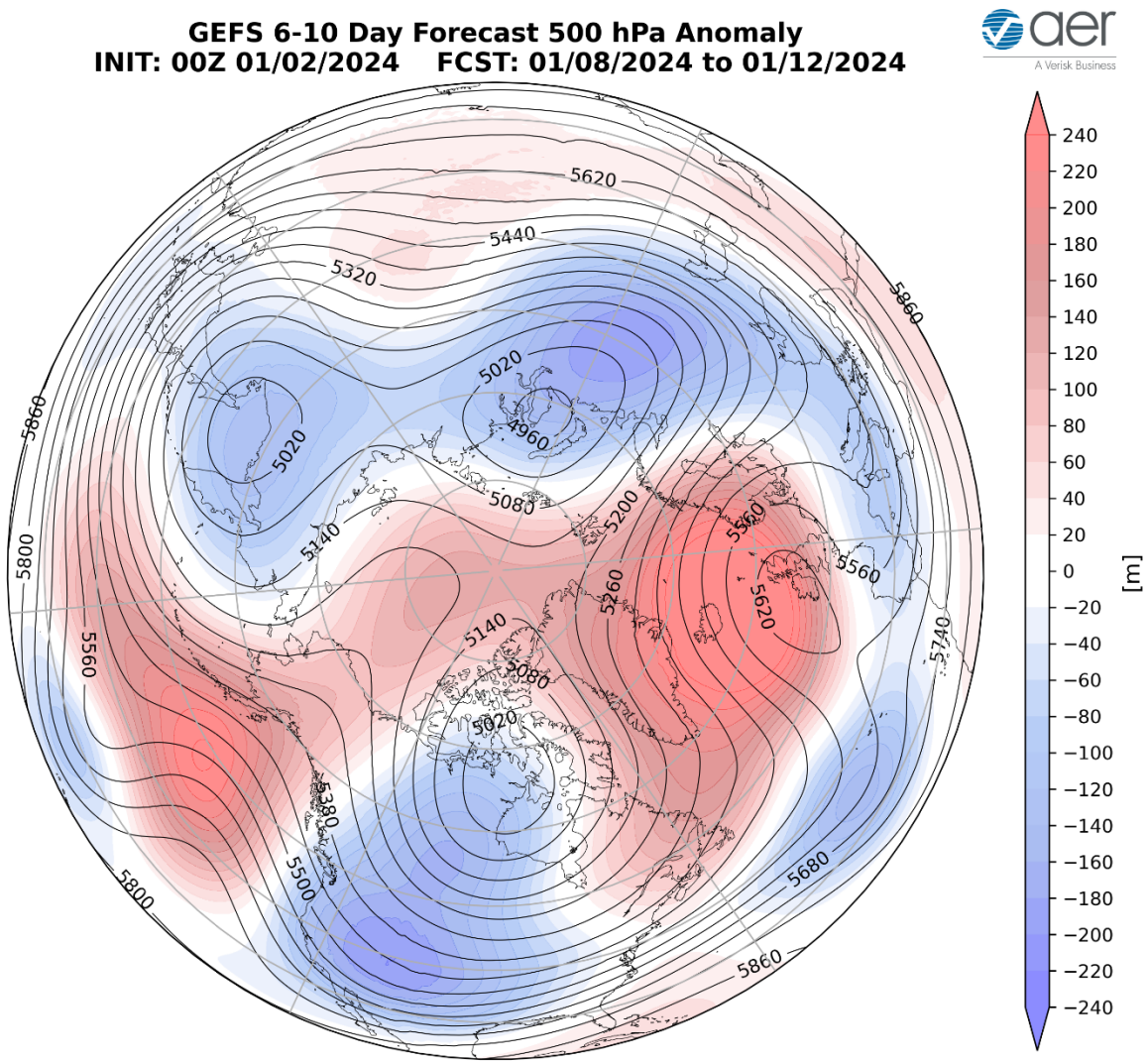

Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 8 – 12 January 2024. The forecasts are from the 00z 2 January 2024 GFS ensemble.

Strengthening ridging/positive geopotential height anomalies centered near Iceland will continue to support troughing/negative geopotential height anomalies across much of Europe this period (**Figure 5**). This pattern will favor widespread normal to below normal temperatures across most of Europe including the UK with normal to above normal temperatures limited to Northern Scandinavia due to rising heights (**Figures 6**). Ridging/positive geopotential height anomalies will persist across Western Asia with troughing/negative geopotential height anomalies across Siberia this period (**Figure 5**). This pattern favors widespread normal to above

normal temperatures across much of Asia with normal to below normal temperatures across Siberia this period (**Figure 6**).

