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Arctic Oscillation and Polar Vortex Analysis and Forecasts

December 22, 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.

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

Summary

- The Arctic Oscillation (AO) is currently positive and is predicted to trend to near neutral the next two weeks as pressure/geopotential height anomalies across the Arctic are currently mostly negative and are predicted to become mostly mixed the next two weeks. 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 the next two weeks as pressure/geopotential height anomalies are predicted to remain mostly positive across Greenland the next two weeks.
- Strengthening ridging/positive geopotential height anomalies across Greenland will support deepening troughing/negative geopotential height anomalies across Europe the next two weeks. This pattern will favor normal to below normal temperatures beginning in Western Europe including the United Kingdom (UK) this week and then spreading across much of Europe next week. Normal to above normal temperatures will dominate Central and Eastern Europe this week.
- This week ridging/positive geopotential height anomalies across Greenland will support troughing/negative geopotential height anomalies across Northern Asia with ridging across Southern Asia. However next week ridging/positive geopotential height anomalies will spread across much of Asia. This pattern favors normal to below normal temperatures across Northern Asia especially Siberia with normal to above normal temperatures across

Southern and Central Asia. Then next week normal to above normal temperatures widespread across Asia.

- The general pattern across North America the next two weeks is ridging/positive geopotential height anomalies centered near the Dateline that will support troughing/negative geopotential height anomalies across Alaska, Gulf of Alaska and across much of Canada into the Northeastern US with ridging/positive geopotential height anomalies spread across much of the United States (US). However next week the US ridging will spread into Eastern Canada. This patten will favor normal to below normal temperatures across Alaska and spreading across much of Canada and episodically into the Northeastern with normal to above normal temperatures across much of the US. However next week relatively temperatures will spread into Eastern Canada.
- I have been discussing how the polar vortex (PV) can walk through three doors and therefore the weather. The PV has clearly opened door number one to the strong PV but will it step completely through? My thoughts below.

Plain Language Summary

Winter has made a quick appearance in Western and Central Siberia, Alaska, Canada and the Eastern US (see **Figure**). In contrast it has been slow to start in Europe, Western, Central and Eastern Asia, Eastern Siberia and the Western US (see **Figure**). The forecast heading into the New Year can quickly summarized as a contraction of the cold across North America (mostly north of 45°N) and an expansion across Northern Asia and much of Europe (see **Figures 3, 6** and **9**) thanks to Greenland blocking. In a break from the entire polar vortex (PV) season so far, the PV is predicted to become circular and strong, which favors relatively mild temperatures across the Northern Hemisphere (NH). For the me the most important question is will a strong PV and mild weather become a runaway train or will the jet stream introduce a speed bump to the PV in early January 2026 that delivers more cold.

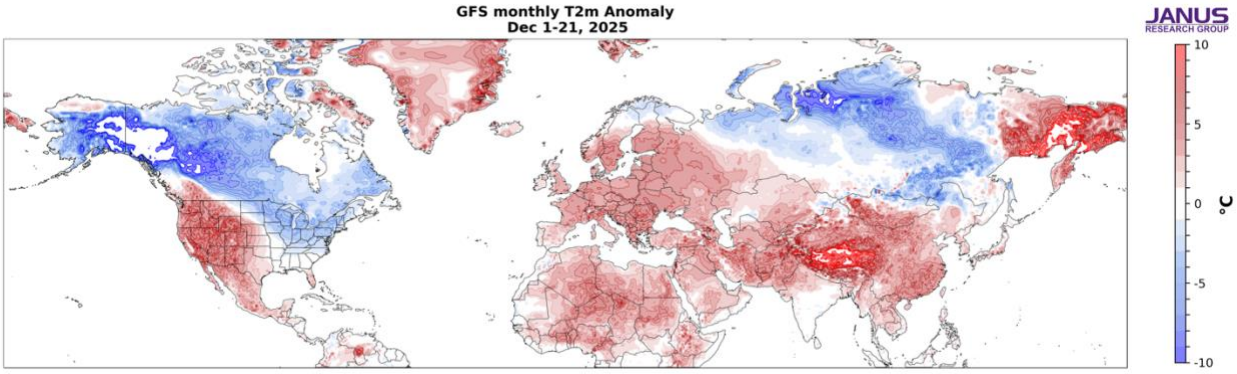

Figure. Estimate of the observed surface temperatures (°C; shading) from 01 Dec to 21 Dec 2025 based on GFS initializations and the GFS forecast from the 22 Dec 2025 run.

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Impacts

As is my habit this season I first discuss the two-week forecast for the mid-tropospheric circulation, which helps set the table for what I am expecting with the polar vortex (PV) and our weather. Once again, the mid-tropospheric circulation is characterized by low pressure centered near the North Pole and high-pressure ridging floating around the mid- to high-latitudes (see **Figure i**). Initially, there is one clear dominant high latitude blocking centered near the Dateline. The other more minor region of high-latitude blocking is currently centered over the Greenwich Meridian. But over the next two weeks the circulation can be characterized by mid-ocean ridging in both the North Atlantic and North Pacific with mid-continent troughing mostly at the higher latitudes of both Eurasia and especially North America. And overall, we are seeing winter conditions continue across North America (mostly from the US-Canadian border and north) and finally expanding beyond Siberia in most emphatically into Europe. But I really want to emphasize what I wrote last week, this pattern has a clear strong wave-two signature that normally supports either a PV split (not happening anytime soon) or PV stretching, which is easier to achieve. But this wave-2 pattern is in quadrature to the ridge/trough axis to either force a large stretched-PV and/or a PV split. Ridging positioned simultaneously near the Dateline and the Greenwich Meridian may support cold air across the continents but not for a large PV disruption. As seen in **Figure 17**, we see very warm sea surface temperatures in the both the North Pacific and North Atlantic that could be favoring ridging in the region. The ridging near the Dateline has been especially persistent and may very well be anchored by the maximum warm anomalies in the central North Pacific. Earlier in the fall there was hype about the “warm” blob, well so far this winter has little resemblance to the winters of 2013/14 and 2014/15 that brought the “warm” blob to prominence.

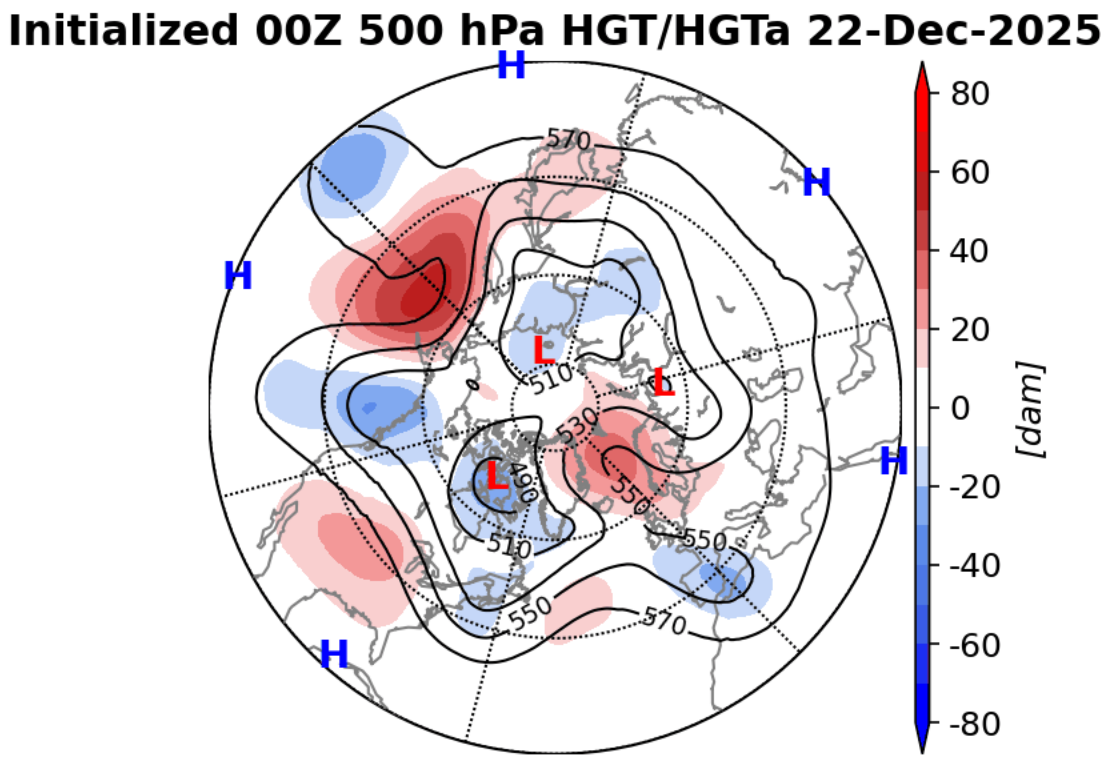

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Figure i. Initialized 500 mb geopotential heights (dam; contours) and decameter anomalies (dam; shading) across the Northern Hemisphere for 15 Dec 2025 and forecasted from 16 Dec to 30 Dec 2025. The forecasts are from the 00Z 15 Dec 2025 GFS model ensemble.

