JANUS RESEARCH GROUP

Arctic Oscillation and Polar Vortex Analysis and Forecasts

November 18, 2025

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.

Subscribe to our email list or follow me on Twitter (@judah47) for notification of updates.

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

Summary

- The Arctic Oscillation (AO) is currently negative and is predicted to flip positive this week and then return to negative to slightly neutral next week as pressure/geopotential height anomalies across the Arctic are currently mostly positive and are predicted to become mostly negative this week and then mixed to positive next week. The North Atlantic Oscillation (NAO) is currently negative as positive pressure/geopotential height anomalies dominate across Greenland, and the NAO is predicted to remain negative to neutral the next two weeks as pressure/geopotential height anomalies are predicted to remain positive nut weaken across Greenland the next two weeks.
- Ridging/positive geopotential height anomalies anchored across Greenland will support troughing/negative geopotential height anomalies across much of Europe with more ridging/positive geopotential height anomalies across Southeastern Europe this week. However next week as Greenland blocking weakens troughing across Europe will recede to Northern Europe and Southern European ridging expands northward. This week, normal to below normal temperatures will be widespread across Europe including the United Kingdom (UK), except for normal to above normal temperatures in Southeastern Europe. However next week normal to above normal temperatures will spread northward across Europe including the UK with normal to below normal temperatures limited to Scandinavia.
- This week ridging/positive geopotential height anomalies will dominate Asia with the

exception of troughing/negative geopotential height anomalies across far Eastern Asia. Then next week strengthening ridging/positive geopotential height anomalies across the North American Arctic will support deepening troughing/negative geopotential height anomalies across Siberia. This pattern favors normal to above normal temperatures across most of Asia with the exception of normal to below normal temperatures across far East Asia and then next week normal to below normal temperatures will spread across Siberia.

- This week across North America ridging/positive geopotential height anomalies will dominate with the exception of troughing/negative geopotential height anomalies in Southeastern Canada and the Northeastern United States (US). Then next week strengthening ridging/positive geopotential height anomalies near Alaska will support deepening troughing/negative geopotential height anomalies across Western Canada and the Western US. This patten will favor normal to above normal temperatures across Alaska, much of Canada and the US with normal to below normal temperatures limited to Southeastern Canada and the Northeastern US this week and then next week normal to below normal temperatures will begin to spread south out of Alaska across Western Canada and the Western US with normal to above normal temperatures in the Eastern US.
- The focus this week in on an anomalous relatively large polar vortex (PV) disruption so early in the season.

Plain Language Summary

So far this fall it has been relatively mild across the Northern Hemisphere (NH) continents with the biggest exception of Siberia (see **Figure**). I do think that the fall temperature pattern across Eurasia has been supportive of a weaker polar vortex (PV) and is the focus of this week's blog. The forecast does feature colder weather, mostly for Europe, Southeastern Europe and the Northeastern US this week and then Siberia and Western Canada next week (see **Figures 3, 6**). Eventually colder air spreads across much of Canada (see **Figures 9**). Longer term the weather will likely depend on the (almost) unprecedented disruption for late November. Potential is there for an interesting period of weather starting in December.

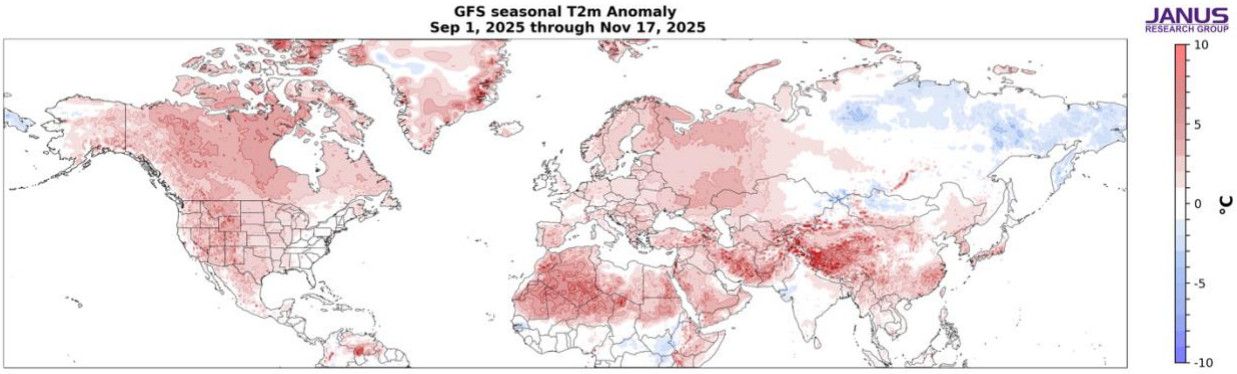

Figure. Estimate of the observed surface temperatures (°C; shading) from 01 Sep to 17 Nov 2025 based on GFS initializations and the GFS forecast from the 18 Nov 2025 run.

Impacts

Just a quick note about snow cover extent. The November dipole has also been discussed in other studies, and I have shared their results in previous blogs. The current SCE across Eurasia remains a dipole (see **Figure i**) that is consistent with those previous studies that argue it favors a weaker PV. Though to be fair it is more of one region being close to normal and the other well below normal. That could change over the coming week or so, but it does seem that the overall atmospheric circulation pattern will continue to support the overall dipole pattern.

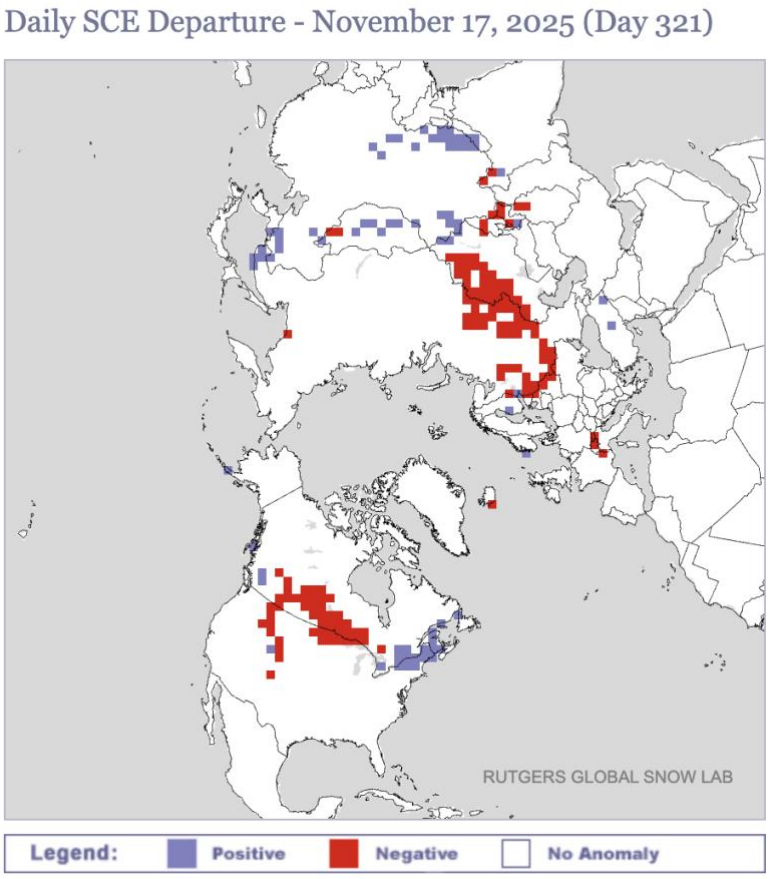

Figure i. Daily snow cover extent across Northern Hemisphere for 17 November 2025 shown in red. Plot taken from https://climate.rutgers.edu/snowcover/index.php.

Once again in general, the two-week forecast for the mid-tropospheric circulation is characterized by low pressure centered near the North Pole and high latitude ridging along the periphery of the Arctic (see **Figure iii**). The main region of high-latitude blocking, over the next two weeks is predicted to begin over Greenland but then shifts hard to the Beaufort Sea. The Greenland has helped to bring colder weather to Siberia, Northern Europe and eastern North America. But the big story over the next two weeks are the predicted strong positive anomalies over the Beaufort Sea. This will focus cold air to the south both across Northern and Eastern Asia and across western North America. This pattern does remind me of a stretched PV/wave

reflection but at least in my energy diagnostics don't show very robust wave reflection. But in general SSWs are very supportive of stretched PVs and that is something to watch for in the coming weeks.

