

Arctic Oscillation and Polar Vortex Analysis and Forecasts

February 15, 2021

Special blog on winter 2018/2019 retrospective can be found here
- <http://www.aer.com/winter2019>

Special blog on winter 2017/2018 retrospective can be found here
- <http://www.aer.com/winter2018>

Special blog on winter 2016/2017 retrospective can be found here
- <http://www.aer.com/winter2017>

Special blog on winter 2015/2016 retrospective can be found here
- <http://www.aer.com/winter2016>

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. With the start of 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 neutral and is predicted to remain neutral to positive the next two weeks as pressure/geopotential height anomalies are predicted to remain mixed with positive pressure/geopotential height anomalies across the Eurasian Arctic but negative on the North American side of the Arctic the next two weeks.

- The North Atlantic Oscillation (NAO) is currently neutral with weak and mixed pressure/geopotential height anomalies across Greenland and Iceland; and the NAO is predicted to remain neutral to positive as mixed pressure/geopotential height anomalies are predicted to persist across Greenland the next two weeks.
- Over the next two weeks predicted ridging/positive geopotential height anomalies centered over Western Europe will favor troughing/negative geopotential height anomalies across Western Asia. Therefore over the next two week's Europe will be divided along a north to south line with normal to above normal temperatures across Western Europe including the United Kingdom (UK) and normal to below normal temperatures for Eastern Europe mostly due to northerly flow upstream from the ridge center.
- Over the next two weeks, persistent ridging/positive geopotential height anomalies in Western Europe and the Arctic, especially focused in the Laptev Sea, will anchor troughing/negative geopotential height anomalies across Northern and Western Asia with ridging/positive geopotential height anomalies to the south. This pattern favors normal to below normal temperatures across Northern and Western Asia and normal to above normal temperatures across Southern and Eastern Asia.
- A strengthened stratospheric polar vortex (PV) centered over the Canadian Archipelagos will favor a reflection in the troposphere with troughing/negative geopotential height anomalies across the Canadian Archipelagos and western North America with ridging/positive geopotential height anomalies in the Southeastern United States (US) the next two weeks. This pattern favors normal to below normal temperatures widespread across Canada and the US with the exceptions of normal to above normal temperatures across Northeastern Canada next week and Alaska and the Southeastern US the end of February and into early march.
- In the Impacts section I discuss the conclusion of the impacts/influence from this winter's polar vortex (PV) disruption on the weather across the Northern Hemisphere (NH).

Impacts

I have been writing how the stratospheric PV disruption that has been so influential on our weather since mid-January has been unusual and perhaps even unique in the observational record, so I guess then it should be no surprise that it's ending is also highly unusual. I was admittedly skeptical, but it does seem that the coupling between the stratospheric PV and the tropospheric circulation is about to come to an abrupt end. I posted this figure from [Baldwin and Dunkerton \(2001\)](#) in the [January 25, 2021](#) blog and post it again in **Figure i**. It is often referred to as the "dripping paint" plot as the episodic downward propagation from the polar stratosphere (usually shown as AO anomalies) to the near-surface Arctic resembles dripping paint.

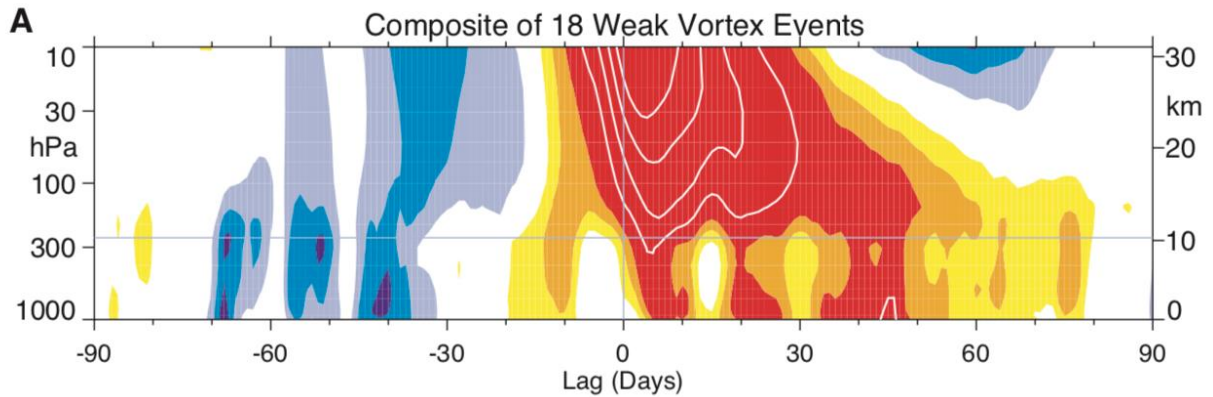


Figure i. Composites of time-height development of the northern annular mode for (A) 18 weak vortex events. The events are determined by the dates on which the 10-hPa annular mode values cross -3.0 . The indices are nondimensional; the contour interval for the color shading is 0.25, and 0.5 for the white contours. Values between 0.25 and 0.25 are unshaded. The thin horizontal lines indicate the approximate boundary between the troposphere and the stratosphere. From Baldwin and Dunkerton (2001).

I am also repeating and updating **Figure i** from the [February 8, 2021](#) blog, since I liked it so much in **Figure ii**. But if **Figure i** is the dripping paint plot, then **Figure ii** is more like the “elevator when the cable is cut” plot, though admittedly not as catchy. The elevated polar cap geopotential height anomalies (PCHs) related to what I like to refer to the third and final PV disruption at the end of January/early February quickly propagates to the surface and even amplifies, peaking this past weekend. And as I have argued, it is during spikes in PCH when severe winter is most likely across the NH mid-latitudes, as demonstrated in [Cohen et al. \(2018\)](#).

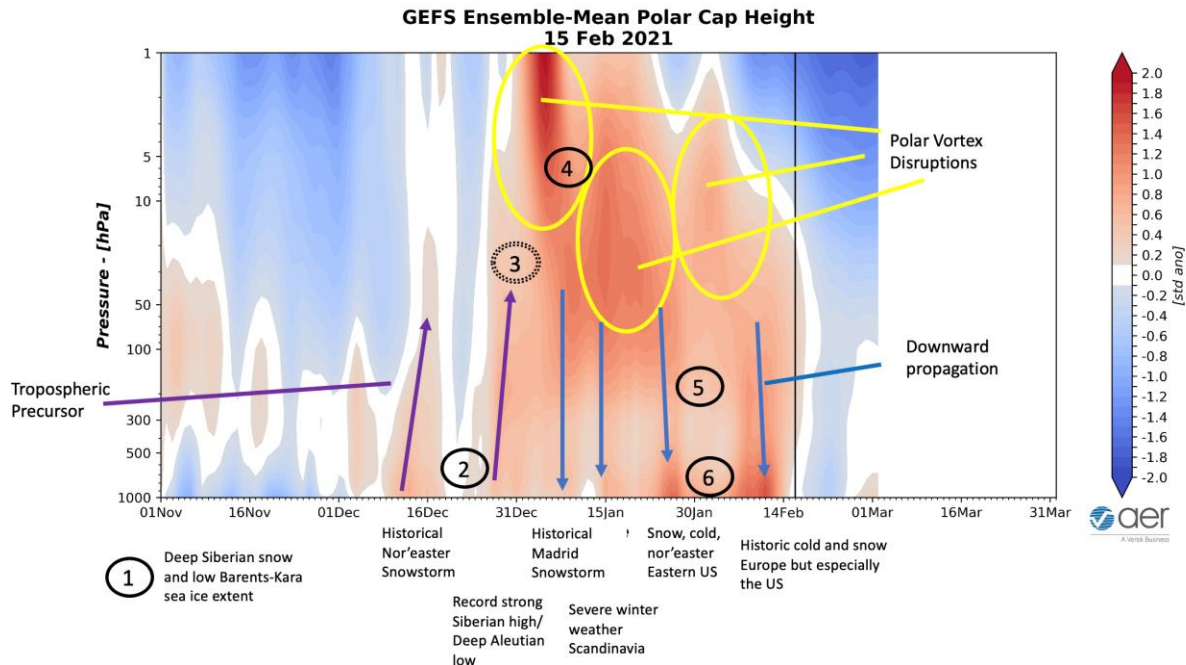


Figure ii. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 15 February 2021 GFS ensemble. Purple arrows show tropospheric precursors, blue arrows show downward propagation of PCHs and yellow ovals show PV disruptions. Numbers correspond to six-step model from [Cohen et al. \(2007\)](#).

But rather than the typical gradual influence from the stratospheric PV disruption over many weeks, maybe akin to the drip, drip, drip of a leaky faucet, the entire signal dropped all at once like an anchor. This also likely contributed to the severity of the current Arctic outbreak in the Central US that is generational and even historical in its severity. But based on the forecast the PV gave all it had all at once, and the entire troposphere-stratosphere-troposphere coupling depicted in **Figure ii** is about to abruptly end in the next few days.

For completeness I also think that it is helpful to include **Figure i** from the [December 14, 2020](#) blog and copied from [Cohen et al. \(2007\)](#). The figure explains the six-step model process shown in **Figure i**. The only step not really shown in **Figure ii** is three, which can be seen in the Wave Activity Flux (WAFz and is proportional to poleward heat transport) plots (**Figure 12**). Hopefully **Figures ii** and **iii** explain the dynamics of this winter.

