

October 28, 2019

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) recently 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.

With the start of spring we transitioned to a spring/summer schedule, which is once every two weeks. Snow accumulation forecasts will be replaced by precipitation forecasts. Also, there will be less emphasis on ice and snow boundary conditions and their influence on hemispheric weather.

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

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

Summary

- The Arctic Oscillation (AO) is currently negative and is predicted to remain mostly negative for the next two weeks.
- The current negative AO is reflective of mostly positive pressure/geopotential height anomalies across the Arctic and mixed pressure/geopotential height anomalies across the mid-latitudes. The North Atlantic Oscillation (NAO) is negative with positive pressure/geopotential height anomalies spread across Greenland and Iceland; and the NAO is predicted to briefly turn positive as geopotential height anomalies turn negative across Greenland. However longer term the NAO looks to turn negative once more as geopotential height anomalies reverse back to positive.

- European temperatures are predicted to be on a bit of a rollercoaster as the NAO vacillates between negative and positive the next couple of weeks. Early on temperature anomalies are predicted to be mostly negative across Europe including the United Kingdom (UK) then turn mostly positive before once again turning negative. The one region that could remain consistently cold throughout the period is Scandinavia.
- Currently temperatures are mostly above normal across Asia as ridging/positive geopotential height anomalies dominate the continent. However, over the next two weeks, troughing/negative geopotential height anomalies with below normal temperatures mostly confined to Northwest Russia will become more widespread across Northern Asia especially Siberia while temperatures remain mostly above normal across Southern Asia.
- Ridging/positive geopotential height anomalies anchored across Alaska and the Gulf of Alaska over the next two weeks will force downstream troughing/negative geopotential height anomalies with normal to below normal temperatures initially over western North America with more ridging/positive geopotential height anomalies with normal to above normal temperatures for eastern North America. However, over the next two weeks, the downstream troughing/negative geopotential height anomalies with normal to below normal temperatures will slide east into Eastern Canada and the Eastern United States (US).
- In the Impacts section I share more thoughts about the upcoming pattern and the Northern Hemisphere (NH) winter and the behavior of the polar vortex (PV).

Impacts

As we gear up for winter and what weather to expect, I did find one feature of the dynamical models very interesting. With a lack of much of a tropical signal, I feel that more forecasters are looking to the Arctic for signs of winter. Though the average or ensemble dynamical models tend to smooth out large anomalies or signals, one consistent signal that seems to have emerged is a fairly strong or robust positive AO/NAO signal. In **Figure ia**, I show the sea level pressure (SLP) anomaly forecast for November, December 2019 and January 2020 from the C3S ensemble of seasonal forecast models which include the ECMWF, UK Met Office and Meteo France global climate models. One feature that jumps out is low pressure across the entire Arctic region with high pressure across the subtropics and mid-latitudes of the North Atlantic basin. This is a classical positive AO and NAO SLP anomaly pattern. A positive AO/NAO is also strongly related to relatively mild temperatures across the NH but especially the Eastern US and northern Eurasia. The C3S surface temperature anomaly forecast is warm across the entire extratropical NH continents but especially eastern North America and northern Eurasia consistent with the positive AO/NAO forecast (**Figure ib**). Just as an aside, in contrast the models are predicting high pressure anomalies across all of Antarctica, likely related to the Southern Hemisphere sudden stratospheric warming observed in September. This forecast is looking good as the Antarctic

Oscillation (AAO) is currently strongly negative and predicted to remain so into the foreseeable future.

