

Arctic Oscillation and Polar Vortex Analysis and Forecasts

October 6, 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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Summary

- The Arctic Oscillation (AO) is currently positive and is predicted to trend negative towards neutral and even negative the next two weeks as pressure/geopotential height anomalies across the Arctic are currently mostly negative and are predicted to become mostly mixed and then mostly positive over the next two weeks. The North Atlantic Oscillation (NAO) is currently positive as negative pressure/geopotential height anomalies dominate across Greenland, and the NAO is predicted to trend negative the next two weeks as pressure/geopotential height anomalies are predicted to become increasingly positive across Greenland.
- The next two weeks, ridging/positive geopotential height anomalies across Northwestern Europe will support troughing/negative geopotential height anomalies downstream across Eastern and Southern Europe. The amplified flow pattern will support normal to above normal temperatures across Northern and Western Europe including the United Kingdom (UK) with normal to below normal temperatures first across Southern and Eastern Europe but cooler temperatures could become more widespread mid-October.
- The general pattern across Asia the next two weeks is an omega block pattern with strong ridging/positive geopotential height anomalies centered first over the Laptev Sea and then over Siberia bookended by troughing/negative geopotential height anomalies first across Siberia and then in Eastern Asia and across Western Asia. This pattern favors normal to

below normal temperatures across Siberia into East Asia this week and then including Western Asia next week with normal to above normal temperatures across Southern and Western Asia this week and then Siberia next week.

- The general predicted pattern across North America this week is ridging/positive geopotential height anomalies across Alaska, Western Canada and the Western and Southern United States (US) and troughing/negative geopotential height anomalies across Eastern Canada this week but with troughing across western North America and ridging in eastern North America next week. This pattern will favor widespread normal to above normal temperatures across Alaska, much of Canada and the Western and Southern US with normal to below normal temperatures in the Canadian Maritimes and the US East Coast this week and then next week normal to below normal temperatures will spread across Alaska and the West Coasts of Canada and the US with normal to above normal temperatures from the Rockies to the Atlantic coast in Canada and the US.
- I continue discussing my thoughts about the upcoming pattern across the Northern Hemisphere (NH) and continue with some preliminary predictors for the upcoming winter.

Plain Language Summary

So far for October, it is a tale of two continents, extremely mild in North America and fairly widespread cold across Eurasia, especially in parts of Siberia (see **Figure**). It has also been chilly in Central Asia and in Europe, especially in Southeast Europe (see **Figure**). And the forecast can be summarized as more of the same for the next two weeks with mild across much of North America and relatively cool in Southeastern Europe, Central into Northeast Asia and Siberia (see **Figures 3, 6 and 9**). Longer term Greenland blocking could become established the second half of the month that could finally bring cooler weather to North America and persist the cooler temperatures across northern Eurasia. I am also closely watching the snow cover advance across Siberia this month, a rapid advance suggests a more severe winter and a slower advance a milder winter.

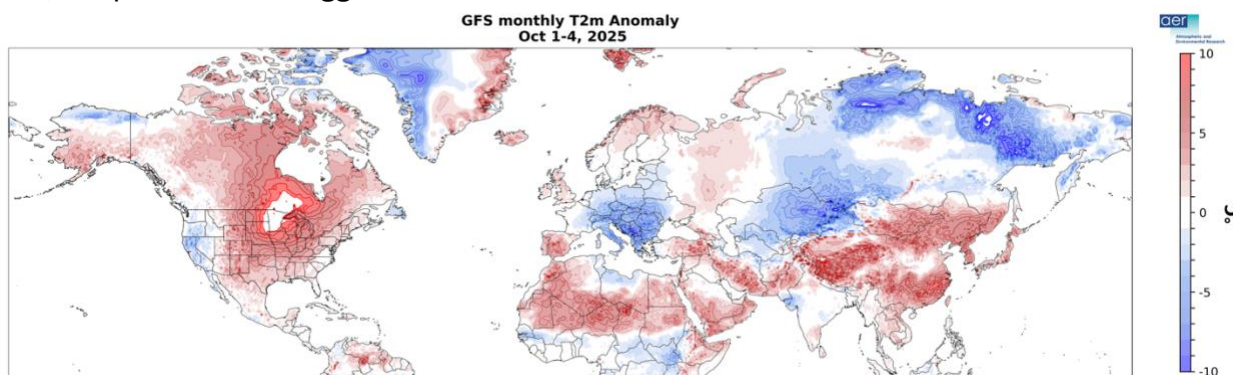


Figure. Estimate of the observed surface temperatures (°C; shading) from 01 Oct to 04 Oct 2025 based on GFS initializations and the GFS forecast from the 5 October 2025 run.

Impacts

First some business that I need to take care of. For much of this year the blog has been made public immediately upon publication but that is going to change starting in November. There be an early release on Monday as was in the past and the blog will go public on Thursday. To access the early release, you will need to be an sCast customer. **At present there is no planned option to purchase the early release per week.**

For much of October there seems to be no lack of high-latitude blocking, and in multiple locations. 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 i**). This week, two dominant high-pressure centers are predicted one over Northwest Europe including Scandinavia and the other over the Laptev Sea (see **Figure ii**). Then next week the Hudson Bay high pressure will return with the Laptev Sea high pressure sliding southeast into Siberia. Eventually the Northwest Europe and the Hudson Bay high pressures are predicted to merge over Greenland. This merger of two blocking highs on either side of the North Atlantic somewhere in the middle, is something that I am watching very carefully.

Initialized 00Z 500 hPa HGT/HGTa 06-Oct-2025

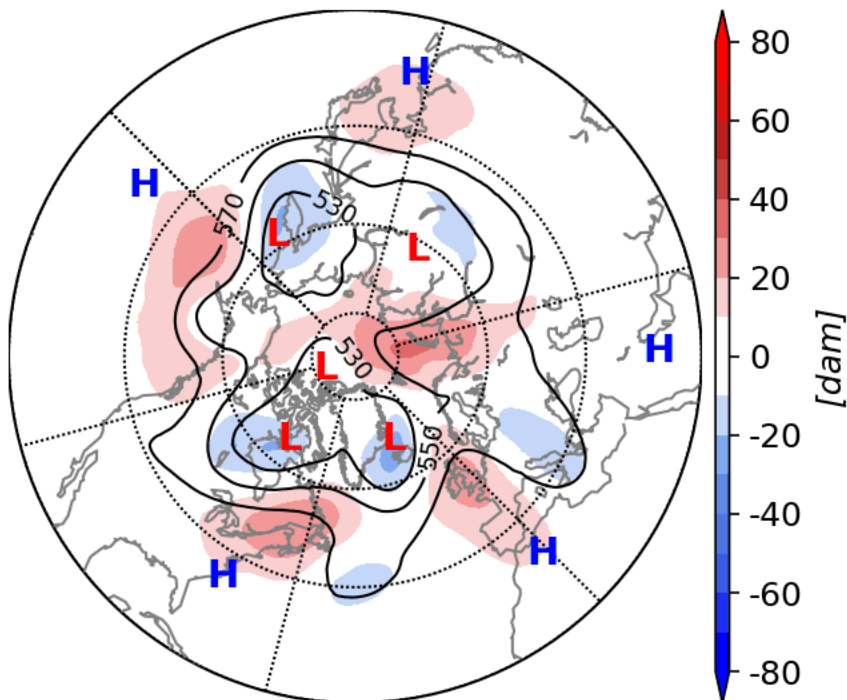


Figure i. Initialized 500 mb geopotential heights (dam; contours) and decameter anomalies (dam; shading) across the Northern Hemisphere for 06 Oct 2025 and forecasted from 07 Oct to 21 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS model ensemble.