Snow Forced Cold Signal

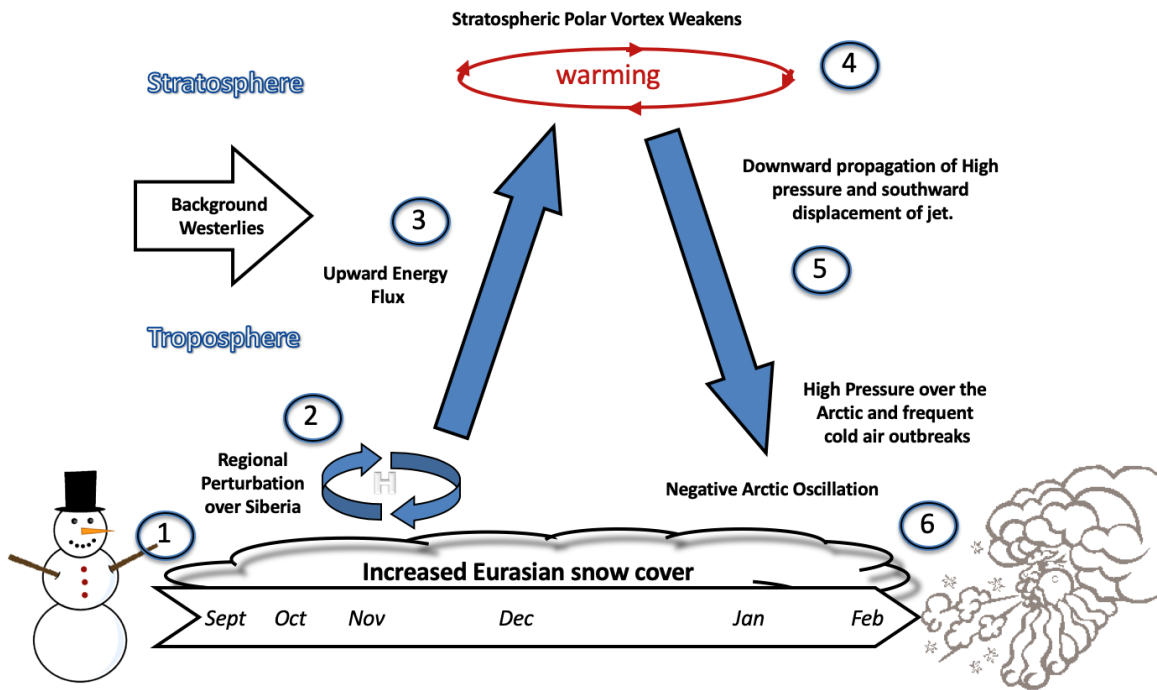


Figure iii. Conceptual model for how fall snow cover modifies winter circulation in both the stratosphere and the troposphere; case for extensive snow cover illustrated: 1. Snow cover increases rapidly in the fall across Siberia, when snow cover is above normal diabatic cooling helps 2. to strengthen the Siberian high and leads to below normal temperatures. 3. Snow forced diabatic cooling in proximity to high topography of Asia increases upward flux of energy in the troposphere, which is absorbed in the stratosphere. 4. Strong convergence of wave activity flux (WAF) indicates higher geopotential heights, a weakened polar vortex and warmer temperatures in the stratosphere. 5. Anomalous geopotential heights and winds appear to propagate down from the stratosphere into the troposphere all the way to the surface. 6. Dynamic pathway culminates with strong negative phase of the Arctic Oscillation at the surface. The third step is the initiation of positive anomalous Wave Activity Flux in the vertical direction (or z coordinate; WAFz). WAFz is the vertical transfer of energy from waves in the atmosphere and is directly proportional to the poleward transport or advection of heat. Only the largest waves also called Rossby waves (wave numbers 1-2) across the Northern Hemisphere (NH) produce energy strong enough to escape the troposphere into the stratosphere. When the vertical energy is absorbed in the polar stratosphere it leads to warming of the polar stratosphere or a weakening of the stratospheric PV. If it is of sufficient amplitude it will result in the fourth step of the model or in a sudden stratospheric warming (SSW).

I am hesitant to bring analogs before 2000 but the extreme cold in Texas did remind me of another winter that brought historic Arctic outbreaks including cold to Texas - January 1977. It does appear that the downward influence from the stratospheric PV to the surface came to an abrupt end at the end of January 1977 (see **Figure iv**) as well. In **Figure v**, I then show the NH temperature anomalies for January, February and March 1977. Relative to normal, January 1977 was the coldest month for both Eurasia and the US when stratosphere-troposphere coupling was active. But the relative cold did persist in both the Eastern US and northern Eurasia in February post the stratosphere-troposphere coupling. By March the cold weather in the Eastern US was over but persisted for northern Eurasia.

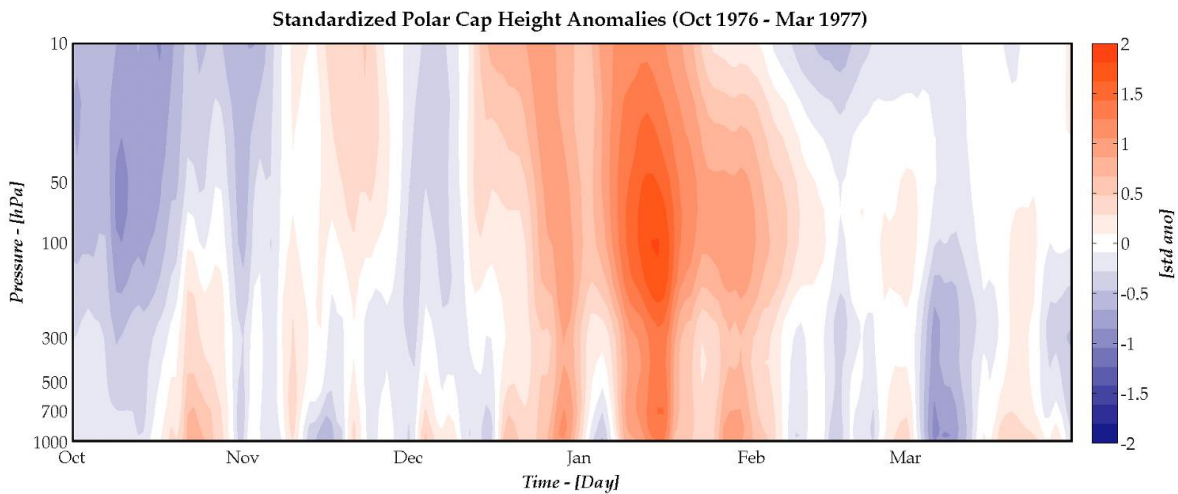


Figure iv. Observed daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies from October 1, 1976 through March 31, 1977.

I would consider the stratosphere-troposphere coupling ended for now and possibly for the remainder of the winter, at least the coupling that favors widespread cold temperatures. This week there does seem to be at least brief coupling of cold/negative PCHs that favors a relatively mild pattern (see **Figure 11**). This limits my ability to share expectations for the NH weather in the coming weeks. Still, I as I expressed last week, I do believe that persistence can be an important factor late February into March. This is especially true with plenty of cold air still available and an extensive snow cover. Also, incredibly enough the cold air in Canada isn't depleted even after the massive dump of Arctic air across the border, as seemed to happen in February 1977. Therefore, I do believe there is a good chance that cold temperatures persist in the Eastern US in March.

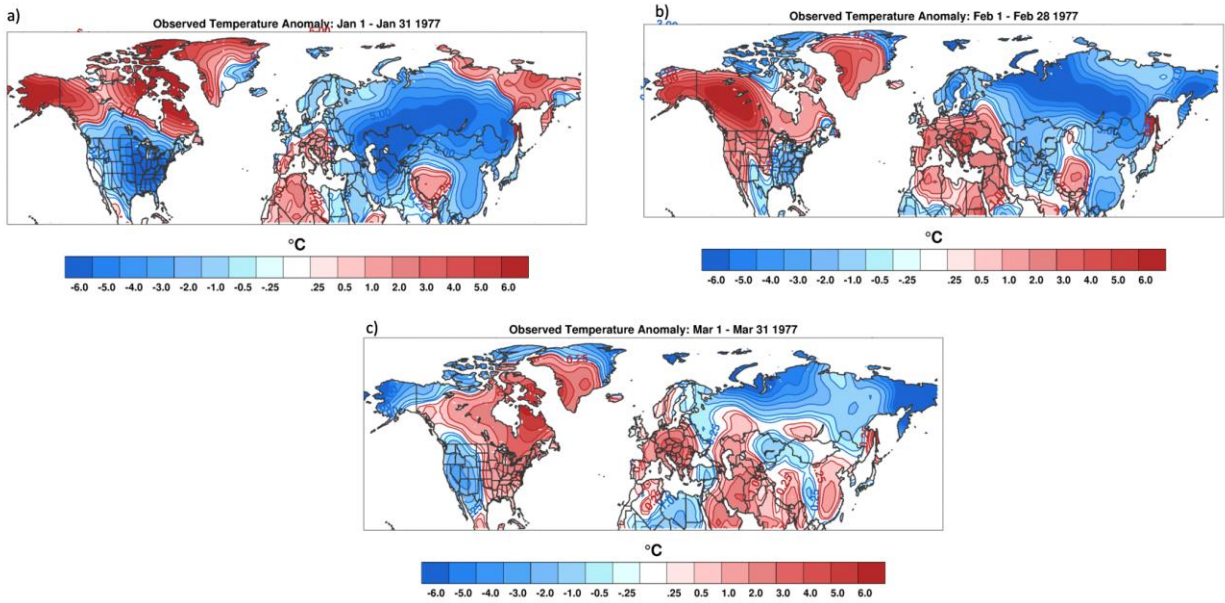


Figure iv. (a) Observed NH surface temperatures for (a) January, (b) February and (c) March 1977.

As far as Eurasia – given how this winter has gone from start till finish, I see no reason to expect the cold air across Northern Asia to disappear any time soon. Europe is turning milder with the absence of Greenland blocking. But with cold air still in Northern Asia, the risk remains for cold temperatures to return for both Northern Europe and the Eastern US, if Greenland blocking returns as well.