The trend that I noted last week is even more evident this week as the weather model forecasts predict a clear strengthening and more circular shape of the PV as its ongoing rebound from the unprecedently weak PV at the end of November that was a bit of two steps forward and one step back finally comes to its conclusion. As seen in **Figure ii** the PV still shows signs of elongation or stretchiness but is predicted to quickly and become more circular in shape. This is more clearly seen in **Figure 12** that in my head, at least, displays a bowling ball of a PV. The last vestiges of the stretched PV are allowing New England to hold on longer to the cold air than the rest of the US, but otherwise we can see the cold air retreat across North America and be mostly confined to Canada this week (see **Figure 3**). And while most of the US population may dream or wax nostalgic of a white Xmas, they will experience a brown and in some cases a record warm holiday instead. It is my strong belief that with a tightly wound PV (circular in shape and confined to high latitudes) it is hard to get meaningful and persistent cold across much of the mid-latitudes. I think two notable exceptions are western North America and near the Urals/Western Russia. And with some exceptions (e.g., Europe and New England) that is the pattern predicted for the post New year period (see **Figures 6** and **9**).

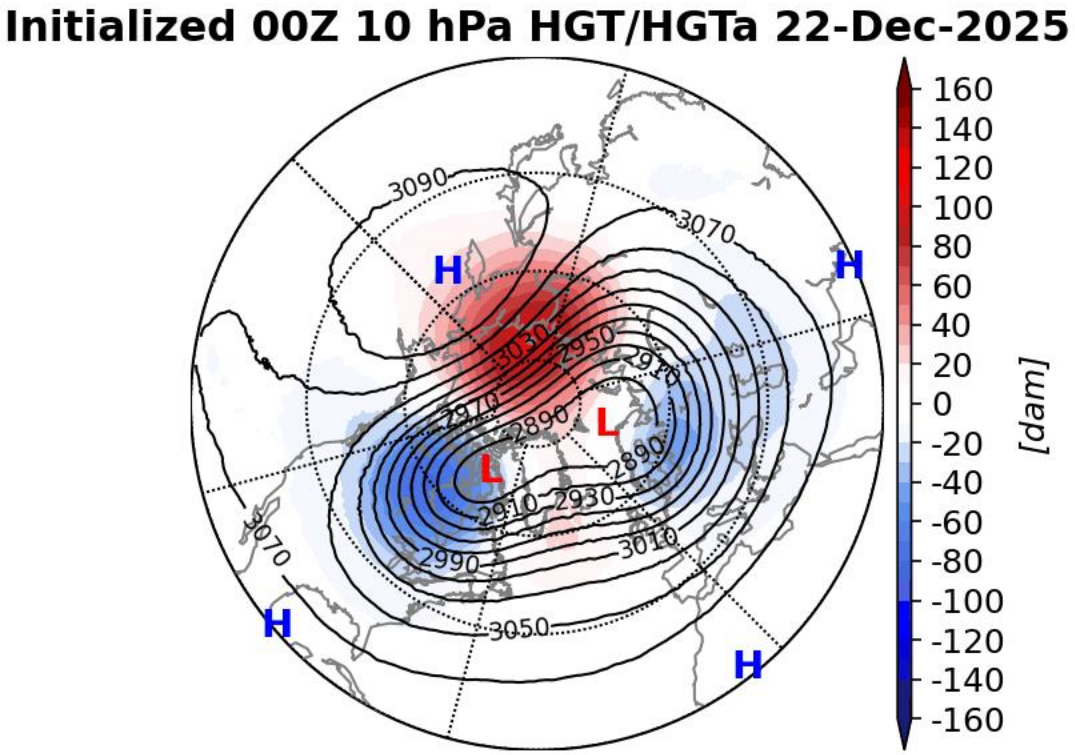

Figure ii. Forecasted average 10 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for 15 Dec 2025 and forecasted from 16 Dec to 30 Dec 2025. The forecasts are from the 00Z 15 Dec 2025 GFS model ensemble.

As seen at the end of animation in **Figure ii** there is pulsing of blue or lowering of heights in Western Canada. I just checked the latest ECMWF operational forecast and it goes bonkers with that feature! The ECMWF can produce some extreme solutions, so just a novelty item for now. This tends to be a precursor of extreme cold building in Alaska and Western Canada, though this year it may be more of a lagging indicator. Regardless, it may be an early indication of an Arctic outbreak into the US. Normally this would favor the Western US but this year I am less sure. Or alternatively even it does enter the Western US, enough Greenland blocking persists to shunt it east.

For the past four weeks, I have been doing my best Monty Hall from "Let's Make a Deal" impression, and this week will be no different. However, again I will keep it short this week. The three doors are: door number one - the reflective layer in the stratosphere that gave rise to the stretched PV also protects the PV from subsequent upwelling energy from the troposphere and allows the PV to strengthen. The second door is though there is short-term strengthening of the PV, high-latitude blocking resumes its assault on the PV and we see more stretched PVs and/or Canadian Warmings (that often transition to stretched PVs) until finally there is knockout punch and a true SSW either in January or February. And finally, the third scenario is that the stretched PVs just keep repeating for much of the winter punctuated or separated by a relatively strong PV and or Canadian warmings.

I think we can quickly dismiss door number two as worthy of any discussion this week. The PV is quickly sliding into beast mode, and I don't see a major sudden stratospheric warming (SSW - defined as a reversal of the wind from westerly to easterly at 60°N and 10 hPa) any time soon and I think we can pretty much put the chances of one in January to almost zero. I would say February is the earliest we can expect one to occur, if at all.

As far door number one, in my opinion the PV has taken a deliberate move towards door number one and by New Year will be turning the handle and opening the door. Will it step through the door, that I remain uncertain about. The predicted troughing centered near the Urals with ridging now developing near Siberia (see **Figure 8**) is favorable for a strong or strengthening PV. The pattern isn't perfect and we will see how the observed pattern shakes out. If the pattern rotates just a bit west it will probably be at least supportive of more stretched PVs.

I have consistently favored door number three or what I like to call a "rinse, lather, repeat" PV and weather pattern for the foreseeable future. Basically, alternating stretched PVs and relaxation to a more circular PV and oscillating or alternating cold and mild periods for East Asia and or North America, that can feature some wild temperature swings. Eventually the pattern could transition to either door number one, persistently strong PV or door number two, a major SSW. As I wrote earlier door number door is currently not on the table. Last week I didn't think that the circulation pattern would support a runaway train of a PV (i.e., strong PV) but may have been wishful thinking on my part.

But here is why I am still riding the door number three train or why I am still expecting another stretched PV in the first half of January (or maybe simply my state of denial runs deep). I have discussed this before in the blog, but Greenland blocking is a fairly reliable predictor of a stretched PV about two weeks later. That is probably the strongest reason for me.

Also looking at the wave diagnostics in **Figure iii** as I did last week**,** some wave reflection is predicted for late December and early January, but this is far from textbook or classic. And please don't get caught up in the details as this diagnostic is highly volatile and much of it will be wrong. If you squint hard enough (or are possibly wishcasting like me) for both periods wave energy goes up and east over Asia, reflects off the stratospheric PV and then heads down and east over North America where the energy is re-absorbed and could potentially amplify the standing wave over North America and deliver cold air from the Arctic south, east of the Rockies. There is westward wave tilt with height over Asia. Admittingly it's pretty ugly looking eastward wave tilt with height over North America but does seem to exist. The big question is whether it is supporting a trough in western or eastern North America, which would have important implications for the weather over the US. That is why I say ignore the details for now and we need to see how the dust settles but wave reflection seems like a non-negligible possibility (I know hedging or double speak at its best).

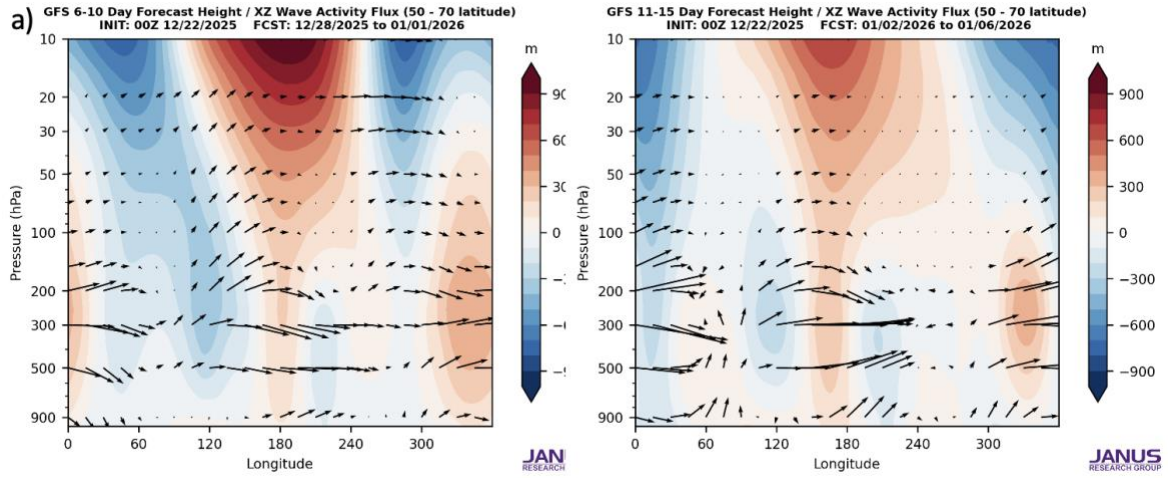

Figure iii. **a)** Longitude-height cross section of geopotential eddy height anomalies (shading) and wave activity flux (vectors) forecasted for 05 December through 26 December 2025 1 January 2026. **b)** same as a) but for 2 January through 6 January 2026. The forecasts are from the 00Z 22 December 2025 GFS ensemble.