Siberian snow cover got off to a quick start in September and that has continued into October (see **Figure ii**), however it seems to me the rapid advance of late September has slowed a bit in October. In fact in a bit of an unusual twist the surface temperatures have been more impressive this month (as in cold) than the snow cover, typically it is the reversed. Above normal Siberian snow cover extent (SCE) favors a weak polar vortex this winter and more widespread severe winter weather across the NH. But the persistence of the pattern that is supportive of a rapid advance of Siberian snow cover for remainder of the month remains cloudy and uncertain in my opinion. As I thought might happen and mentioned in the last blog, the trough across Siberia transitions to high-pressure ridging, this scenario is now predicted by the models. That would greatly reduce the odds of a weak polar vortex and colder weather this winter. This seems to have been a fairly common occurrence the past few Octobers. If there is a sign that the cavalry is coming (that is if you are a winter weather enthusiast) it is the development and even dominance of Greenland blocking. That should squash any Siberian ridging and resume the rapid advance of Siberian SCE. But predicting high latitude blocking is a known model weakness and confidence for the second half of October is low.

Daily SCE Departure - October 5, 2025 (Day 278)

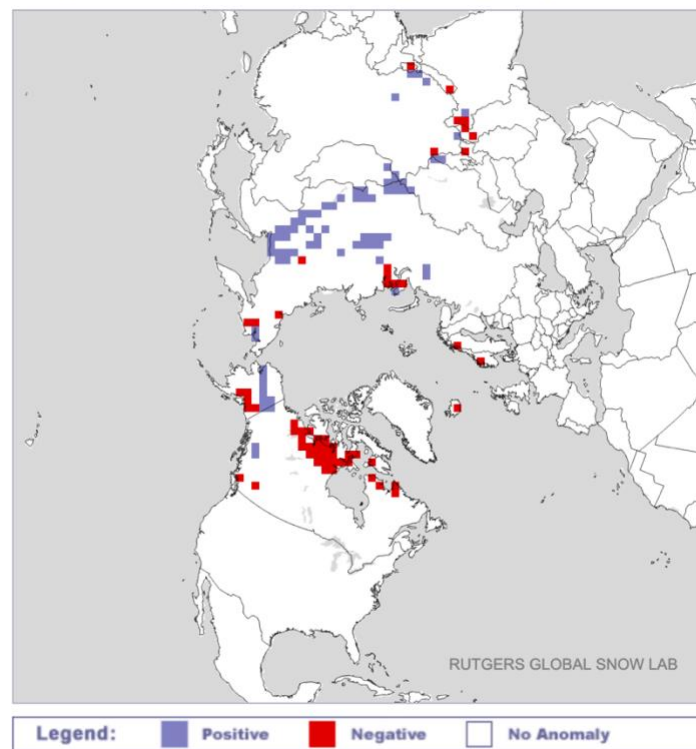


Figure ii. Daily snow cover anomaly across the Northern Hemisphere for 05 October 2025. Plot taken from: <https://climate.rutgers.edu/snowcover/index.php>

I am also watching Arctic sea ice. Current conditions are shown in **Figure iii**. 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. Since sea ice is currently low in both the North Atlantic and the North Pacific sectors, it is too early to make that call. However, the forecast from mid to late-October are for relatively low heights in the North Pacific sector and relatively high heights in the North Atlantic sector (See **Figure 8**). This should support the growth of Arctic sea ice faster in the North Pacific sector than in the North Atlantic sector. That is what I believe is the proper bias but like snow cover, it depends on an accurate forecast from the weather models and is a low confidence forecast.

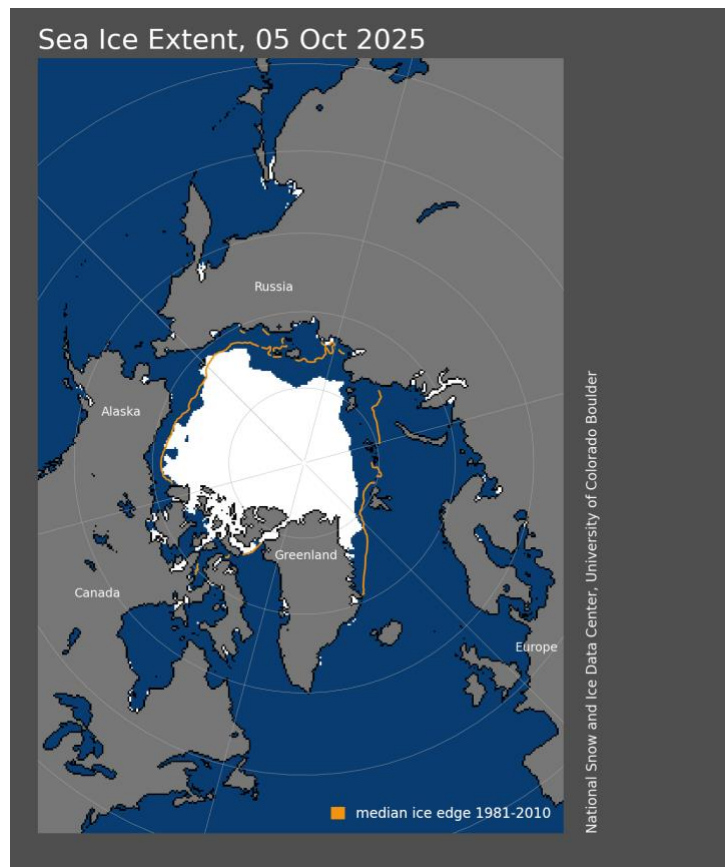


Figure iii. Arctic sea ice cover extent for 05 October 2025. White depicts ice covered areas and the orange contour the climatological extent of Arctic sea ice for the date. Plot taken from: <https://nsidc.org/sea-ice-today>

Another winter predictor that I use in the AER seasonal forecast is the dominant monthly mean sea level pressure anomaly across northern Eurasia. Again, no lack of high latitude blocking across Eurasia and if the weather models' forecast is close to being correct that could continue for much of the month. In my opinion, all three Arctic predictors that I rely on for the winter forecast: the Eurasian snow cover, the Arctic sea ice and the Eurasian Arctic sea level pressure anomaly pattern all favor a weaker polar vortex this winter and more widespread severe winter weather across at least parts of the mid-latitude continents. Throw in an easterly quasi biennial

oscillation and the chips are starting to fall for a weaker polar vortex. However, it is really early and things can change dramatically, as I have experienced all too often. A younger me would have a hard time containing my excitement at this point but I have too many scars from promising winters that turned into duds to give it more than a pretty blasé passing thought at this point.