1-5 day

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

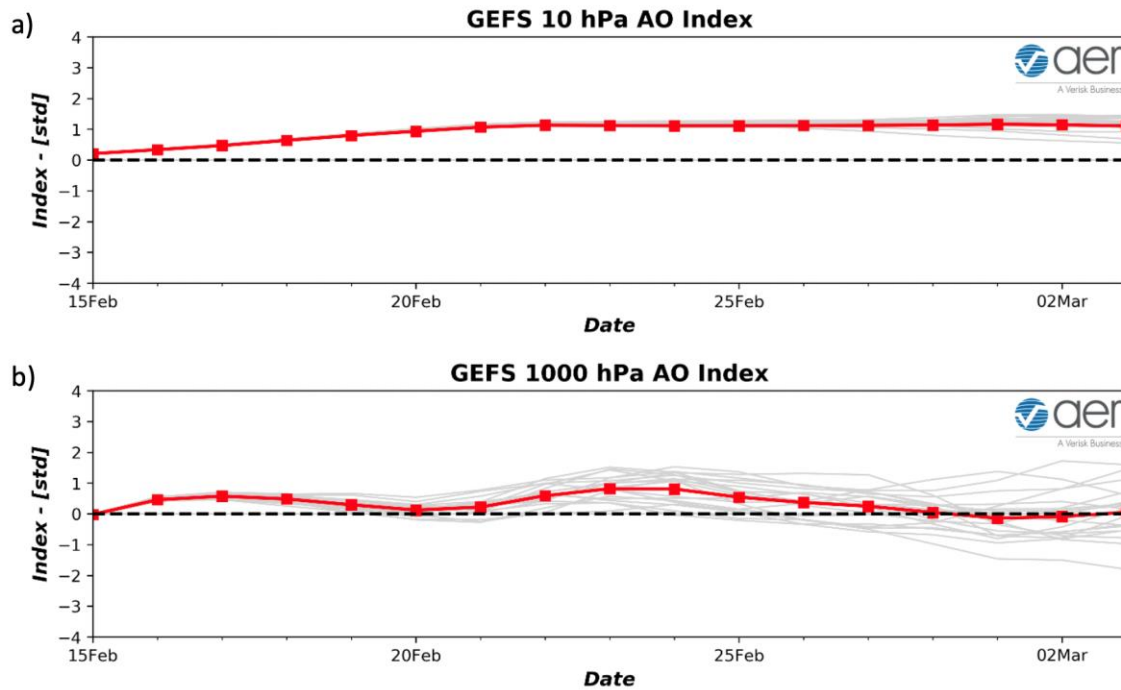


Figure 1. (a) The predicted daily-mean AO at 10 hPa from the 00Z 15 February 2021 GFS ensemble. (b) The predicted daily-mean near-surface AO from the 00Z 15 February 2021 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble-mean AO index given by the red line with squares.

This week, ridging/positive geopotential height anomalies is predicted across Western Europe forcing downstream troughing/negative geopotential height anomalies across Eastern Europe (**Figure 2**). This pattern favors normal to above normal temperatures across Western Europe including much of the UK while a cold northerly flow will favor normal to below normal temperatures across Eastern Europe (**Figure 3**). This week, ridging/positive geopotential height anomalies over Western Europe and centered over the Laptev Sea will help to anchor troughing/negative geopotential height anomalies across Northern and Western Asia with ridging/positive geopotential height anomalies across Southern and Central Asia (**Figure 2**). This pattern favors normal to below normal temperatures for Northern and Western Asia with normal to above normal temperatures for Central, Eastern and Southern Asia (**Figure 3**).

GEFS 1-5 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 02/15/2021 FCST: 02/16/2021 to 02/20/2021

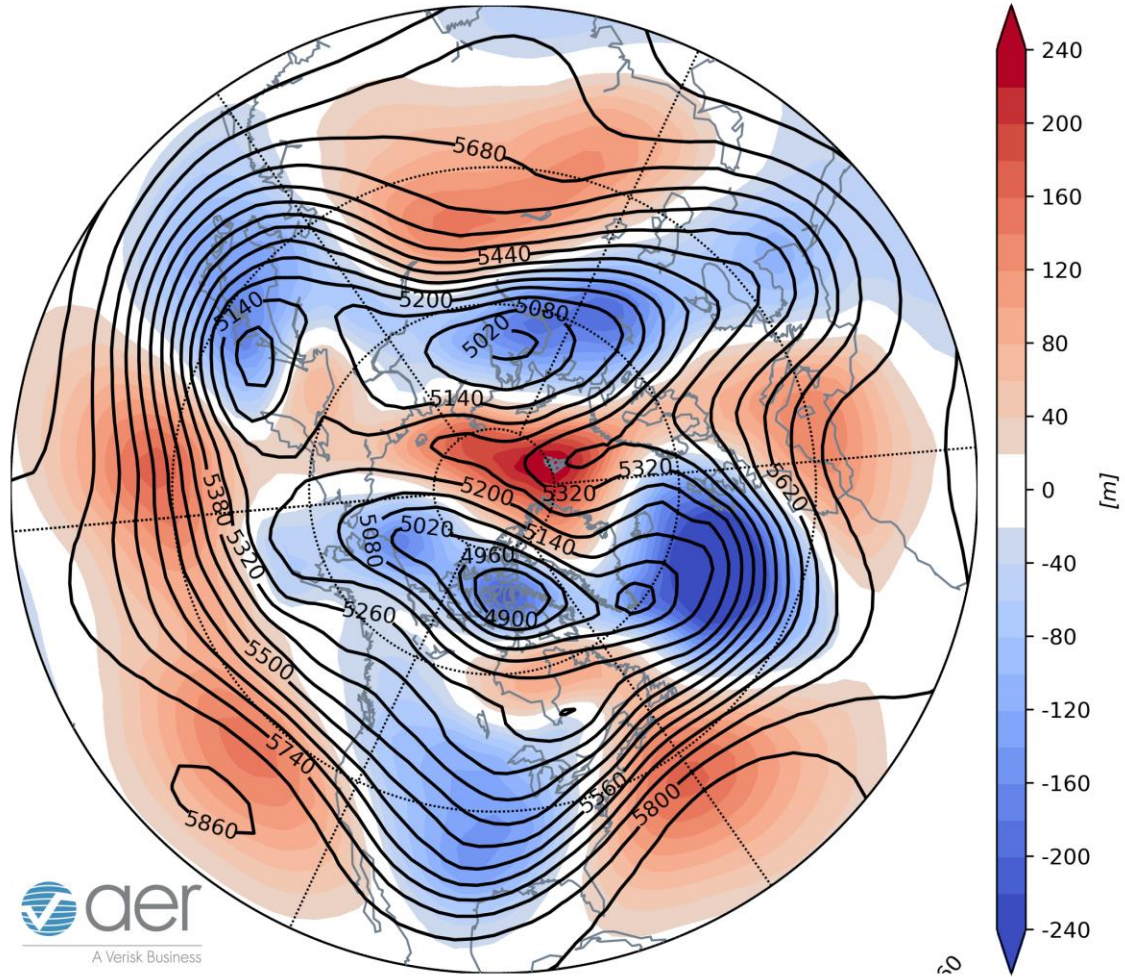


Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 16 – 20 February 2021. The forecasts are from the 00z 15 February 2021 GFS ensemble.

This week ridging/positive geopotential height anomalies across the Eurasian Arctic, the Gulf of Alaska and along the US East Coast will favor broad troughing/negative geopotential height anomalies across much of North America. Also, the stratospheric PV centered over the Canadian Archipelagos will favor a mid-tropospheric reflection in the same region (**Figure 2**). This pattern is predicted to bring widespread normal to below normal temperatures across Alaska, Canada and the US with normal to above normal temperatures limited to regionally to Northeastern Canada and Florida (**Figure 3**).

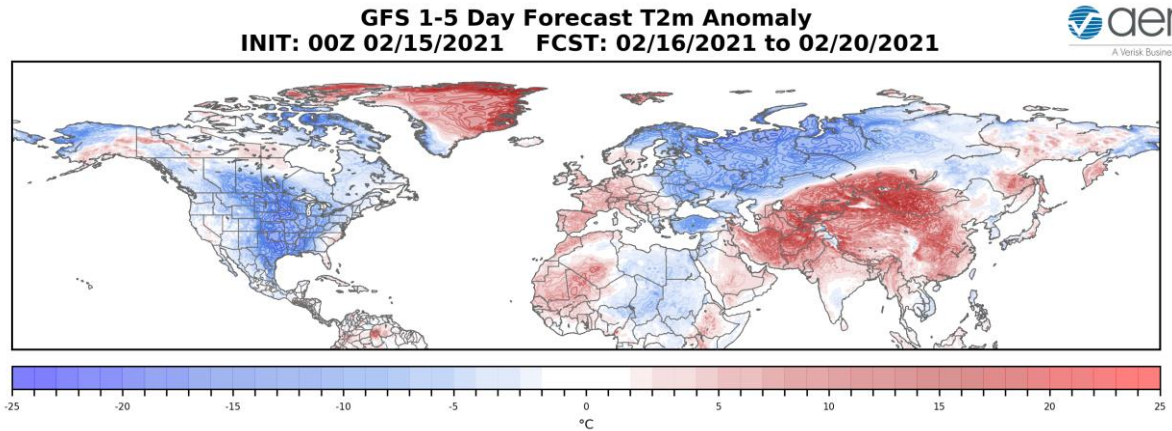


Figure 3. Forecasted surface temperature anomalies (°C; shading) from 16 – 20 February 2021. The forecast is from the 00Z 15 February 2021 GFS ensemble.

Trounging and/or colder temperatures are predicted to support new snowfall across Central Asia, the Levant and Anatolia and East Asia while warmer temperatures will cause snow melt in Southwestern and Northeastern Asia (**Figure 4**). Trounging and/or colder temperatures are predicted to support new snowfall across Alaska, the Ohio Valley, the Northeastern US and Quebec while warmer temperatures will cause snow melt in parts of the Plains, the western Gulf of Mexico, Western Canada and the Canadian Maritimes (**Figure 4**).

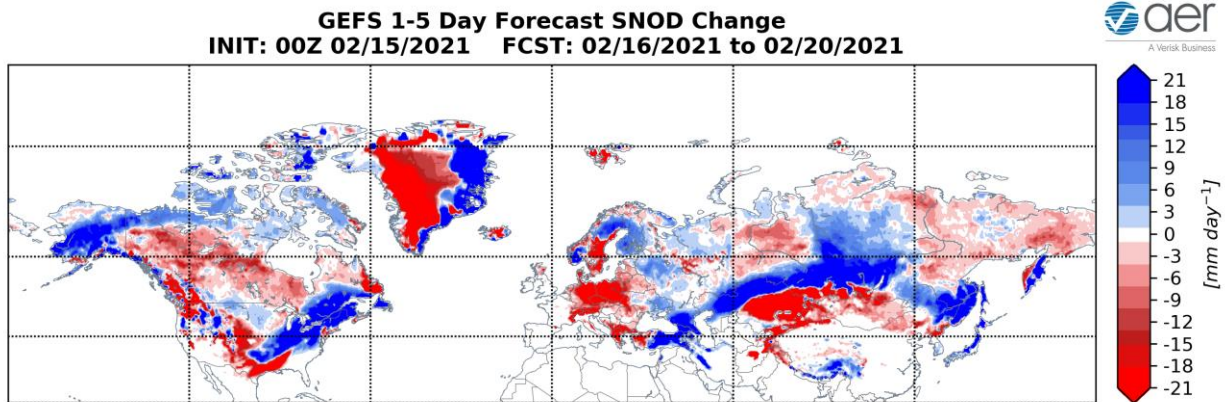


Figure 4. Forecasted snow depth changes (mm/day; shading) from 16 – 20 February 2021. The forecast is from the 00Z 15 February 2021 GFS ensemble.