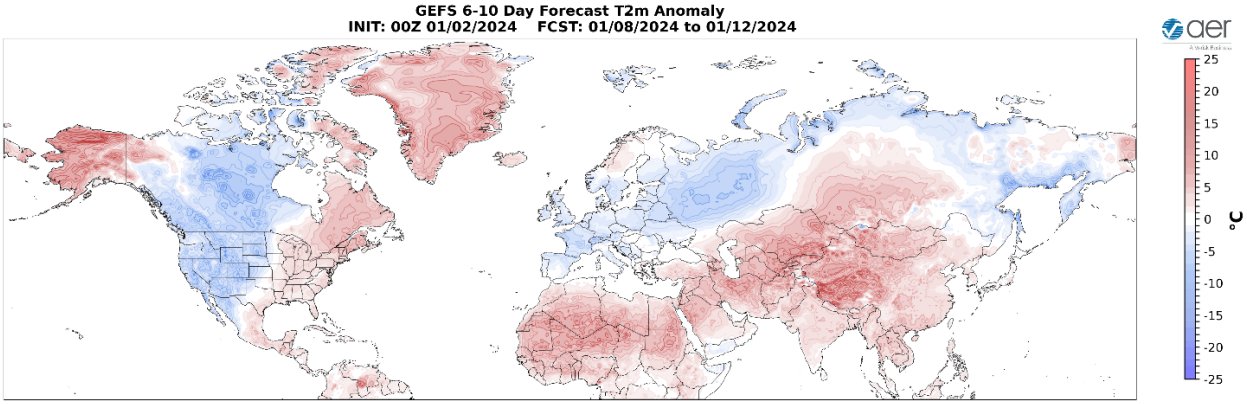

Figure 6. Forecasted surface temperature anomalies (°C; shading) from 8 – 12 January 2024. The forecasts are from the 00z 2 January 2024 GFS ensemble.

The predicted general pattern across North America this period is strengthening ridging/positive geopotential height anomalies across Alaska and the Gulf of Alaska forcing troughing/negative geopotential height anomalies across Western Canada and the Western US with more ridging/positive geopotential height anomalies along the East Coasts of Canada and the US (**Figure 5**). This pattern favors normal to above normal temperatures across Alaska, much of Eastern Canada and the Eastern US with normal to below normal temperatures across Western and Central Canada and the Western US (**Figure 6**).

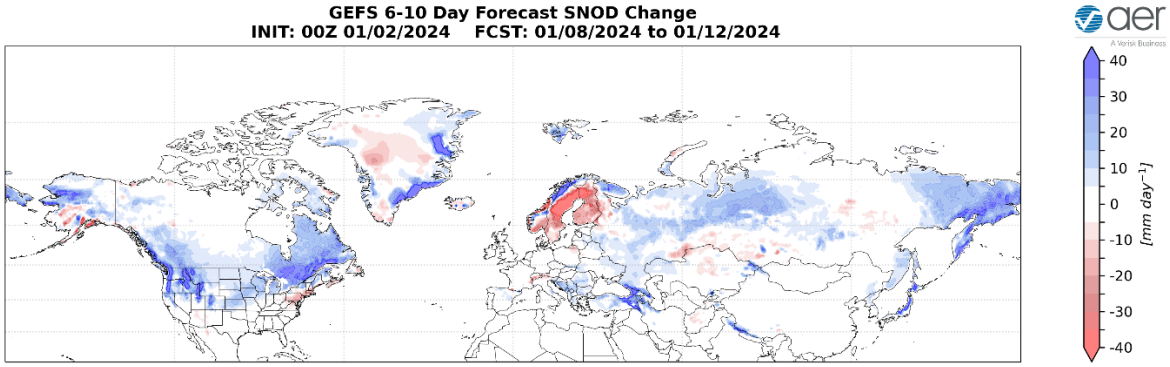

Figure 7. Forecasted snow depth changes (mm/day; shading) from 8 – 12 January 2024. The forecast is from the 00Z 2 January 2024 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across the Norway, Southeastern Europe including Turkey, the Tibetan Plateau, Siberia and Northeast Asia while mild temperatures will support snowmelt in Scandinavia and Southern Siberia this period (**Figure 7**). Troughing and/or cold temperatures will support new snowfall across central

Alaska, the Western and Eastern Canada, the higher elevations of the Western US, the US Plains into the Great Lakes and New England while mild temperatures will support snowmelt in southern Alaska and the Northeastern US this period (**Figure 7**).

Mid Term

Week Two

With increasingly positive geopotential height anomalies across the Arctic especially Greenland and mixed geopotential height anomalies across the mid-latitudes this period (**Figure 8**), the AO remain negative this period (**Figure 1**). With predicted strongly positive pressure/geopotential height anomalies across Greenland (**Figure 8**), the NAO should remain negative to possibly strongly negative this period.