I did see after I finished writing the blog that the 12z suite of models did turn much colder in the 6-10 period in the Eastern US and I think is likely related to the wave reflection I discuss in **Figure iiia**. So maybe I am not simply shoehorning my preferences and biases into the model diagnostics. I did write last: "However, a great rule of thumb with stretched PVs is - the models are always playing catch-up… So, it would not surprise me if the cold air predicted for the holiday period becomes more impressive with subsequent model forecasts." It took a while but finally looking to verify. And in **Figure ii** a stretched PV is still quite evident the last few days of December.

And finally there are the intangibles. Maybe like politics, all weather is local. I have to say I am impressed how the cold air and the chances of snow have hung in in the Northeast but especially New England, despite a hostile pattern. The 800-pound gorilla in the atmosphere is the ridging near the Dateline. That is a great location for the Western US and awful for the Eastern US (and my adjectives are meant to describe wintry weather). Yet so far that has not happened. Every winter has its own unique character and in recent winters, I think the current pattern would have shut down the winter in the Eastern US. But there is no denying we are currently in a very mild pattern for the US as a whole. Also that cold pool in Alaska and Western Canada is stubborn, it's like the Energizer bunny, it just keeps "going and going and going." And in late December and early January it doesn't take much for the dam to break and for cold air to rush southward.

As I wrote, December is often the rogue winter month. Certainly, this is looking prescient for Europe. So far, this winter has been exceptionally mild in Europe, but a colder pattern is upon Europe for the holiday period, especially next week. But without an SSW, I am skeptical it can be of long duration. But I also wrote previously that the true face of winter tends to reveal itself

around the New Year, so maybe it has more staying power than I give it credit. But at least in my opinion that means the next one to two weeks are really critical for how the rest of winter evolves.

And as an unsatisfying discussion that might have been some progress was made. For the foreseeable future door number two has been eliminated. The probability of door number three has been reduced while the probability of door number one has been increased. I am still choosing door number three, but the momentum is on door number one's side.

I think no need to update the snow cover extent anomaly plot. Other than NH SCE being below normal not that interesting to discuss.

Near-Term

This week

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

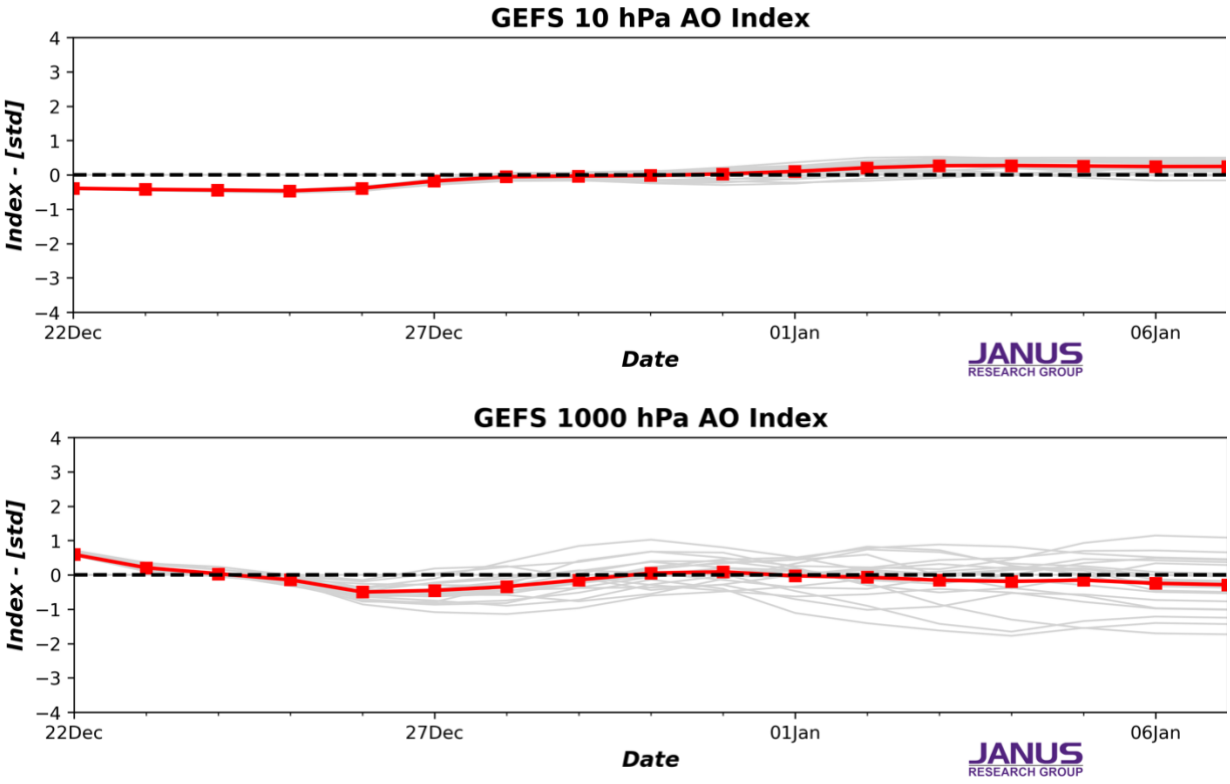

Figure 1. The predicted daily-mean AO at a) 10 hPa and b) 1000 hPa from the 00Z 22 Dec 2025 GFS ensemble. Gray lines indicate the AO index from each individual

ensemble member, with the ensemble mean AO index given by the red line with squares.

Ridging/positive geopotential height anomalies centered south of Iceland will support troughing/negative geopotential height anomalies across Western Europe with more ridging across Northern and Eastern Europe this week (**Figure 2).** This pattern will support normal to below normal temperatures across Western Europe including the UK with normal to above normal temperatures across the rest of Europe this week (**Figure 3**). This week ridging/positive geopotential height anomalies stretching from Iceland the Scandinavia will support troughing/negative geopotential height anomalies across Northern Asia with more ridging across the remainder of Asia (**Figure 2**). This pattern favors normal to above normal temperatures widespread across much of Asia but especially Central Asia and Eastern Siberia with normal to below normal temperatures across Western and Central Siberia and parts of Western Russia this week **(Figure 3**).

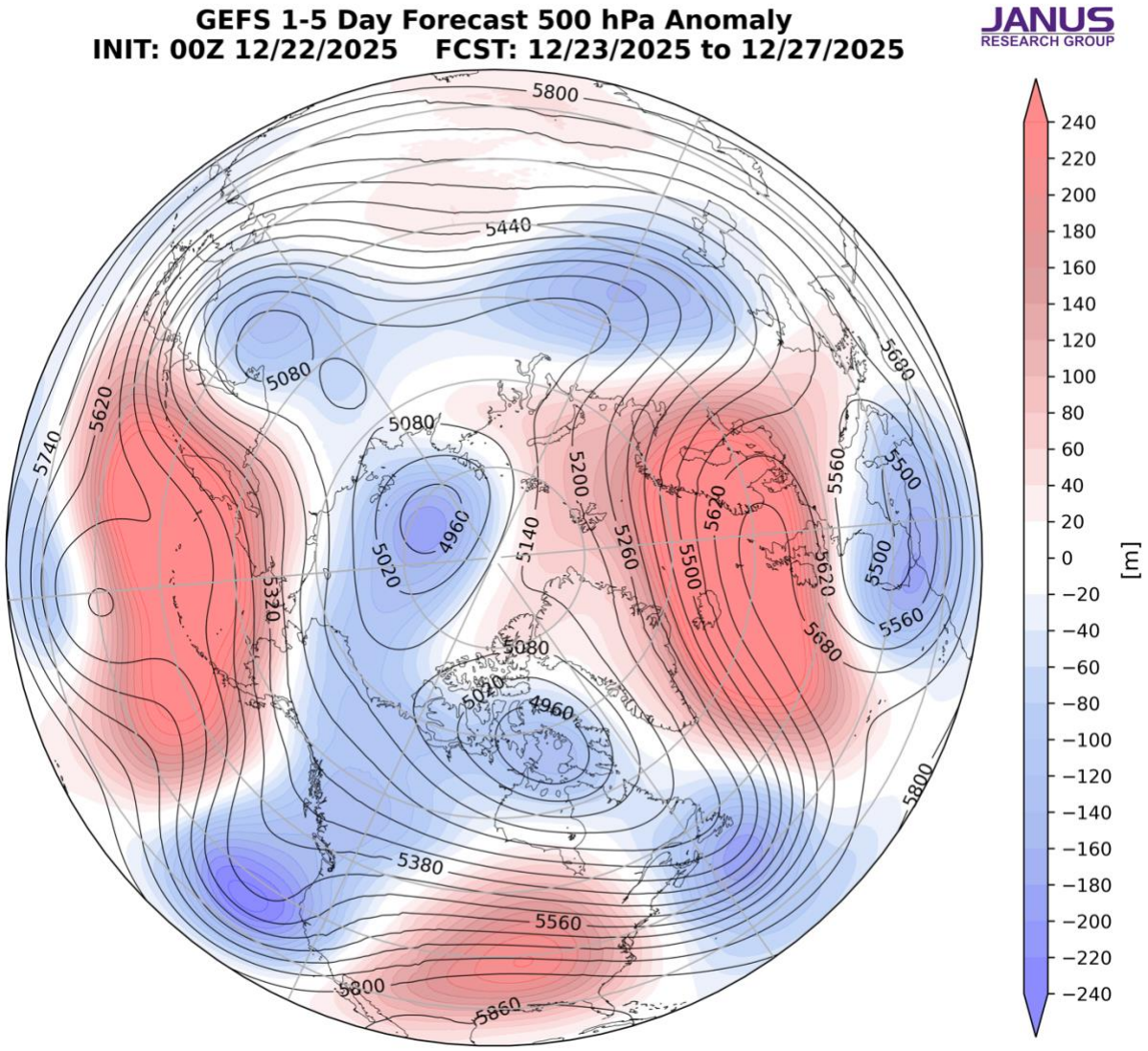

Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 23 Dec to 27 Dec 2025. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

This week ridging/positive geopotential height anomalies centered on the Dateline supporting troughing/negative geopotential height anomalies across Alaska into the Gulf of Alaska and much of Canada and into Baffin Bay with more ridging across much of the US this week (**Figure 2**). This patten will favor widespread normal to below normal temperatures across much of Alaska and Canada and into New England with normal to above normal temperatures across far Northeastern Canada and much of the US this week (**Figure 3**).