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

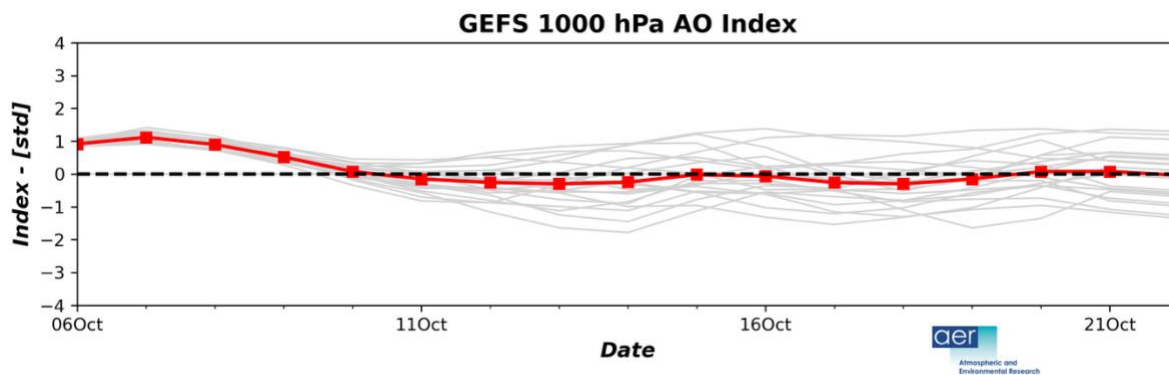


Figure 1. The predicted daily-mean AO at 1000 hPa from the 00Z 06 Oct 2025 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble mean AO index given by the red line with squares.

This week ridging/positive geopotential height anomalies centered between the UK and Scandinavia will support troughing/negative geopotential height anomalies to the southeast across Southeastern Europe (**Figure 2**). This pattern will support widespread normal to above normal temperatures across Northwestern Europe including the UK with normal to below normal temperatures across Southern and Eastern Europe this period (**Figure 3**). This week two thirds of an omega block will dominate Asia with ridging/positive geopotential height anomalies centered over the Laptev Sea forcing troughing/negative geopotential height anomalies across Siberia, Central and East Asia with more ridging across Southeastern Asia (**Figure 2**). This pattern favors normal to above normal temperatures across Western Asia with normal to below normal temperatures across Siberia, Central and Northeastern Asia and India this period (**Figure 3**).

GEFS 1-5 Day Forecast 500 hPa Anomaly
INIT: 00Z 10/06/2025 FCST: 10/07/2025 to 10/11/2025

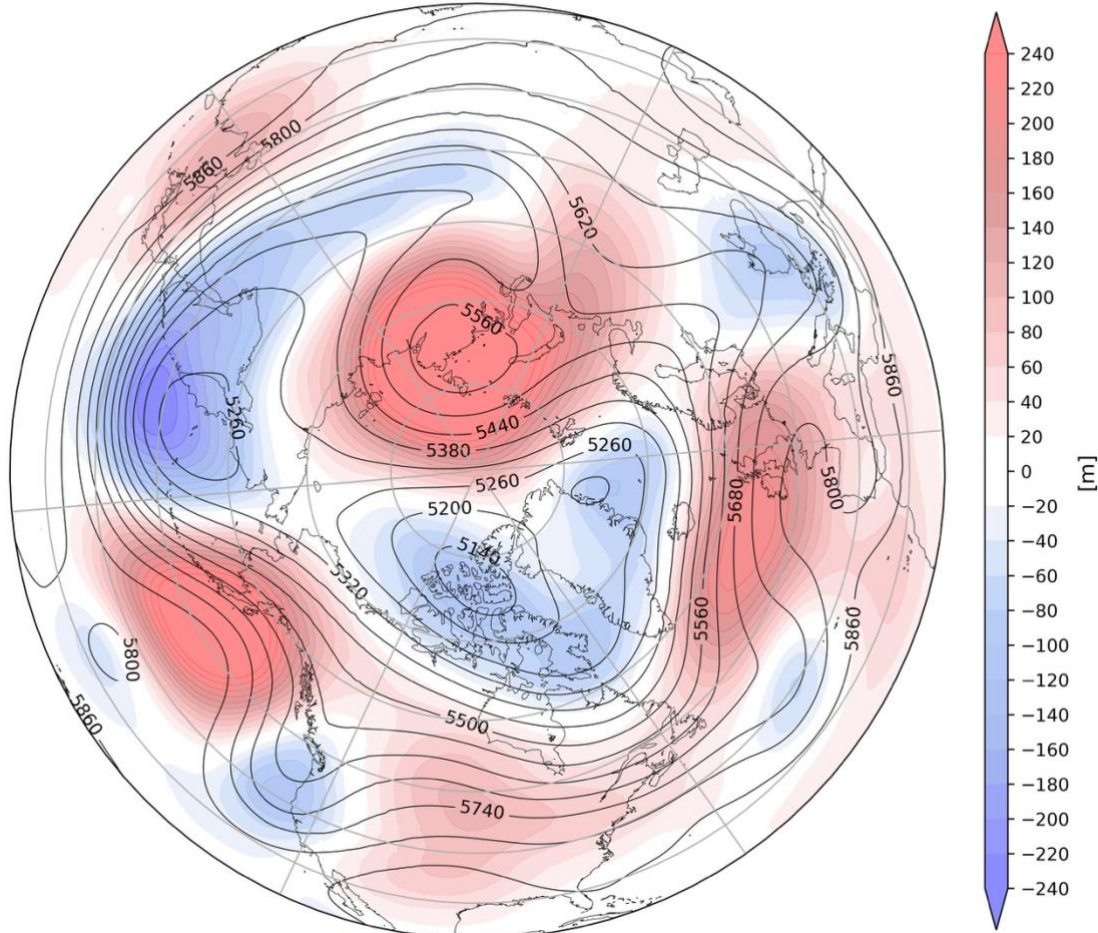


Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 07 Oct to 11 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

This week ridging/positive geopotential height anomalies will dominate Alaska, Western Canada and the Western and Southern US with troughing/negative geopotential height anomalies across Eastern Canada this week (**Figure 2**). This pattern will favor widespread normal to above normal temperatures across the US and Canada with the exceptions of normal to below normal temperatures along the US West Coast and swinging through the US East Coast late in the week (**Figure 3**).

