Arctic Oscillation and Polar Vortex Analysis and Forecasts

October 30, 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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Summary

- The Arctic Oscillation (AO) is currently negative and is predicted to remain negative to neutral the next two weeks as pressure/geopotential height anomalies across the Arctic are currently mostly positive and are predicted to remain positive to mixed over the next two weeks. The North Atlantic Oscillation (NAO) is currently negative with mostly positive pressure/geopotential height anomalies across Greenland and the NAO is predicted to remain negative to neutral the next two weeks as pressure/geopotential height anomalies remain positive to mixed across Greenland.
- Over the next two weeks, ridging/positive geopotential height stretching from Greenland to the Barents-Kara Seas will force troughing/negative geopotential height anomalies across Western and Northern Europe and inducing southwesterly flow across Eastern Europe. This pattern will support normal to

below normal temperatures across Western and Northern Europe including the United Kingdom (UK) with normal to above normal temperatures across Southern and Eastern Europe the next two weeks.

- This week the predicted pattern across Asia is ridging/positive geopotential height anomalies across Southern and Eastern Asia with troughing/negative geopotential height anomalies across Western and Northern Asia. Then next week the troughing/negative geopotential height anomalies across Northwest Asia will consolidate with Siberian troughing replaced by ridging/positive geopotential height anomalies centered across the Urals. This pattern favors normal to above normal temperatures across Southern and Eastern Asia with normal to below normal temperatures across Northwestern Russia and Siberia this week and then spreading into Northern and Eastern Asia with normal to above normal temperatures across Southern and Western Asia next week.

- The general predicted pattern across North America the next two weeks is troughing/negative geopotential height anomalies near the Aleutians and into the Gulf of Alaska forcing ridging/positive geopotential height anomalies across western North America with downstream troughing/negative geopotential height anomalies across eastern North America. This pattern generally favors normal to above normal temperatures across Alaska, Western Canada and the Western United States (US) with normal to below normal temperatures across Eastern Canada and the Eastern US.

- In the Impacts section I remain focused on Eurasian snow cover as I believe October is the critical month for predicting the upcoming winter circulation and weather. And I discuss the upcoming prospects of polar vortex behavior over the coming weeks.

- I continue the transition to the winter season, which should occur over the next few weeks.

Plain Language Summary

I use October Eurasian snow cover extent as one of our main winter predictors. The advance of snow cover has been robust the past week not only across Eurasia (see **Figure i**) but also across North America this past week (see **Figure ii**).

In the meantime, a stretching of the polar vortex like a rubber band being pulled on both ends has brought colder and snowier weather to Asia and North America (see **Figure 3**). Models predicting a relaxation of the pattern (i.e., milder weather) but I think this pattern can repeat itself in the second half of November. But if I am wrong, winter may never recover from this stumble right at the starting line.

Impacts

This whole month my focus is on the snow cover advance across Siberia and what impact it may have on the stratospheric polar vortex (PV). More extensive snow cover across Eurasia in October, and this mostly confined to Siberia, the more likely the PV will be weaker than normal during the winter months that favors widespread colder

temperatures across the Northern Hemisphere (NH) but in particular in East Asia and the US east of the Rockies. It also includes Northern Europe, but the relationship is weaker across Europe and in my own research rarely is it statistically significant.

As I have been reporting all month, the snow cover extent across Eurasia started out near normal but for most of the month has been below normal. I have been expecting an acceleration of the snow cover advance across Siberia as the mid-tropospheric circulation transitions from one of a high-pressure ridge to a low-pressure trough over much of Siberia.

So, as I have been doing all month, I include an update to the plot of daily Eurasian snow cover extent (SCE) so far in October in **Figure i**. The black dashed line represents the mean value using October 2009 through 2022. Finally, the SCE is showing some life and after a long stretch, SCE is getting off the bottom and making a run back to normal. And with only a couple days left to the month of October, could the SCE even get above normal to end the month?
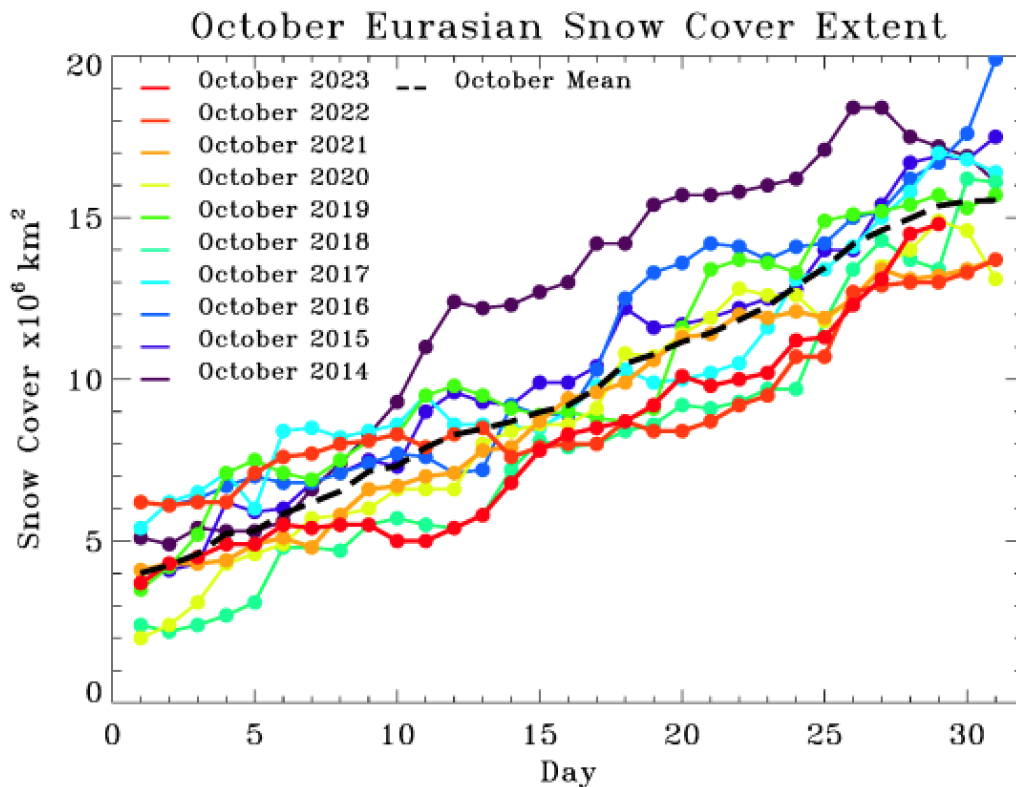

Figure i. Observed Eurasian daily snow cover extent (SCE) in millions of km squared for the month of October through 29 October 2023 (shown in red).

Looking more closely at the details and comparing to last week's blog, snow cover advance has made much progress over the past week (see **Figure ii**). Positive SCE anomalies clearly dominate over negative SCE anomalies across Eurasia with the last

large region of negative anomalies being in Central Siberia. I think there is a good chance that there is snow cover on the ground there but may be hidden by cloud cover. You might be thinking that **Figure i** and **Figure ii** seem inconsistent because based on **Figure ii**, Eurasian SCE is above normal and based on **Figure i** it is slightly below normal. The difference is that the climatology or average for **Figure ii** is much longer (I think going back to 1972) while the climatology in **Figure i** only goes back to 2009. The climatology or average is higher for the more recent period than the longer period.
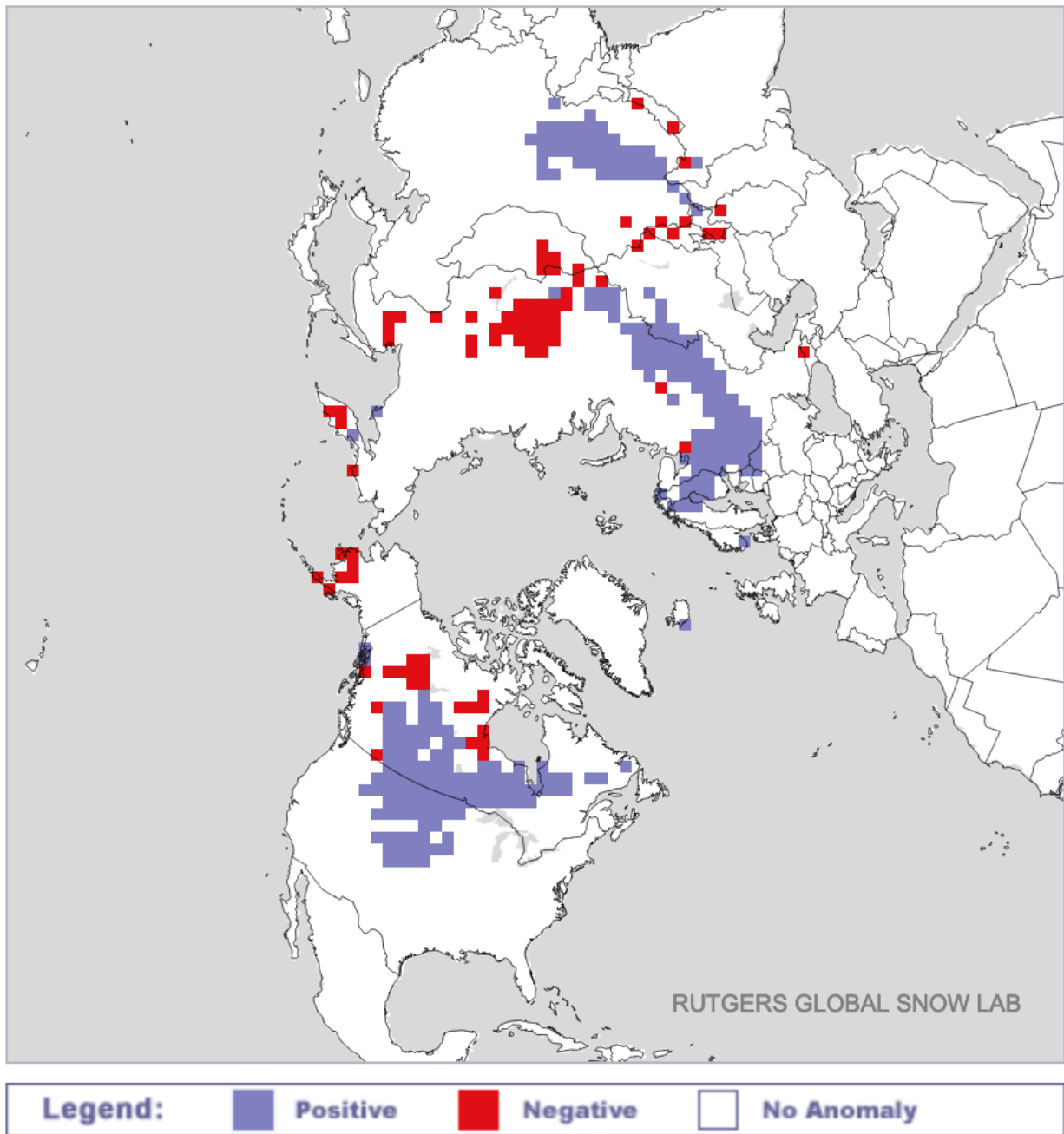
Daily SCE Departure - October 29, 2023 (Day 302)

Figure ii. Observed Northern Hemisphere daily snow cover extent (SCE) anomalies for 29 October 2023. Plot taken from http://climate.rutgers.edu/snowcover/