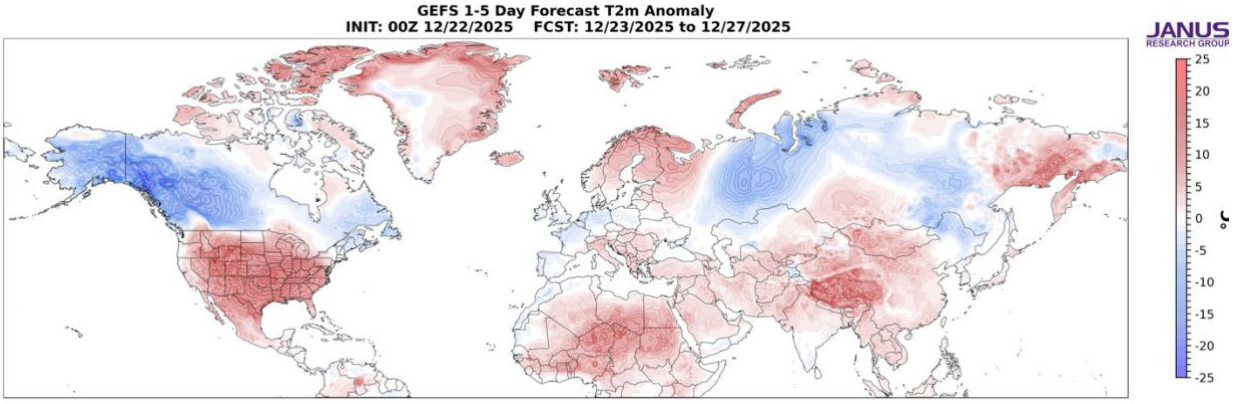

Figure 3. Forecasted surface temperature anomalies (°C; shading) from 23 Dec to 27 Dec 2025. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across parts of Siberia, Western Russia, Northeast and Japan while milder temperatures will support snowmelt across southern Scandinavia and into adjacent Northwest Russia this week (**Figure 4**). Troughing and/or cold temperatures will support new snowfall across much of Alaska, much of Southern Canada, the higher elevations of the Western US and New England while milder temperatures will support snowmelt widespread across the Upper Midwest and Great Lakes this week (**Figure 4**).

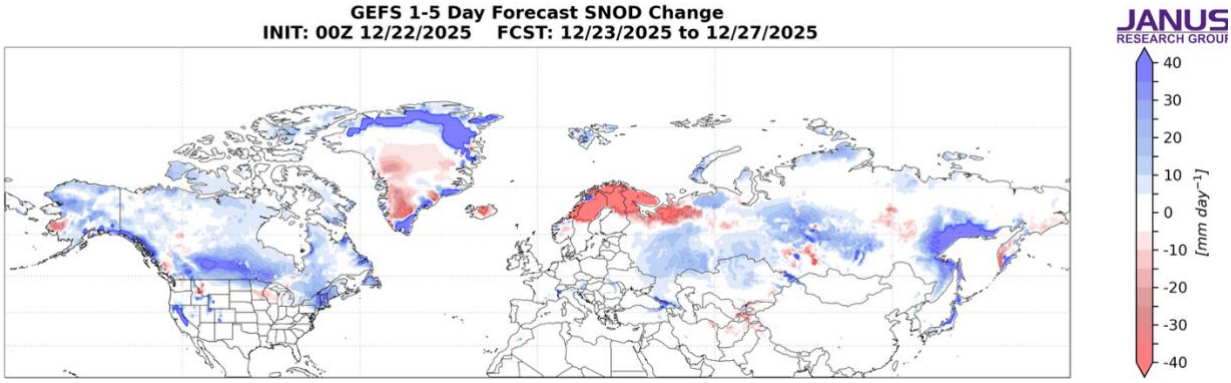

Figure 4. Forecasted snowfall (mm/day; shading) from 23 Dec to 27 Dec 2025. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Near-Mid Term

Next week

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

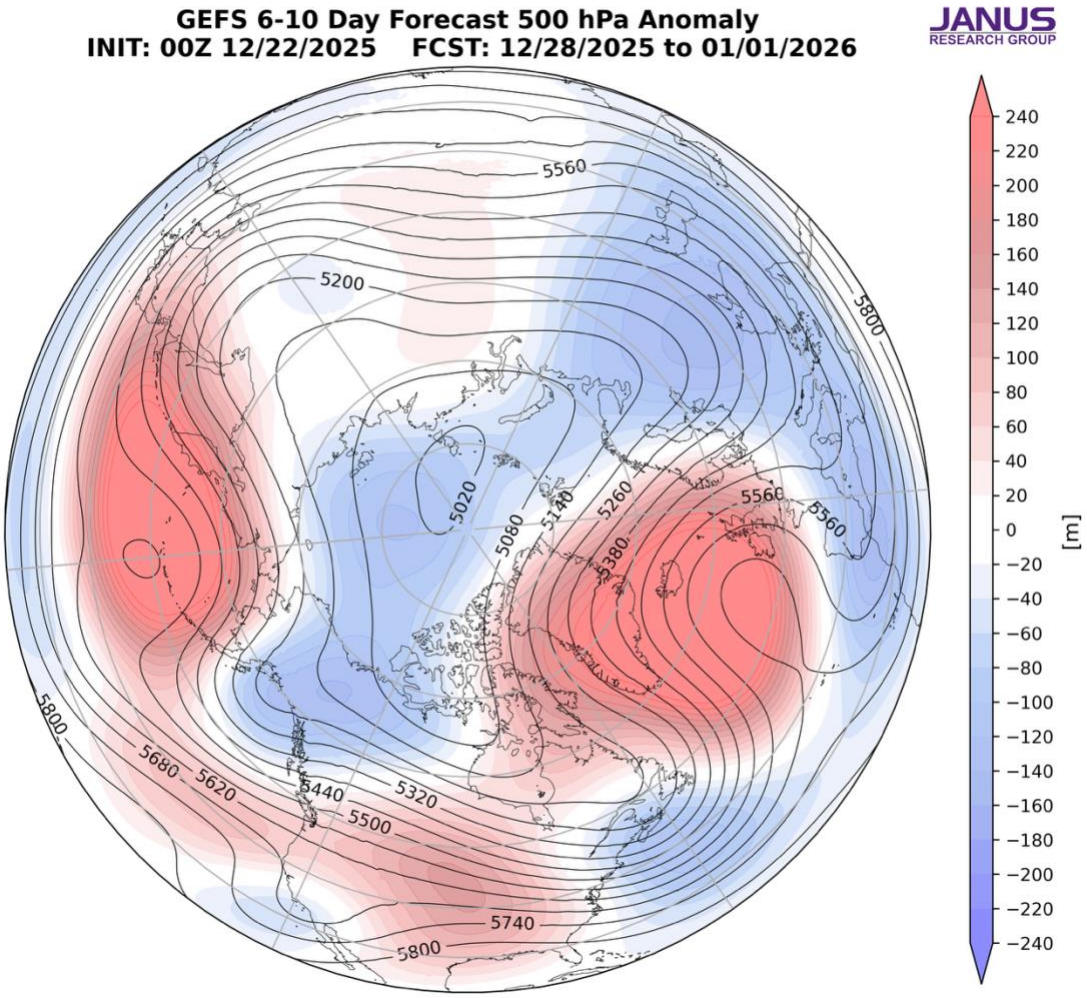

Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 28 Dec 2025 to 1 Jan 2026. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Strengthening ridging/positive geopotential height anomalies across Greenland will support deepening troughing/negative geopotential height anomalies across much of Europe this period (**Figure 5**). The pattern will support normal to below normal temperatures widespread across much of Europe including the UK with the exception of normal to above normal temperatures across Scandinavia this period (**Figure 6**). Strengthening

ridging/positive geopotential height anomalies across Greenland will support deepening troughing/negative geopotential height anomalies across Western Asia and into Siberia with more ridging centered in Central Asia this period (**Figure 5**). This pattern favors widespread normal to above normal temperatures across Southern and Eastern Asia focused in the Central Asia but also including Israel and the Middle East, most of China and Japan with normal to below normal temperatures in Western Russia to Southern Siberia this period (**Figure 6**).