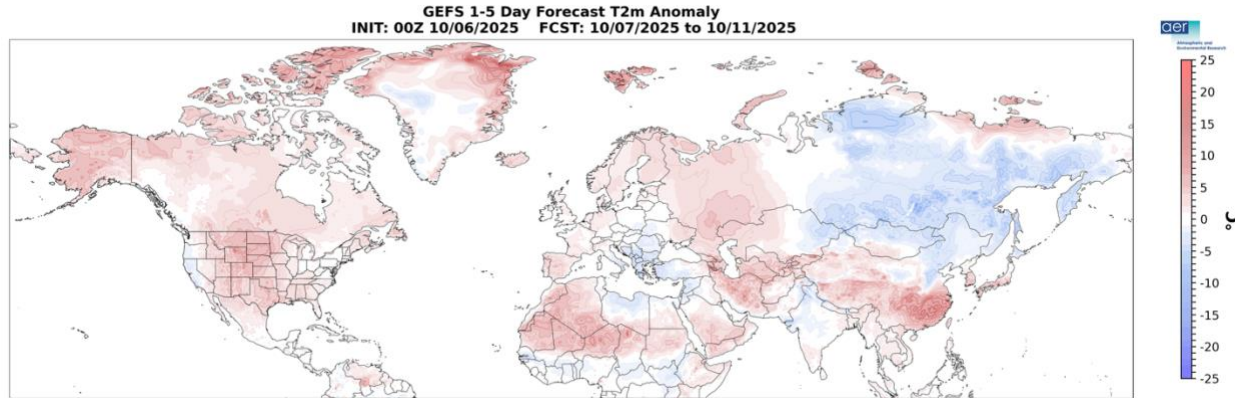


Figure 3. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 07 Oct to 11 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

Troughing will support new rainfall across Norway, Southeastern Europe, Northern Siberia, parts of East Asia, India and Pakistan with otherwise mostly dry conditions widespread across Europe and Asia, with near normal precipitation across Afghanistan this week (**Figure 4**). Troughing will support new rainfall across Alaska, the Southwestern US and the Ohio Valley with otherwise mostly dry conditions widespread across Canada and the US this week (**Figure 4**).

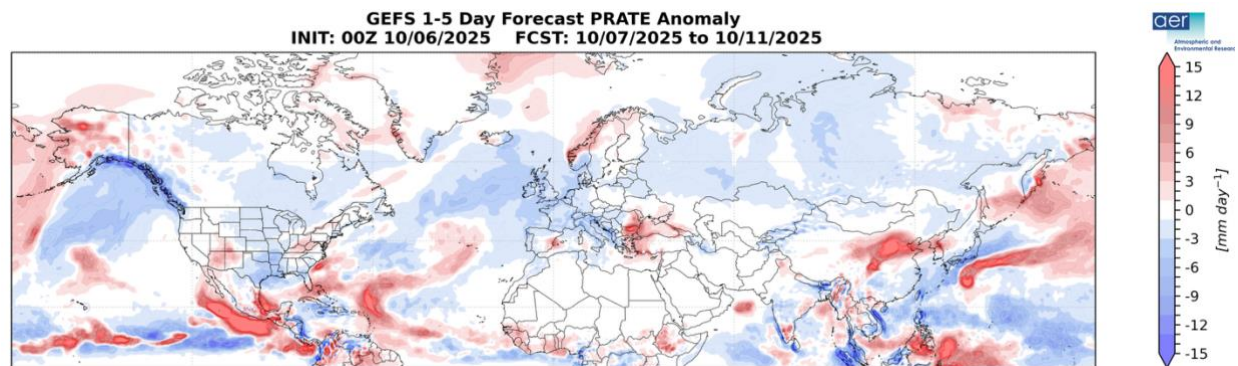


Figure 4. Forecasted rainfall (mm/day; shading) from 07 Oct to 11 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

Near-Mid Term

Next week

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

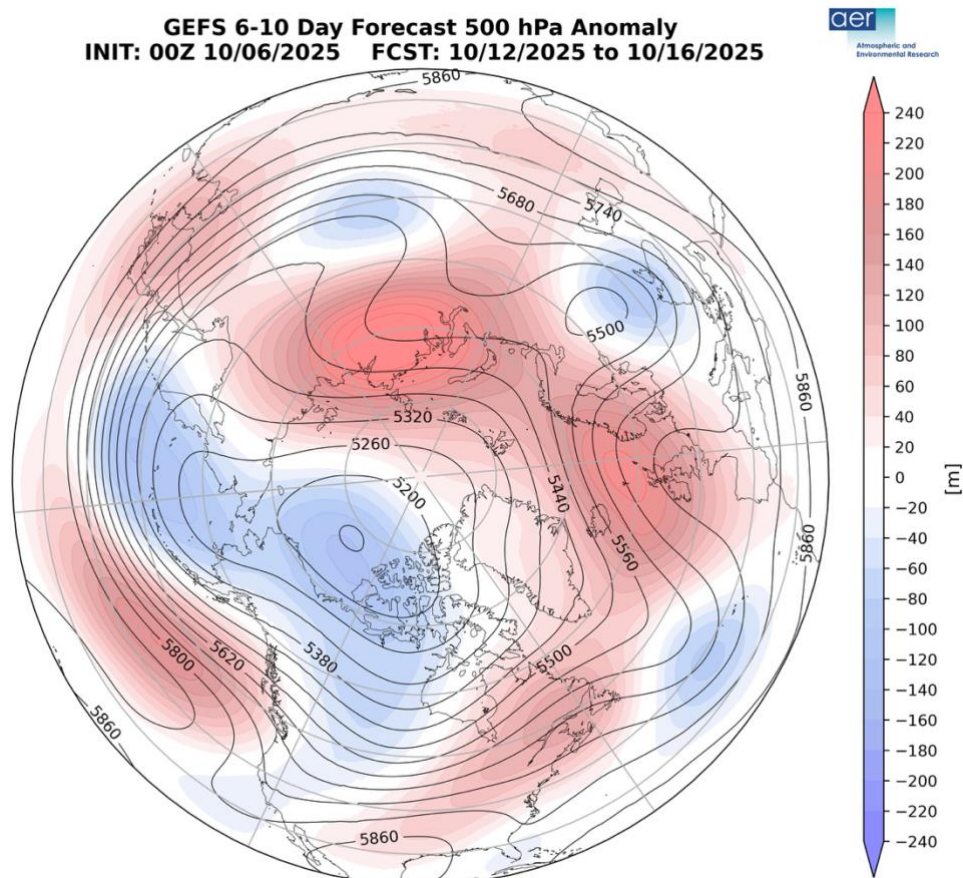


Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 12 Oct to 16 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

Strong ridging/positive geopotential height anomalies will remain parked between Iceland and Scandinavia will force troughing/negative geopotential height anomalies to the east across Eastern Europe (**Figure 5**). The blocked pattern will support normal to above normal temperatures across Northern and Western Europe including the UK with normal to below normal temperatures across Eastern and Southern Europe this period (**Figure 6**). A persistent omega block will cover Asia with ridging/positive geopotential height anomalies centered in the Laptev Sea bookended by troughing/negative geopotential height anomalies

both across Western and Eastern Asia this period (**Figure 5**). This pattern favors widespread normal to above normal temperatures across Western, Central and Southern Asia including Pakistan and Afghanistan with normal to below normal temperatures across Siberia, Northeast Asia and parts of India this period (**Figure 6**).