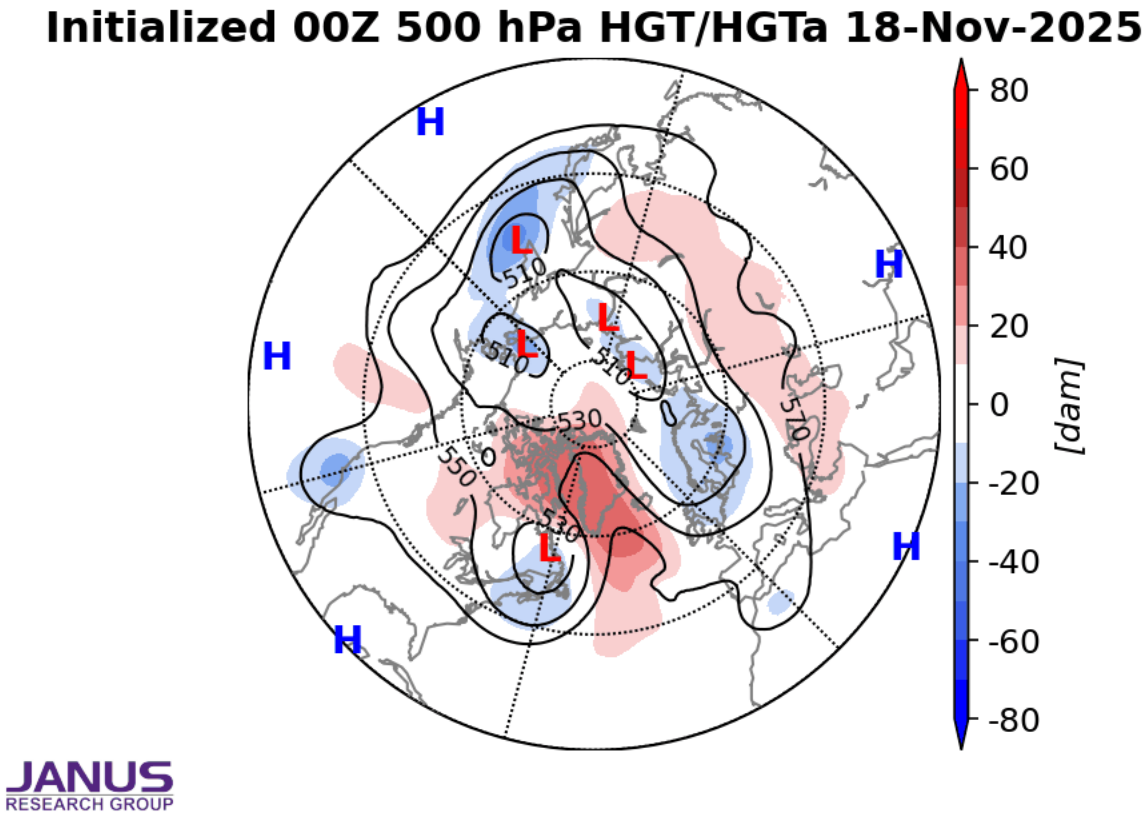

Figure iii. Initialized 500 mb geopotential heights (dam; contours) and decameter anomalies (dam; shading) across the Northern Hemisphere for 18 Nov 2025 and forecasted from 19 Nov to 03 Dec 2025. The forecasts are from the 00Z 18 Nov 2025 GFS model ensemble.

Of course I have been delaying getting to the big story of this week and maybe the month - the evolving large PV disruption. As I have been discussing we had one Canadian warming that transitioned to a stretched PV. Then a second Canadian warming that is predicted to become a sudden stratospheric warming (SSW - defined as a reversal of the wind from westerly to easterly at 60°N and 10 hPa) or very close to it as shown in **Figure iv**. As we showed in Agel et al. 2025 Canadian warmings are followed almost exclusively by stretched PVs or SSWs.

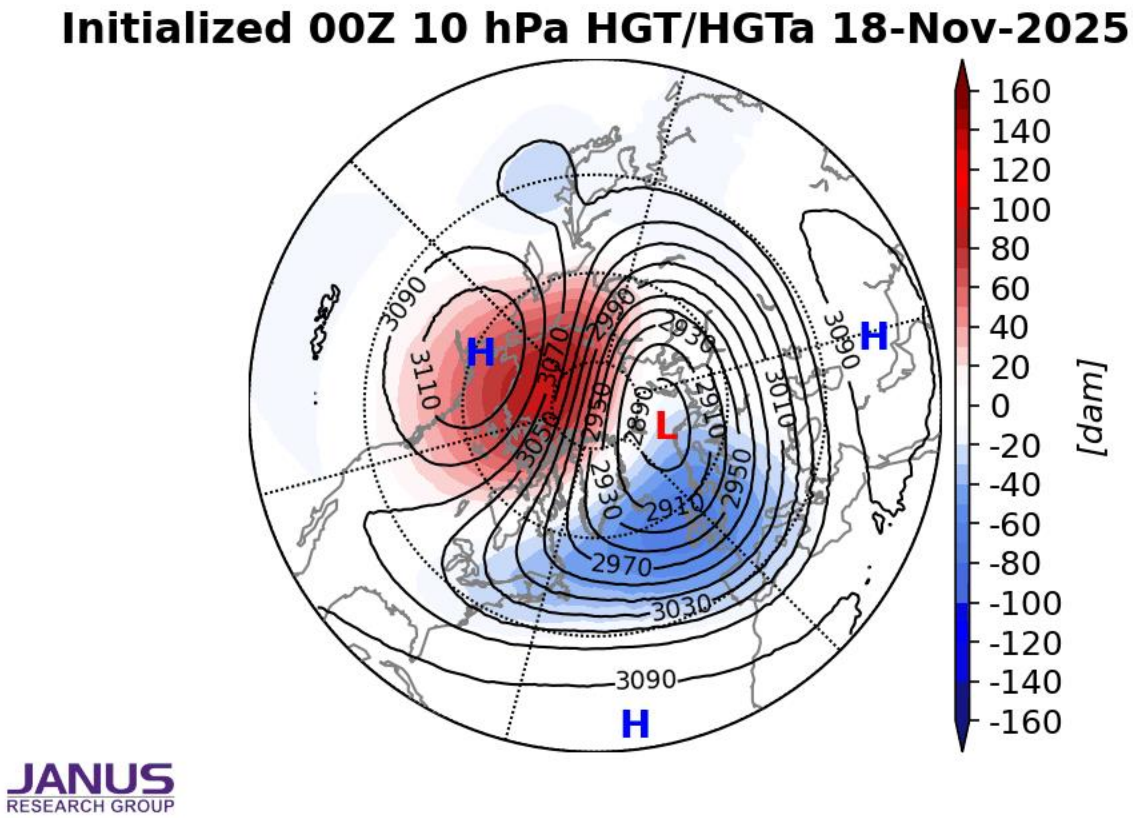

Figure iv. Forecasted average 10 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for November 2025. The forecasts are from the 00Z 18 Nov 2025 GFS.

I admit I was heavily leaning on another stretched PV or skeptical of a full SSW because of the timing, it is unusually early in the PV/winter season. If a full SSW is achieved in November (as predicted by the ECMWF) that would be the first time in the satellite era (post 1979). SSWs have been observed in 1958 and 1968 but I question how reliable the data is. Otherwise, we have early December SSWs in 1981 and 1987. A little later in December we have 1998 and 2001. So, if an SSW occurs in either very late November or early December it will be in rare company. At least in the satellite era, the SSWs of 1981 and 1987 were followed by relatively cold winters but the SSWs of 1998 and 2001 were not. In fact, winter 2001-2002 was quite mild at least in the Eastern US. So based on those four case studies what does a possible early SSW mean for the winter – it is a coin flip. A sobering thought for everyone to keep in mind.

Other possible analog events are the near or minor SSWs of November 2009 and December 2000. Those were both severe winters in the US and Europe in 2009/10. I was hoping to show some maps from those winters, but I am having computer problems. I did look at November and December 2000 and from what I saw then and with the forecasts and I don't think that December

2000 is a good analog. November into December 2009 might be a better analog but I think too early to know just yet.

Here are some highlights or bullets that I have learned from recent SSWs. During the event itself it tends to be warm in the Eastern US but can be cold in the Western US. And if anything, the observations verify being warmer in the Eastern US than the forecasts. Some forecasts are colder than others in the Eastern US over the next two weeks especially I guess the AIFS (I am as a big a fan as anyone with using AI but not a deterministic model when I can look at ensembles) but I will remain skeptical until proven otherwise.

There is an immediate tropospheric response and a delayed tropospheric response. The immediate one is the appetizer and the delayed one the main course. I think we are seeing the immediate response already in the forecasts and for the most part should be close to what we can expect. In the polar stratosphere we can see the PV centered and the coldest temperatures in the Barents-Kara Seas and northwest Eurasia coupled with strengthening ridging of high pressure and warm temperatures over Alaska and the Beaufort Sea (see **Figure 12**). Similarly, we see in the mid-troposphere troughing and cold temperatures across northern Europe and northern Asia with the main ridging over Alaska and the Beaufort Sea (see **Figures 5, 8**). This will result in colder temperatures persisting across Scandinavia and then across Siberia and eventually western North America (see **Figures 6, 9**). I think that is the easy part, the much harder part is what happens post the SSW event itself.