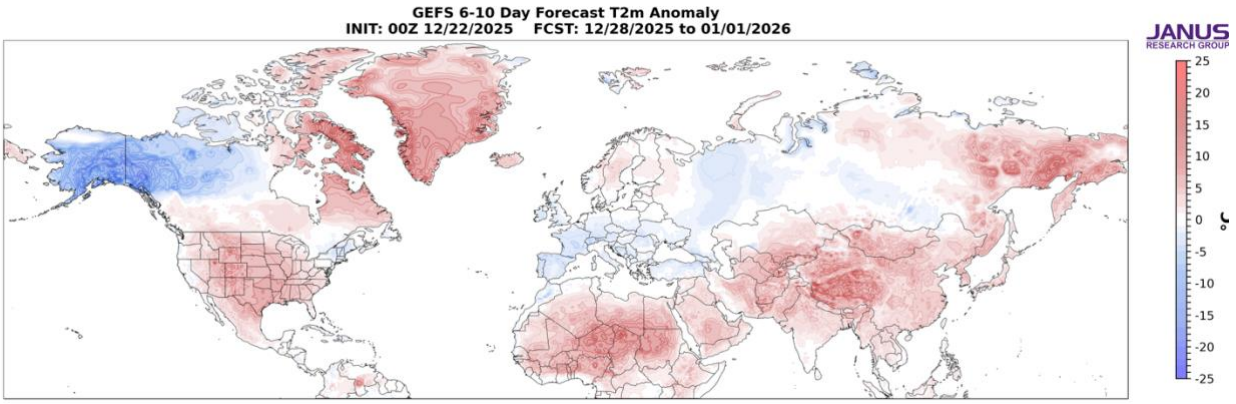

Figure 6. Forecasted surface temperature anomalies (°C; shading) from 28 Dec 2025 to 1 Jan 2026. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Persistent ridging/positive geopotential height anomalies centered near the Dateline and in the Central US will support troughing/negative geopotential height anomalies stretching from Alaska across Canada to New England this period (**Figure 5**). This pattern will favor normal to below normal temperatures across Alaska, much of Western and Central Canda and New England with normal to above normal temperatures across Southern and Eastern Canada and much of the US (**Figure 6**). I did see that the 12z suite of models did get much colder in the US east of the Mississippi River for this period that did not show up in previous runs. An interesting development to watch.

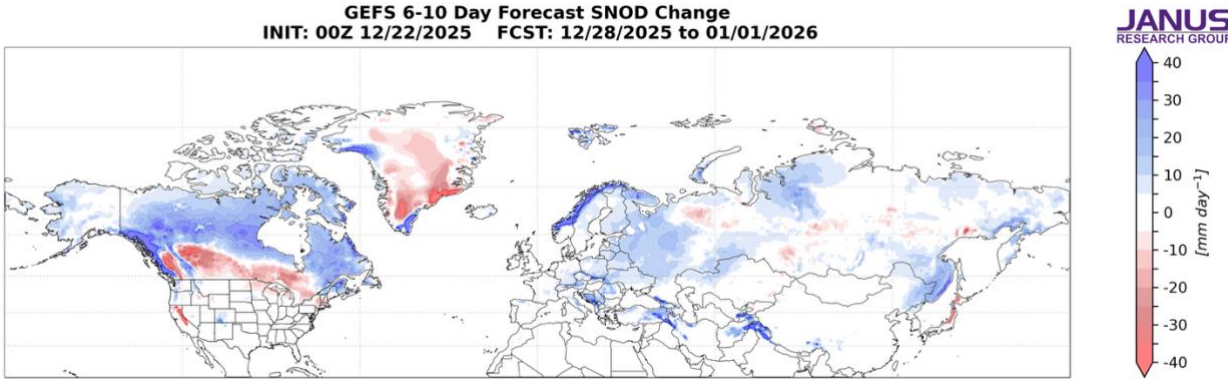

Figure 7. Forecasted snowfall rate (mm/day; shading) from 28 Dec 2025 to 1 Jan 2026. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Troughing and/or cold temperatures will support new snowfall in Norway, the Alps, Eastern Europe, the Caucuses, northwestern Kazakhstan parts of Siberia and Northeast Asia while milder temperatures will support snowmelt in parts of Northwest Russia, Southern Siberia and Japan this period (**Figure 7**). Troughing and/or cold temperatures will support new snowfall in western Alaska, much of Northern Canada and northern New England while milder temperatures will support snowmelt in Southern Canada Plains, California, parts of New England and the Great Lakes this period (**Figure 7**).

Mid Term

Week Two

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

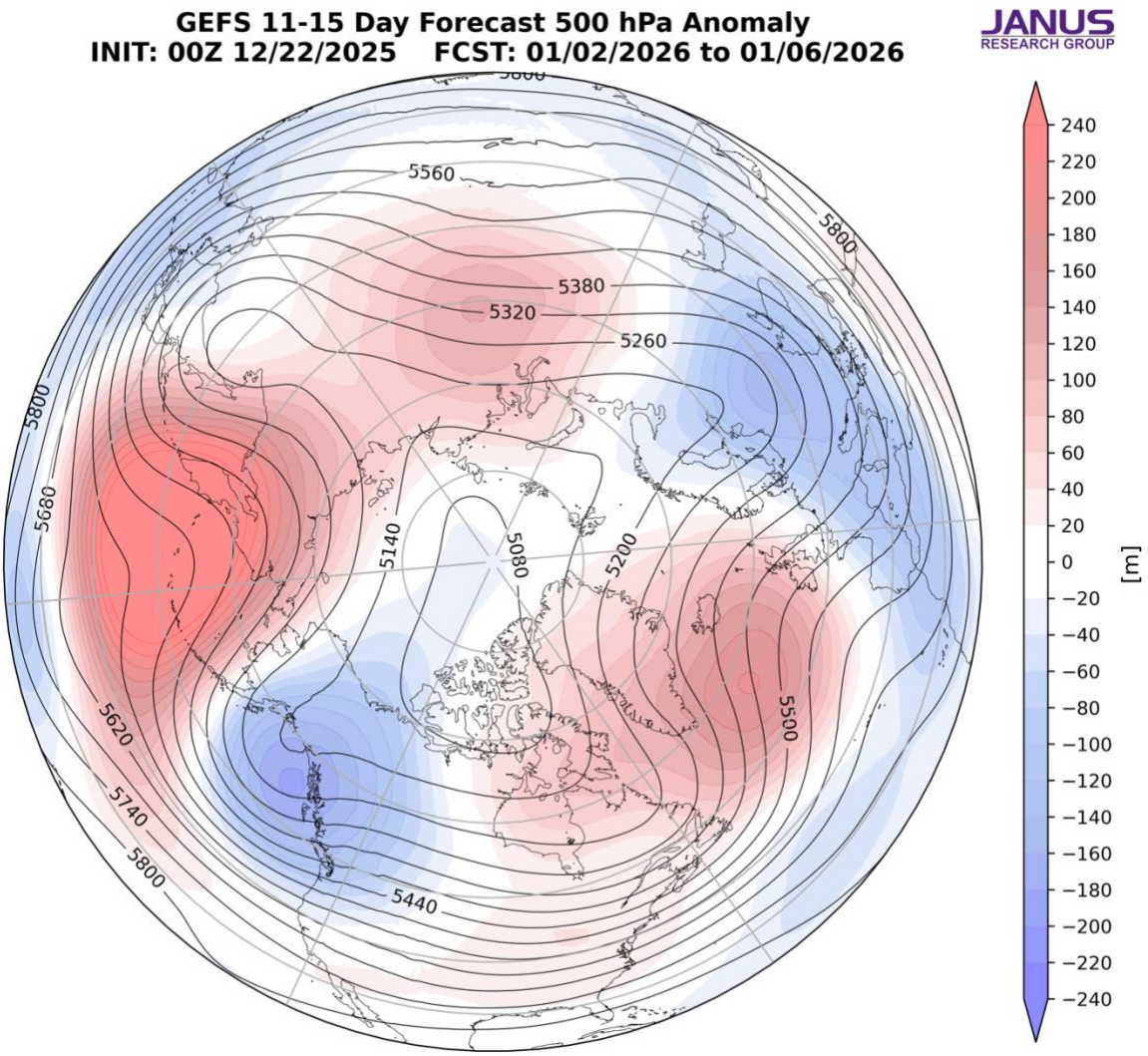

Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 2 Jan to 6 Jan 2026. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Persistent ridging/positive geopotential height anomalies across Greenland will continue to support troughing/negative geopotential height anomalies across much of Europe this period (**Figure 8**). This pattern should favor normal to below normal temperatures across much of Europe including the UK this period (**Figures 9**). Ridging/positive geopotential height anomalies are predicted to persist across Greenland and near the Dateline will support troughing/negative geopotential height anomalies across Western and Northeastern Asia this period (**Figure 8**). The predicted pattern favors widespread normal to above normal temperatures across much of Asia including stretching from the Middle East to China with normal to below normal temperatures limited to Western Russia and parts of Northeast Asia this period (**Figure 9**).