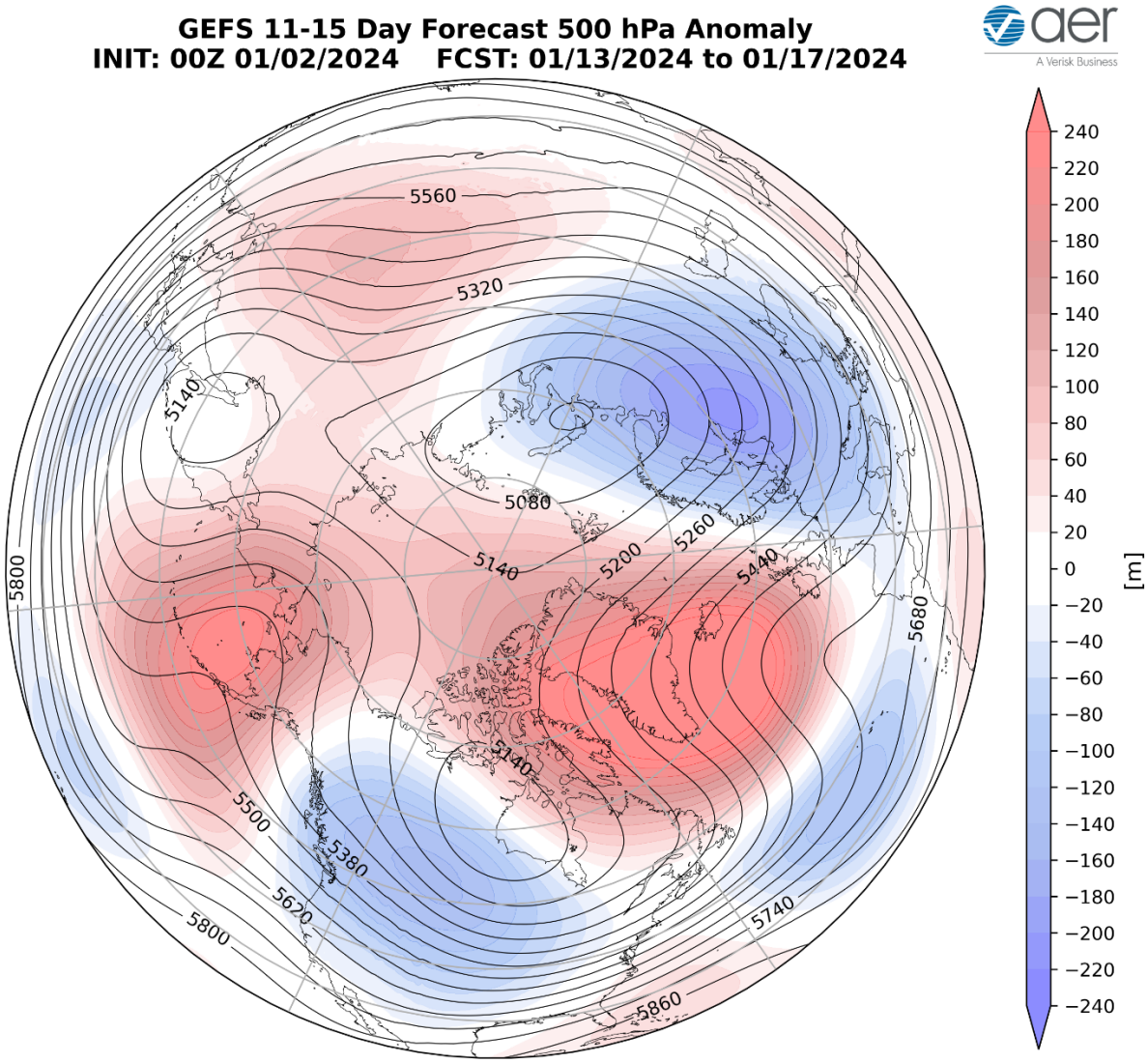

Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 13 – 17 January 2024. The forecasts are from the 00z 2 January 2024 GFS ensemble.

Predicted ridging/positive geopotential height anomalies across Greenland should continue to support troughing/negative geopotential height anomalies across Europe this period (**Figure 8**). This pattern should favor normal to below normal temperatures widespread across most of Europe including the UK with the exception of normal to above normal temperatures across the Iberian Peninsula this period (**Figures 9**). With ridging/positive geopotential height anomalies continuing to consolidate across the North American Arctic will help to anchor troughing/negative geopotential height anomalies across Northern Asia with more ridging/positive geopotential height anomalies across Central Asia this period (**Figure 8**). The predicted pattern favors widespread normal to above normal temperatures widespread across Southern and Eastern Asia with normal to below normal temperatures across Northern and Western Asia this period (**Figure 9**).

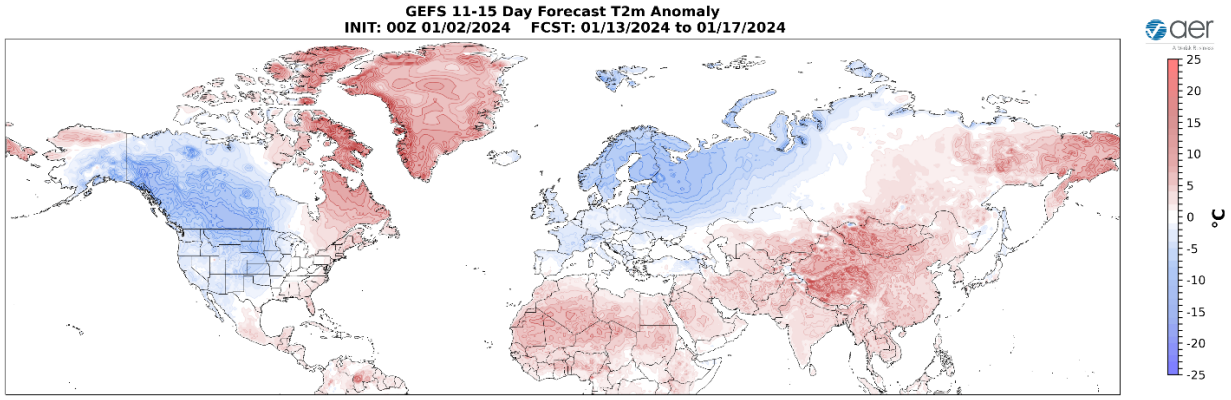

Figure 9. Forecasted surface temperature anomalies (°C; shading) from 13 – 17 January 2024. The forecasts are from the 00z 2 January 2024 GFS ensemble.