First the SSWs can be complicated and go through many different iterations and even head fakes. The main signal is still in the upper stratosphere (see **Figure 11**). I expect the weather models (and human forecasters) to struggle until the signal makes it to the lower stratosphere. The tropospheric response to the PV disruption is called dripping paint and maybe the first drip takes place in early December but likely more consequential ones to follow (see **Figure 11**).

As far as a truly cold pattern becoming established in the Eastern US, I am looking at mid-December. It is my experience that the Eastern US turns colder two weeks following a colder turn in Siberia. You can see the colder forecasts for Siberia below so that is the basis for my own expectation. The warmer Eastern US with turn to colder weather around mid-December is what I was trying to illustrate in **Figure vi** from last week.

Of course the big question is do we get strong Greenland blocking, a more extended cold and snowy period for Europe? If an SSW is verified, I hope to create a Greenland blocking forecast with my ex-postdoc Mostafa Hamouda. Hopefully we get to test ride this brand-new AI/machine learning model.

Near-Term

This week

The AO is predicted to be first negative and then positive this week **(Figure 1**) with mostly first positive and then negative geopotential height anomalies currently across the Arctic and mixed

geopotential height anomalies across the mid-latitudes of the NH (**Figure 2**). With predicted positive geopotential height anomalies across Greenland (**Figure 2**), the NAO is predicted to be negative this week.

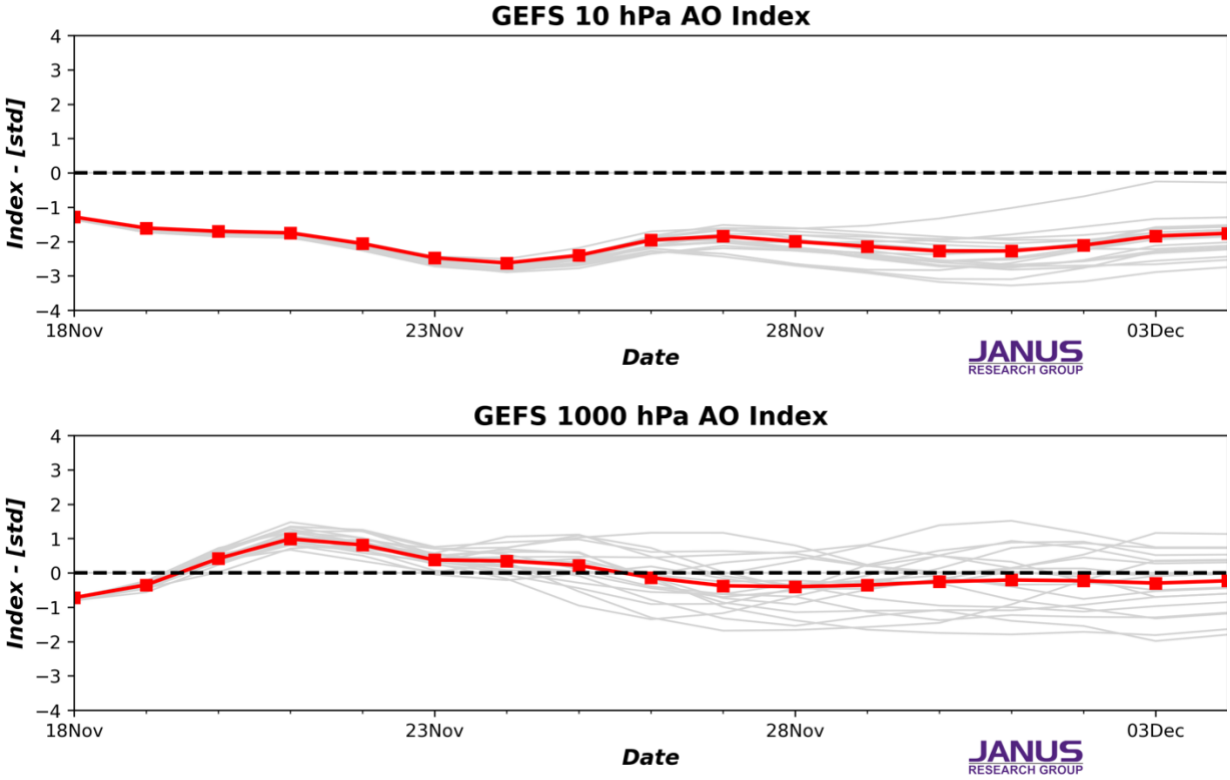

Figure 1. The predicted daily-mean AO at a) 10 hPa and b) 1000 hPa from the 00Z 18 Nov 2025 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble mean AO index given by the red line with squares.

This week, ridging/positive geopotential height anomalies across Greenland will support troughing/negative geopotential height anomalies centered across much of Europe with the exception of ridging/positive geopotential height anomalies across Southeastern Europe (**Figure 2).** This pattern will support widespread normal to below normal temperatures across Europe including the UK with the exception of normal to above normal temperatures across Southeastern Europe this period (**Figure 3**). This week ridging/positive geopotential height anomalies will dominate much of Asia but centered across the Levant region with the exception of troughing/negative geopotential height anomalies across far Northern Siberia and far East Asia (**Figure 2**). This pattern favors normal to above normal temperatures across much of Asia but especially the Levant region including Israel with normal to below normal temperatures across Northern Siberia and far East Asia this period **(Figure 3**).

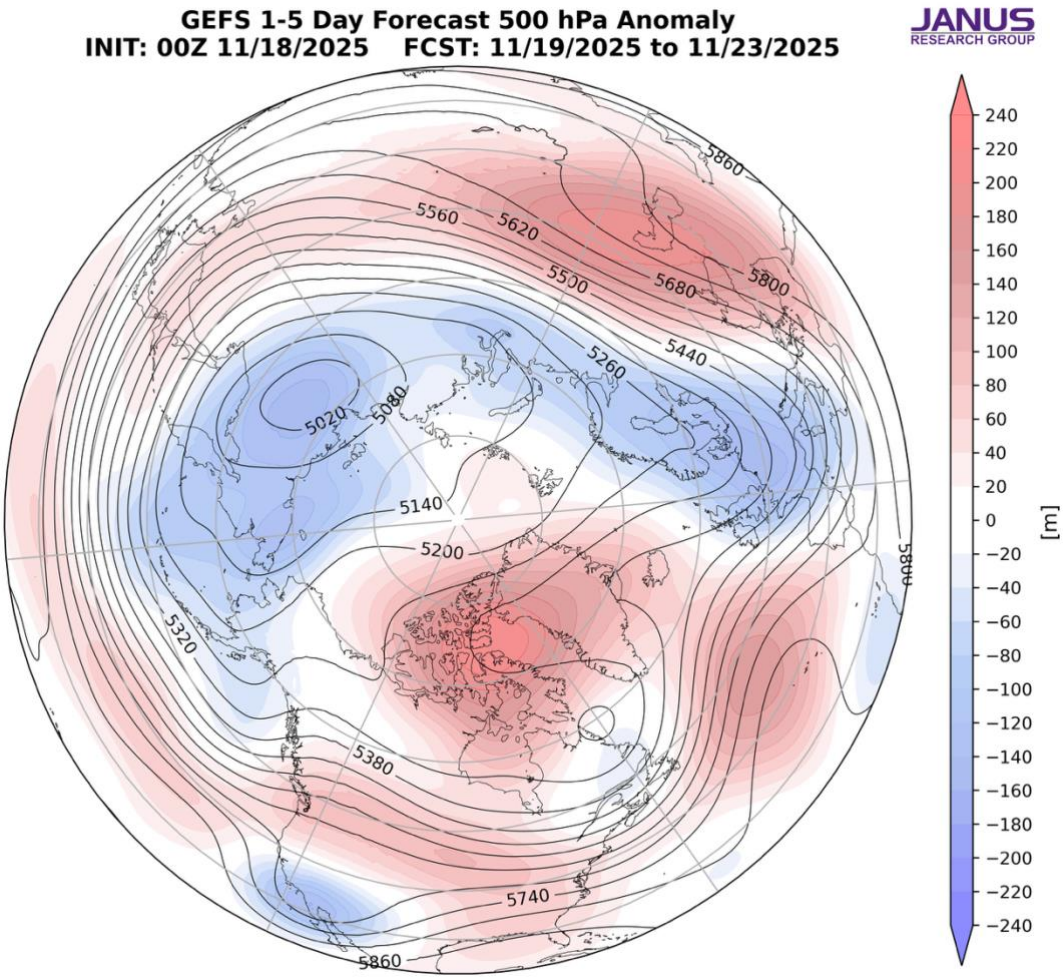

Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 18 Nov to 23 Nov 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

This week ridging/positive geopotential height anomalies will dominate North America with the exception of troughing/negative geopotential height anomalies mostly limited to Southeastern Canada and the Northeastern US this week (**Figure 2**). This patten will favor widespread normal to above normal temperatures across much of Alaska, Canada and the US with normal to below normal temperatures mostly limited to Southeastern Canada and the Northeastern US this week (**Figure 3**).