Mid-Term

6-10 day

The AO is predicted to remain neutral to positive next week (**Figure 1**) as positive geopotential height anomalies persist across the Eurasian side of the Arctic with negative geopotential height anomalies persist across the North American side of the Arctic with mixed geopotential height anomalies across the mid-latitudes of the NH (**Figure 5**). And with mixed geopotential height anomalies predicted across Greenland (**Figure 5**), the NAO is predicted to also remain neutral to positive.

GEFS 6-10 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 02/15/2021 FCST: 02/21/2021 to 02/25/2021

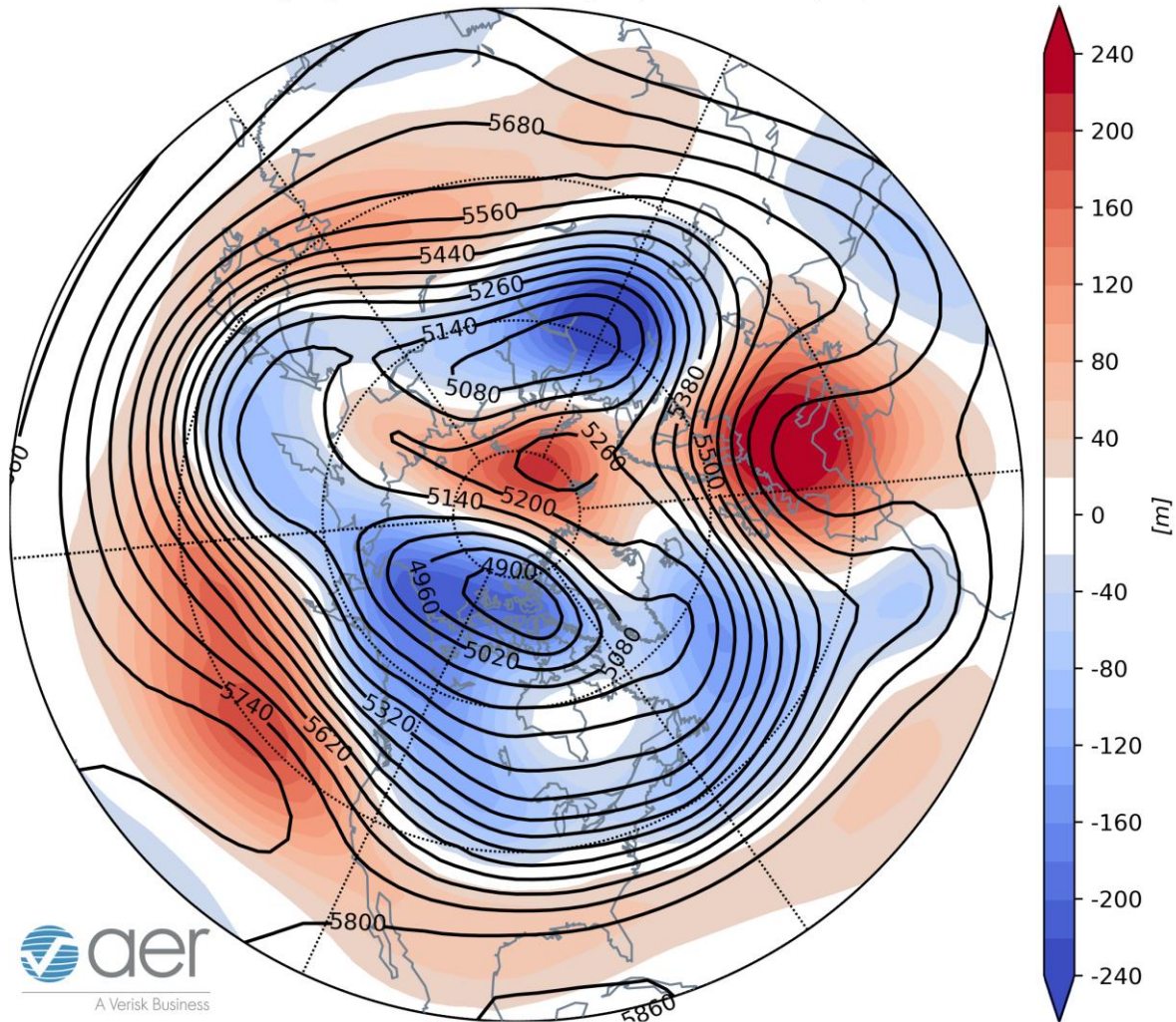


Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 21 – 25 February 2021. The forecasts are from the 00z 15 February 2021 GFS ensemble.

Persistent ridging/positive geopotential height anomalies previously centered across Western and Central Europe will favor troughing/negative geopotential height anomalies across Western Asia this period (**Figures 5**). **This will favor** normal to above

normal temperatures to become more widespread across Western and Central Europe including the UK **with normal to below normal temperatures limited to Eastern Europe (Figure 6)**. Persistent ridging/positive geopotential height anomalies in Europe and in the Laptev Sea will anchor troughing/negative geopotential height anomalies across northern and Western Asia with ridging/positive geopotential height anomalies across Southern and Eastern Asia this period (**Figure 5**). This is predicted to favor widespread normal to below normal temperatures across much of Northern and Western Asia with normal to above normal temperatures in Southern and Eastern Asia (**Figure 6**).

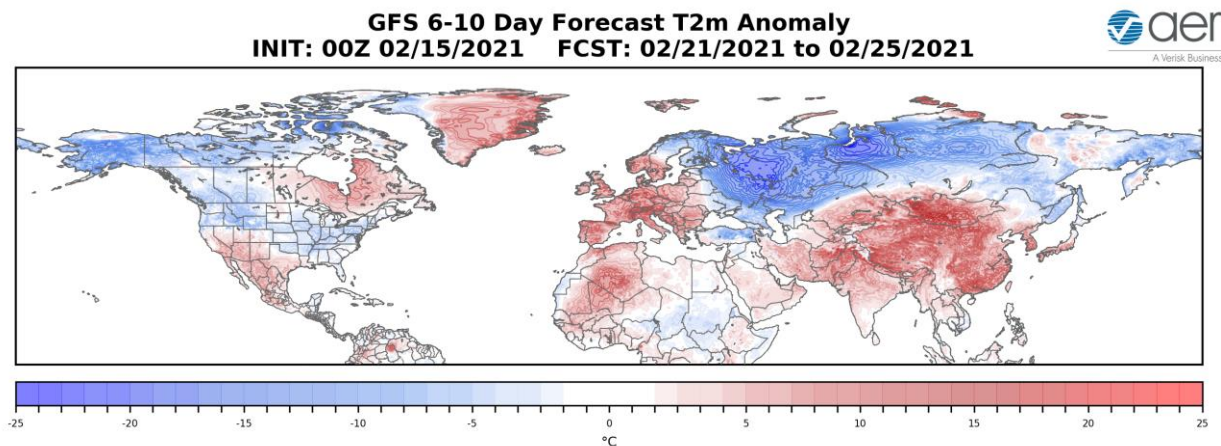


Figure 6. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 21 – 25 February 2021. The forecasts are from the 00Z 15 February 2021 GFS ensemble.

I would argue that the stratospheric PV centered over the Canadian Archipelagos will favor a mid-tropospheric reflection in the same region while ridging/positive geopotential height anomalies in the Gulf of Alaska will help persist broad troughing/negative geopotential height across much of Canada and the Northern US this period (**Figure 5**). This pattern is predicted to bring widespread normal to below normal temperatures across Alaska, much of Canada and the Northern US with normal to above normal temperatures limited to the Northeastern Canada and the Southwestern US (**Figure 6**).

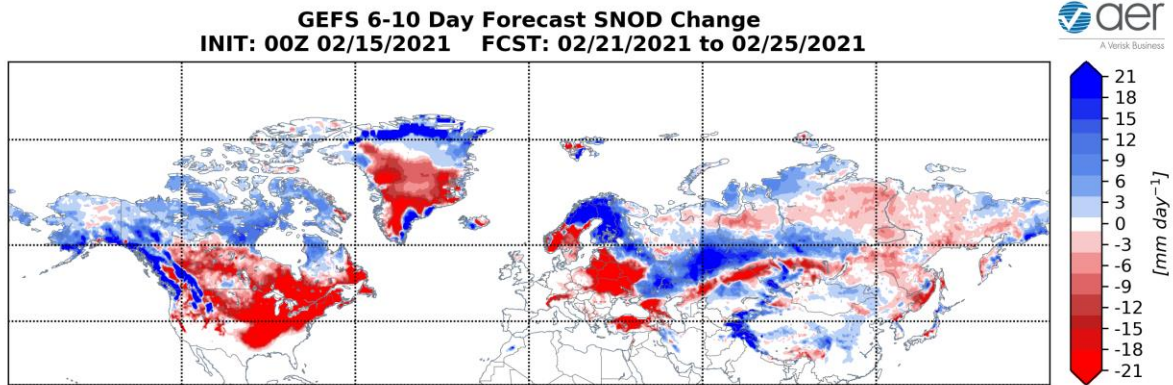


Figure 7. Forecasted snow depth changes (mm/day; shading) from 21 – 25 February 2021. The forecasts are from the 00Z 15 February 2021 GFS ensemble.

Trouging and/or colder temperatures are predicted to potentially support new snowfall across Lapland, the Himalayas, Western and Central Asia while warmer temperatures will cause regionalized snow melt in Central Europe and East Asia (**Figure 7**). Trouging and/or colder temperatures are predicted to support the potential for new snowfall across Alaska, Western and Northern Canada while warmer temperatures will cause possible snow melt in the Northeastern US and Southeastern Canada (**Figure 7**). The predicted melting is likely overdone.

11-15 day

As geopotential height anomalies are predicted to remain positive on the Eurasian and North Atlantic side of the Arctic and negative geopotential height anomalies across the North American side of the Arctic with mixed geopotential height anomalies across the mid-latitudes of the NH (**Figure 8**), the AO should remain neutral this period (**Figure 1**). With continued weak pressure/geopotential height anomalies spread across Greenland (**Figure 8**), the NAO is predicted to remain near neutral this period as well.