Strengthening ridging/positive geopotential height anomalies near the Aleutians will anchor troughing/negative geopotential height anomalies in western North America with more ridging/positive geopotential height anomalies across Northeastern Canada this period (**Figure 8**). This pattern favors normal to below normal temperatures across Southern Alaska, Western and Central Canada and the Western and Central US with normal to above normal temperatures across Northern Alaska, Eastern Canada and the Eastern US (**Figure 9**).

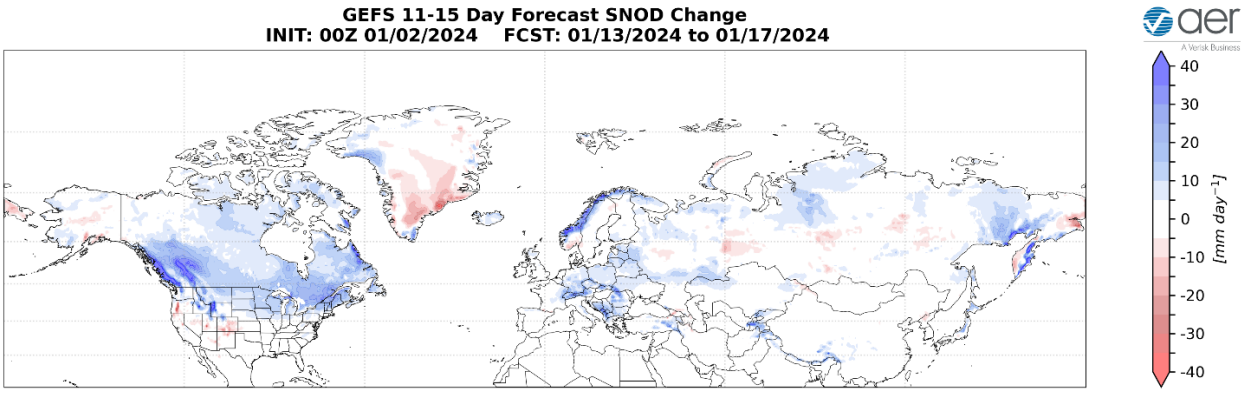

Figure 10. Forecasted snow depth changes (mm/day; shading) from 13 – 17 January 2024. The forecast is from the 00Z 2 January 2024 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Norway, the Alps, Eastern Europe, Western Asia, Siberia and the Tibetan Plateau while mild temperatures will support snowmelt in Southern Siberia this period (**Figure 10**). Troughing and/or cold temperatures will support new snowfall across Southern Canada, the Northern US and the higher elevations of the northwestern US and New England. Mild temperatures will support snowmelt in US Southern Rockies this period (**Figure 10**).

Longer Term

30–day

The latest plot of the polar cap geopotential height anomalies (PCHs) currently shows warm/positive PCHs in the stratosphere with near normal PCHs in the troposphere (**Figure 11**). However, next week PCHs in the troposphere are predicted to become increasingly warm/positive as the downward influence associated with a sudden stratospheric warming reaches into the troposphere (**Figure 11**).

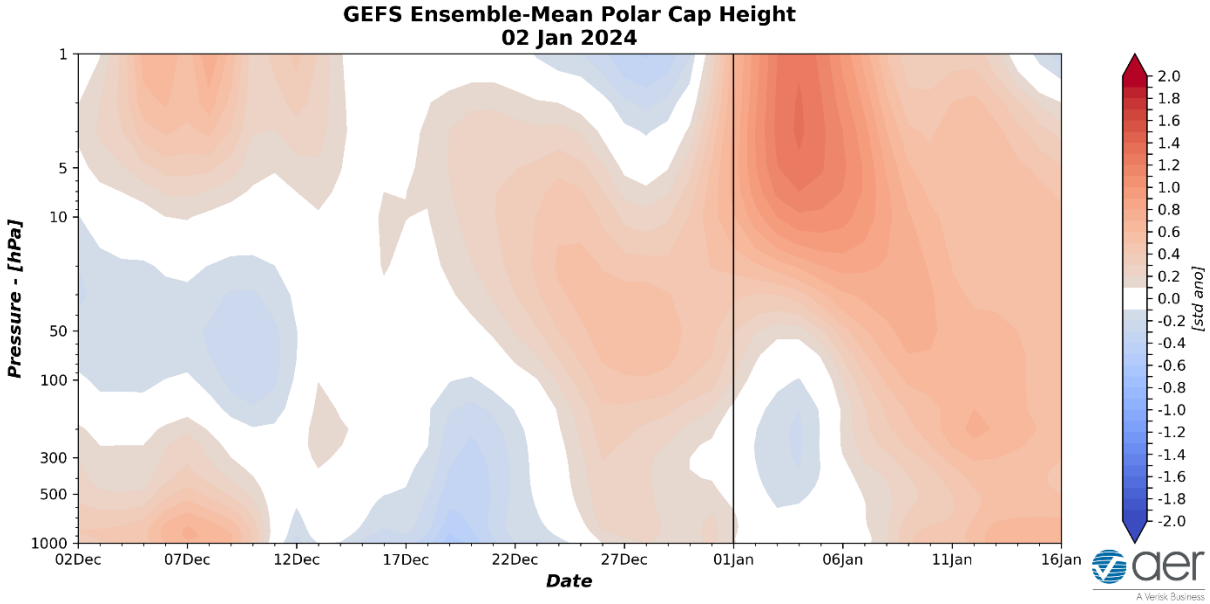

Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 2 January 2024 GFS ensemble.