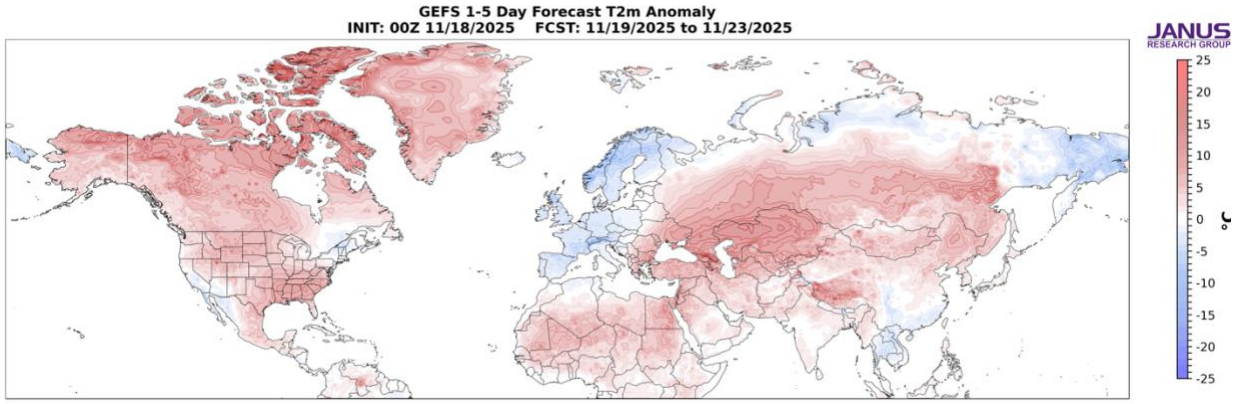

Figure 3. Forecasted surface temperature anomalies (°C; shading) 19 Nov to 23 Nov 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across Scandinavia, the Alps and parts of Siberia while milder temperatures will support snowmelt across southwestern Siberia this week (**Figure 4**). Troughing and/or cold temperatures will support new snowfall across Western and Northern Canada, Quebec the Canadian Rockies while milder temperatures will support snowmelt across Ontario and northern New England this week (**Figure 4**).

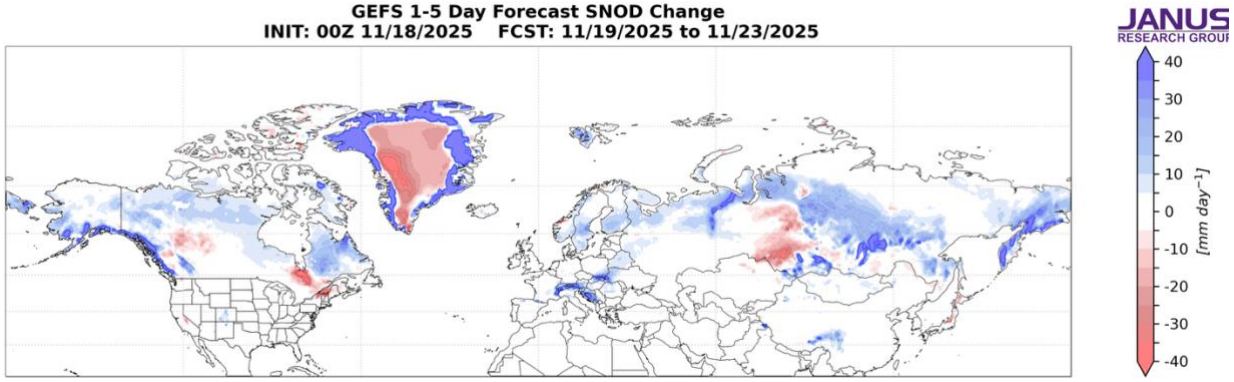

Figure 4. Forecasted snowfall (mm/day; shading) from 19 Nov to 13 Nov 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Near-Mid Term

Next week

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

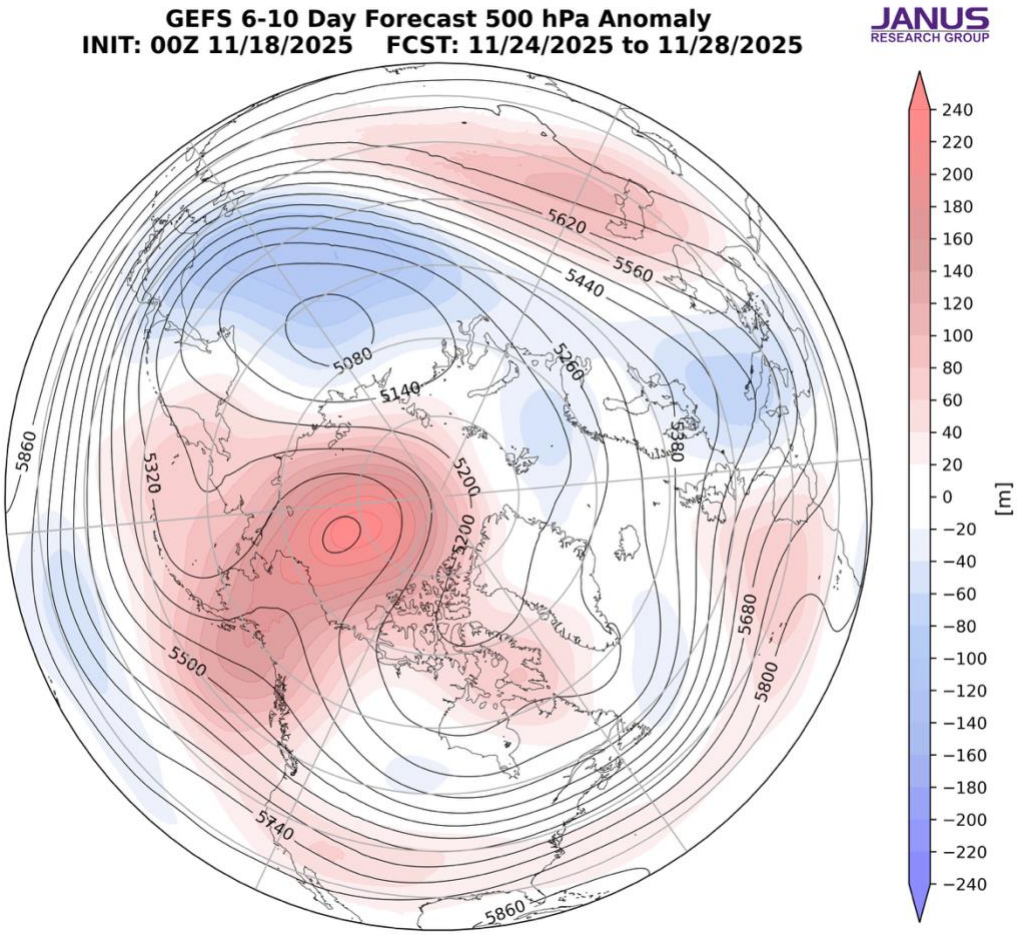

Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 24 Nov to 28 Nov 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Weakening but persistent ridging/positive geopotential height anomalies across Greenland will continue to support troughing/negative geopotential height anomalies across Europe except for ridging/positive geopotential height anomalies across Southeastern Europe (**Figure 5**). The pattern will support normal to below normal temperatures across much of Europe including the UK with normal to above normal temperatures across Southeastern Europe this period (**Figure 6**). Strengthening ridging/positive geopotential height anomalies

across the North American Arctic will support deepening troughing/negative geopotential height anomalies across Siberia with more ridging/positive geopotential height anomalies across Southern Asia this period (**Figure 5**). This pattern favors widespread normal to above normal temperatures across much of Asia Including Israel and the Middle East, Central Asia and China with normal to below normal temperatures across parts of Northwestern Russia and spreading across Siberia this period (**Figure 6**).