GEFS 11-15 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 02/15/2021 FCST: 02/26/2021 to 03/02/2021

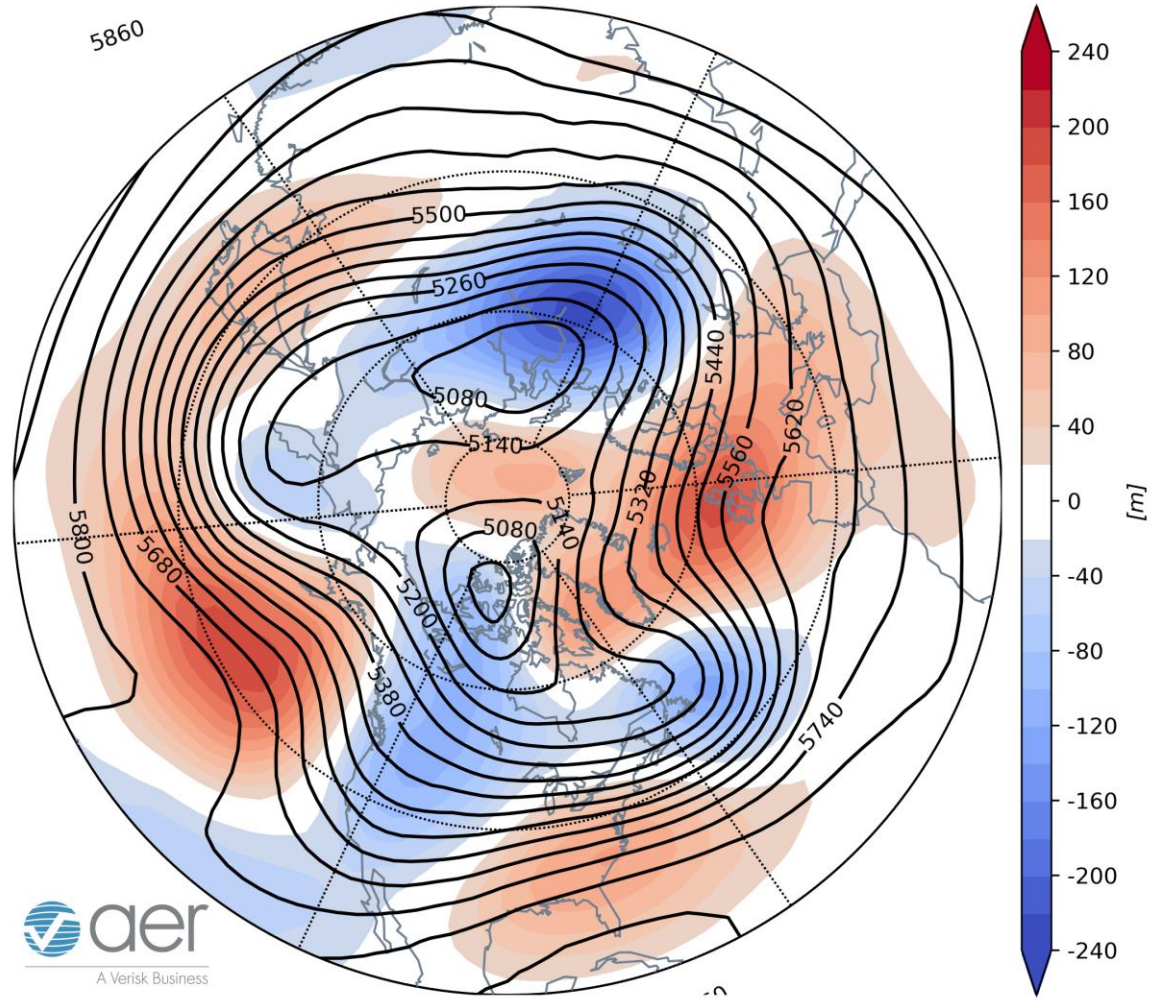


Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 26 February – 2 March 2021. The forecasts are from the 00z 15 February 2021 GFS ensemble.

Persistent ridging/positive geopotential height anomalies across Western Europe will anchor troughing/negative geopotential height anomalies across Western Asia with northerly flow across Eastern Europe this period (**Figures 8**). The forecast remains for widespread normal to above normal temperatures across Western and Central Europe, while northerly flow will persist normal to below normal temperatures across Eastern Europe this period (**Figures 9**). Ridging/positive geopotential height anomalies across Europe and over the Laptev Sea will help persist troughing/negative geopotential height anomalies across Northern and Western Asia with ridging/positive geopotential height anomalies across Southern and Eastern Asia this period (**Figure 8**). This pattern favors

normal to below normal temperatures across Northern and Western Asia with normal to above normal temperatures across Southern and Eastern Asia (**Figure 9**).

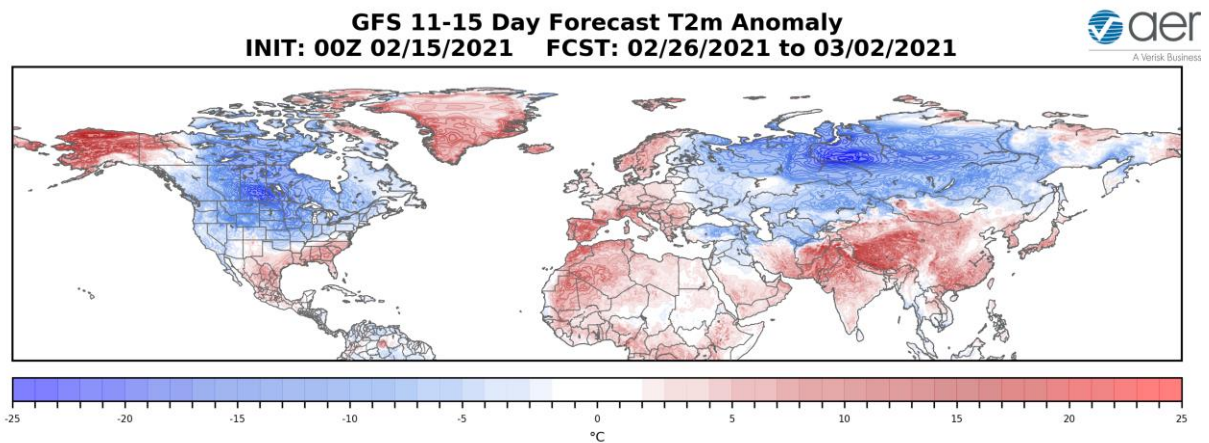


Figure 9. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 26 February – 2 March 2021. The forecasts are from the 00z 15 February 2021 GFS ensemble.

I continue to argue that the stratospheric PV centered over the Canadian Archipelagos will favor a mid-tropospheric reflection in the same region while ridging/positive geopotential height anomalies in the Gulf of Alaska will help persist broad troughing/negative geopotential height across much of Canada and the Western US with more ridging/positive geopotential height anomalies in the Southeastern US this period (**Figure 8**). This pattern favors widespread normal to below normal temperatures for much of Canada and the Northern US with normal to above normal temperatures mostly limited to Alaska and the Southeastern US (**Figure 9**).

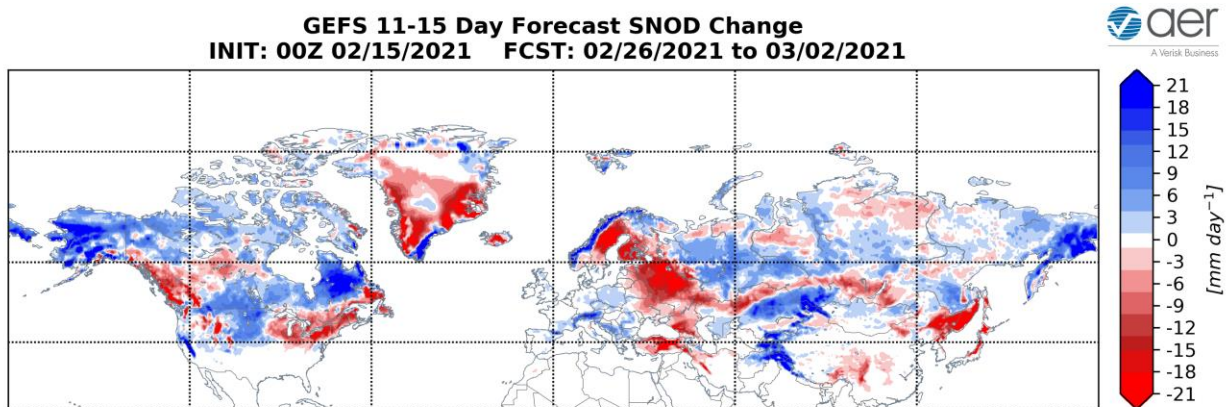


Figure 10. Forecasted snow depth changes (mm/day ; shading) from 26 February – 2 March 2021. The forecasts are from the 00z 15 February 2021 GFS ensemble.

Trouching and/or colder temperatures are predicted to support new snowfall across Southern Europe, Northern and Central Asia while warmer temperatures will cause snowmelt in Eastern Europe and East Asia (**Figure 10**). Trouching and/or colder temperatures are predicted to support new snowfall across Alaska and much of Central and Eastern Canada while warmer temperatures will result in snowmelt in Western Canada and the Northeastern US (**Figure 10**).

Longer Term

30-day

The latest plot of the polar cap geopotential height anomalies (PCHs) currently shows warm/positive PCHs throughout the troposphere and mid- to lower-stratosphere (**Figure 11**). In the upper stratosphere, PCHs are currently cold/negative and are predicted to intensify and descend quickly through the stratosphere and troposphere this week all the way to the surface (**Figure 11**) as the PV recovers from the long and/or multiple PV disruptions. Warm/positive PCHs are predicted to return to the lower troposphere at the end of the month.