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

Also shown in **Figure 1** is the stratospheric AO. The stratospheric AO is currently negative and is predicted to dip further 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 a sudden stratospheric warming albeit minor in early January.

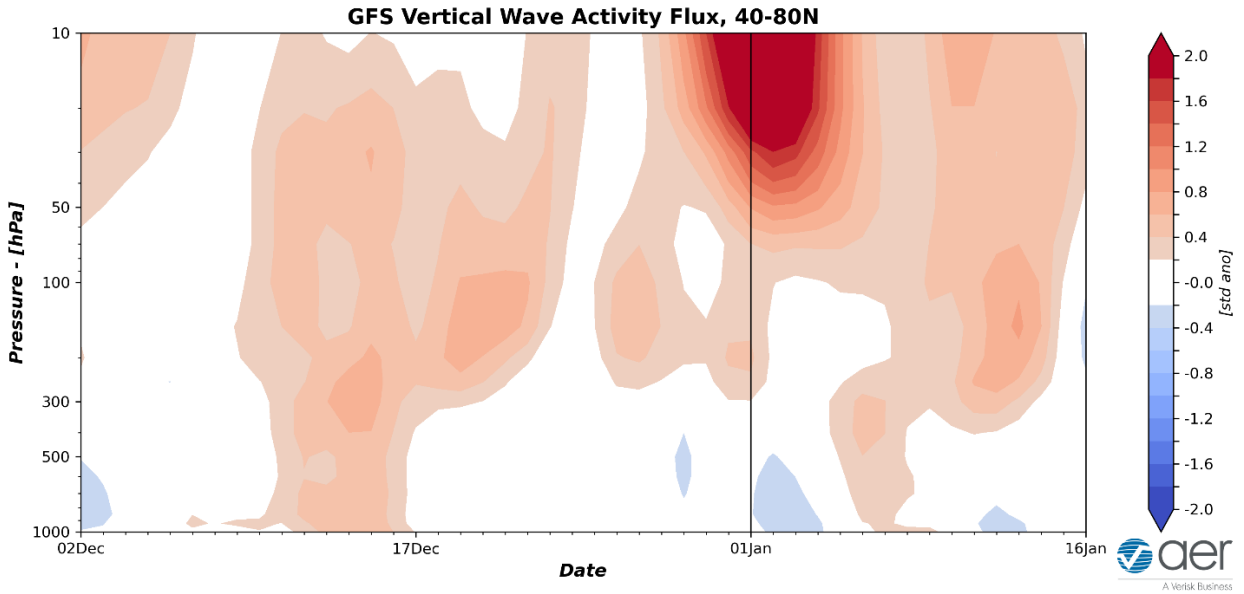

Figure 12. Observed and predicted daily vertical component of the wave activity flux (WAFz) standardized anomalies, averaged poleward of 40-80°N. The forecast is from the 00Z 2 January 2024 GFS ensemble.

Vertical Wave Activity Flux (WAFz) from the troposphere to the stratosphere or poleward heat transport in the stratosphere has been active since mid-November and looks to peak this week (**Figure 12**). This has resulted in multiple but brief minor PV disruptions (**Figure 12**) and the return of the stratospheric AO to neutral and now negative (**Figure 1**). The peak in WAFz activity this week (**Figure 12**), which should result in a minor sudden stratospheric warming but not a major warming.