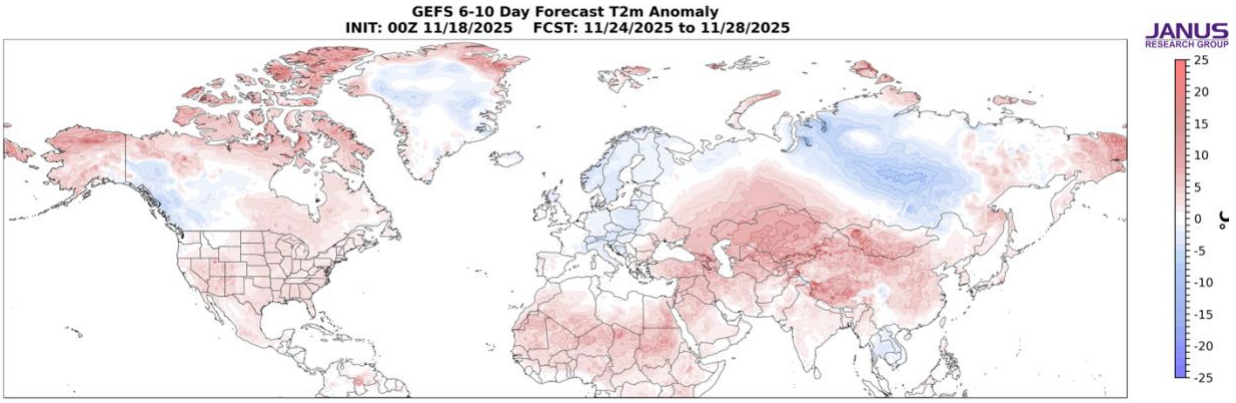

Figure 6. Forecasted surface temperature anomalies (°C; shading) from 24 Nov to 28 Nov 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Strengthening ridging/positive geopotential height anomalies across Alaska and the Beaufort Sea will support deepening troughing/negative geopotential height anomalies across Western Canada and the Northwestern US with more ridging across the Southern US this period (**Figure 5**). This pattern will favor widespread normal to above normal temperatures across Alaska, Northern and Eastern Canada and much of the US with normal to below normal temperatures limited to Western Canada and the Northwestern US (**Figure 6**).

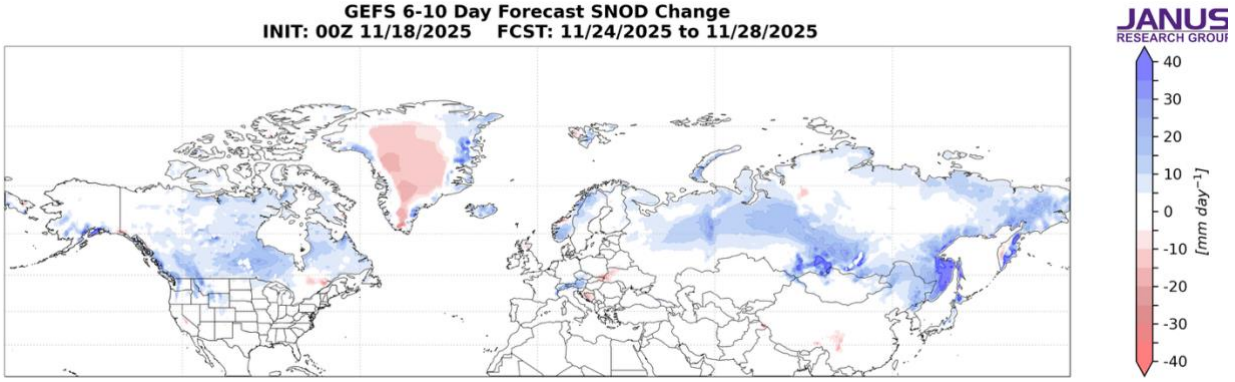

Figure 7. Forecasted precipitation rate (mm/day; shading) from 24 Nov to 28 Nov 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall in the Alps, Scandinavia, Northwestern Russia, Siberia and Northeast Asia this period (**Figure 7**). Troughing and/or cold

temperatures will support new snowfall in western Alaska, much of Canada and the US Northern Rockies while milder temperatures will support snowmelt in Quebec this period (**Figure 7**).

Mid Term

Week Two

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

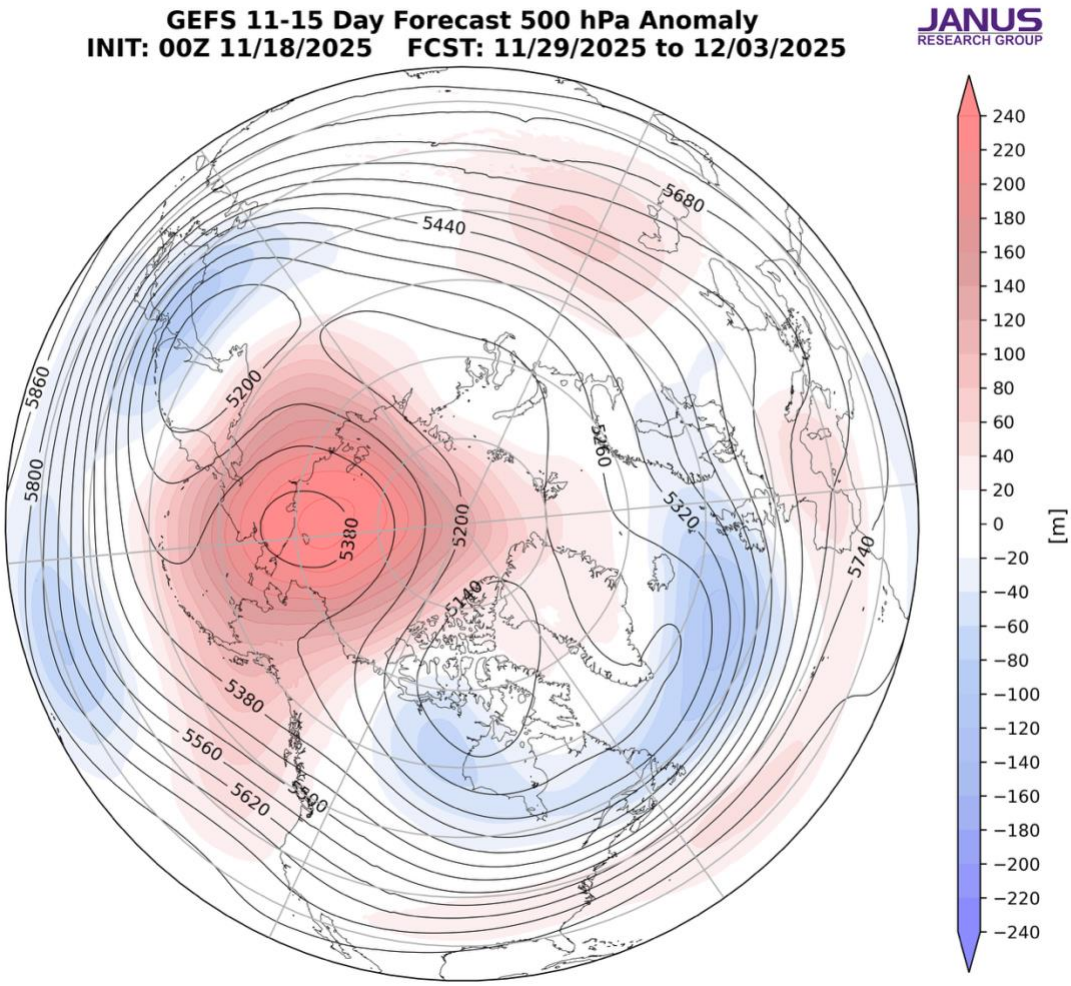

Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 29 Nov to 03 Dec 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Weakening ridging/positive geopotential height anomalies across Greenland are predicted to allow troughing/negative geopotential height anomalies to recede north across Europe with ridging/positive geopotential height anomalies spreading northward out of Southern Europe this period (**Figure 8**). This pattern should favor widespread normal to above normal temperatures across most of Europe the UK with normal to below temperatures mostly limited to Scandinavia this period (**Figures 9**). Persistent ridging/positive geopotential height anomalies across the Beaufort Sea will continue to support troughing/negative geopotential height anomalies across Siberia into Northeastern Asia with ridging/positive geopotential height anomalies across Southwestern Asia this period (**Figure 8**). The predicted pattern favors widespread normal to above normal temperatures across much of Asia including the Middle East and Central Asia with normal to below normal temperatures limited to parts of Siberia and Northeastern Asia this period (**Figure 9**).