Not only has snow cover advance been robust across Eurasia but is probably even more impressive across North America. I include the plot from NOAA NESDIS that I

have shown in the past for North America in **Figure iii**. I haven't been paying much attention to North American snow cover, but it literally went sideways for much of the month and in recent history is unprecedented. But the recovery since has been very impressive. I think the advance will stall as a lot of the new snow cover is unusually far south and will inevitably melt. But I think this dramatic reversal highlights the importance of stretched PVs on North American weather.
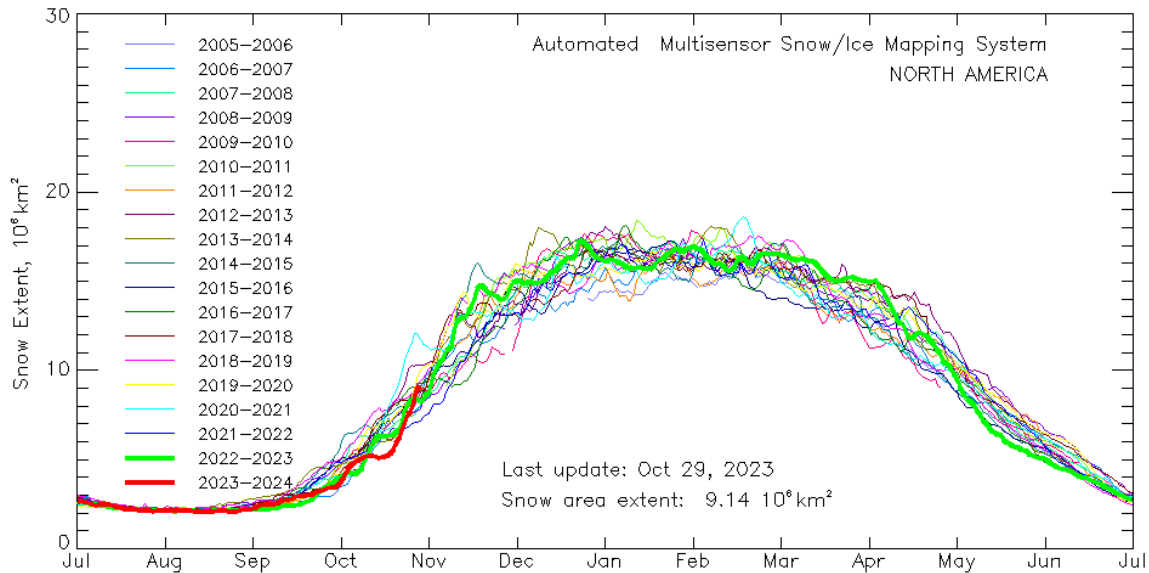

Figure iii. Observed North American (bottom) snow cover extent through 29 October 2023. Image source: https://www.star.nesdis.noaa.gov/smcd/emb/snow/HTML/snow_extent_monitor.html
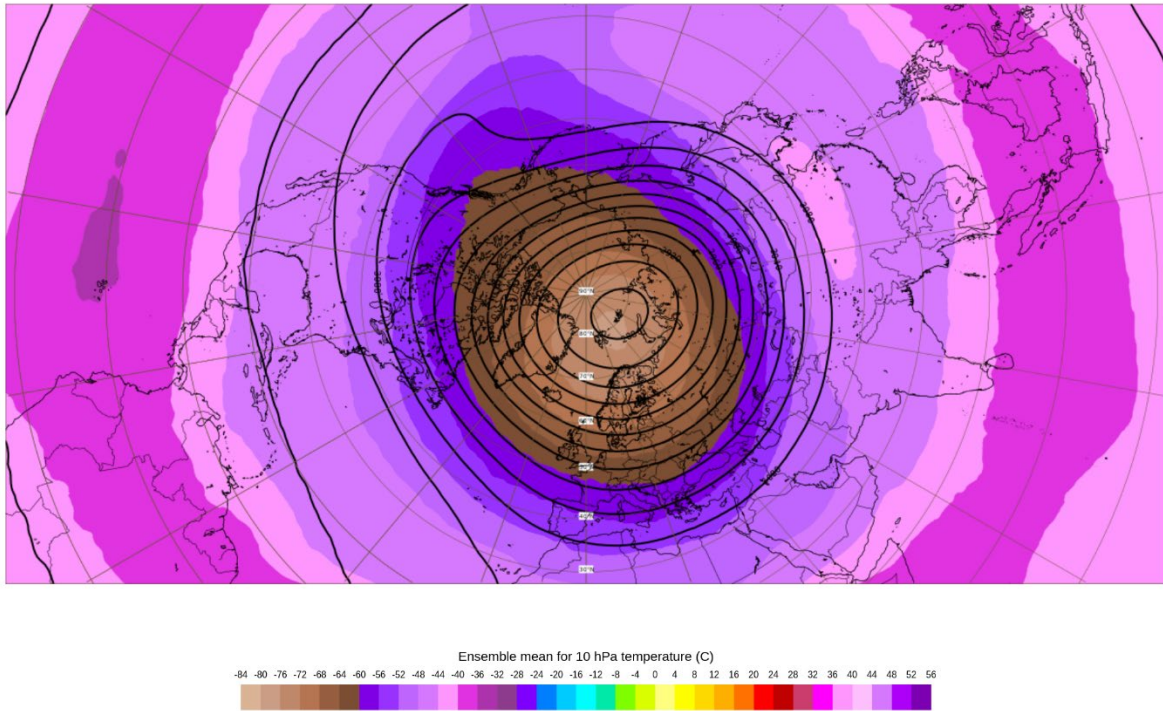
The pattern change to colder, snowier weather not only across Siberia but also North America is related to a stretched PV which has begun and will continue into next week. A stretched PV is supportive of cold temperatures and an acceleration of snow advance across Central and Eastern Asia and North America mostly east of the Rockies. Looking at the dramatic reversal in Northern Hemisphere SCE and also surface temperatures, especially across North America where temperatures went from record warm to record cold, really demonstrates the potential influence of stretched PV events. I am sure an exaggeration, but the stretched PV event of October just may have saved whatever chance of the NH experiencing a normal to close to normal winter. It is pretty mind boggling to me how after a summer of and fall superlative warmth, the first Arctic air mass can already produce record cold temperatures. This topic of surprisingly resilient extreme cold in a warming world but focused in the Arctic, was the topic of my most recent scientific paper Cohen et al. 2023.

As I discussed last week, It remains my expectation that the predicted pattern in both the GEFS/CFS and ECMWF models, is supportive of another stretched PV in the second half of November. But I admit this can go in a completely different

direction. The weather models are predicting a strong circular PV will develop the third week of November (see **Figure 12b** and **Figure iv** from the ECMWF). The forecasts advertise an almost perfect circular shape to the PV with cold temperatures in the center, the unambiguous characteristics of a strong PV.

Ensemble mean for 10 hPa temperature and geopotential

Base time: Mon 30 Oct 2023 00 UTC Valid time: Tue 14 Nov 2023 00 UTC (+360h) Area : North Pole

Ensemble mean for 10 hPa temperature (C)

-84 -80 -76 -72 -68 -64 -60 -56 -52 -48 -44 -40 -36 -32 -28 -24 -20 -16 -12 -8 -4 0 4 8 12 16 20 24 28 32 36 40 44 48 52 56

ECMWF

Figure iv. Forecasted average 10 mb geopotential heights (dam; contours) and geopotential height anomalies (dam; shading) across the Northern Hemisphere for 14 November 2023. The forecasts are from the 00z 30 October 2023 ECMWF ensemble. Plot taken from https://charts.ecmwf.int/

It seems that the reason for the strengthening PV is the wave activity flux IWAF) or the energy transfer from the troposphere to the stratosphere. Looking at the WAF in the vertical and meridional direction in **Figure v**, though the WAF is upward which would typically weaken the PV but for that to happen the WAF also needs to be directed towards the North Pole. However as seen in **Figure v** the WAF is directed towards the equator. This is something that I have seen many times in the past and WAF upward

and southward will strengthen the PV. This needs to be watched very carefully. If the strong PV can couple to a tropospheric pattern with little to no high-latitude blocking (i.e., positive AO), the strong PV and a mostly zonal flow can reinforce each other to produce an extended mild pattern across the Northern Hemisphere (NH). This could pretty much end any chance of a cold winter before winter even starts. This is what happened in December 2019 and winter 2019/20 just never got started.
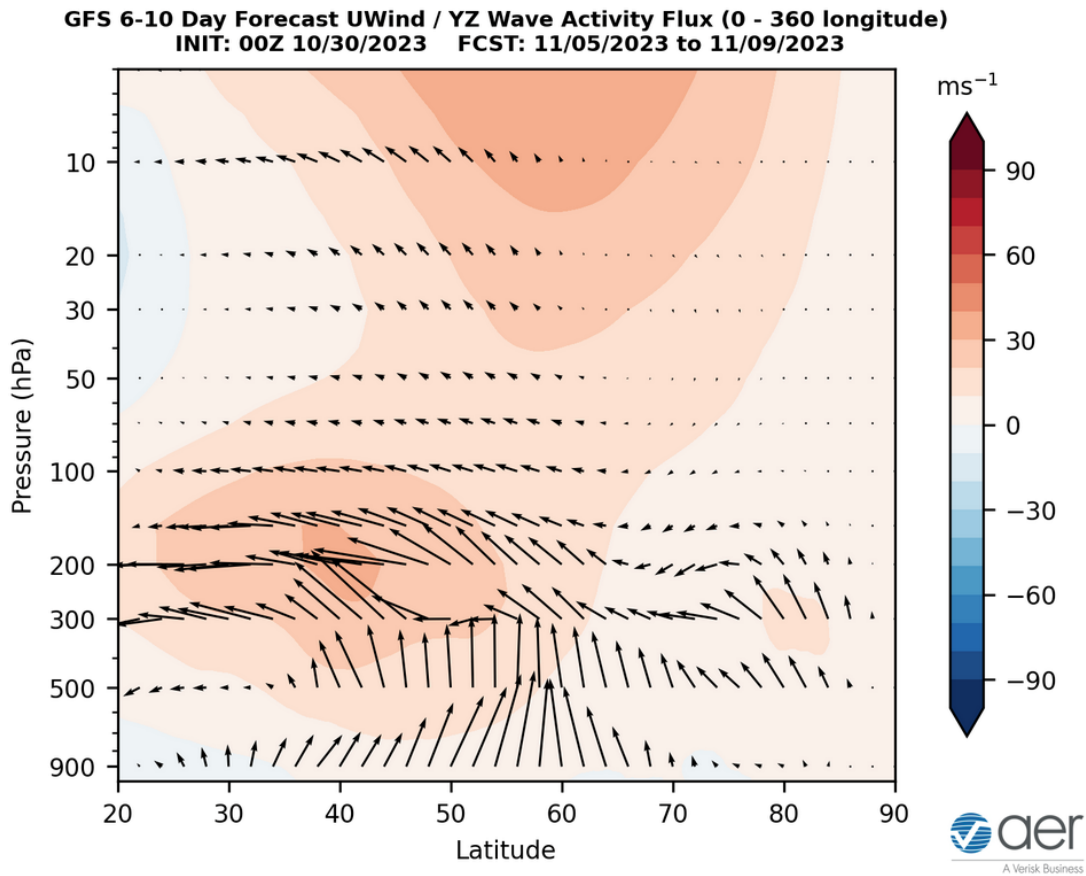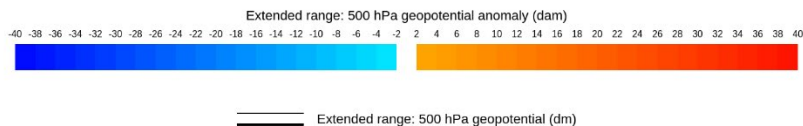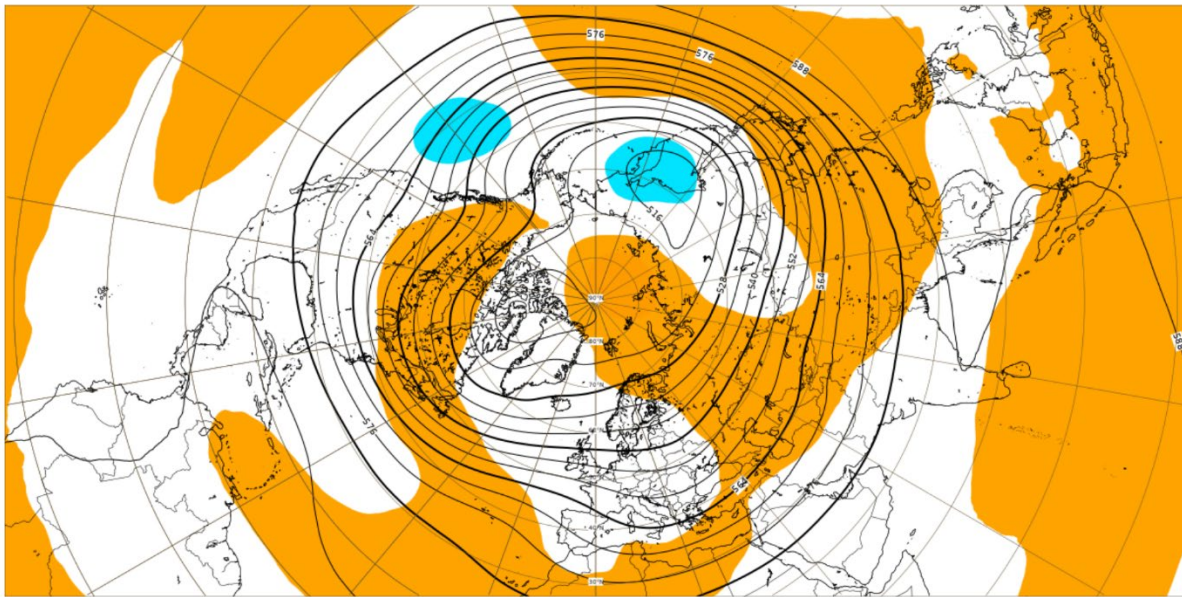