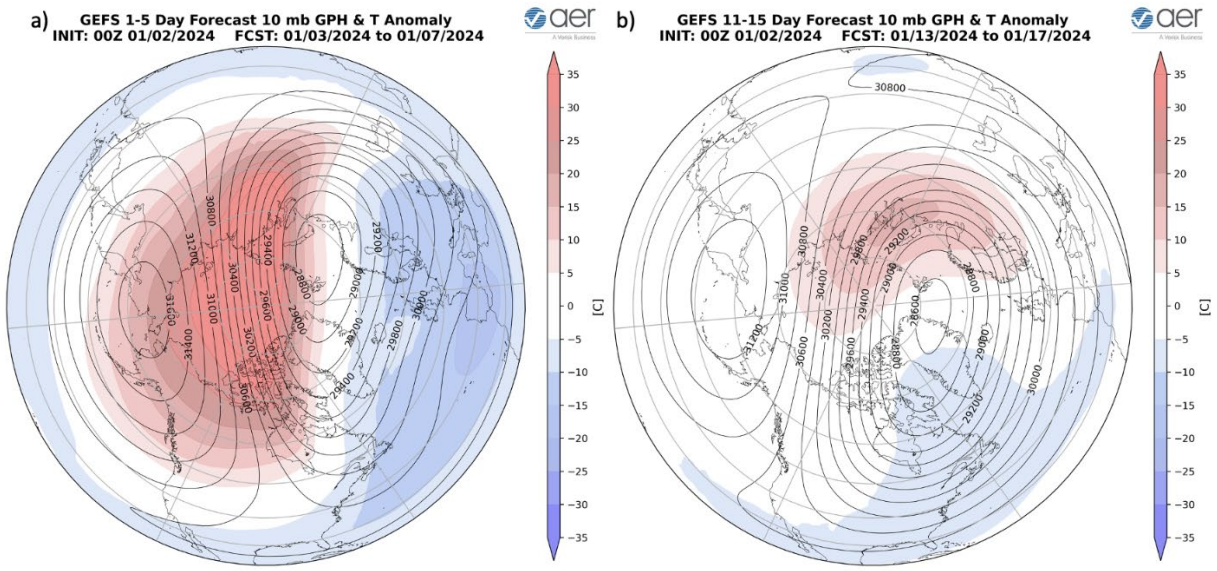

Figure 13. (a) Forecasted 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere for 3 – 7 January 2024 . (b) Same as (a) except forecasted averaged from 13 – 17 January 2024. The forecasts are from the 00Z 2 January 2024 GFS model ensemble.

This week the polar vortex (PV) is elongated in shape with the PV center shifted south of the North Pole over the Barents Kara Seas (**Figure 13a**). This elongated PV configuration is predicted oriented along an axis from Western Siberia to Eastern Canada. Ridging in the polar stratosphere is predicted to be centered on the Dateline with the strongest warming centered in the Central Arctic. This PV configuration is consistent with a stretched PV that favors colder temperatures across East Asia and eastern North America. However, the warming in the Arctic is a sign of a minor warming following on the heels of the stretched PV. Then next week the PV center slides towards closer to Greenland with an elongated shape but now oriented from Western Siberia towards Western Canada coupled with warming more emanating from Northwest Asia (**Figure 13b**).

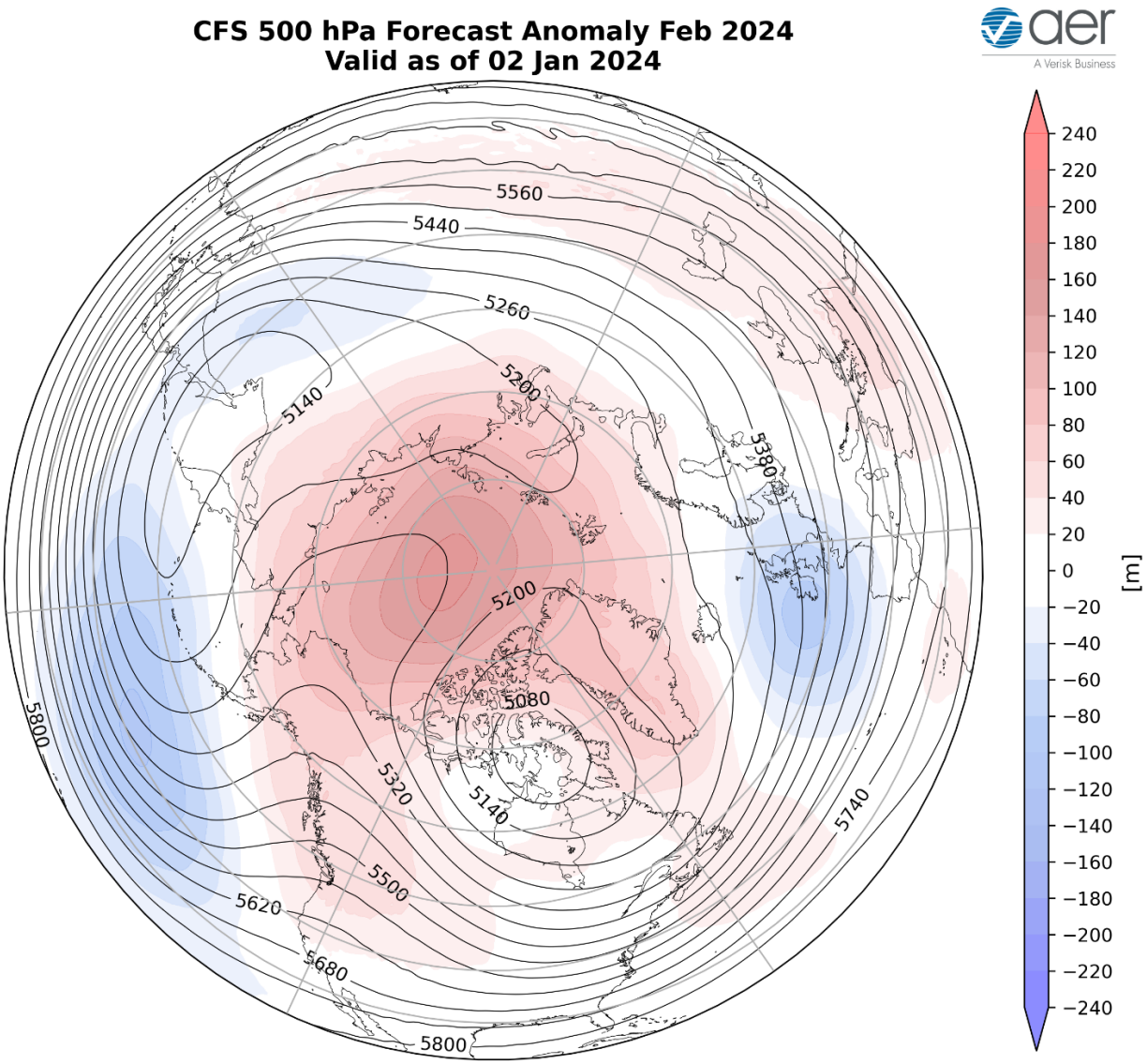

Figure 14. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for February 2024. The forecasts are from the 00Z 2 January 2024 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 14**) and surface temperatures for February (**Figure 15**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging stretching centered near the North Pole, Greenland Eastern Siberia, Alaska and Western Canada with troughing in Western Europe, Northeast Asia, the Aleutians and eastern North America (**Figure 14).** This pattern is consistent with a negative AO that often follows an SSW but I am highly skeptical. This pattern favors seasonable to relatively warm temperatures across Southern Europe, Southern Asia, Eastern Siberia, Alaska, Western Canada and the Western