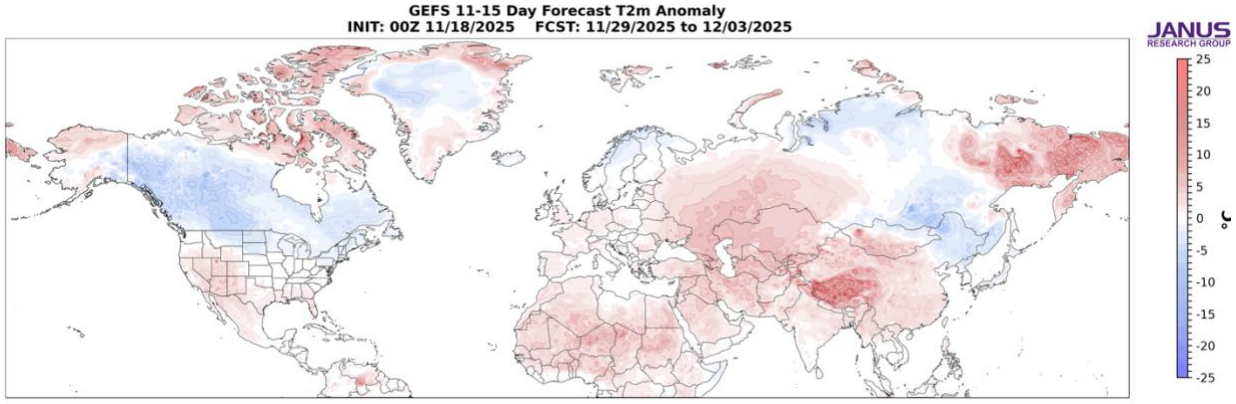

Figure 9. Forecasted surface temperature anomalies (°C; shading) from 29 Nov to 03 Dec 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to persist across the Beaufort Sea supporting troughing/negative geopotential height anomalies to the south across the Alaska, Western Canada and the Western US with more ridging in the Southeastern US this period (**Figure 8**). This pattern supports widespread normal to above normal temperatures across northern Alaska, the Canadian Arctic and the Southern US with normal to below normal temperatures across much of Canada and the Northern US this period (**Figure 9**).

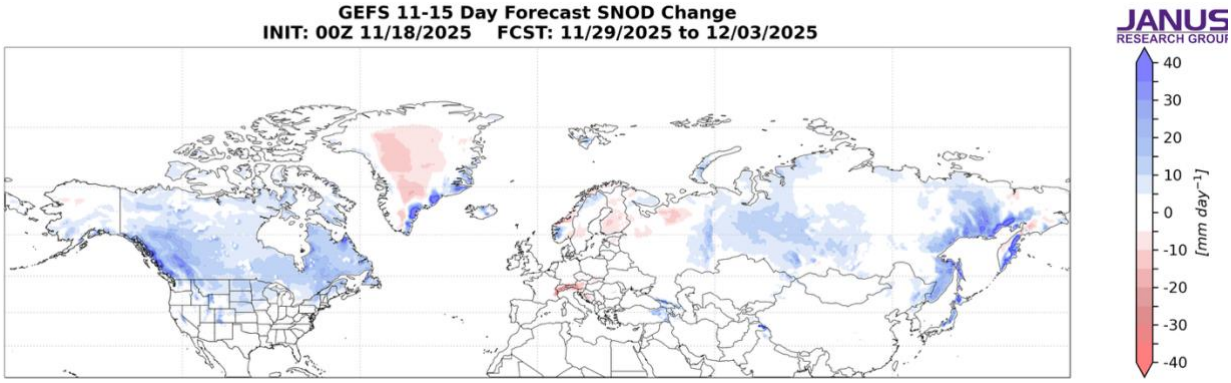

Figure 10. Forecasted snowfall (mm/day; shading) from 29 Nov to 03 Dec 2025. The forecasts are from the 00Z 18 Nov 2025 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall in the Urals, Western and Eastern Siberia while milder temperatures will support snowmelt in Scandinavia and the Alps this period (**Figure 10**). Troughing and/or cold temperatures will support new snowfall in southern Alaska, Canada, the US Northern Plains and the higher elevations of the Western US 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 upper stratosphere and lower troposphere with warm/positive PCHs in the mid to lower stratosphere and throughout much of the troposphere (**Figure 11**). The warm/positive PCHs are predicted to persist in the troposphere and expand upward and strengthen throughout the stratosphere over the next two weeks.

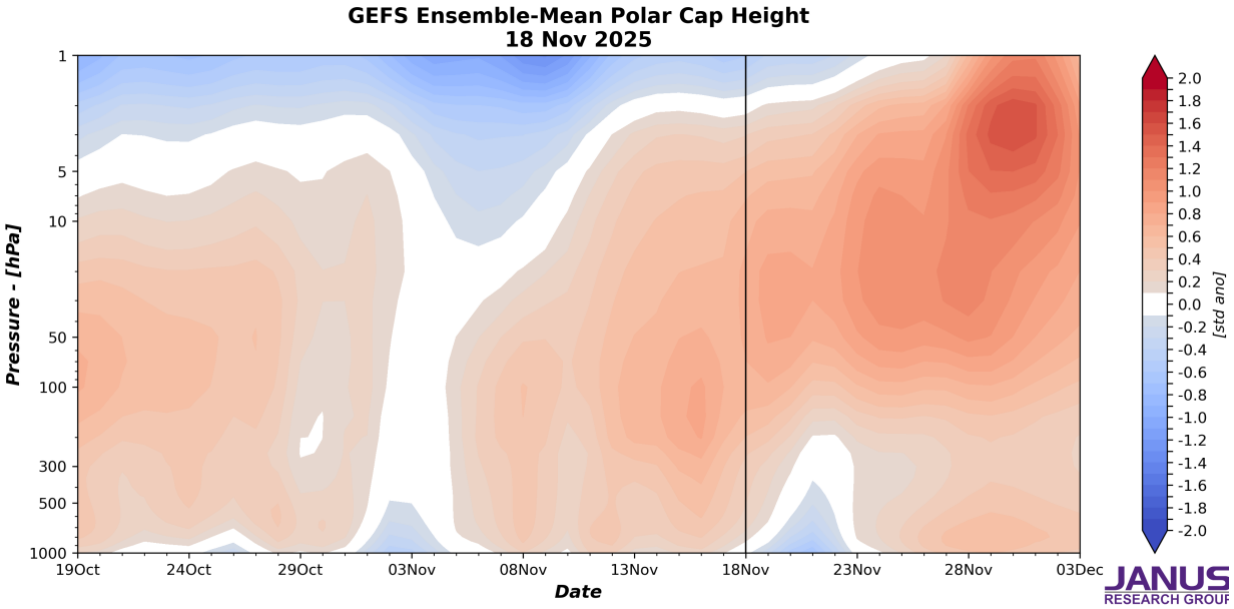

Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 18 Nov 2025 GFS ensemble.

The predicted mixed PCHs in the lower troposphere this week (**Figure 11**) are consistent with the predicted mixed AO this week (**Figure 1**). Then next week the forecast of warm/positive PCHs descending to the surface (**Figure 11**) should favor a negative surface AO bias next week (**Figure 1**).

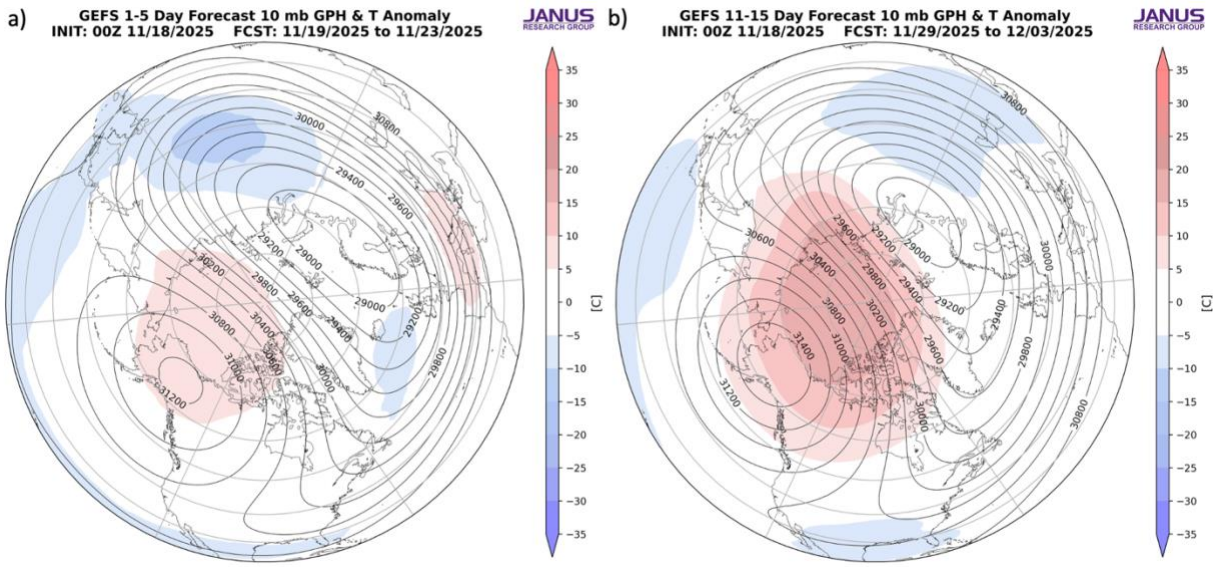

Figure 12. (a) Predicted 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere averaged for 19 Nov to 23 Nov 2025. (b) Same as (a) except forecasted averaged from 29 Nov to 03 Dec 2025. The forecasts are from the 00Z 18 November 2025 GFS model ensemble.