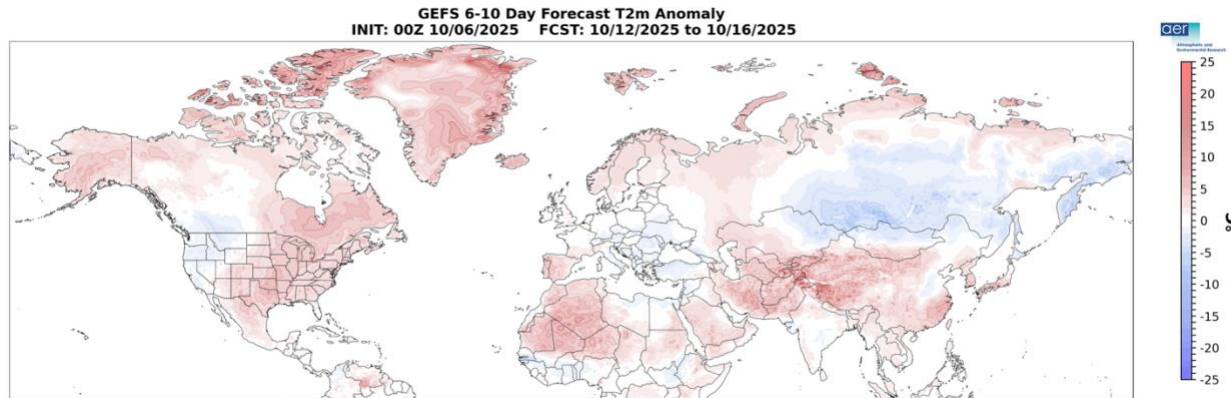


Figure 6. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 12 Oct to 16 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

A pattern flip is predicted across North America with troughing/negative geopotential height anomalies across Western Canada and the Western US with ridging/positive geopotential height anomalies across Eastern Canada and the Eastern US this period (**Figure 5**). This pattern will favor widespread normal to above normal temperatures across Alaska and much of Canada and the US from the Rockies eastward with normal to below normal temperatures limited to the West Coasts of Canada and the US (**Figure 6**).

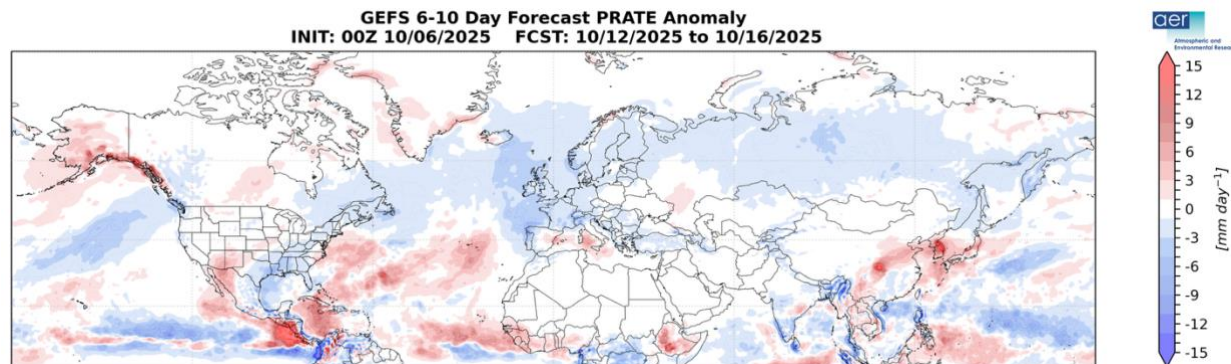


Figure 7. Forecasted precipitation rate (mm/day; shading) from 12 Oct to 16 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

Troughing will support new rainfall around the Tyrrhenian Sea, Eastern Siberia, Eastern China, Japan, parts of Southeast Asia with otherwise mostly dry conditions widespread across Europe and Asia and near normal across Afghanistan and Pakistan this period (**Figure 7**). Troughing will support new rainfall across the Alaska, the Canadian Plains and the Western US with otherwise mostly dry conditions widespread across Canada and the US this period (**Figure 7**).

Mid Term

Week Two

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

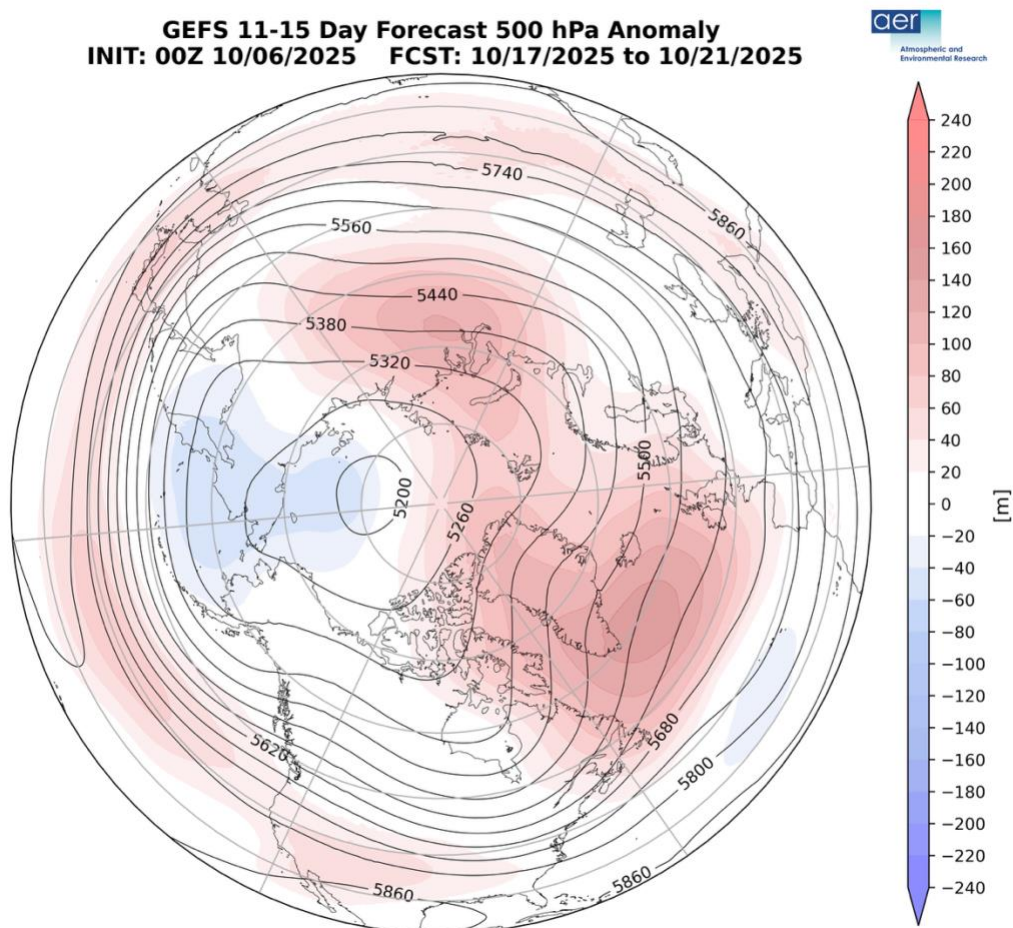


Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 17 Oct to 21 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

Ridging/positive geopotential height anomalies across Northern Europe and eastern North America are predicted to consolidate near Greenland supporting deepening troughing/negative geopotential height anomalies across much of Europe this period (**Figure 8**). This pattern should favor normal to above normal temperatures across Northern Europe including the UK and Spain with normal to below temperatures across Central and Southern Europe this period (**Figures 9**).