Figure v. Latitude-height cross section of xonal mean zonal wind (shading) and wave activity flux (vectors) forecasted for 5 – 9 October 2023. The forecast is from the 00Z 30 October 2022 GFS ensemble.

Yet similar to last week, looking at the CFS forecast for November (see **Figure 13**) and even more impressively the ECMWF weekly forecasts are suggestive of Urals-Barents-Kara Seas blocking/high pressure ridging with downstream troughing across Siberia for much of November possibly into December (see **Figure vi**). And as I discussed the past two weeks, if this is correct, we can potentially observe a relatively early large PV disruption (i.e., sudden stratospheric warming or SSW), which I do believe is supported by an easterly quasi-biennial oscillation (QBO).

500 hPa height: Weekly mean anomalies

Base time: Mon 30 Oct 2023 Valid time: Mon 27 Nov 2023 - Mon 04 Dec 2023 (+840h) Area : North Pole

Extended range: 500 hPa geopotential anomaly (dam)

-40 -38 -36 -34 -32 -30 -28 -26 -24 -22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

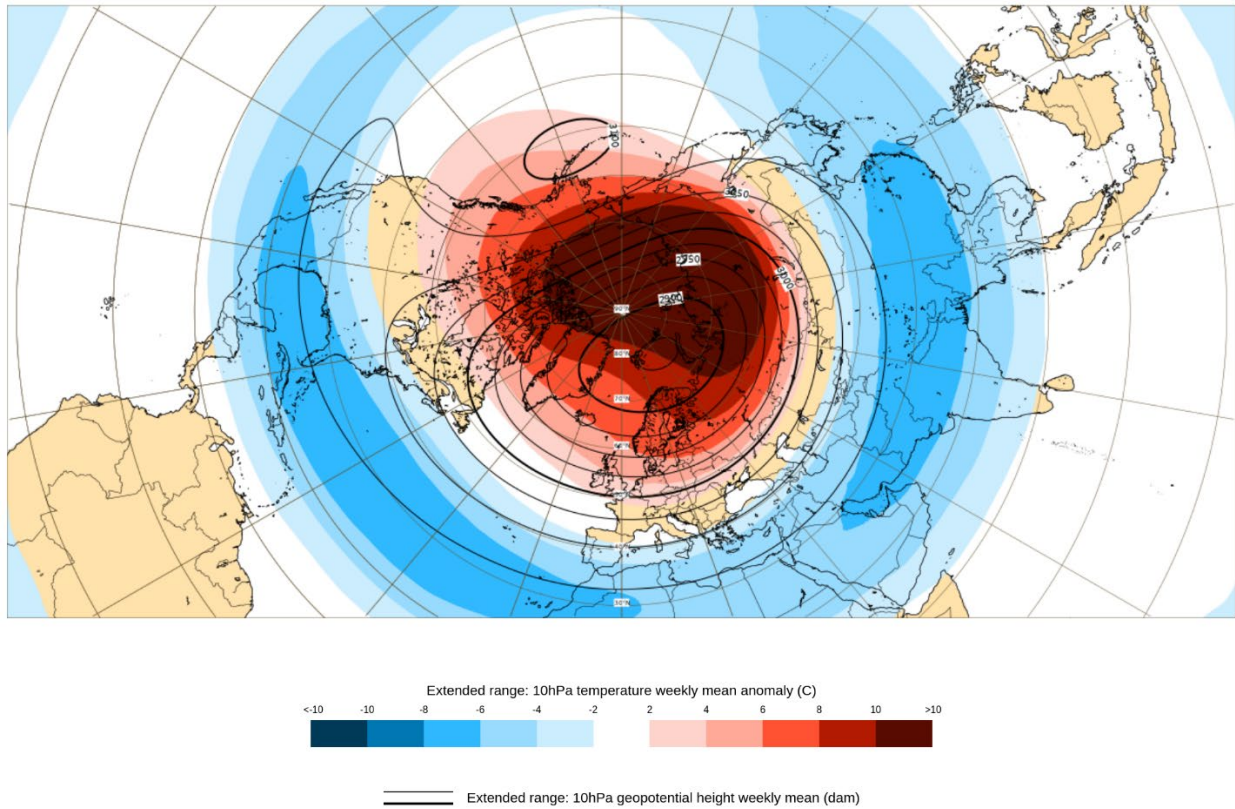Extended range: 500 hPa geopotential (dm)

ECMWF

Figure vi. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (dam; shading) across the Northern Hemisphere from 27 November – 4 December 2023. The forecasts are from the 00z 30 October 2023 ECMWF ensemble. Plot taken from https://charts.ecmwf.int/

The timing would likely be very late December into early January. And if there is a large PV disruption, the probability of cold and snowy weather greatly increases across the NH. The ECMWF weeklies have been consistently advertising a larger PV disruption in early December (see **Figure vii**). Not sure if the ECMWF is onto something or not, but the predicted tropospheric pattern is supportive of a larger PV disruption, but I continue to think that the ECMWF might be premature.

10hPa temperature: Weekly mean anomalies

Base time: Mon 30 Oct 2023 00 UTC Valid time: Mon 04 Dec 2023 00 UTC - Mon 11 Dec 2023 00 UTC (+1008h) Area : North Pole

Extended range: 10hPa temperature weekly mean anomaly (C)

<-10   -10   -8   -6   -4   -2   2   4   6   8   10   >10

Extended range: 10hPa geopotential height weekly mean (dam)

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Created at 2023-10-30T20:32:07.486Z

ECMWF

Figure vii. Forecasted average 10 mb geopotential heights (dam; contours) and geopotential height anomalies (dam; shading) across the Northern Hemisphere from 4 – 11 December 2023. The forecasts are from the 00z 30 October 2023 ECMWF ensemble. Plot taken from https://charts.ecmwf.int/

In conclusion as I have been doing this month, I conclude with Arctic sea ice extent (see **Figure viii**). Sea ice extent has been growing at a good clip but especially in the North Pacific sector, with sea ice filled in on the Asian side. I continue to expect that the negative sea ice anomalies will become more focused in the North Atlantic sector. And as I have been trying to emphasize today, blocking in the Barents-Kara sea region is critical from keeping a runaway PV that will squash any widespread and meaningful cold in Northern Eurasia and eastern North America for weeks and possibly even months to come.
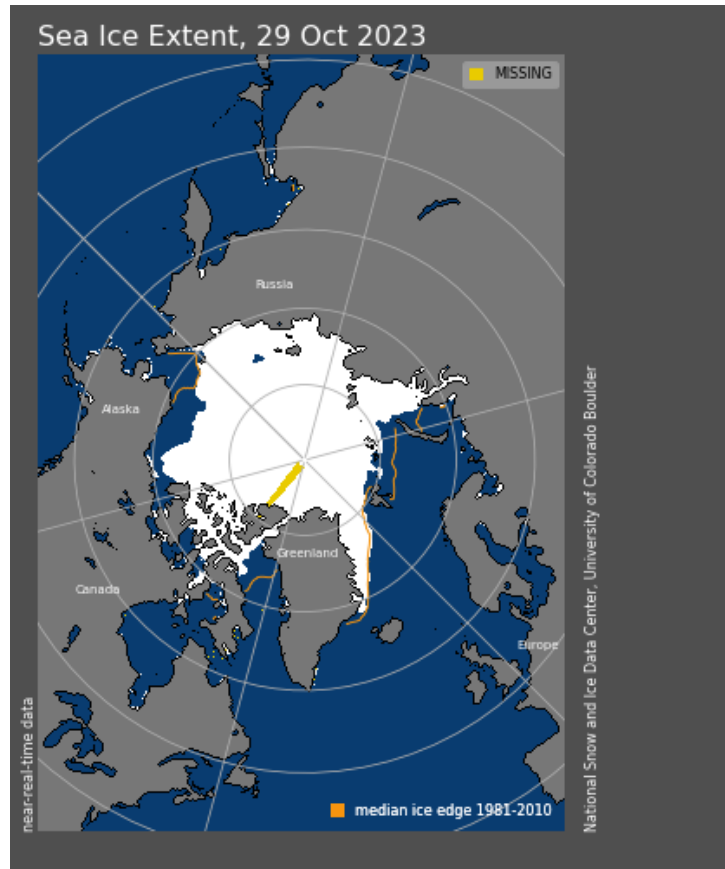
Figure viii. Observed Arctic sea ice extent on 29 October 2023 (white). Orange line shows climatological extent of sea ice based on the years 1981-2010. Image courtesy of National Snow and Ice Data Center (NSIDC). Snow and Ice Data Center (NSIDC).