This week the polar vortex (PV) is predicted to be elongated in shape with the PV center over the Barents-Kara Seas with relatively cold temperatures focused in eastern Asia and with high pressure centered near Alaska and warm temperatures in the North Pacific sector of the Arctic in the polar stratosphere (**Figure 12a**). This is the beginning of an unusually early large PV disruption. Then, for late November into early December the PV center is predicted to be pushed a little further south into Asia and become more distorted in shape with strong high pressure over Alaska and warming extending out of Asia and covering much of the Arctic in the polar stratosphere (**Figure 12b**). This resembles a highly disrupted PV configuration still and may even qualify as a sudden stratospheric warming. I include the stratospheric AO in **Figure 1** this week to show just how weak the PV is being predicted by the GFS with a strongly negative stratospheric AO over the next two weeks.

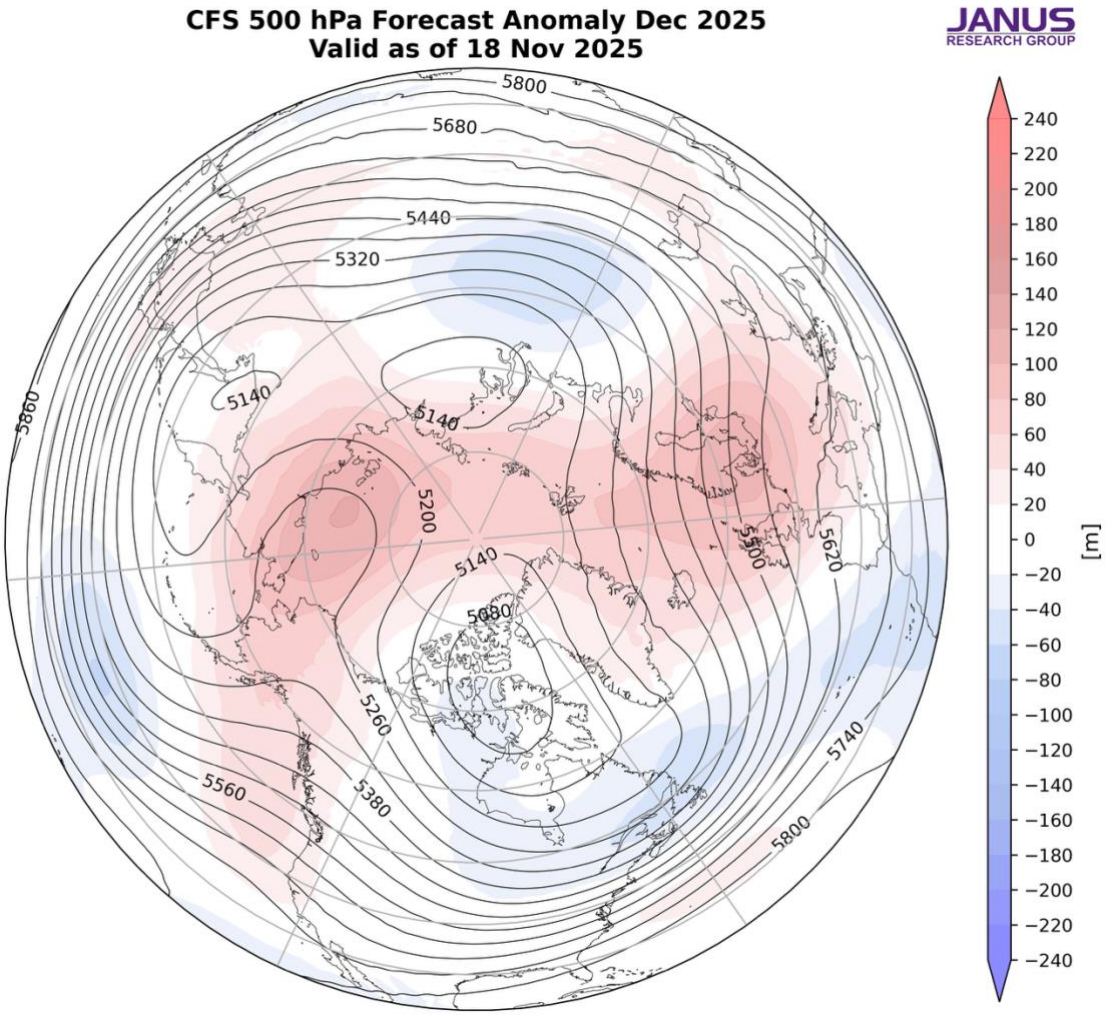

Figure 13. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for December 2025. The forecasts are from the 00Z 18 Nov 2025 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 13**) and surface temperatures for December (**Figure 14**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging across Europe, Southern Asia, Eastern Siberia and across the Beaufort Sea to Alaska and the Central Arctic with troughing across the southwestern Mediterranean, Western Asia, Western and Southern Siberia, Eastern Canada and the Eastern US (**Figure 13**). This pattern favors seasonable to relatively warm temperatures across Europe, Southern Asia, including the Middle East and the Tibetan Plateau, Pakistan, Afghanistan, Eastern Siberia, Alaska, Northeastern Canada and the Western US with seasonable to relatively cool temperatures across Western Russia, Western and southeastern Siberia, Northeast Asia, much of Canada and the Eastern US (**Figure 14**).

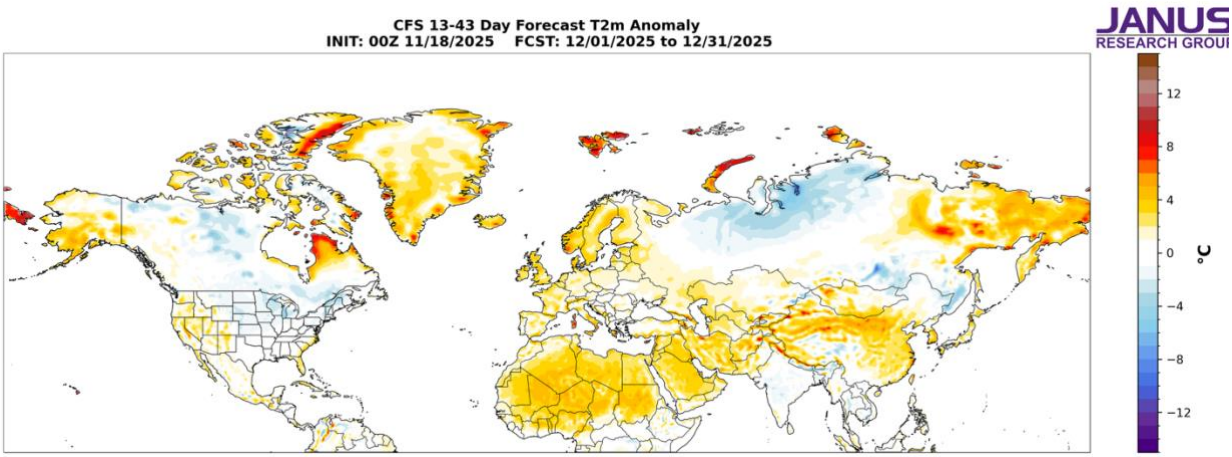

Figure 14. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for December 2025. The forecasts are from the CFS 00Z 18 Nov 2025.

Boundary Forcings

Arctic Sea Ice

I am and will continue to watch Arctic sea ice. Current conditions are shown in **Figure 15**. It has been shown that less sea ice in the North Atlantic sector of the Arctic weakens the polar vortex while less sea ice in the North Pacific sector strengthens the polar vortex. Arctic sea ice anomalies continue to show a strong focus or weighting of negative anomalies towards the North Atlantic sector relative to the North Pacific sector and this is a robust signal of an overall weaker PV this winter. However, the negative anomalies exist both in the Eurasian sector and the North American sector. This week negative anomalies are emerging in Hudson Bay related to the water temperatures being are well above normal (see **Figure 16**). Therefore, I do think that there may be some competition where the strongest coupling to the atmosphere might be occurring - with low sea ice in the Barents-Kara Seas favoring Ural/Scandinavian blocking and low sea ice/warm temperatures in Baffin and Hudson Bays favoring Greenland/Northeastern Canada blocking.