Persistent ridging/positive geopotential height anomalies previously centered over the Laptev Sea will slide southeastward into Siberia and weaken with troughing/negative geopotential height anomalies across Eastern and Western Asia with more ridging across Southern and Eastern Asia this period (**Figure 8**). The predicted pattern favors normal to above normal temperatures across Western and Southern Asia including Pakistan and Afghanistan with normal to below normal temperatures across Southern Siberia and Northeastern Asia this period (**Figure 9**).

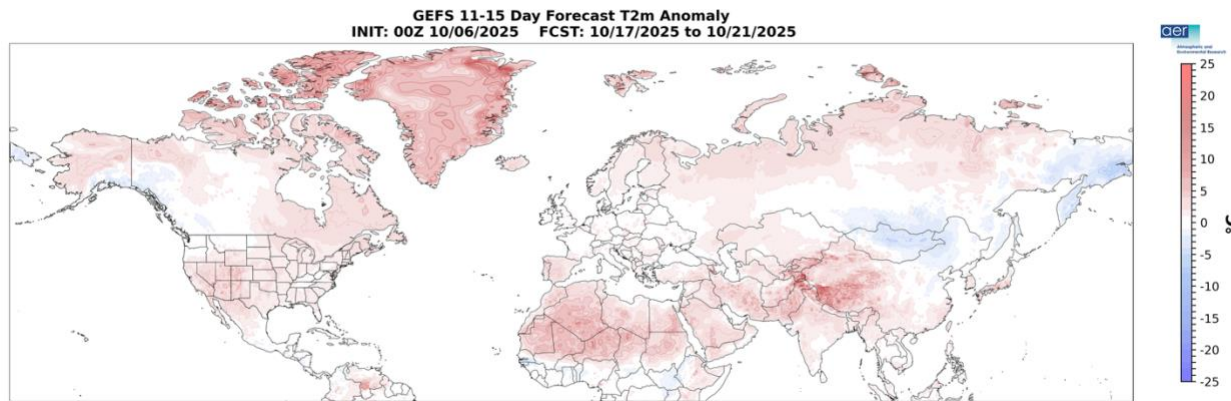


Figure 9. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 17 Oct to 21 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

The predicted pattern across North America is troughing/negative geopotential height anomalies across western North America and ridging/positive geopotential height anomalies across eastern North America this period (**Figure 8**). This pattern supports widespread normal to above normal temperatures across most of Canada and the US with normal to below normal temperatures mostly limited to southern Alaska, Western Canada and the Western US this period (**Figure 9**). If Greenland blocking does materialize, cooler temperatures could quicker usher into the Eastern US around the end of the period.

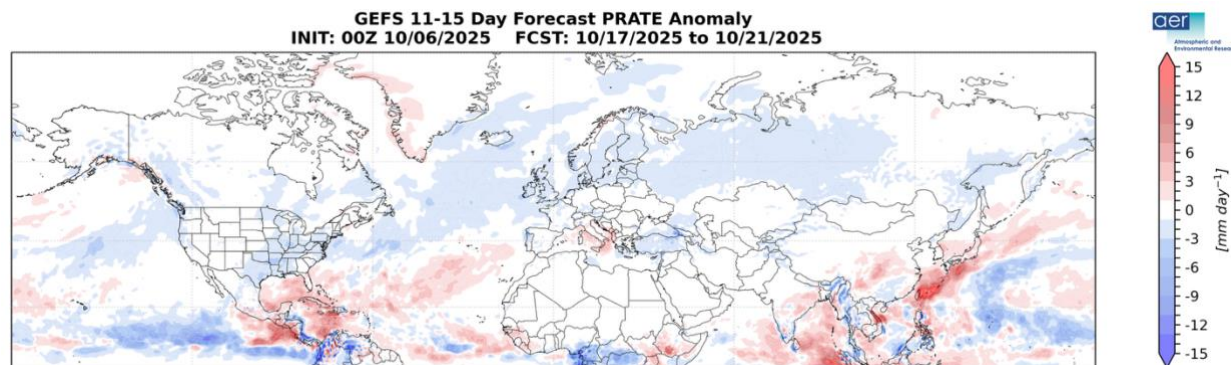


Figure 10. Forecasted precipitation rate (mm/day; shading) from 17 Oct to 21 Oct 2025. The forecasts are from the 00Z 06 Oct 2025 GFS ensemble.

Troughing will support new rainfall across the Aegean Sea, Southern China and Central India with otherwise mostly dry conditions widespread across Europe and Asia and near normal precipitation in Afghanistan and Pakistan this period (**Figure 10**). Troughing will support new rainfall along the coastal mountains of Western Canada and the US Gulf States with otherwise mostly dry conditions widespread across Canada and the 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 lower stratosphere and upper to mid-troposphere (**Figure 11**). The cold/negative PCHs are predicted to persist in the upper stratosphere over the next two weeks with warm/positive PCHs strengthening and expanding higher in the stratosphere and extending to the surface.

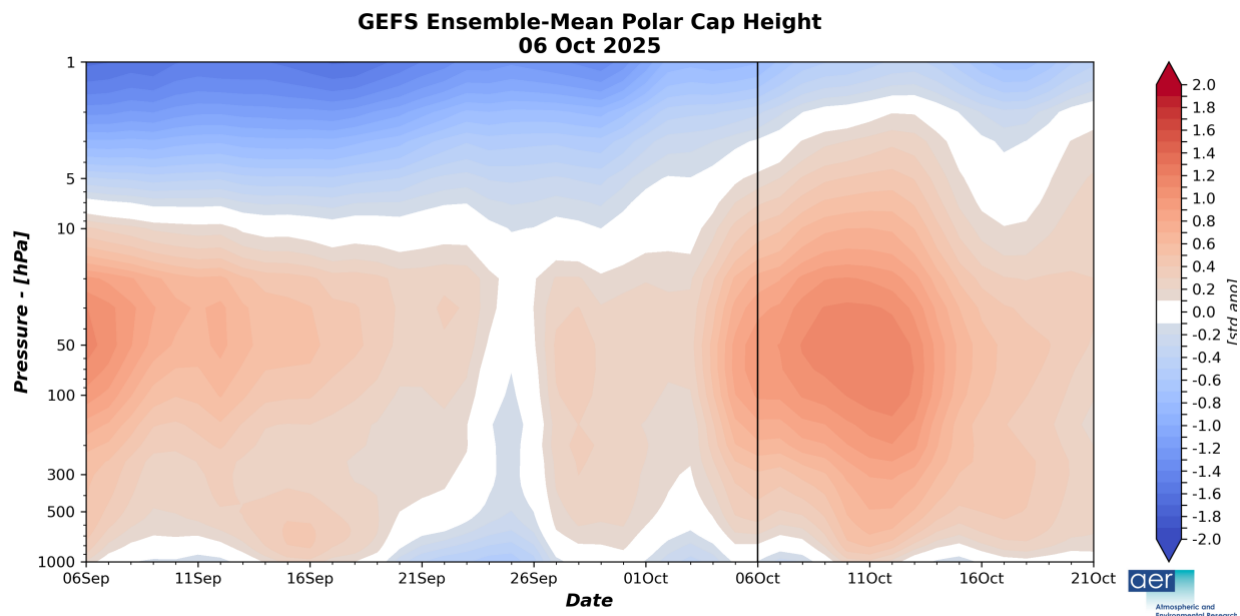


Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 06 Oct 2025 GFS ensemble.