One final note, the predicted pattern of western North America troughing and eastern North America ridging might seem consistent with recent winters and La Niña and not El Niño. However, I don't think this is necessarily indicative of the pattern in mid to late winter. So, if you are telling yourself "here we go again," maybe but also maybe not.

Wednesday Update

Not much to update. I was hoping to have complete the final numbers for snow cover extent and the snow advance index for today, but I am having some technical

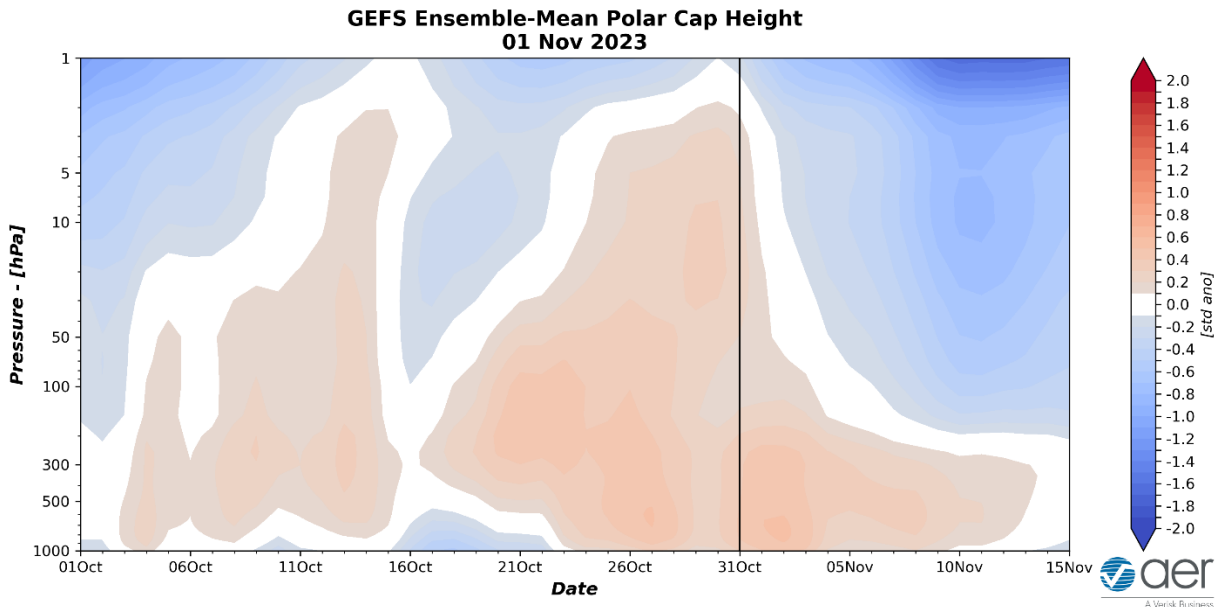issues. But I hope to have an update shortly.

GEFS Ensemble-Mean Polar Cap Height
01 Nov 2023

Figure ix. 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 1 November 2023 GFS ensemble.

Otherwise, what I wrote about Monday, I feel is still valid. I still believe the polar vortex is quickly approaching a fork in the road or a crossroads of sorts. I see that the ECMWF weeklies are still predicting a larger PV disruption in December, which I feel is a credible forecast with maybe some timing issues. But to give credence to the other possibility that I discussed of a strong PV coupling to a troposphere with a lack of high latitude blocking or a positive AO, the latest PCH is suggesting this scenario more strongly today (see **Figure ix**). Right at the end of the forecast it does appear the coupling has completed with blue shading throughout the atmospheric column. It is oh so slight and a low confidence forecast as the PCHs tend to be quite noisy especially after week one.
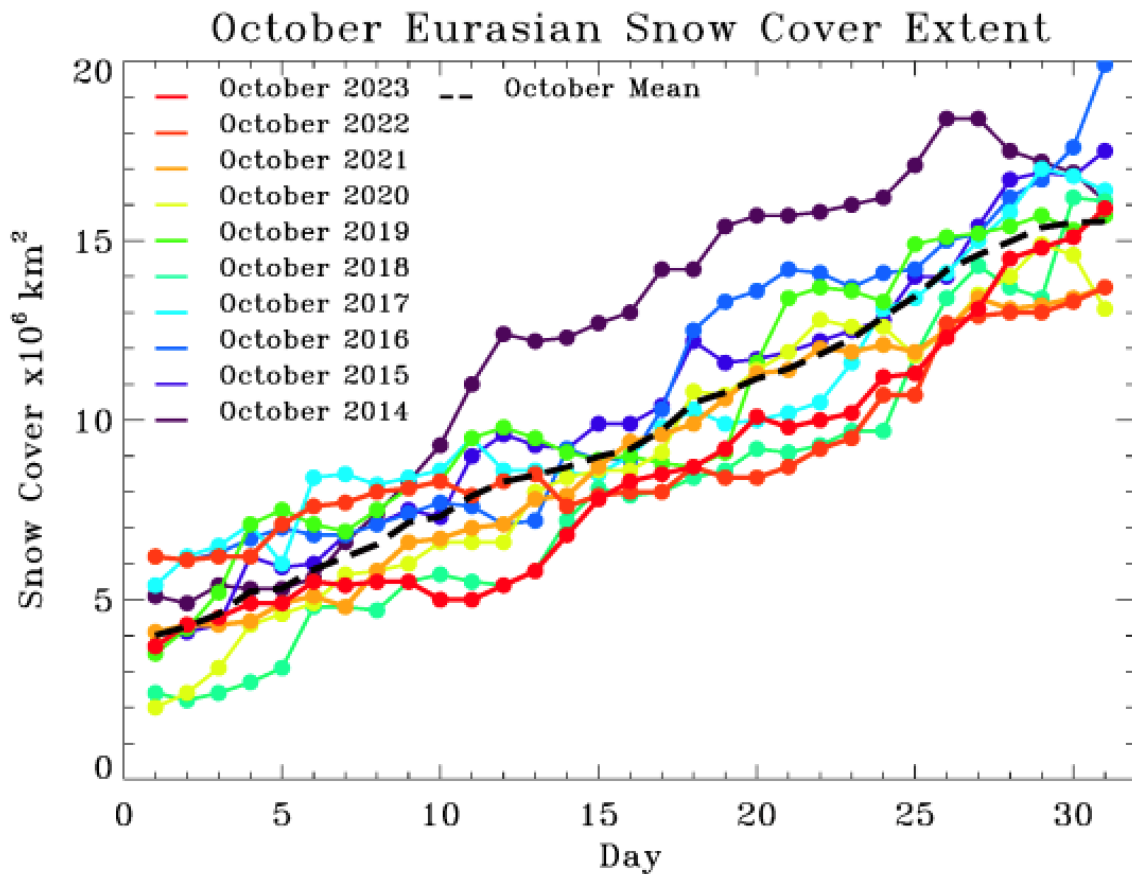
Otherwise, what I wrote about Monday, I feel is still valid. I still believe the polar vortex is quickly approaching a fork in the road or a crossroads of sorts. I see that the ECMWF weeklies are still predicting a larger PV disruption in December, which I feel is a credible forecast with maybe some timing issues. But to give credence to the other possibility that I discussed of a strong PV coupling to a troposphere with a lack of high latitude blocking or a positive AO, the latest PCH is suggesting this scenario more strongly today (see **Figure ix**). Right at the end of the forecast it does appear the coupling has completed with blue shading throughout the atmospheric column. It is oh so slight and a low confidence forecast as the PCHs tend to be quite noisy especially after week one.

Figure x. Observed Eurasian daily snow cover extent (SCE) in millions of km squared for the month of October through 31 October 2023 (shown in red).

I finished computing the snow cover extent (SCE) and snow advance index (SAI) for October 2023. If you need a refresher on the SAI you can read Cohen and Jones (2011). The SAI came in at +0.5 for the month thanks to a late surge of snow cover across Eurasia. And late the little engine that could the SCE finally barely got above the normal line for the first time of the month only on the very last day (see **Figure x**). I will discuss in next week's blog how I interpret the SAI and SCE of October 2023 and the implications for the polar vortex and weather for winter 2023/24.

Near-Term

This week

The AO is predicted to be negative this week **(Figure 1)** with mostly positive geopotential height anomalies across the Arctic and with mixed geopotential height anomalies across the mid-latitudes of the NH (**Figure 2**). With mostly positive geopotential height anomalies between Greenland (**Figure 2**), the NAO is predicted to be negative this period.
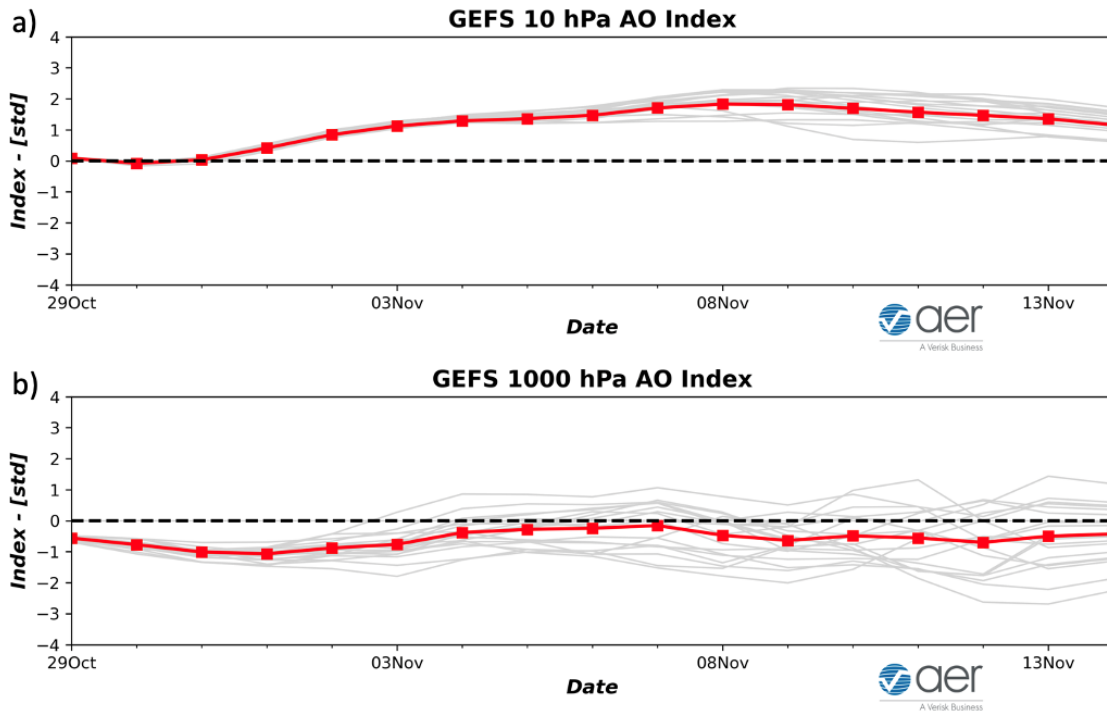
Figure 1. (a) The predicted daily-mean AO at 1000 hPa from the 00Z 30 October 2023 GFS ensemble. (b)The predicted daily-mean near-surface AO from the 00Z 30 October 2023 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble-mean AO index given by the red line with squares.