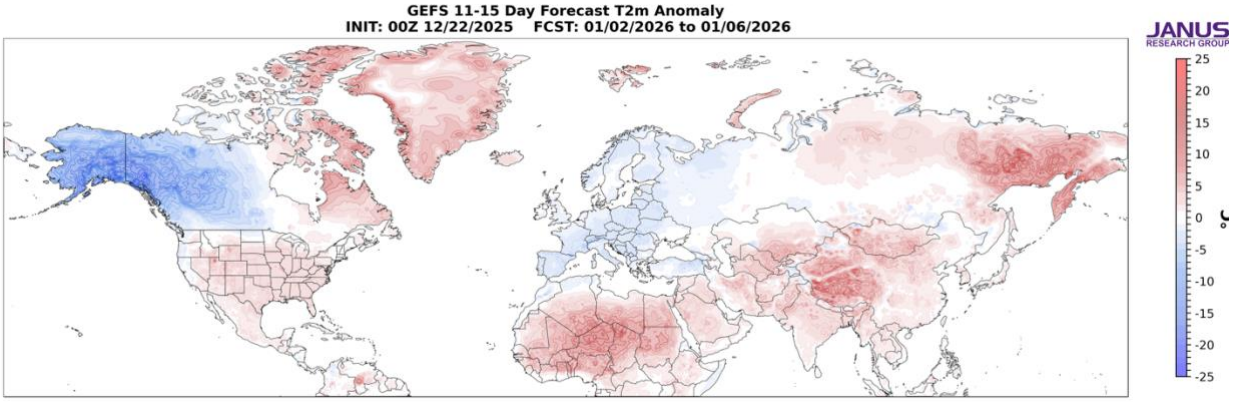

Figure 9. Forecasted surface temperature anomalies (°C; shading) from 2 Jan to 6 Jan 2026. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Persistent ridging/positive geopotential height anomalies centered near the Dateline will support downstream troughing/negative geopotential height anomalies stretching from Alaska to Western Canada and into the Northwestern US with more ridging across Eastern Canada and much of the US this period (**Figure 8**). This pattern supports widespread normal to below normal temperatures across Alaska, much of Western and Central Canada and the Pacific Northwest with normal to above normal temperatures across Northeastern Canda and much of the US this period (**Figure 9**).

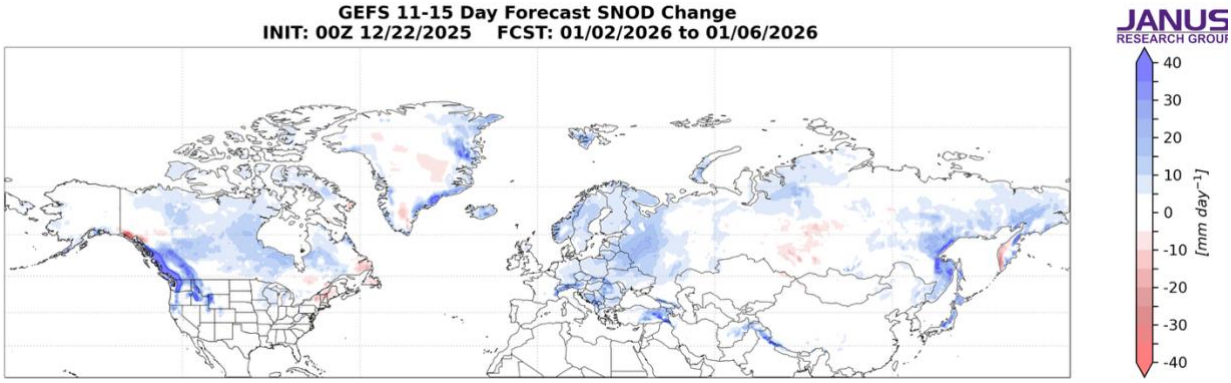

Figure 10. Forecasted snowfall (mm/day; shading) from 2 Jan to 6 Jan 2026. The forecasts are from the 00Z 22 Dec 2025 GFS ensemble.

Troughing and/or cold temperatures will support some possible new snowfall in Scandinavia, the Alps, Central and Eastern Europe the Caucuses, Northeastern Asia and the Tibetan Plateau while milder temperatures will support snowmelt in parts of Southern Siberia this period (**Figure 10**). Troughing and/or cold temperatures will support new snowfall in much of Canada, the higher elevations of the Western US while milder temperatures will support snowmelt in New England this period (**Figure 10**).

Longer Term

30–day

Unfortunately the most recent polar cap geopotential height anomalies (PCHs) from 17 Dec 2026 shows warm/positive PCHs in the middle to lower stratosphere and the upper troposphere with cold/negative PCHs in the upper stratosphere and lower troposphere (**Figure 11**). Then for the remainder of the month warm/positive PCHs in the stratosphere are predicted to descend throughout the troposphere while PCHs in the stratosphere are predicted to turn cold/negative.

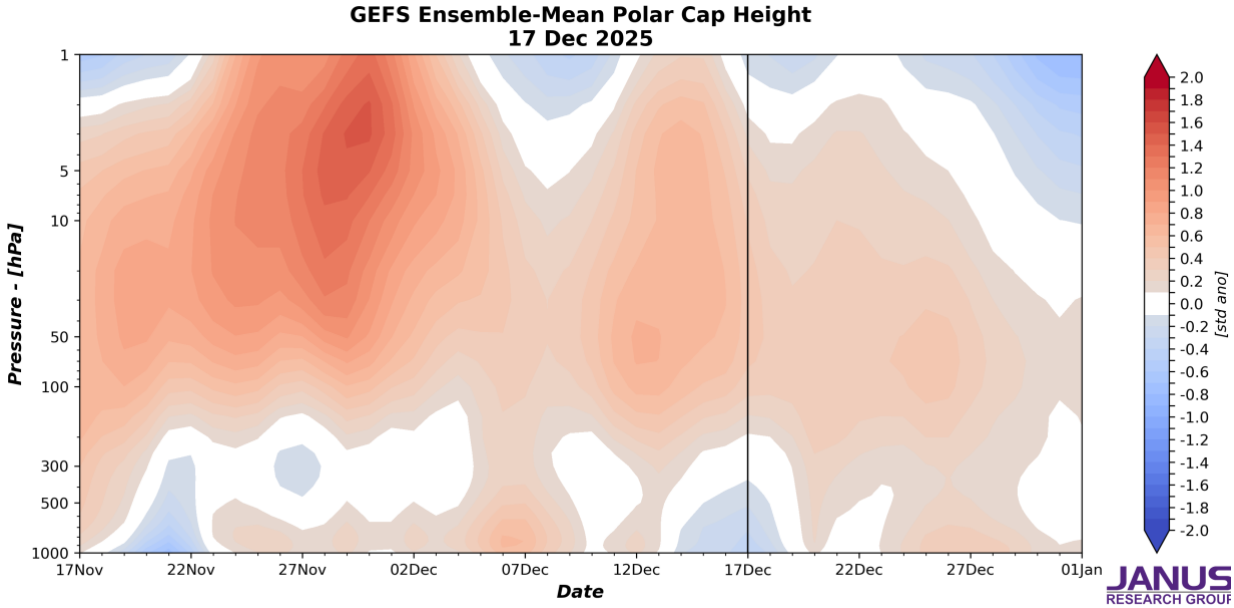

Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 17 Dec 2025 GFS ensemble.

The predicted cold/negative PCHs in the lower troposphere this week (**Figure 11**) are consistent with the predicted positive AO this week (**Figure 1**). Then next week the forecast of descending warm/positive PCHs into the lower troposphere (**Figure 11**) should favor a near neutral to even possibly negative AO next week (**Figure 1**).

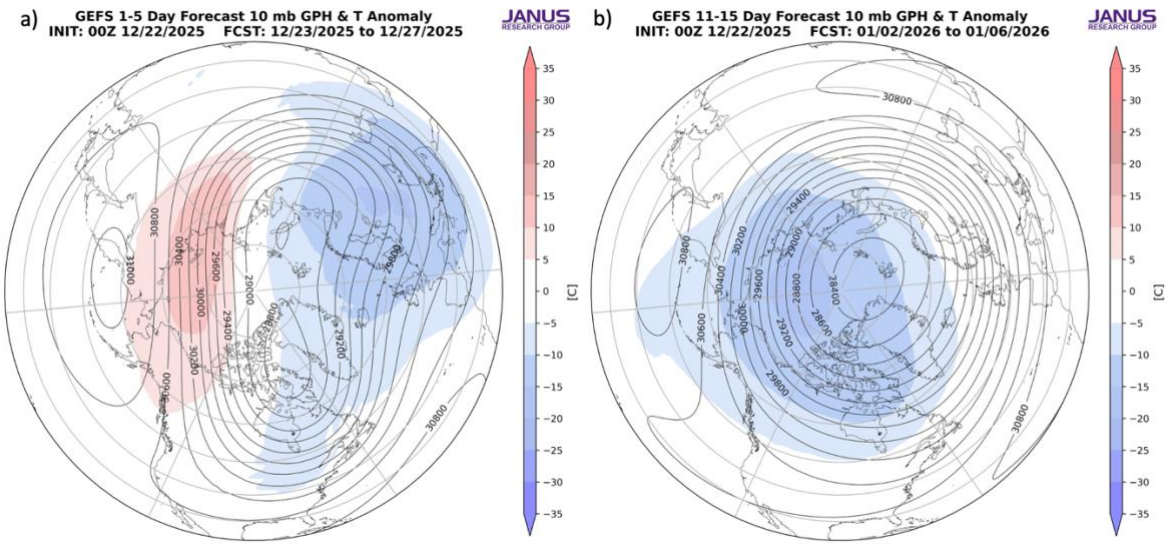

Figure 12. (a) Predicted 10 mb geopotential heights (dam; contours) and temperature anomalies (°C; shading) across the Northern Hemisphere averaged for 23 Dec to 27 Dec 2025. (b) Same as (a) except forecasted averaged from 2 Jan to 6 Jan 2026. The forecasts are from the 00Z 22 December 2025 GFS model ensemble.