The predicted cold/negative PCHs in the lower troposphere this week (**Figure 11**) are consistent with the predicted positive to near neutral surface AO this week (**Figure 1**). Then next week with the forecast of the PCHs extending to the lower troposphere (**Figure 11**) and a negative surface AO is more likely (**Figure 1**).

**CFS 500 hPa Forecast Anomaly Nov 2025
Valid as of 06 Oct 2025**

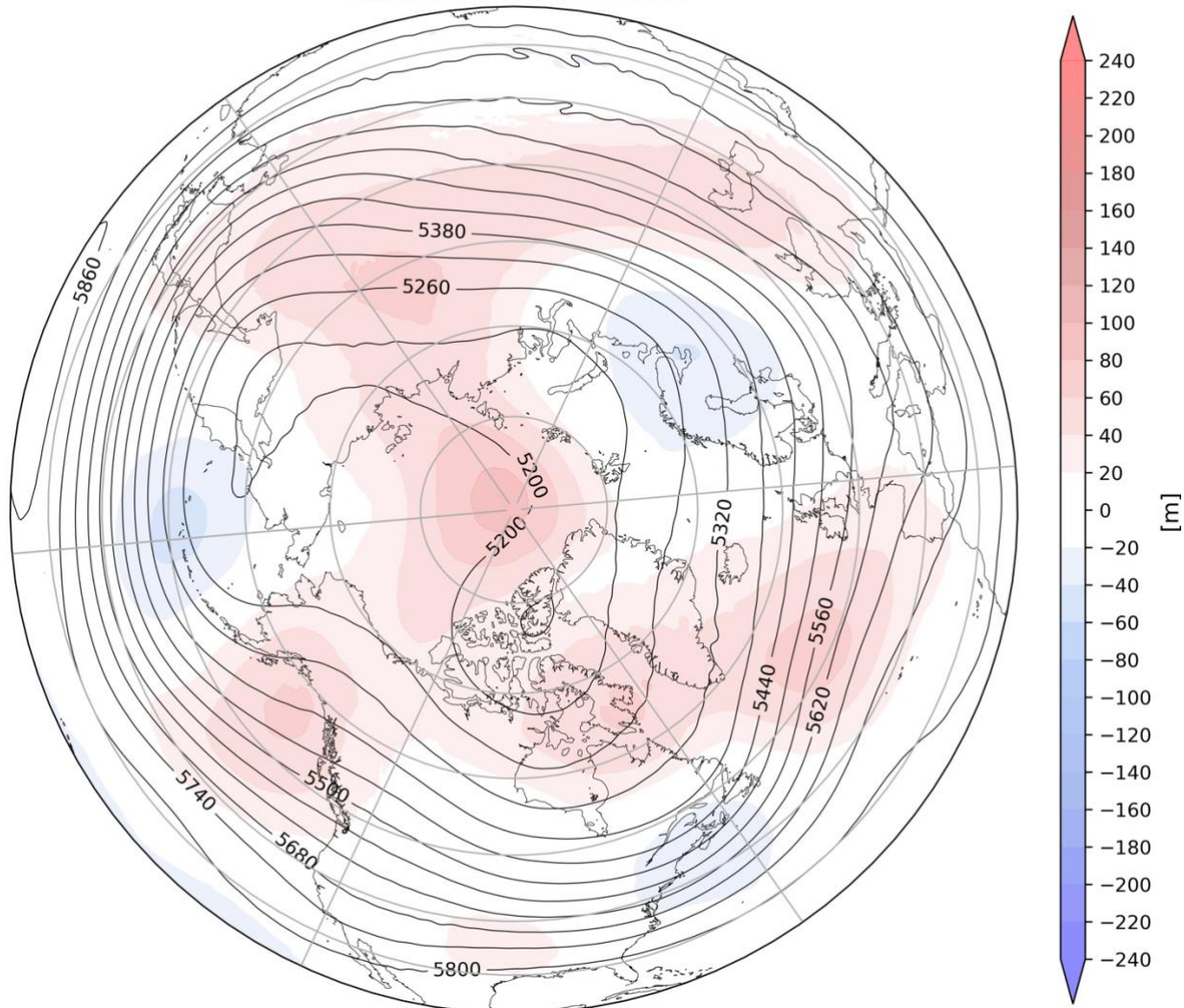


Figure 12. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for November 2025. The forecasts are from the 00Z 06 Oct 2025 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 12**) and surface temperatures for November (**Figure 13**) from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging centered over Baffin Bay, Greenland and into Western Europe, the North Pole, Siberia and Central Asia and the Gulf of Alaska with troughing across Northeastern Europe, Eastern Siberia, Eastern Canada and the Eastern US (**Figure 12**). This pattern favors seasonable to relatively warm temperatures across Northern and Western Europe, much of Asia, the Tibetan Plateau, Pakistan, Afghanistan, Alaska, much of Canada and the Central US with seasonable to relatively cool temperatures across Northeastern Europe, Northeast Asia, the West Coasts of Canada and the US and the Eastern US (**Figure 13**).

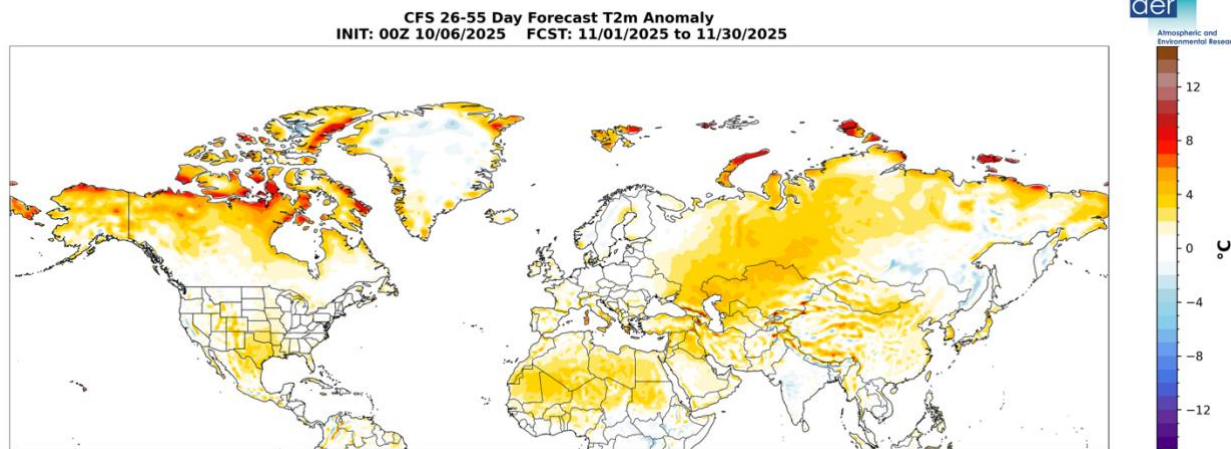


Figure 13. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for November 2025. The forecasts are from the CFS 00Z 06 Oct 2025.