There has been some high-pressure blocking in the Eurasian sector but for November it does seem the North American sector will dominate. In my opinion, Ural/Scandinavian blocking is more favorable for weakening the PV than Greenland/Northeastern Canada blocking.

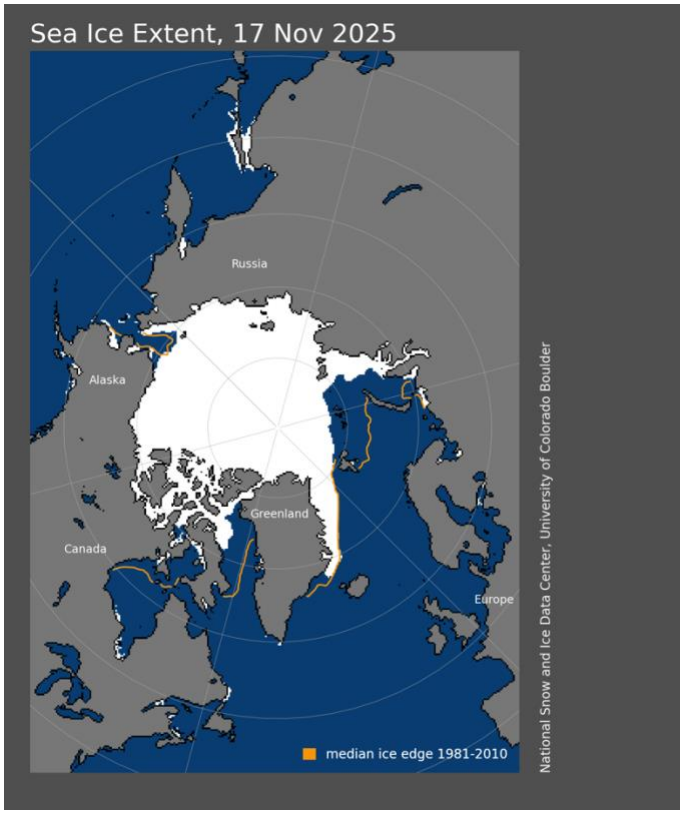

Figure 15. Arctic sea ice cover extent for 17 November 2025. White depicts ice covered areas and the orange contour the climatological extent of Arctic sea ice for the date. Plot taken from: https://nsidc.org/sea-ice-today

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies are slightly below normal, along the equatorial Pacific (**Figure 15**) consistent with neutral conditions but suggestive that La Niña could return once again this winter and current forecasts show large spread and plenty of uncertainty but now mostly favor a return of La Niña conditions this winter. Observed SSTs across the NH remain well above normal especially in the North Pacific and much of the North Atlantic, though below normal SSTs exist regionally especially in the South Pacific. The “warm blob” in the Northeastern North Pacific has received some hype this fall. Warranted or not, something that I am watching as well but is showing signs of fading or already may be gone for this winter.

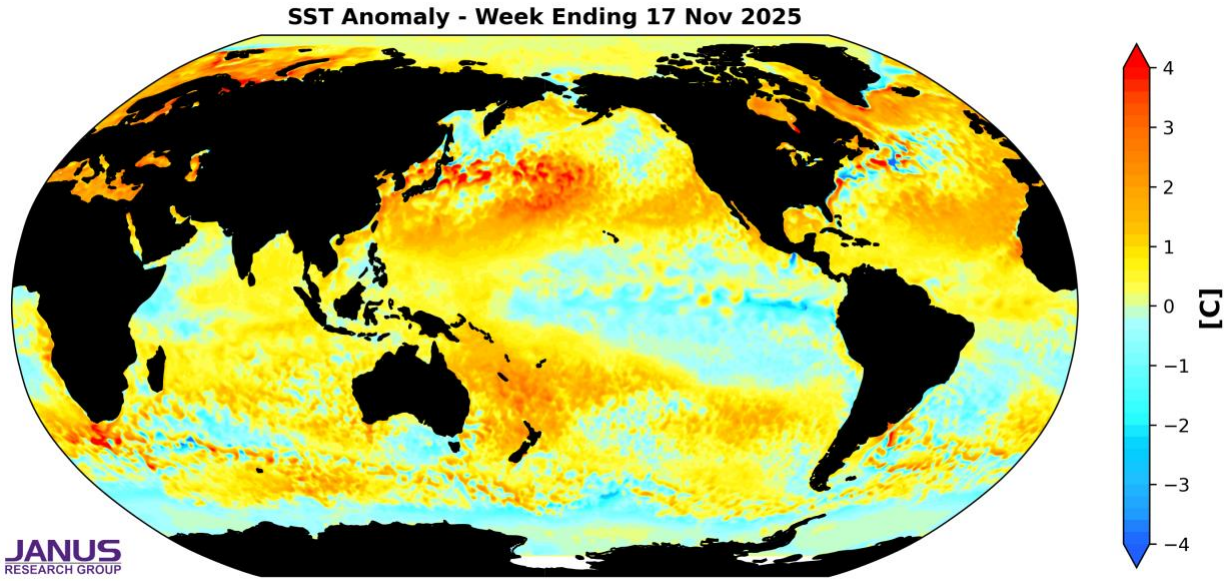

Figure 16. The latest daily-mean global SST anomalies for week ending 18 Nov 2025.

Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is in phase six (**Figure 17**) and the forecasts are for the MJO to hang out in phase six weaken and then eventually move into phase seven over the next two weeks (**Figure 17**). Phase six favors ridging in centered in the US and troughing in Canada. Therefore, it seems that the MJO is having some influence on North American weather the next two weeks. But admittedly this is outside of my expertise.

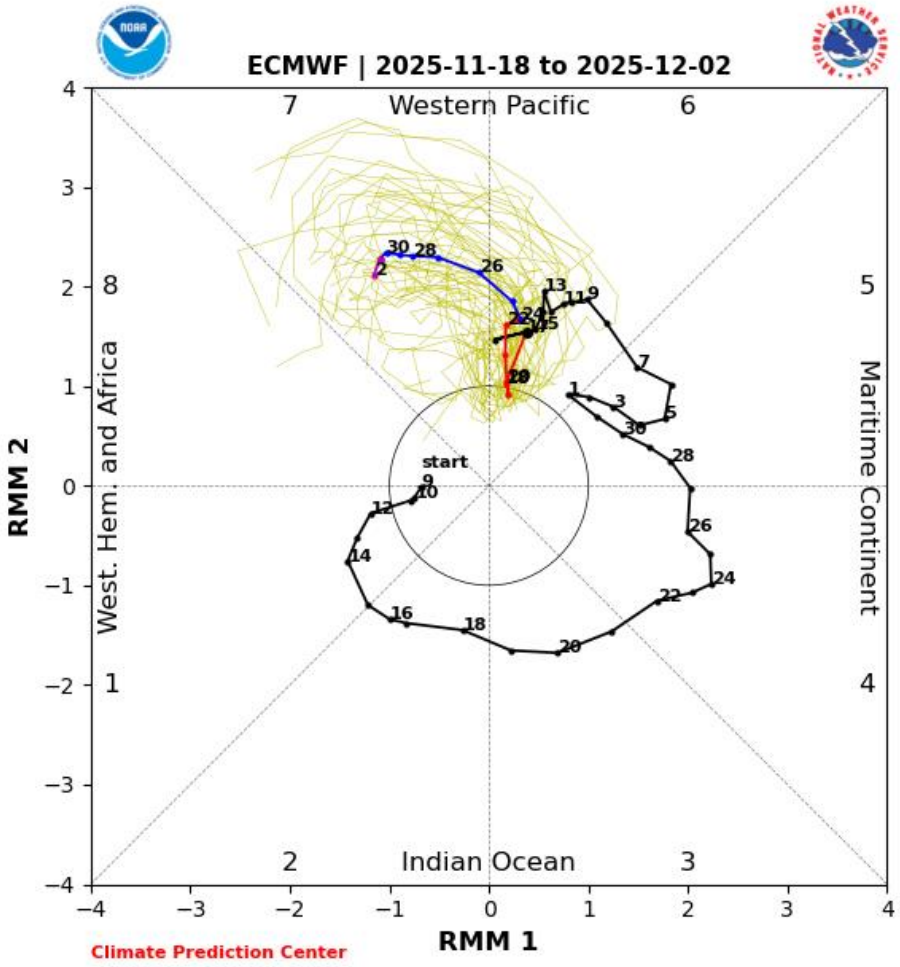

Figure 17. Past and forecast values of the MJO index. Forecast values from the 00Z 18 Nov 2025 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model 'spread' is denoted by the gray shading. Sector numbers indicate the phase of the MJO, with geographical labels indicating where anomalous convection occurs during that phase. Image source https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/ecmf.shtml

JANUS
RESEARCH GROUP

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. 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!