This week the polar vortex (PV) is predicted to be elongated in shape, from Siberia to Hudson Bay, with the PV center near Greenland with relatively cold temperatures focused in Western Asia/Eastern Europe and with high pressure centered near the Dateline and warm temperatures stretching from Siberia to Western Canada in the polar stratosphere (**Figure 12a**). The elongated shape in appearance, signals a perturbed and stretched PV, even if minor. Then, in early January the PV center is predicted to become circular in shape and centered near the North Pole with high pressure centered in the western North Pacific and plenty of cold temperatures in the polar stratosphere (**Figure 12b**). This resembles a strong PV configuration. The stratospheric AO in **Figure 1** this week is predicted to remain somewhat negative and then positive next week, signaling a strengthening PV.

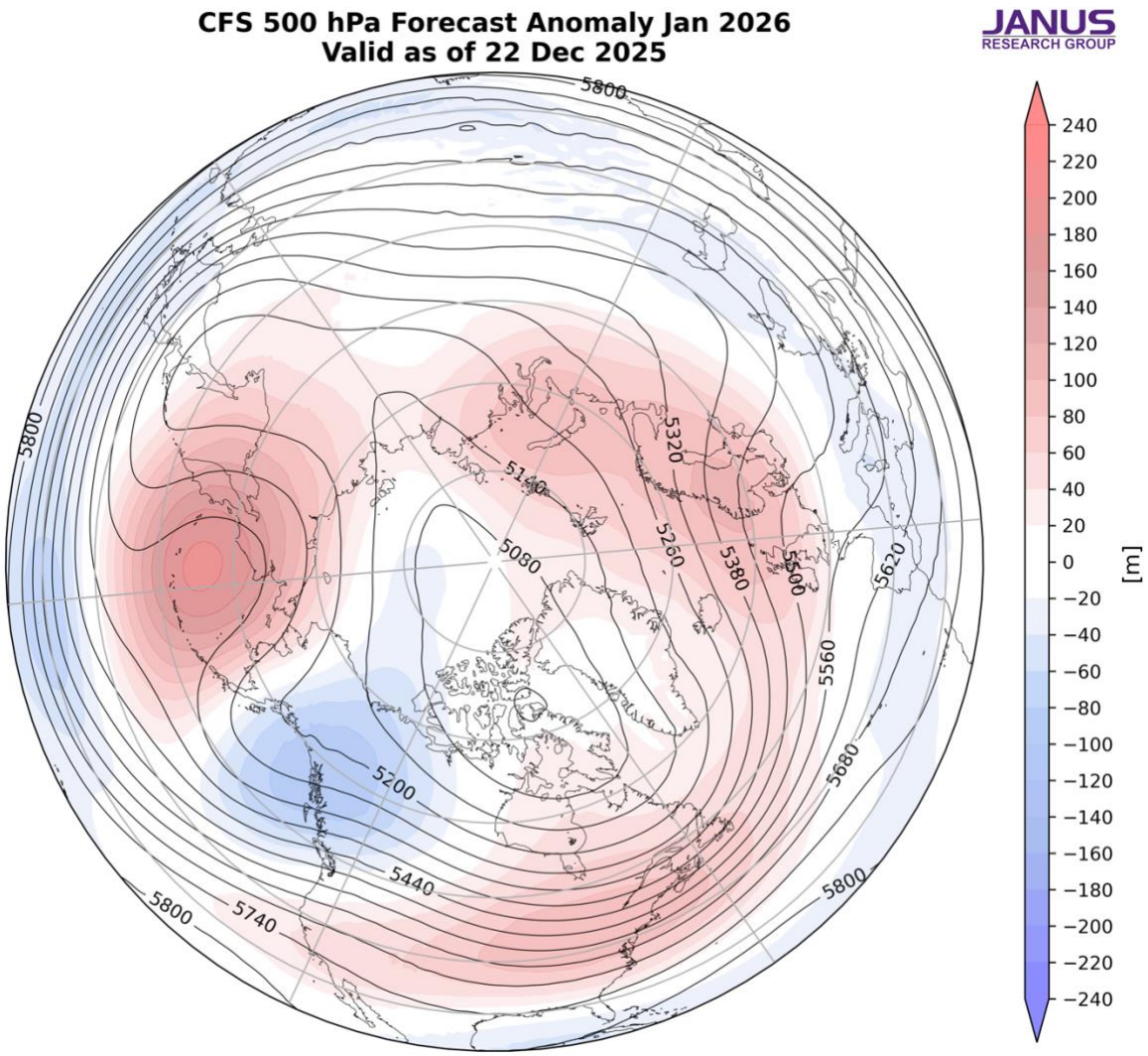

Figure 13. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for January 2025. The forecasts are from the 00Z 22 Dec 2025 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 13**) and surface temperatures for January (**Figure 14**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). I do want to emphasize unless I say otherwise, I find the CFS forecasts of low confidence and most often don't match my own thinking. The forecast for the troposphere is ridging centered over Scandinavia and into the Barents-Kara Seas, Eastern Siberia and across the Bering Strait and the Eastern US with troughing across Southern Europe, Northern and Eastern Asia, the Gulf of Alaska into Western Canada and the Northwestern US (**Figure 13**). This pattern favors seasonable to relatively warm temperatures across Northern Europe, Southern Asia, including the Middle East, China the Tibetan Plateau, Pakistan and Afghanistan, Eastern Siberia and much of the US with seasonable to relatively cool temperatures across Central and Southern Europe, Northern Asia into Northeast Asia, Alaska and much of Canada (**Figure 14**).

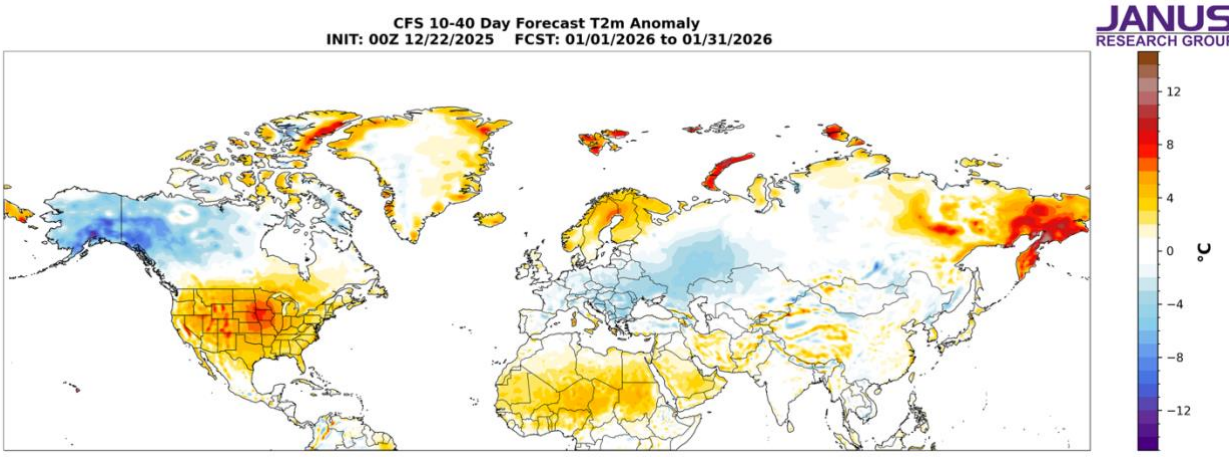

Figure 14. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for January 2025. The forecasts are from the CFS 00Z 22 Dec 2025.

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, i.e., Barents Kara Seas and the North American sector, now mostly in Baffin Bay (see **Figure 15**). 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 both sectors but so far relatively weak. In my opinion, Ural/Scandinavian blocking is more favorable for weakening the PV than Greenland/Northeastern Canada blocking. The predicted ridging for late December in the North Atlantic sector could signal a stalemate for now.