Ridging/positive geopotential height anomalies stretching from Greenland to Scandinavia will support troughing/negative geopotential height anomalies across Europe with more ridging/positive geopotential height anomalies across far Eastern Europe this week (**Figures 2**). The induced southwesterly flow pattern favors normal to above normal temperatures across Southern and Eastern Europe with normal to below normal temperatures across Northern and Western Europe including the UK (**Figure 3**). This week Asia is predicted to be dominated by ridging/positive geopotential height anomalies centered in Southern and Eastern Asia with troughing/negative geopotential height anomalies in Western Russia and Northern Asia (**Figure 2**). This pattern favors widespread normal to above normal temperatures across much of Southern and Eastern Asia with normal to below normal temperatures across Northern and Western Russia **(Figure 3)**.
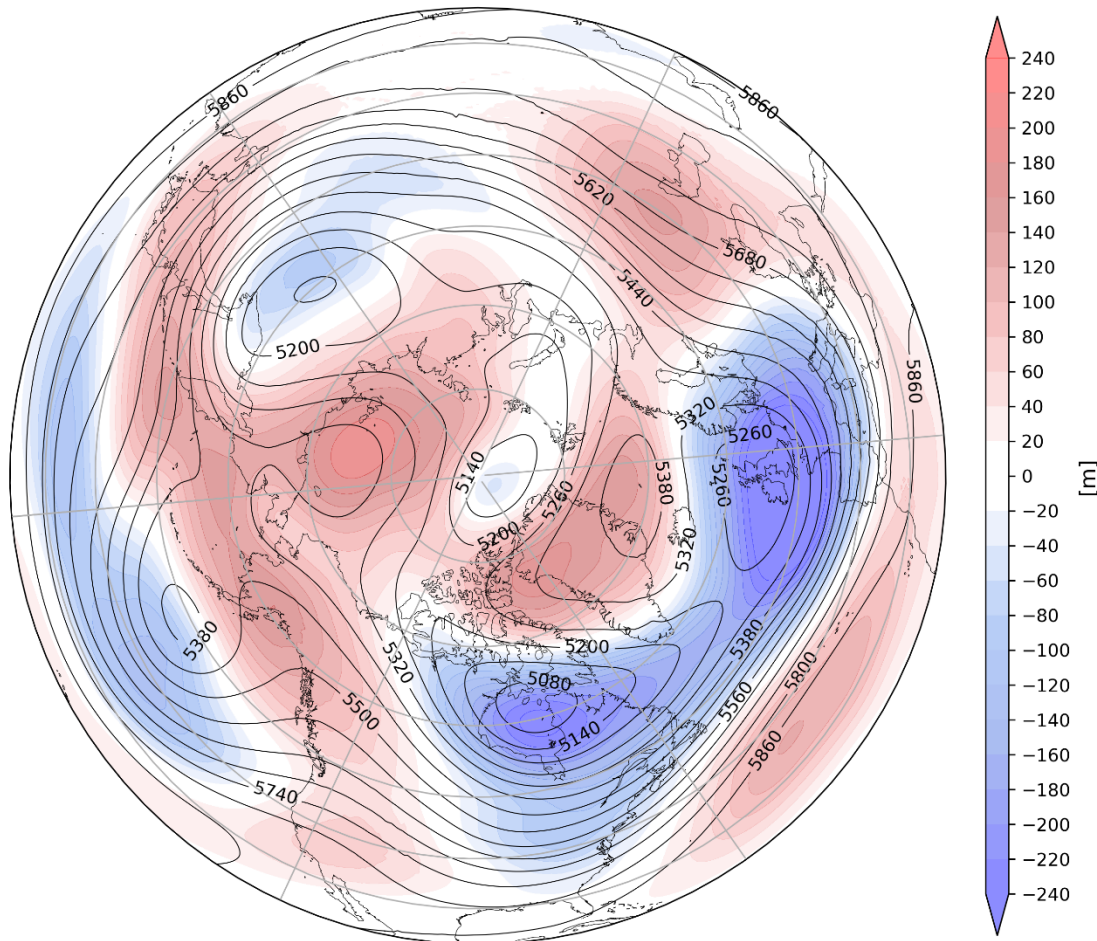
Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 31 October – 4 November 2023. The forecasts are from the 00z 30 October 2023 GFS ensemble.

The pattern this week across North America is troughing/negative geopotential height anomalies near the Aleutians forcing ridging/positive geopotential height anomalies centered across western North America with downstream troughing/negative geopotential height anomalies across Eastern Canada and the Eastern US **(Figure 2).** This pattern will favor widespread normal to above normal temperatures across Alaska, Western Canada, the Western US with normal to below normal temperatures across Eastern Canada and the Eastern US **(Figure 3).**
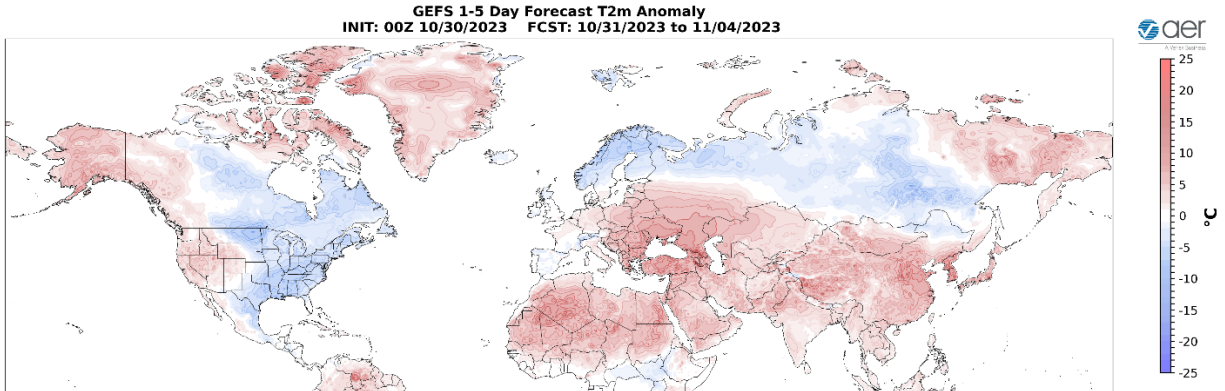
Figure 3. Forecasted surface temperature anomalies (°C; shading) from 31 October – 4 November 2023. The forecast is from the 00Z 30 October 2023 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Scandinavia the Alps, Northwest Asia and Siberia while mild temperatures will support snowmelt across southwestern Russia this week (**Figure 4**). Troughing and/or cold temperatures will support new snowfall across Northern Alaska and Northern Canada while mild temperatures will support snowmelt across the Canadian Southern Plains and US Northern Plains this week (**Figure 4**).
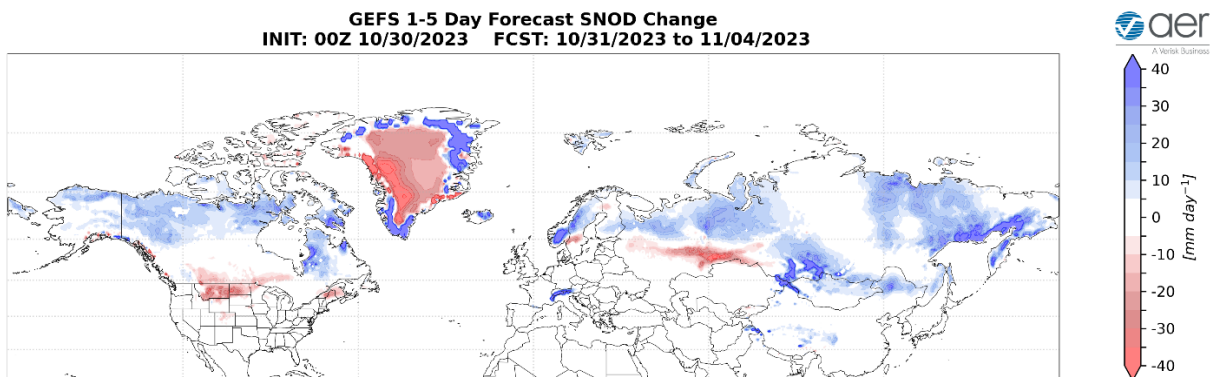

Figure 4. Forecasted snow depth changes (mm/day; shading) from 31 October – 4 November 2023. The forecast is from the 00Z 30 October 2023 GFS ensemble.

Near-Mid Term

Next week

With mixed geopotential height anomalies across the Arctic and with mixed geopotential height anomalies across the mid-latitudes this period (**Figure 5**), the AO should remain slightly negative to neutral this period (**Figure 1**). With predicted mostly positive pressure/geopotential height anomalies across Greenland (**Figure 5**), the NAO will likely be negative this period.
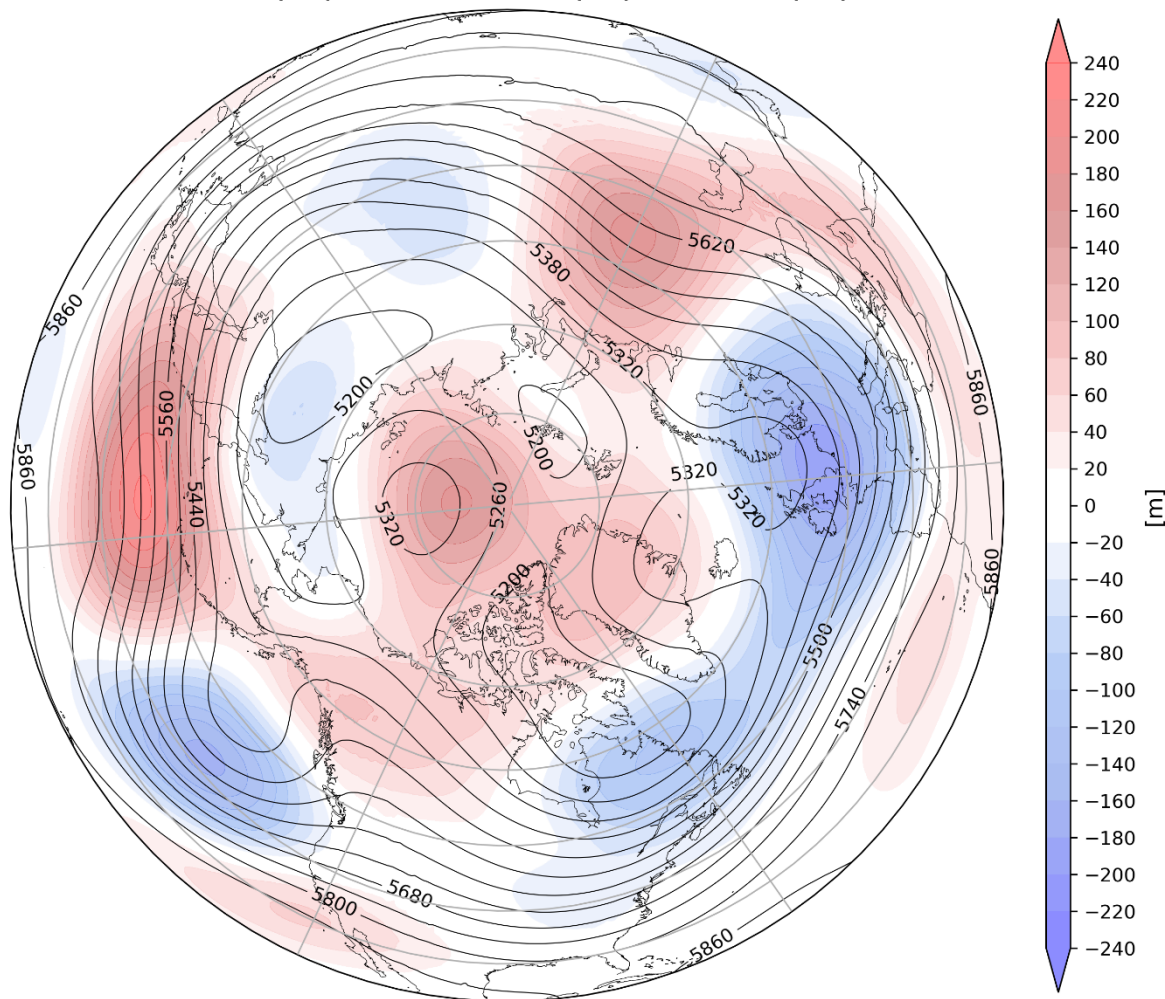
Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 5 – 9 November 2023. The forecasts are from the 00z 30 October 2023 GFS ensemble.