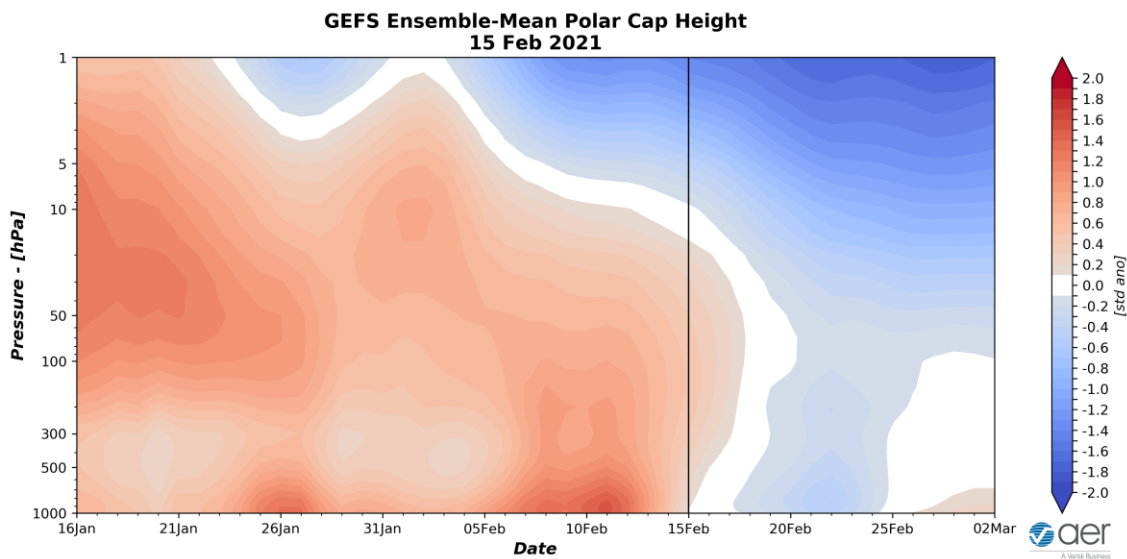


Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecast is from the 00Z 15 February 2021 GFS ensemble.

The overall weak and transitory PCHs in the lower troposphere are consistent with the predicted near neutral surface AO the next two weeks (**Figure 1**). However, as the PCHs turn cold/negative next week the surface AO could turn positive at least temporarily. Increasingly cold/negative PCHs in the mid-stratosphere are consistent

with the increasingly positive stratospheric AO (at 10 hPa) the next two weeks (**Figure 1**).

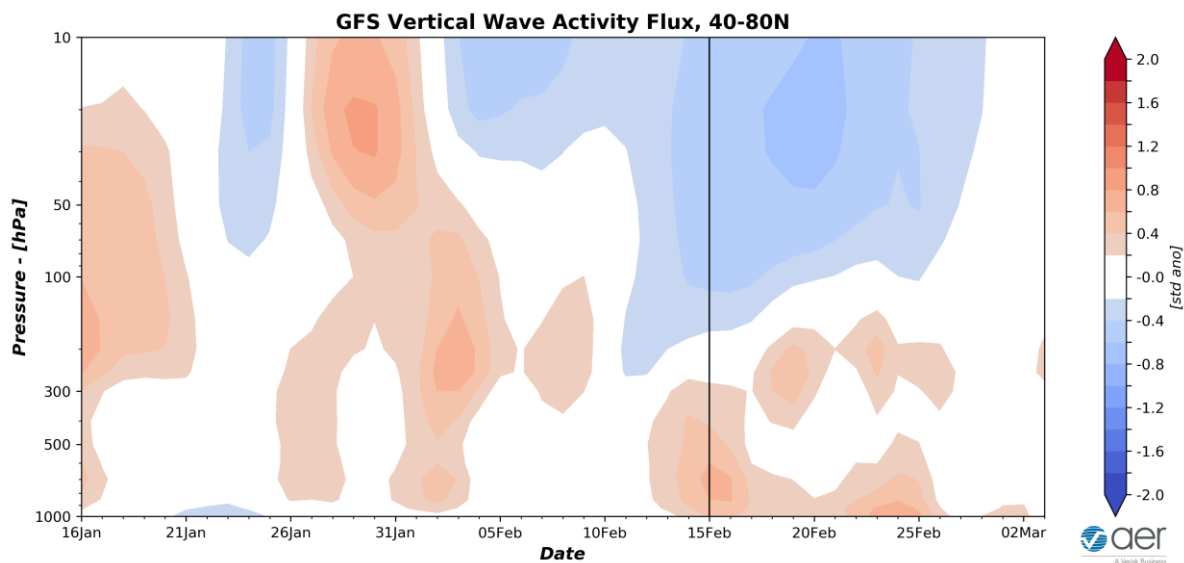


Figure 12. Observed and predicted daily vertical component of the wave activity flux (WAFz) standardized anomalies, averaged poleward of 40-80°N. The forecast is from the 00Z 15 February 2021 GFS ensemble.

The plot of the Wave Activity Flux (WAFz and is proportional to poleward heat transport) forecast is showing currently below normal WAFz in the stratosphere but more active WAFz in the troposphere (**Figure 12**). Still overall, the WAFz is predicted to be quiet, consistent with expectations following major mid-winter warmings (MMWs where the zonal winds reverse from westerly to easterly at 60°N and 10 hPa) allowing the stratospheric PV to recover.

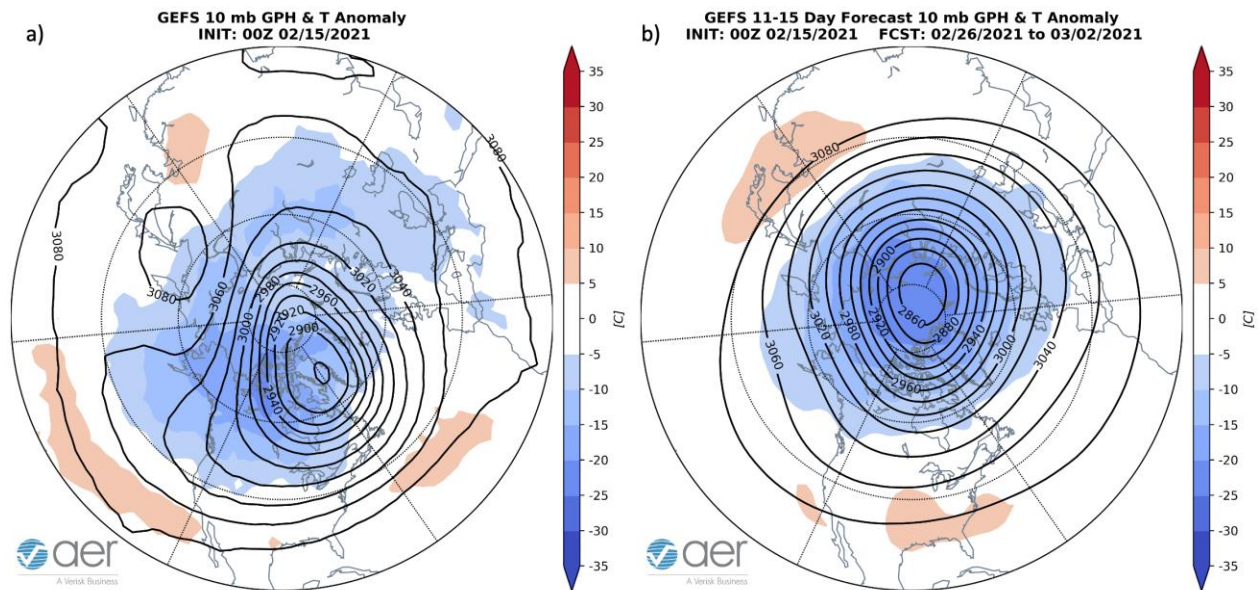


Figure 13. (a) Observed 10 mb geopotential heights (dam; contours) and temperature anomalies ($^{\circ}\text{C}$; shading) across the Northern Hemisphere for 15 February 2021. (b) Same as (a) except forecasted averaged from 26 February – 2 March 2021. The forecasts are from the 00Z 15 February 2021 GFS model ensemble.

The PV continues to strengthen with the vortex centered near Greenland (**Figure 13**). High pressure centered over Eastern Siberia is preventing the PV center from returning to the North Pole, at least this week (**Figure 13**). The PV center is predicted to migrate over towards the North Pole at the end of the month (**Figure 13**). I believe that the PV center over North America and the oblong shape of the PV inducing cross polar flow from Siberia to Canada continues to support cold temperatures in North America (**Figure 13**).