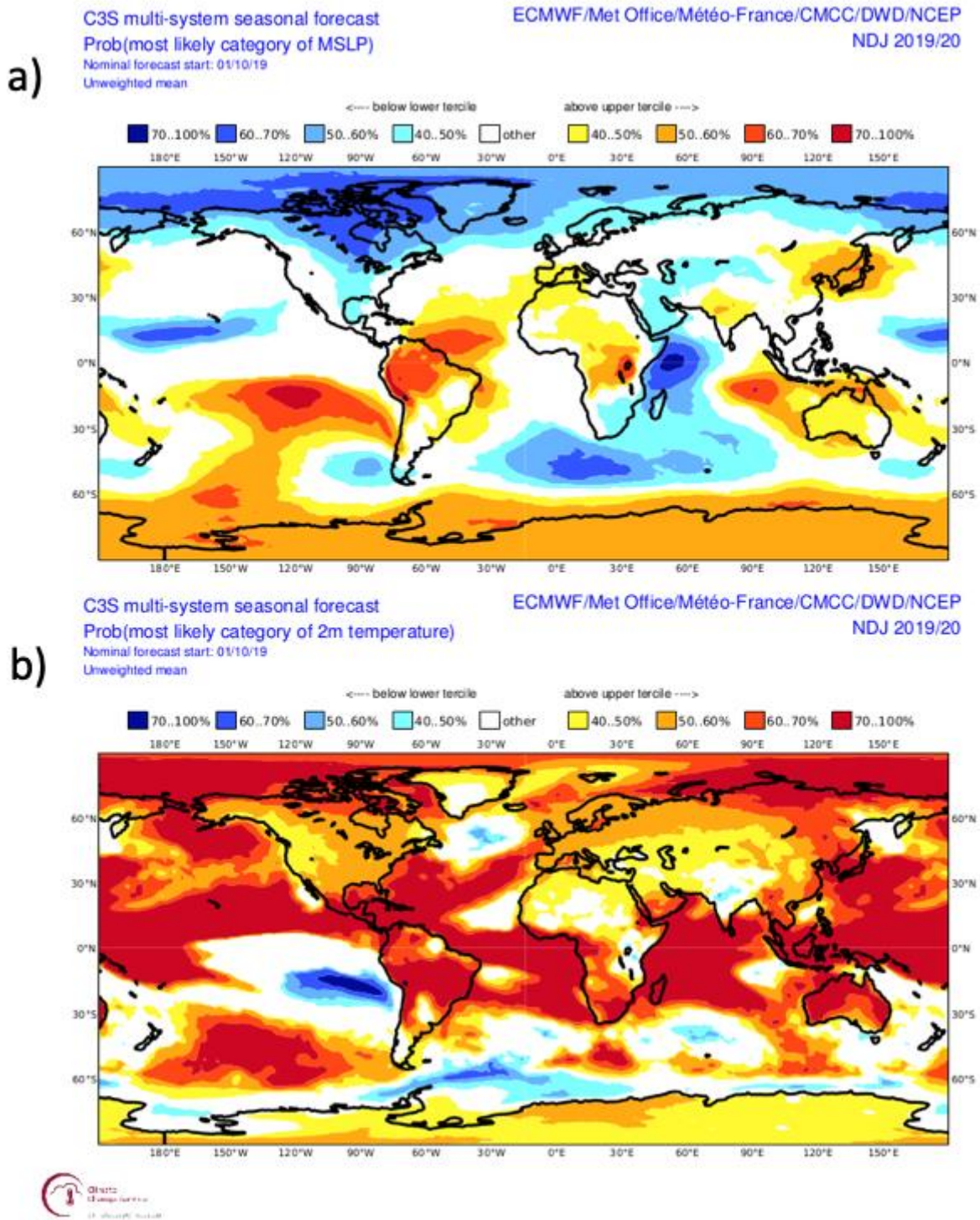


Figure i. a) predicted sea-level pressure and b) surface temperature anomalies November, December 2019 and January from 2020 from the C3S model ensemble. Plots provided by https://climate.copernicus.eu/charts/c3s_seasonal/

Now if you are a regular reader of the blog and/or my research then you are already familiar with my arguments that Arctic amplification which not only includes amplified Arctic warming but low sea ice extent and high snow cover extent in the fall is favorable for high pressure in the Arctic and downstream troughing and cold temperatures at least regionally across the NH continents.