US with seasonable to relatively cold temperatures across Northern Europe, Northern Asia, Eastern Canada and the Eastern US (**Figure 15**).

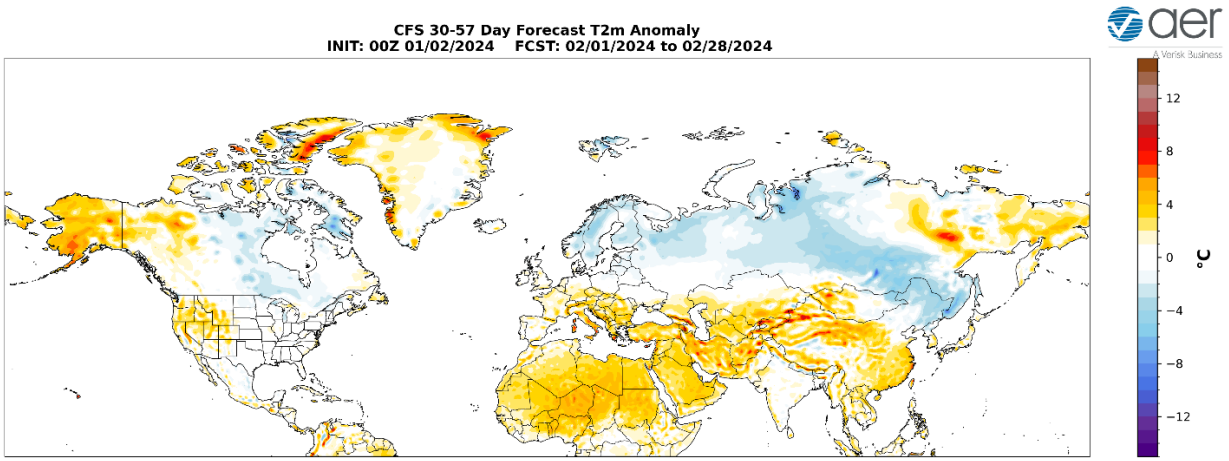

Figure 15. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for February 2024. The forecasts are from the 00Z 2 January 2024 CFS.

Arctic sea ice extent

Arctic sea ice extent continued growing normally this week. I continue to expect that the negative sea ice anomalies will become more focused in the North Atlantic sector, which is currently the case. 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, which can persist for weeks. Arctic sea ice extent is higher than many recent years and is comparable to 2021 on this date.

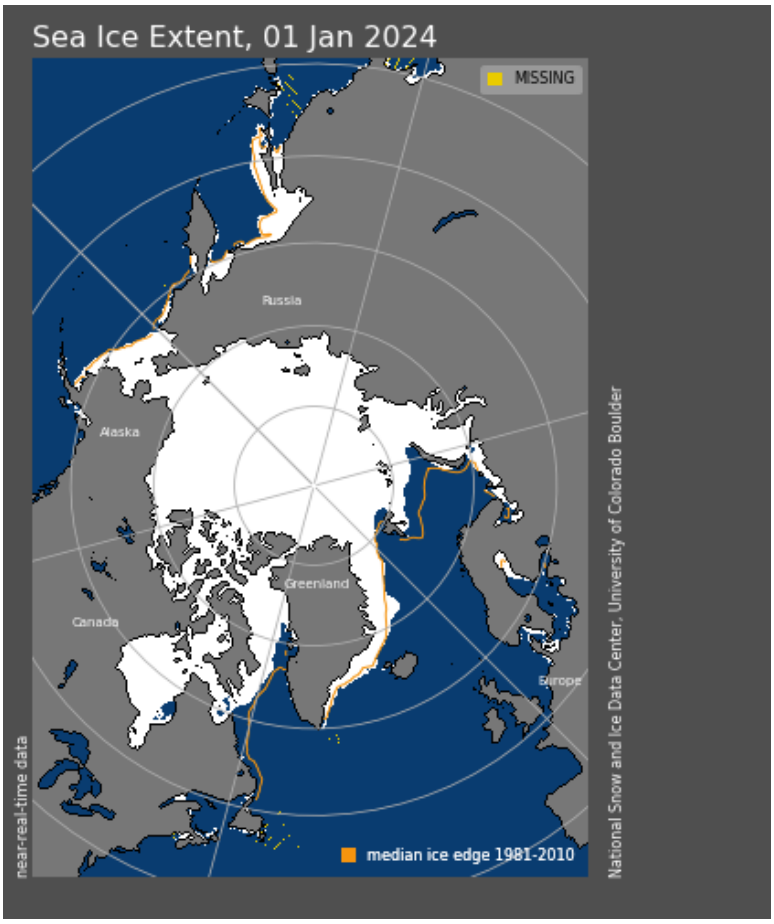

Figure 16. Observed Arctic sea ice extent on 1 January 2024 (white). Orange line shows climatological extent of sea ice based on the years 1981-2010. Image courtesy of National Snow and Ice Data Center (NSIDC). Snow and Ice Data Center (NSIDC).