**CFS 500 hPa Forecast Anomaly Mar 2021
Valid as of 15 Feb 2021**

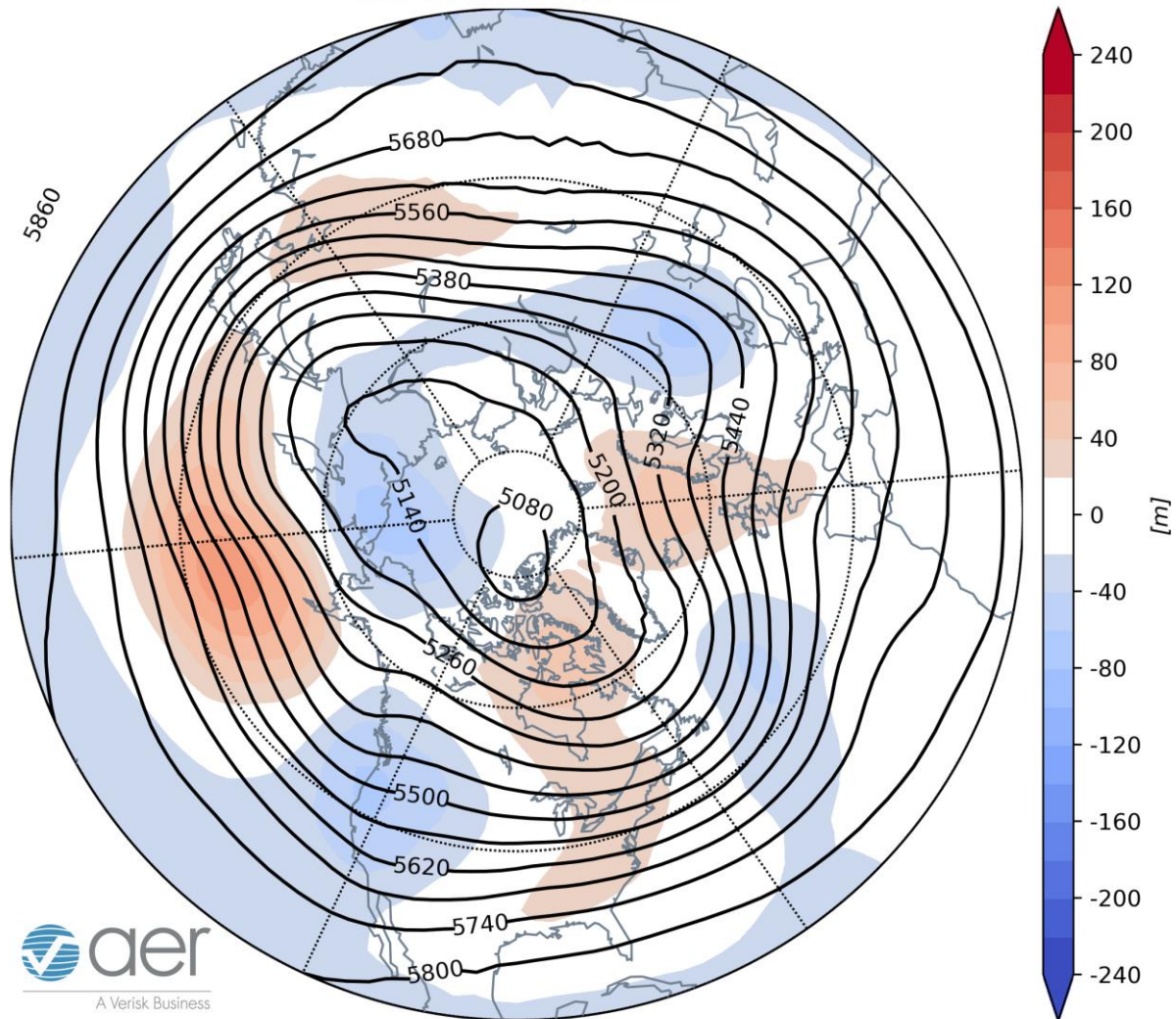


Figure 14. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for March 2021. The forecasts are from the 00Z 15 February 2021 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 14**) and the surface temperatures (**Figure 15**) forecast for March from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging across Baffin Bay, Western Europe, and near the Dateline with troughing in Western Asia, East Asia and western North America (**Figure 14**). This pattern favors relatively cold temperatures for Northern and Eastern Europe, Northern, Western and Eastern Asia, Southeastern Canada and the Eastern US with seasonable to relatively warm temperatures for Western Europe, Central Asia, Alaska, Western and Northern Canada and the Western US (**Figure 15**). The temperature forecast seems inconsistent with the predicted tropospheric circulation.

**CFS T2m Forecast Anomaly Mar 2021
Valid as of 15 Feb 2021**

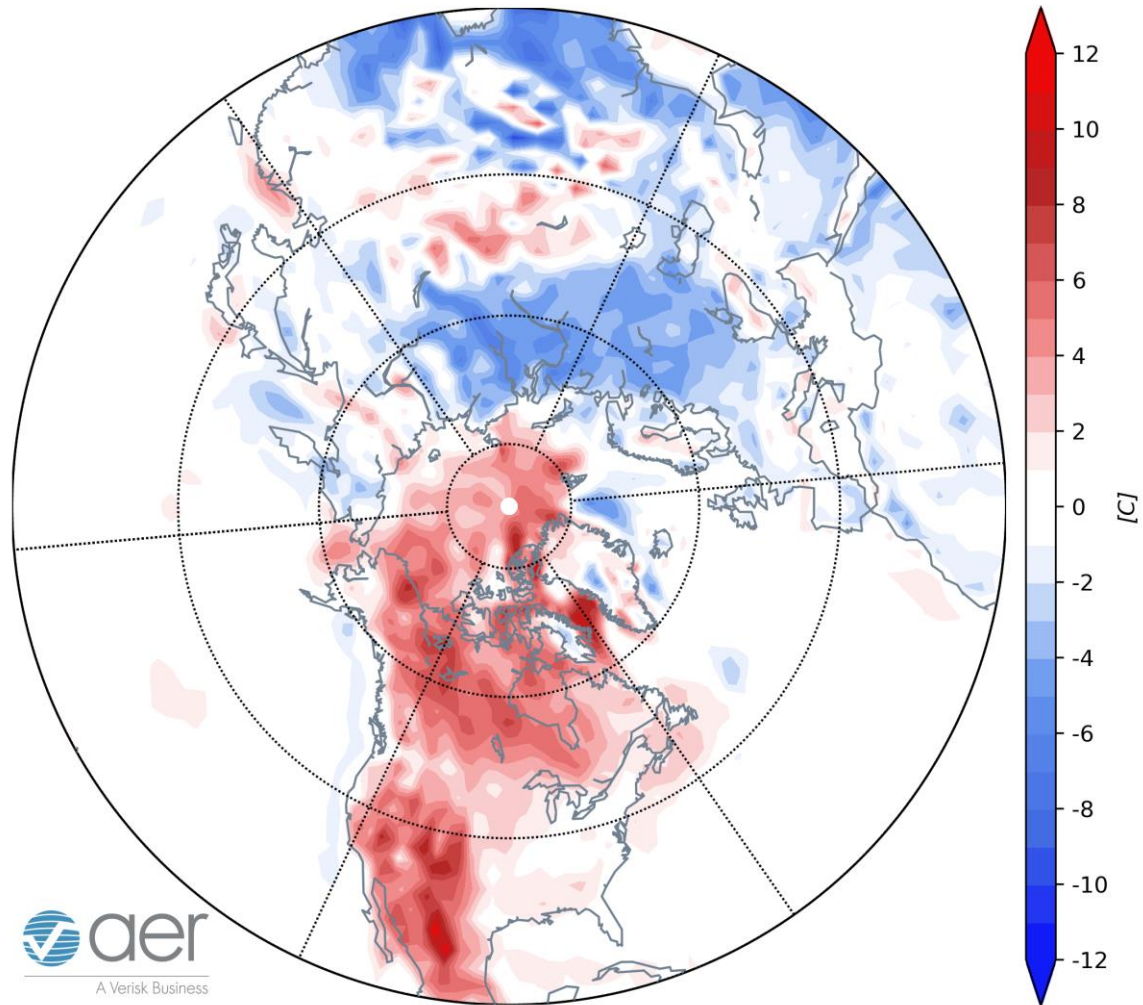


Figure 15. Forecasted average surface temperature anomalies (°C; shading) across the Northern Hemisphere for March 2021. The forecasts are from the 00Z 15 February 2021 CFS.

Surface Boundary Conditions

Arctic sea ice extent

Arctic sea ice continues to grow but currently remains below normal but more extensive than recent winters. Negative sea ice anomalies exist mostly in Baffin Bay (**Figure 16**). A cold winter in Siberia has resulted in above normal sea ice in the Sea of Okhotsk. Below normal sea ice in the Barents-Kara seas favor Ural blocking and cold temperatures in Central and East Asia, however this topic remains controversial. Recent research has shown that the regional anomalies that are most highly correlated with the

strength of the stratospheric PV are across the Barents-Kara seas region where low Arctic sea ice favors a weaker winter PV. Low sea ice in the Chukchi and Bering seas may favor colder temperatures across North America but have not been shown to weaken the PV. Sea ice should continue to grow in this region based on the forecast.

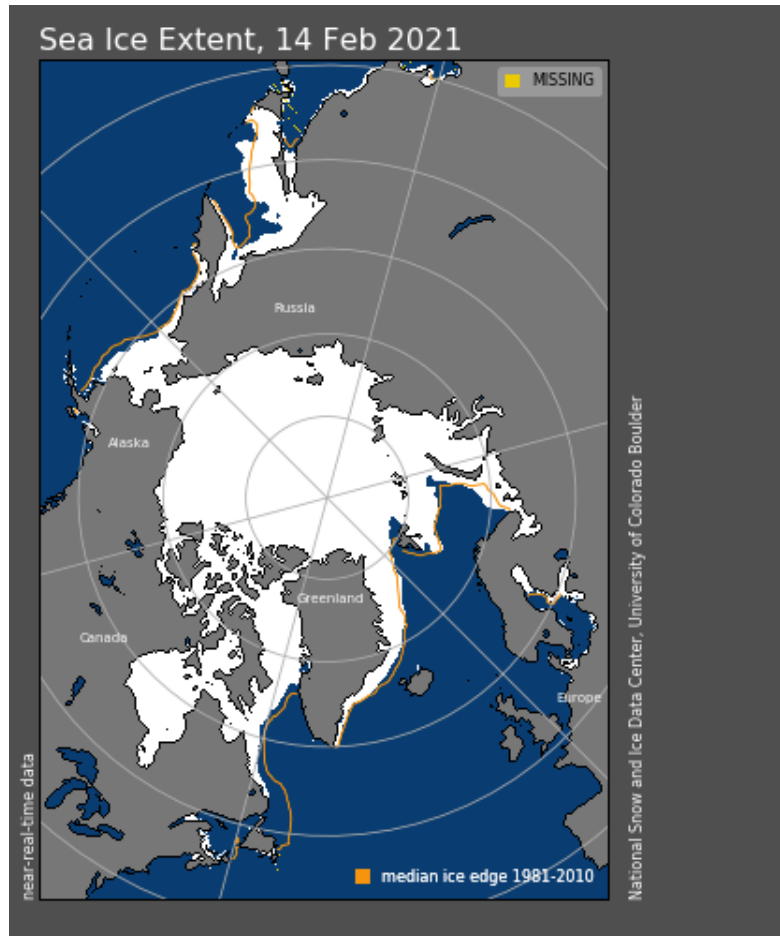


Figure 16. Observed Arctic sea ice extent on 14 February 2021 (white). Orange line shows climatological extent of sea ice based on the years 1981-2010. Image courtesy of National Snow and Ice Data Center (NSIDC).

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies remain negative and we continue to observe a weak La Niña conditions (**Figure 17**) and La Niña is expected to persist and remain weak through the winter. Observed SSTs across the NH remain well above normal especially near Alaska and in the Gulf of Alaska, the western North Pacific and offshore of eastern North America though below normal SSTs exist regionally especially in the Southern Hemisphere and south of Iceland. Warm SSTs in the Gulf of Alaska may favor mid-tropospheric ridging in the region.