Boundary Forcings

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies are slightly below normal, along the equatorial Pacific (**Figure 14**) 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 and mostly favor a continuation of neutral conditions or weak La Niña. Observed SSTs across the NH remain well above normal especially in the North Pacific and much of the North Atlantic with the exception east of the Canadian Maritimes and extending south of Iceland, though below normal SSTs exist regionally especially in the South Pacific.

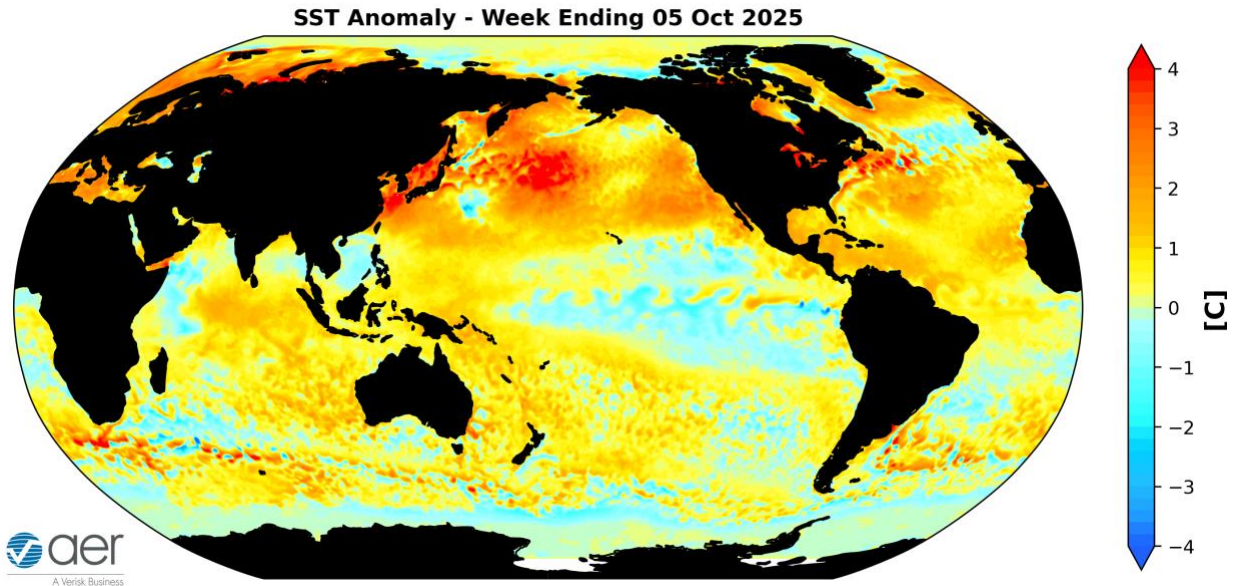


Figure 14. The latest daily-mean global SST anomalies (ending 05 Oct 2025). Data from NOAA OI High-Resolution dataset.

Madden Julian Oscillation

Currently the Madden Julian Oscillation (MJO) is weak where no phase is favored (**Figure 15**) and the forecast are for the MJO to remain weak and then emerge into phase one next week (**Figure 15**). Phase one favors troughing in western North America and ridging in eastern North America. Therefore, it seems to me that the MJO is likely having some influence on North American weather next week. But admittedly this is outside of my expertise.

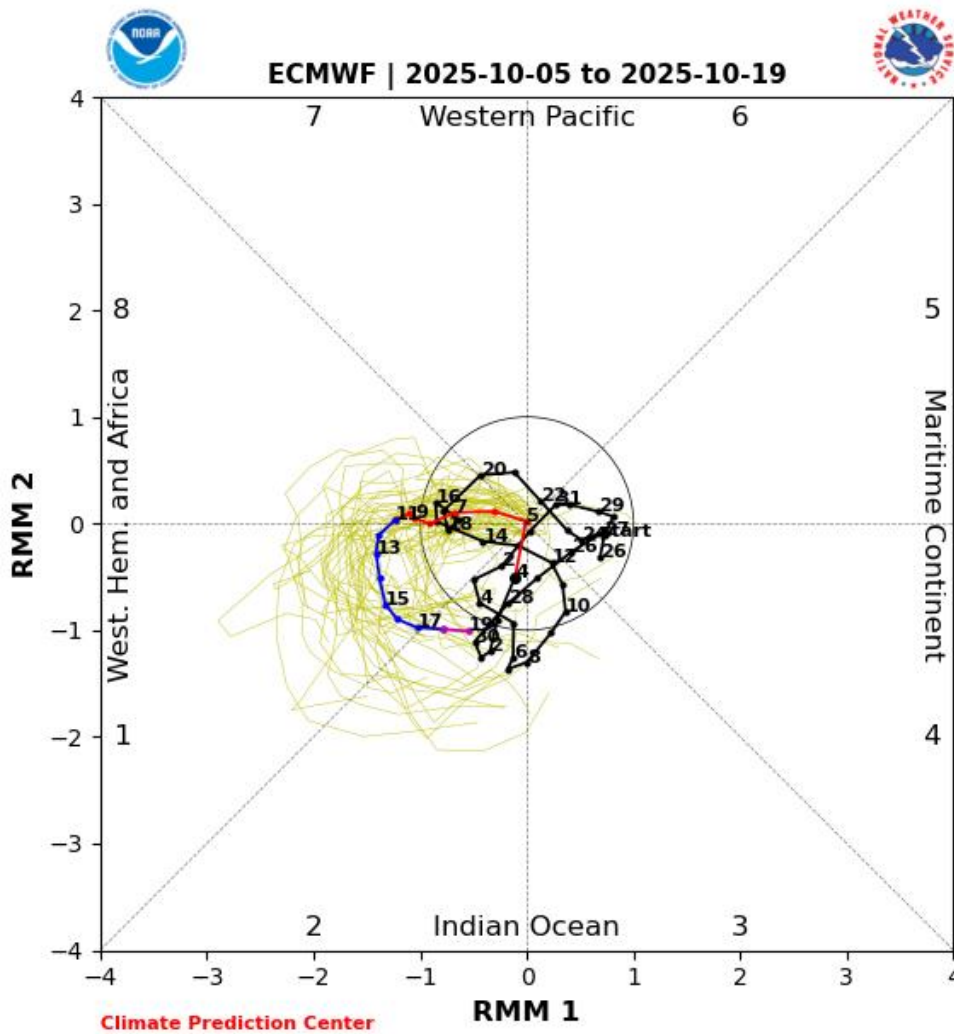


Figure 15. Past and forecast values of the MJO index. Forecast values from the 00Z 05 Oct 2025 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model 'spread' is denoted by the gray shading. Sector numbers indicate 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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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.

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