Persistent ridging/positive geopotential height anomalies between Greenland and the Barents-Kara Seas will continue to support troughing/negative geopotential height anomalies to the south across Western and Northern Europe with induced southwesterly flow across Eastern Europe this period (**Figure 5**). This southwesterly flow pattern will favor normal to above normal temperatures across Southern and Eastern Europe **with** normal to below normal temperatures across Northern and Western Europe including the UK (**Figures 6**). The general pattern across Asia is predicted ridging/positive geopotential height anomalies in Western Asia with troughing/negative geopotential height anomalies in eastern Asia this period (**Figure 5**). This pattern favors widespread normal to above normal temperatures

across Western and Southern Asia with normal to below normal temperatures across much of Siberia and regionally across Northeast Asia this period (**Figure 6**).
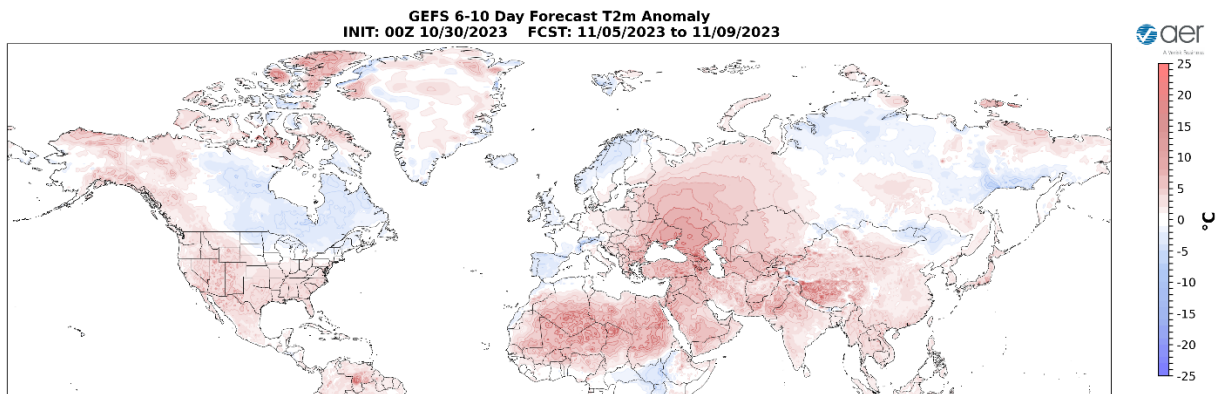

Figure 6. Forecasted surface temperature anomalies (°C; shading) from 5 – 9 November 2023. The forecasts are from the 00z 30 October 2023 GFS ensemble.

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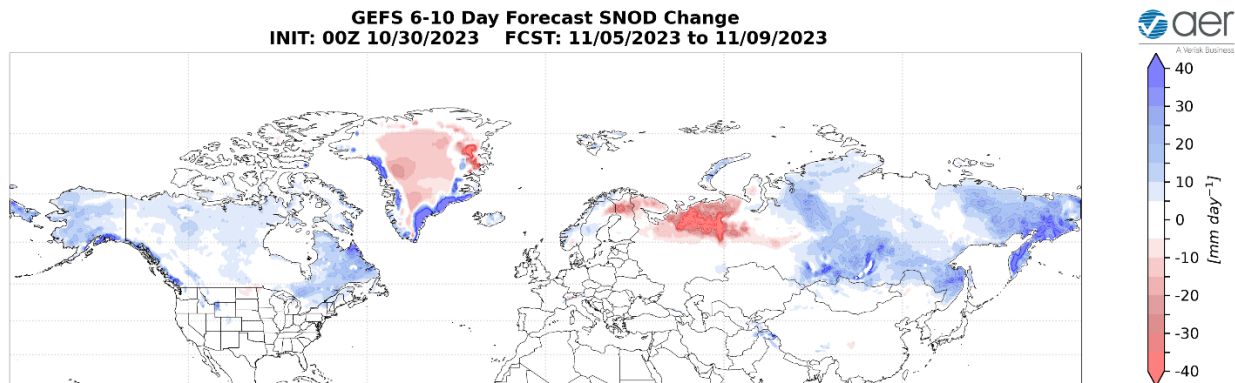

Figure 7. Forecasted snow depth changes (mm/day; shading) from 5 – 9 November 2023. The forecast is from the 00Z 30 October 2023 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across much of Siberia while mild temperatures will support snowmelt in Northwestern Russia and Scandinavia this period (**Figure 7**). Troughing and/or cold temperatures will support new snowfall across Alaska, Northern and Eastern Canada, the US Northern Rockies and northern

New England while mild temperatures will support snowmelt in the US Northern Plains this period (**Figure 7**).

Mid Term

Week Two

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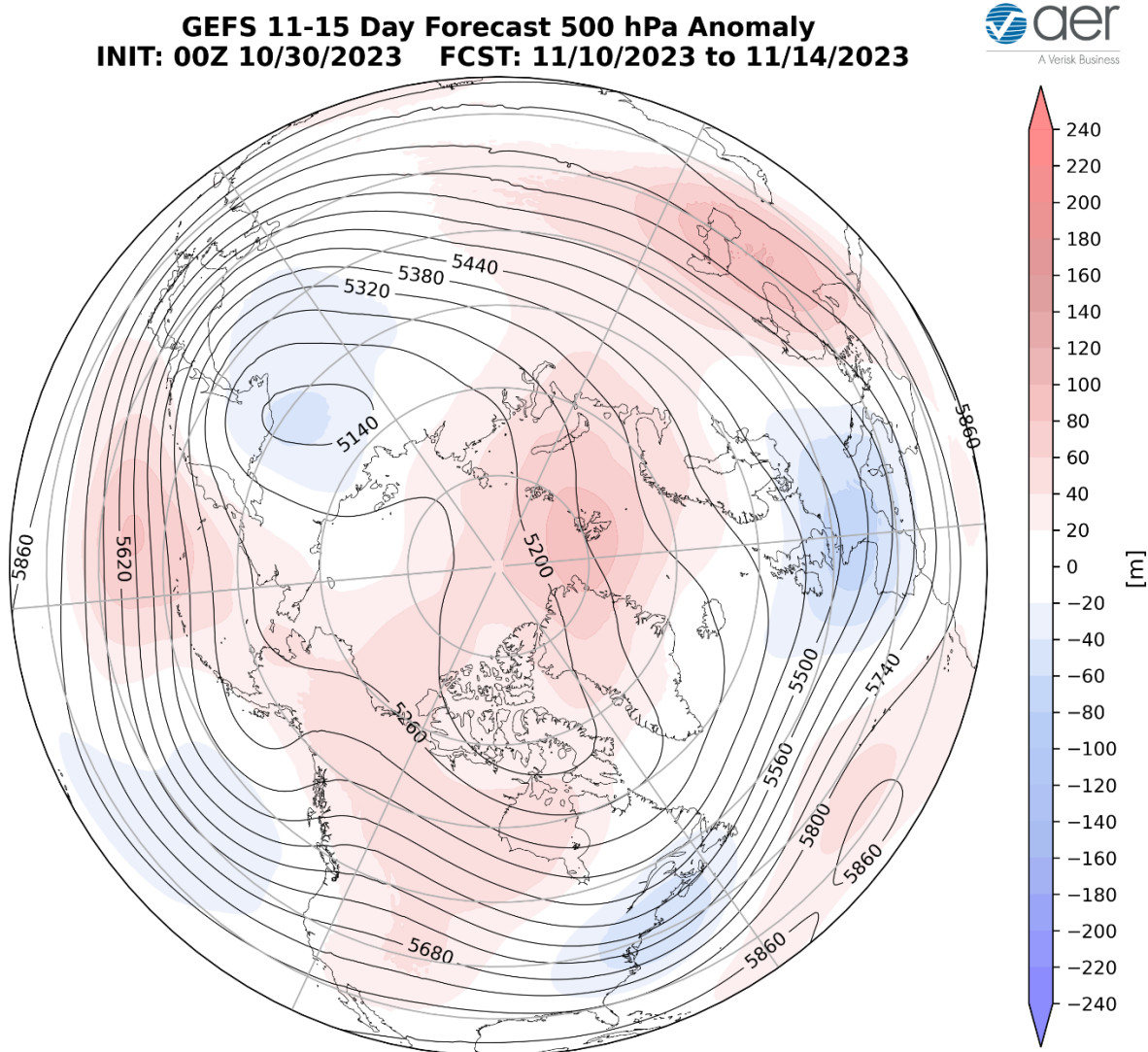

GEFS 11-15 Day Forecast 500 hPa Anomaly
INIT: 00Z 10/30/2023   FCST: 11/10/2023 to 11/14/2023

Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 10 – 14 November 2023. The forecasts are from the 00z 30 October 2023 GFS ensemble.