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies are well above normal, especially along the South America coast, indicating that and El 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.

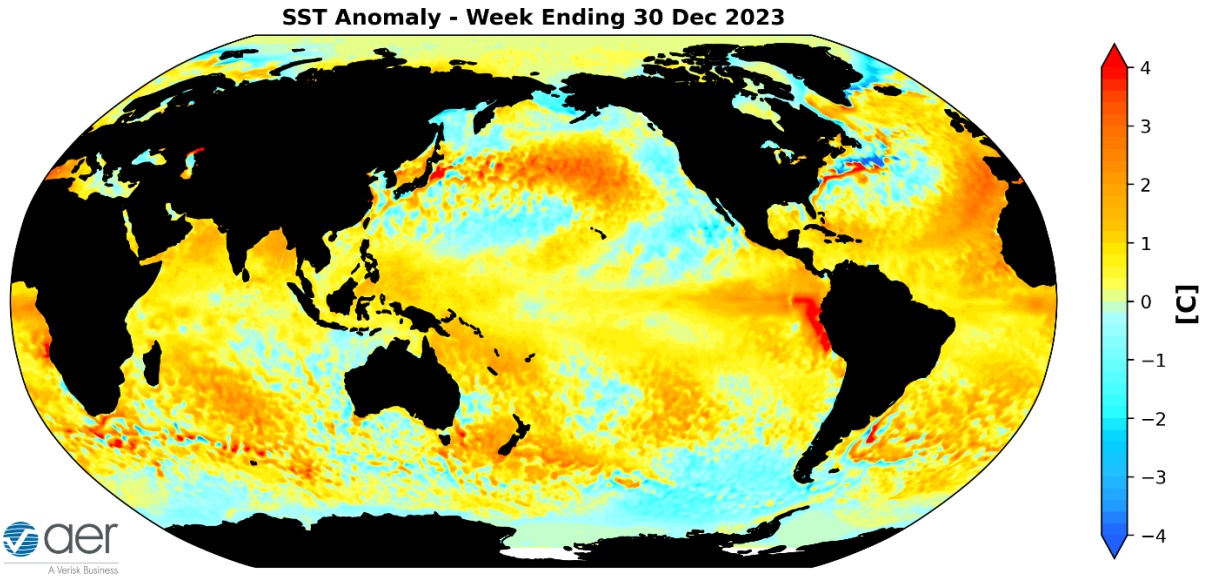

Figure 17. The latest weekly-mean global SST anomalies (ending 30 December 2023). Data from NOAA OI High-Resolution dataset.

Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is in phase two (**Figure 1**). The forecasts are for the MJO to move into phase three and then weaken where no phase is favored. Phases two and three favor ridging near the Aleutians and ridging in western North America. Therefore it seems that the MJO could be having some influence on North American weather the next two weeks. But admittedly this is outside of my expertise.

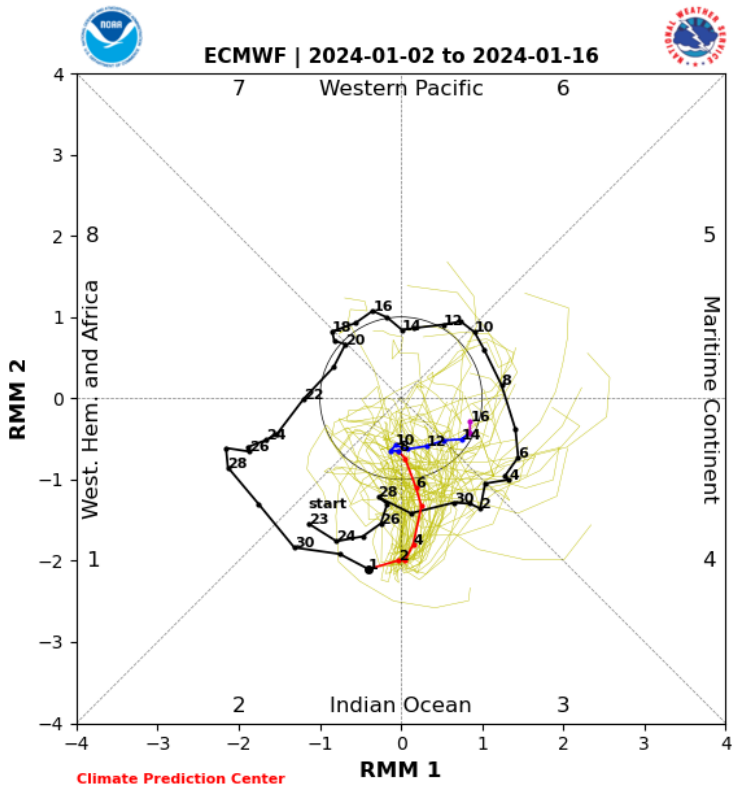

Figure 18. Past and forecast values of the MJO index. Forecast values from the 00Z 2 January 2024 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model "spread" is denoted by the gray shading. Sector numbers indicate 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/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!