SST Anomaly - Week Ending 14 Feb 2021

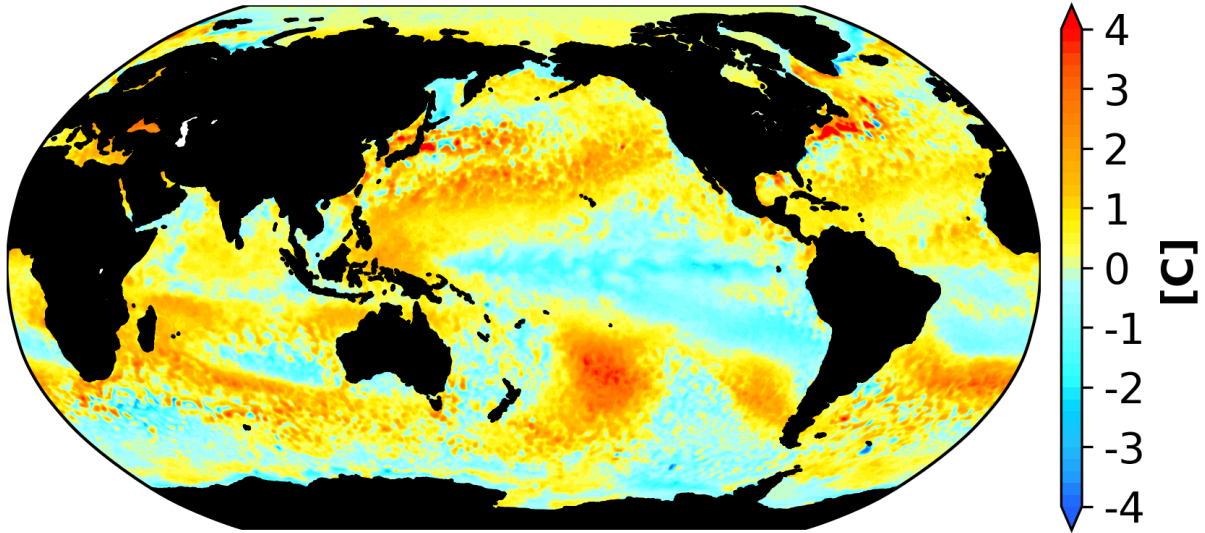


Figure 17. The latest weekly-mean global SST anomalies (ending 14 February 2021).
Data from NOAA OI High-Resolution dataset.

Currently the Madden Julian Oscillation (MJO) is in phase seven (**Figure 18**). The forecasts are for the MJO to remain in phase seven and then weaken. Phase seven favors ridging in eastern North America but eventually favors blocking across Northern Canada and troughing in the Eastern US. The MJO could eventually contribute to a colder pattern across eastern North America but admittedly this is outside of my expertise.

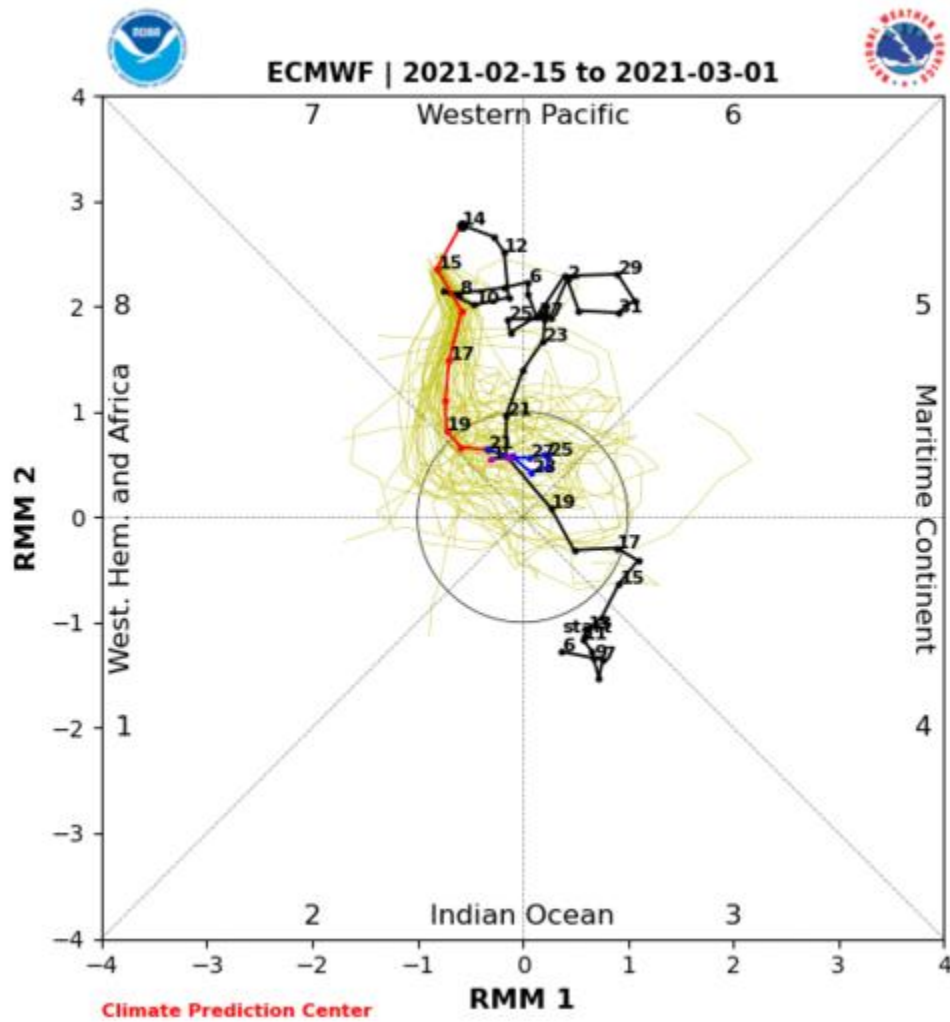


Figure 18. Past and forecast values of the MJO index. Forecast values from the 00Z 8 February 2021 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model “spread” is denoted by the gray shading. Sector numbers indicate the phase of the MJO, with geographical labels indicating where anomalous convection occurs during that phase. Image

source: <http://www.atmos.albany.edu/facstaff/roundy/waves/phasediags.html>

Northern Hemisphere Snow Cover

Snow cover extent advanced over the past week across Eurasia with advances in Europe but remains near decadal lows. Snow cover advance will likely begin its seasonal decline soon. Above normal snow cover extent in October, favors a strengthened Siberian high, cold temperatures across northern Eurasia and a weakened

polar vortex/negative AO this upcoming winter followed by cold temperatures across the continents of the NH.

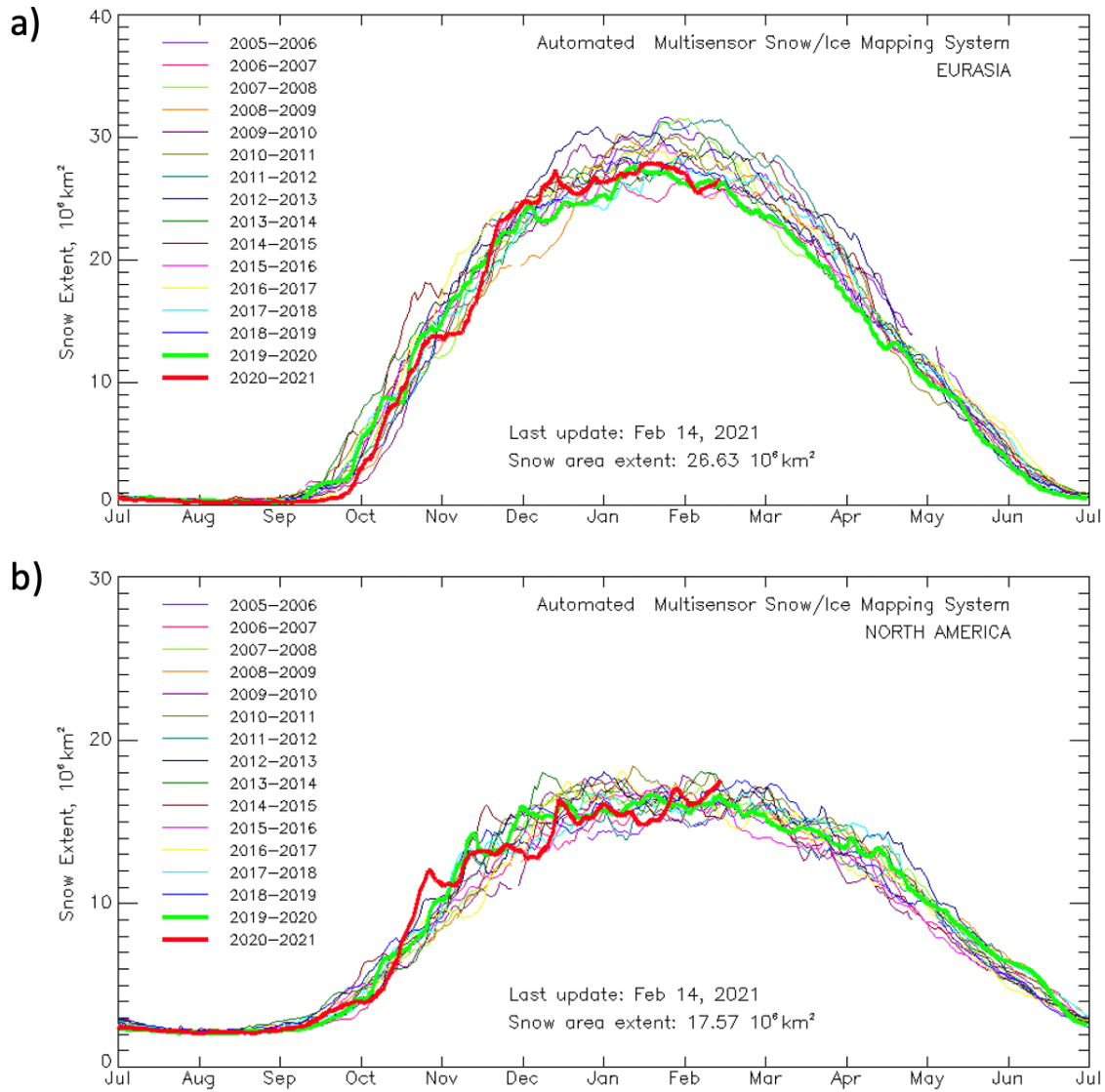


Figure 19. Observed Eurasian (top) and North American (bottom) snow cover extent through 7 February 2021. Image source:

https://www.star.nesdis.noaa.gov/smcd/emb/snow/HTML/snow_extent_plots.html

North American snow cover advanced strongly over the past week and is near decadal highs. Snow cover is probably near its high-water mark and will likely begin its seasonal decline soon. The advance of snow cover will help amplify colder temperatures across North America.