Persistent ridging/positive geopotential height anomalies stretching from Greenland to the Barents-Kara Seas will continue to support troughing/negative geopotential height anomalies to the south across Western Europe with induced southwesterly flow across Eastern Europe this period (**Figure 8**). This pattern should favor normal to above normal temperatures across Southern and Eastern Europe with normal to below normal temperatures across Western and Northern Europe including the UK this period (**Figures 9**). Ridging/positive geopotential height anomalies are predicted to consolidate in the Barents-Kara Seas and Western Asia with troughing/negative geopotential height anomalies across Siberia and East Asia this period (**Figure 8**). The predicted pattern favors widespread normal to above normal temperatures across Western and Southern Asia with normal to below normal temperatures mostly limited to Central and Eastern Siberia and parts of Northeast Asia this period (**Figure 9**).
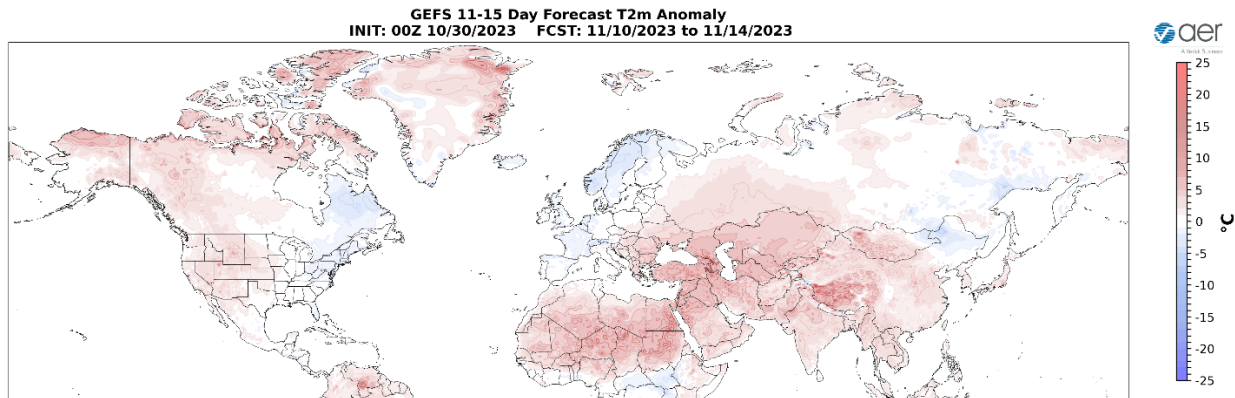

Figure 9. Forecasted surface temperature anomalies (°C; shading) from 10 – 14 November 2023. The forecasts are from the 00z 30 October 2023 GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to persist across Alaska, Western Canada and the Western US with troughing/negative geopotential height anomalies across Eastern Canada and the Eastern US this period (**Figure 8**).   This pattern favors widespread normal to above normal temperatures across Alaska, Western Canada and the Western US with normal to below normal temperatures across Eastern Canada and the Eastern US (**Figure 9**).
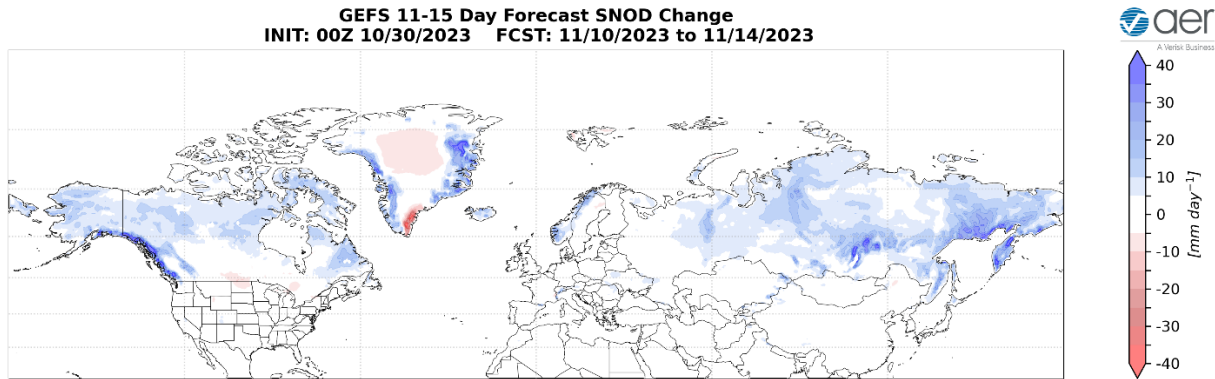
Figure 10. Forecasted snow depth changes (mm/day; shading) from 10 – 14 November 2023. The forecast is from the 00Z 30 October 2023 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Norway and Siberia and this period (**Figure 10**). Troughing and/or cold temperatures will support new snowfall across Alaska and Western and Northern Canada while milder temperatures will support snowmelt across the US Northern Rockies 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 and lower to mid stratosphere with cold/negative PCHs in the upper stratosphere (**Figure 11**). This week and into next week cold/negative PCHs are predicted to expand throughout the stratosphere while warm/positive PCHs are predicted to become focused in the mid to lower troposphere (**Figure 11**).
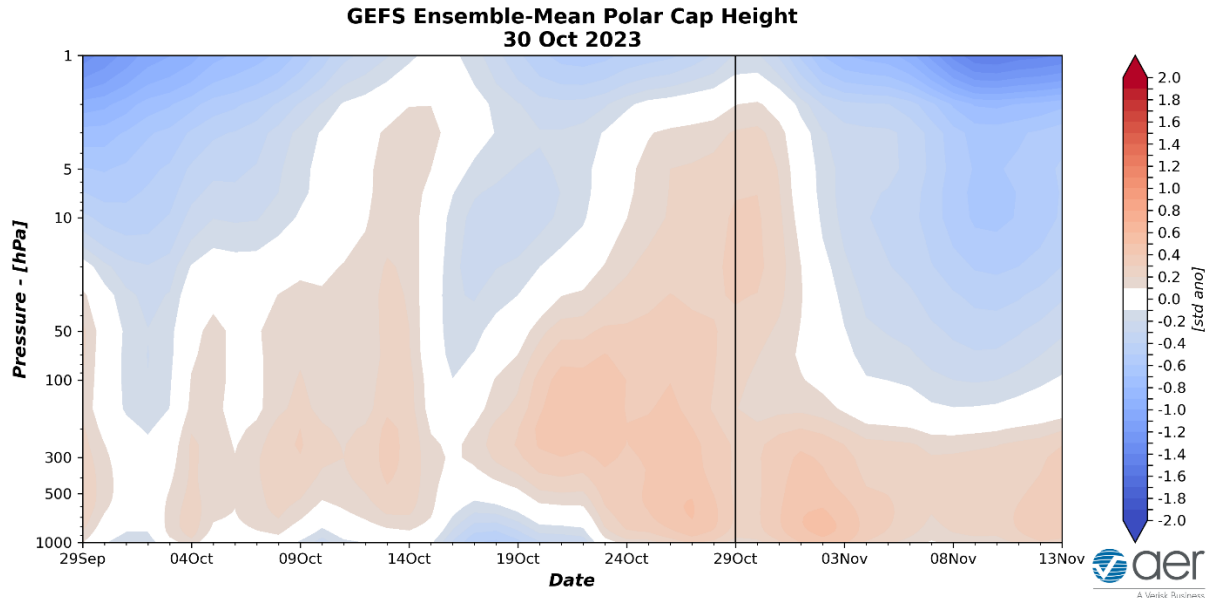
Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 30 October 2023 GFS ensemble.

The predicted warm/positive and weak PCHs in the lower troposphere the next two weeks (**Figure 11**) are consistent with the predicted negative to neutral surface AO the next two weeks (**Figure 1**). However, the surface AO is predicted to become more biased negative later this week (**Figure 1**) coinciding with the predicted with strengthening of warm/positive PCHs into the lower troposphere (**Figure 11**).

Also shown in **Figure 1** is the stratospheric AO. The stratospheric AO is currently neutral but is predicted to become strongly positive for much of the two weeks. This is consistent with cold/negative stratospheric PCHs and a strong PV that is often associated with widespread mild temperatures across the NH.
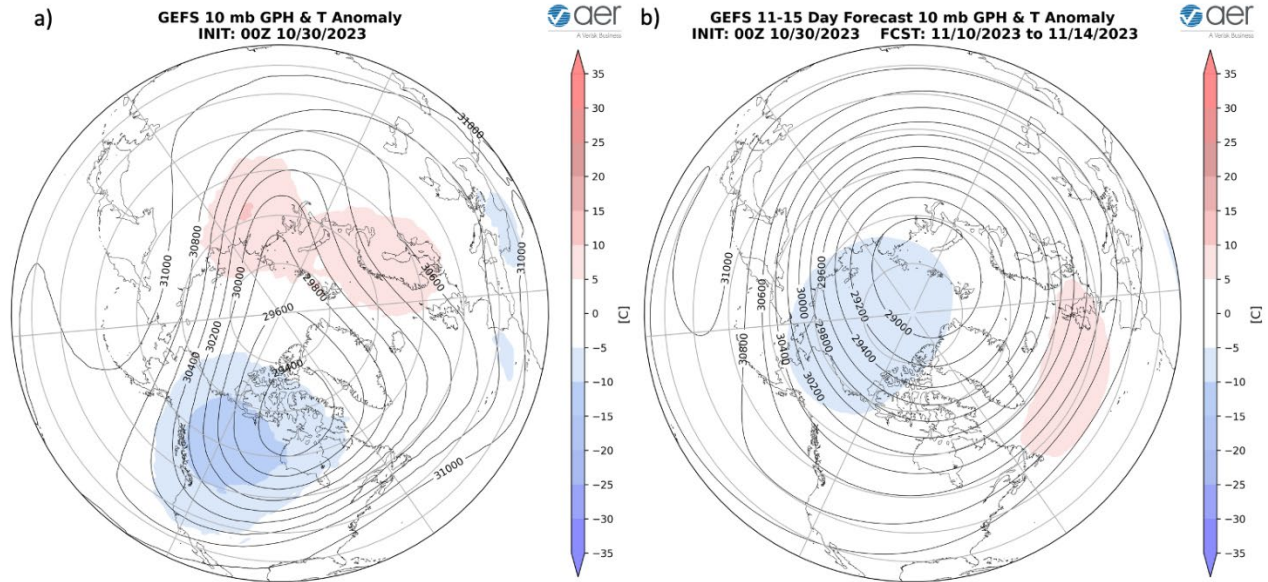
Figure 12. (a) Initialized 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere for 30 October 2023. (b) Same as (a) except forecasted averaged from 10 – 14 November 2023. The forecasts are from the 00Z 23 October 2023 GFS model ensemble.