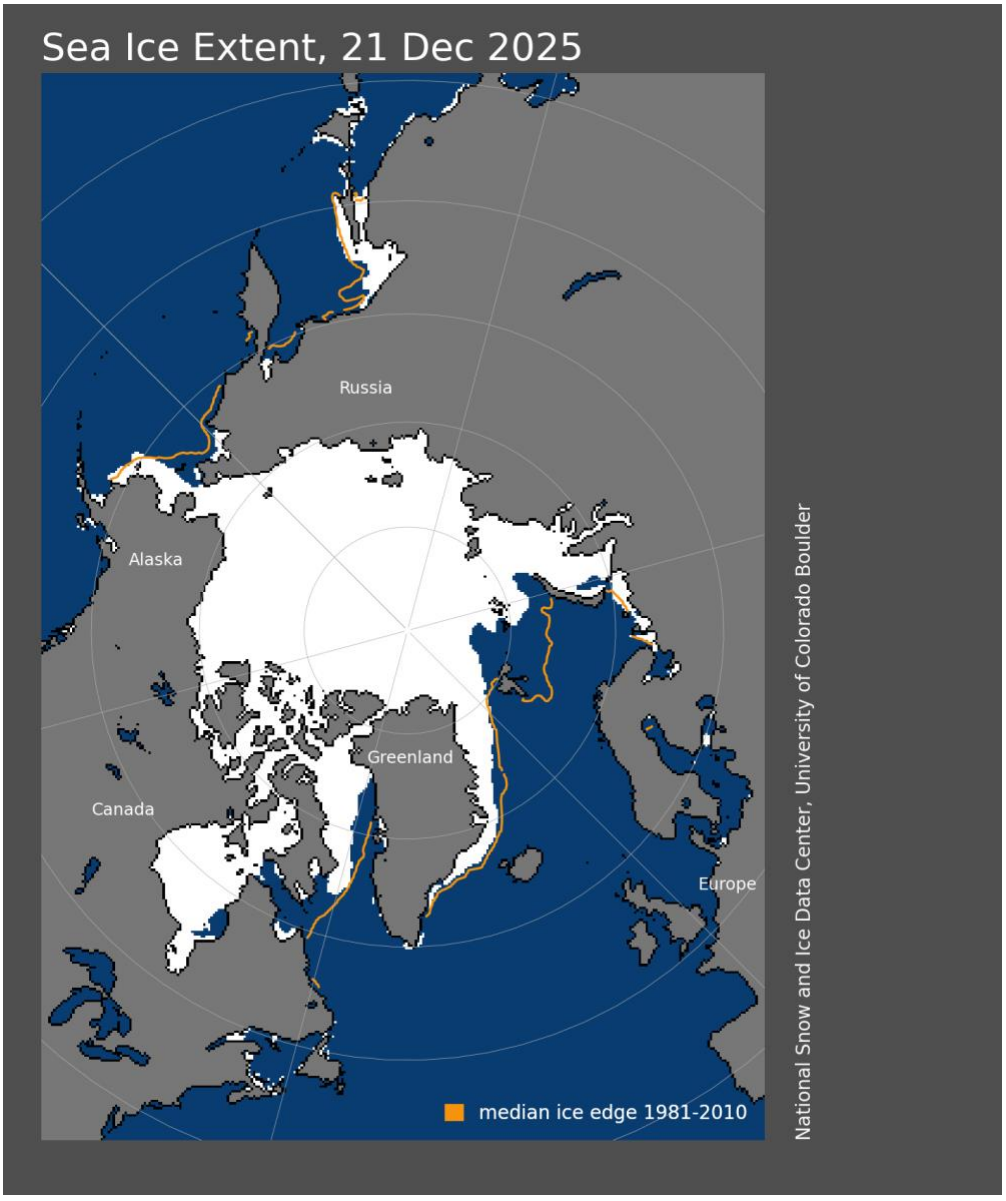

Figure 15. Arctic sea ice cover extent for 21 December 2025. White depicts ice covered areas and the orange contour the climatological extent of Arctic sea ice for the date. Plot taken from: https://nsidc.org/sea-ice-today

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies are below normal, along the equatorial Pacific (**Figure 15**) consistent with La Niña conditions for much of the winter but current forecasts show some uncertainty but for now mostly favor weak 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 very warm SSTs in both ocean basins could be supporting the predicted mid-ocean ridging in both basins.

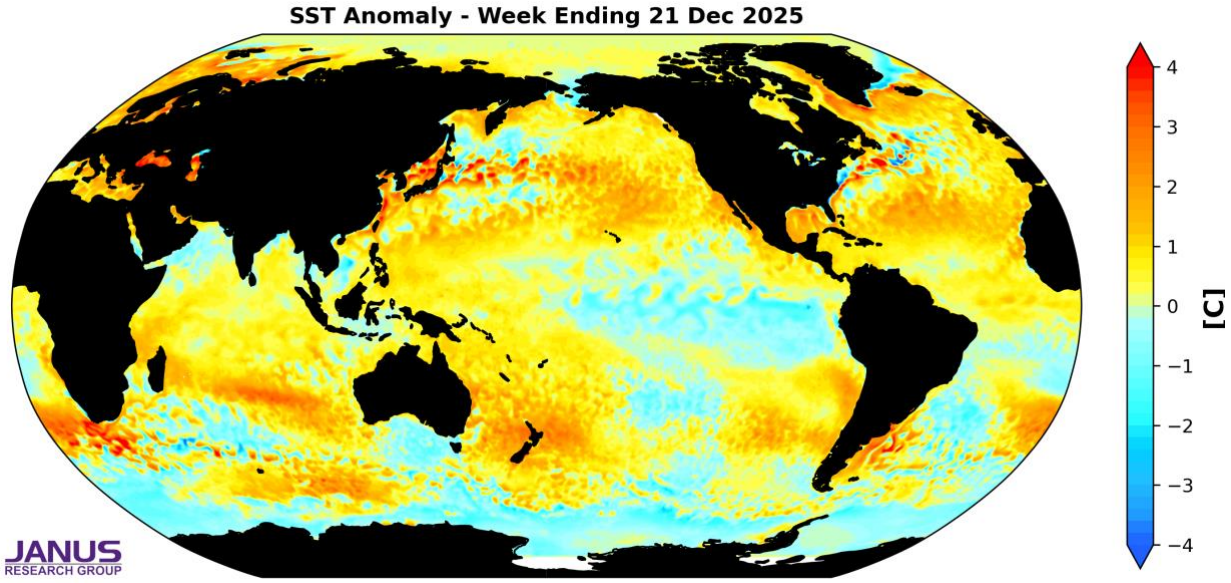

Figure 16. The latest daily-mean global SST anomalies for week ending 21 Dec 2025.

Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is currently weak where no phase is favored (**Figure 17**) and the forecasts are for the MJO to remain weak where no phase is favored over the next two weeks (**Figure 17**). Therefore, it seems that the MJO is having little influence on North American weather in the next two weeks. But admittedly this is outside of my expertise.

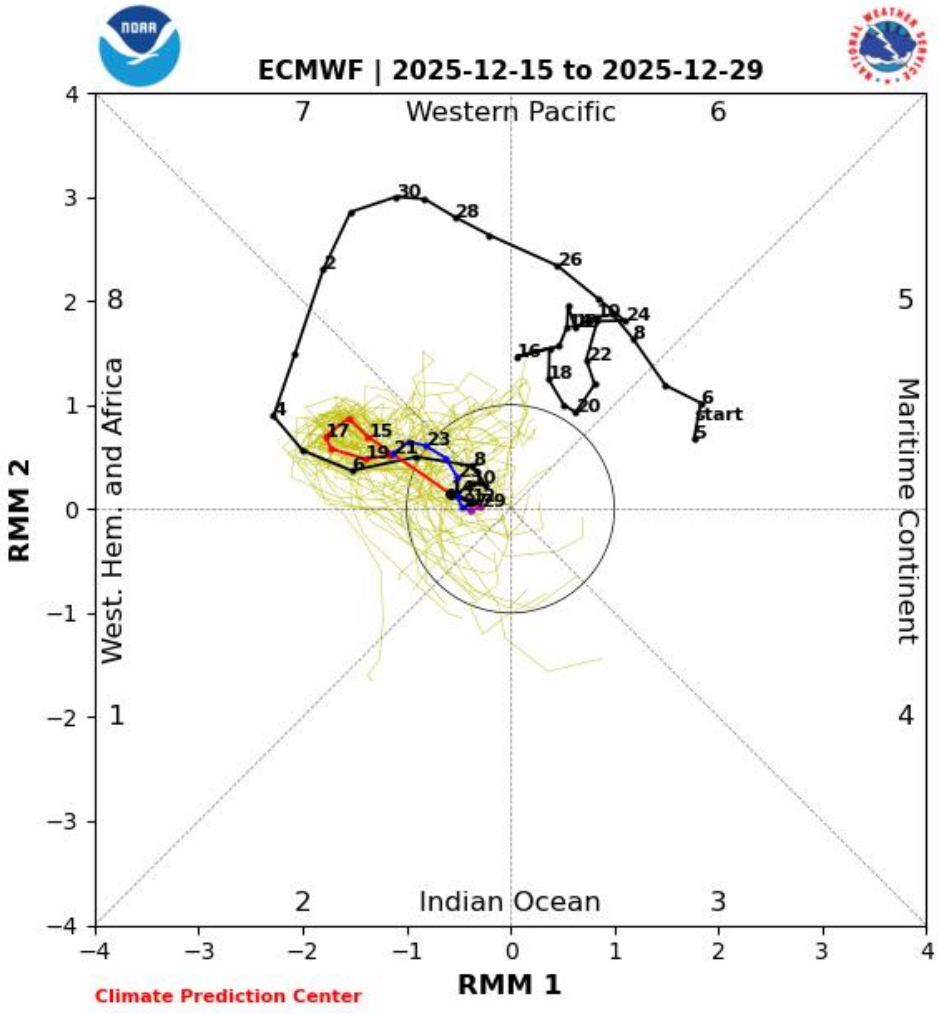

Figure 17. Past and forecast values of the MJO index. Forecast values from the 00Z 15 Dec 2025 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model 'spread' is denoted by the gray shading. Sector numbers indicate 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

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