Currently the polar vortex (PV) is contorted in shape where it is elongated along an axis from Siberia to Western Canada with the PV center shifted away from the North Pole centered near Hudson Bay (**Figure 12a**). The displaced PV center and elongation is a result of a minor PV disruption. However, starting next week and continuing into the second week of November, the PV center is predicted to return to the North Pole while becoming circular in shape (**Figure 12b**). This circular PV configuration is characteristic of a strong PV that often favors relatively mild temperatures widespread across the continents of the NH.
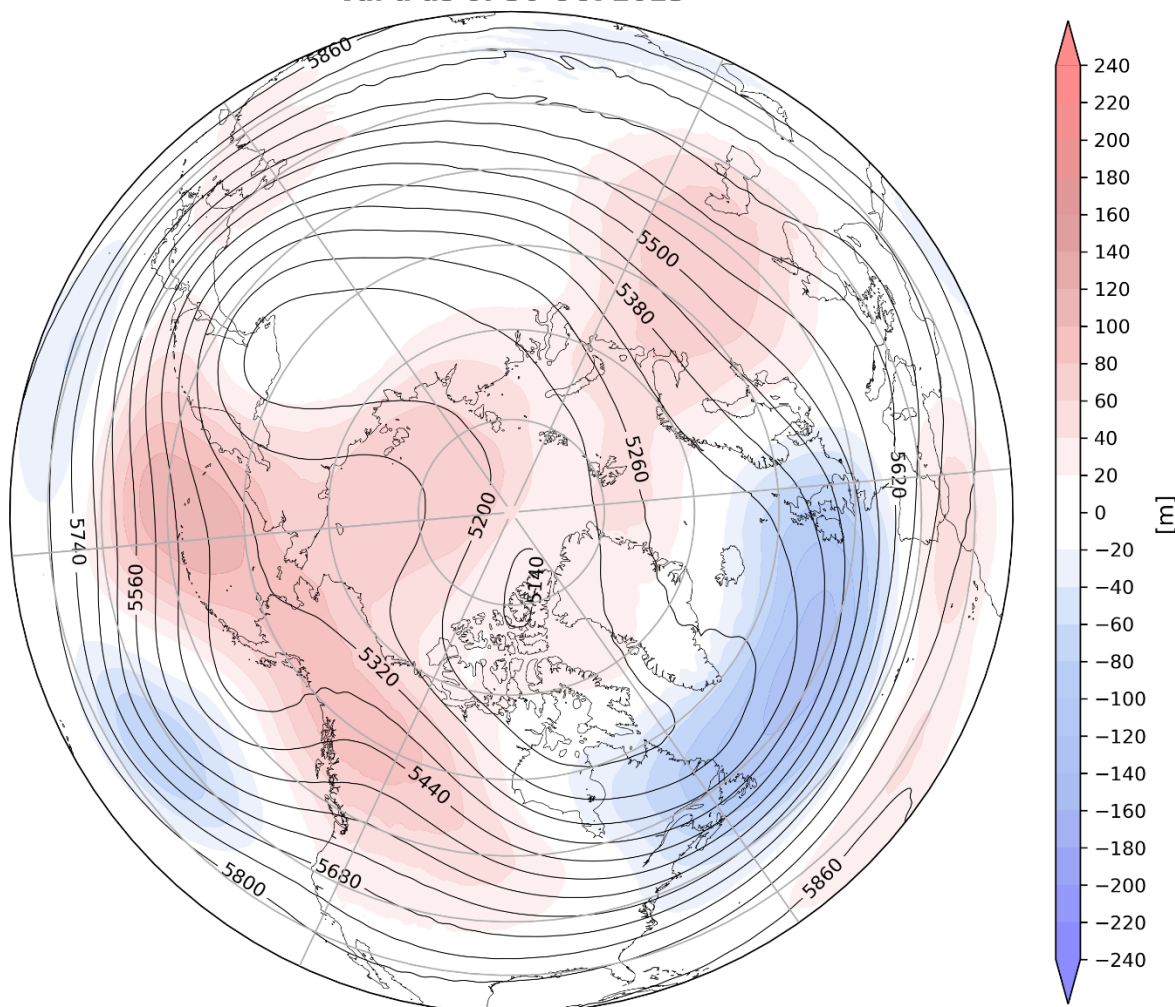
Figure 13. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for November 2023. The forecasts are from the 00Z 30 October 2023 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 13**) and surface temperatures for November (**Figure 14**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging extending from Western Asia to the Barents-Kara Seas, the North Pacific side of the Arctic, Alaska and Western Canada with troughing in Siberia, Northeast Asia and into the North Pacific, eastern North America extending into the North Atlantic and into Western Europe (**Figure 12**). This pattern favors seasonable to relatively warm temperatures across Central and Eastern Europe, Western and Southern Asia, Eastern Siberia, Alaska, Western Canada and the Western US with seasonable to relatively cold temperatures across Western Europe, much of Siberia, Northeast Asia, Eastern Canada and the Eastern US (**Figure 13**).
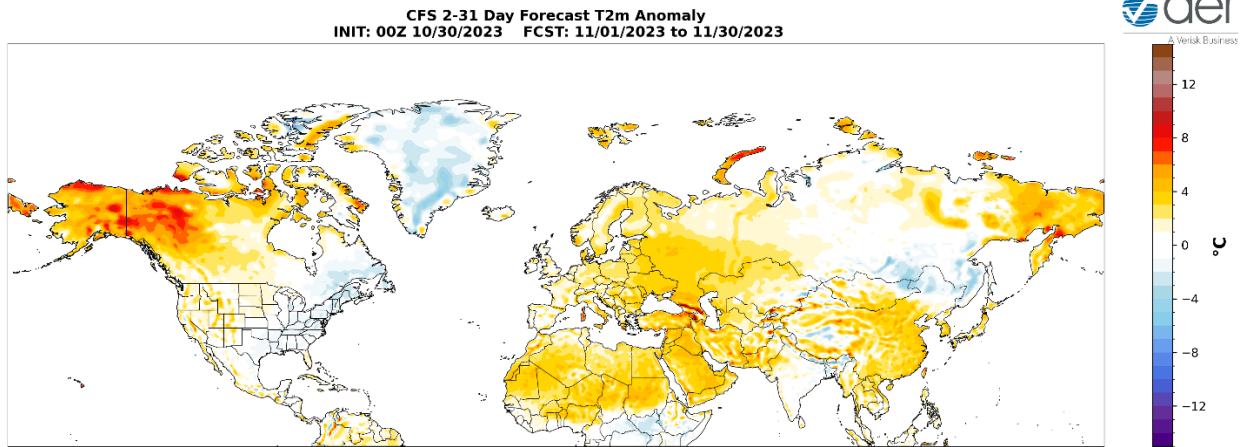
Figure 14. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for November 2023. The forecasts are from the 00Z 30 October 2023 CFS.

Boundary Forcings

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies are above normal, especially along the South America coast, indicating that anEl Niño is pertty much a sure thing (**Figure 15)** 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.
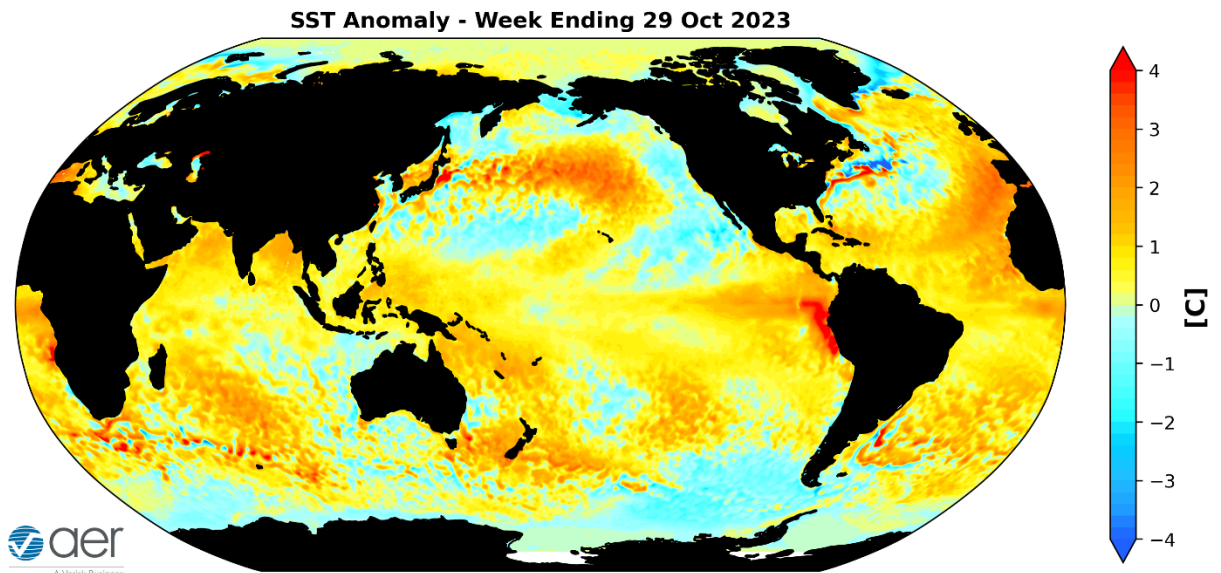
Figure 15. The latest weekly-mean global SST anomalies (ending 29 October 2023). Data from NOAA OI High-Resolution dataset.

Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is in weak phase one (**Figure 16**). The forecasts are for the MJO to weaken further where no phase is favored. Phase one favors troughing along the west coast of North America and ridging in eastern North America. Therefore it seems that the MJO is having little to none influence on North American weather this week and into next week. But admittedly this is outside of my expertise.
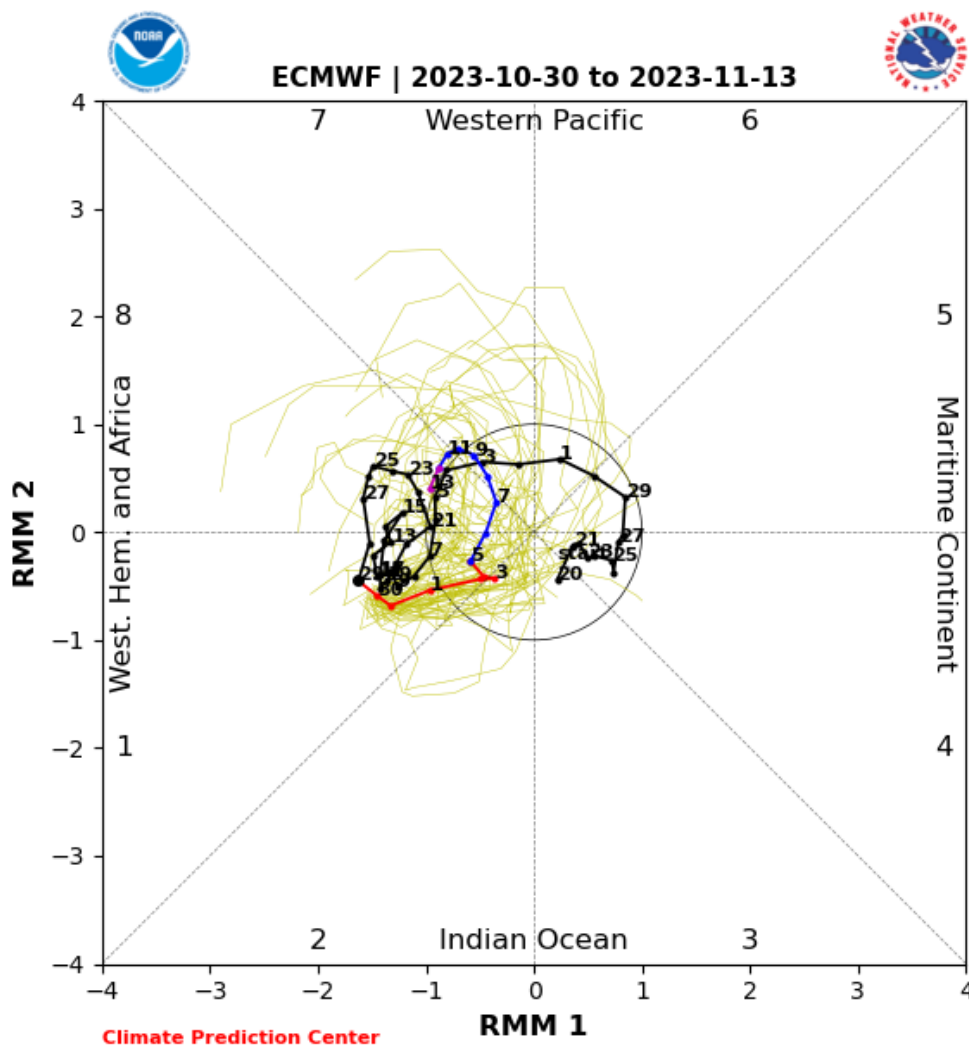

Figure 16. Past and forecast values of the MJO index. Forecast values from the 00Z 30 October 2023 ECMWF model. Yellow lines indicate individual ensemble-member

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!