JRA-55 Global Temperature Anomaly [°C]
October 2019 month-to-date --> 18Z26OCT2019

ANALYSIS T: 15.18°C
ANOMALY T: 0.57°C

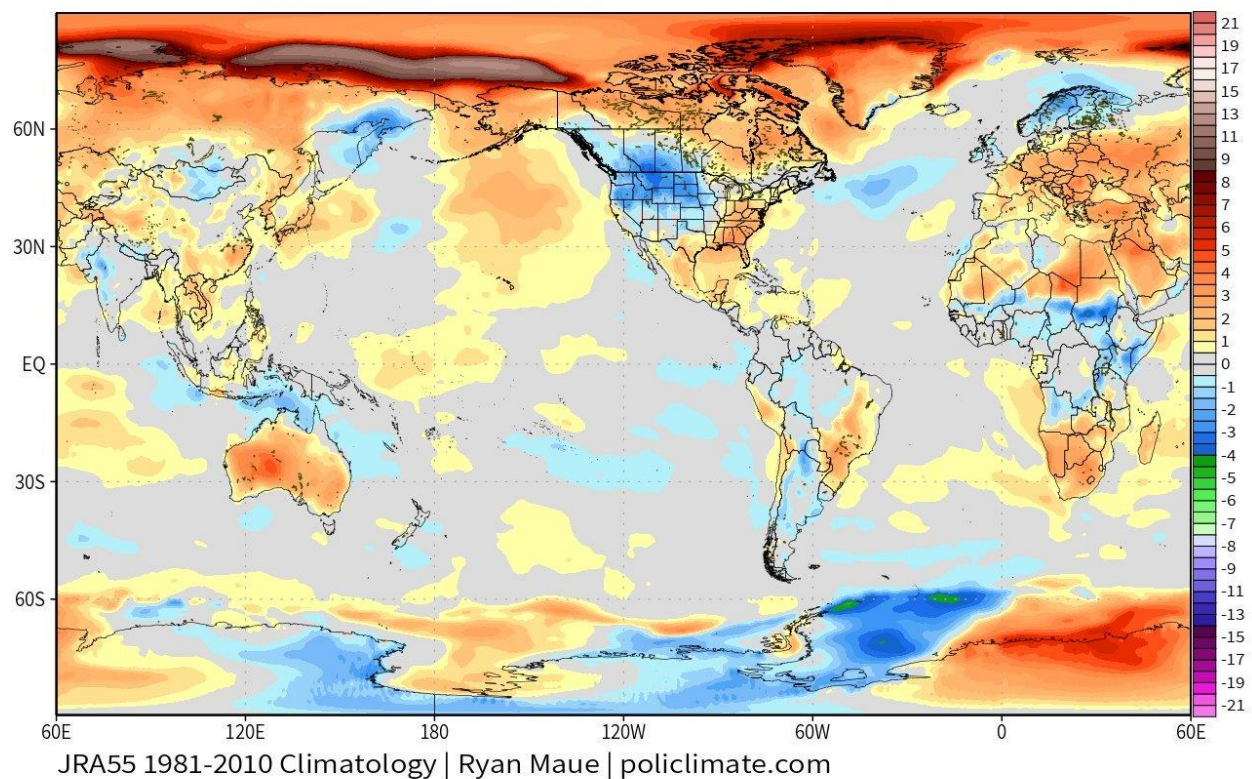


Figure ii. Observed surface temperature anomalies October 2019. Graphic found at <https://twitter.com/RyanMaue/status/1188866944813932545>

Global October surface temperature anomalies are shown in **Figure ii** (taken from Ryan Maue's Twitter feed). The Arctic exhibits amplified warming relative to the rest of the globe especially in regions where sea ice normally present but is currently absent (see below **Figure 16**). In fact, Arctic sea ice is currently at record low extent beating the

previous record low of 2012 pretty handily and sea ice extent is more typical for mid-September than late October as seen in **Figure iii**. And though temperatures are relatively mild across the NH continents, cold pockets do exist downstream of the warm bullseyes in the Arctic basin. Below normal temperatures are observed in western North America downstream of the warm maxima in the Chukchi and Beaufort Seas, in Scandinavia downstream of the warm maxima around Greenland and Mongolia downstream of the maxima in the Barents-Kara Seas. The regional cold anomalies were not predicted by the subseasonal dynamical models (see [NMME October temperature forecasts](#)).

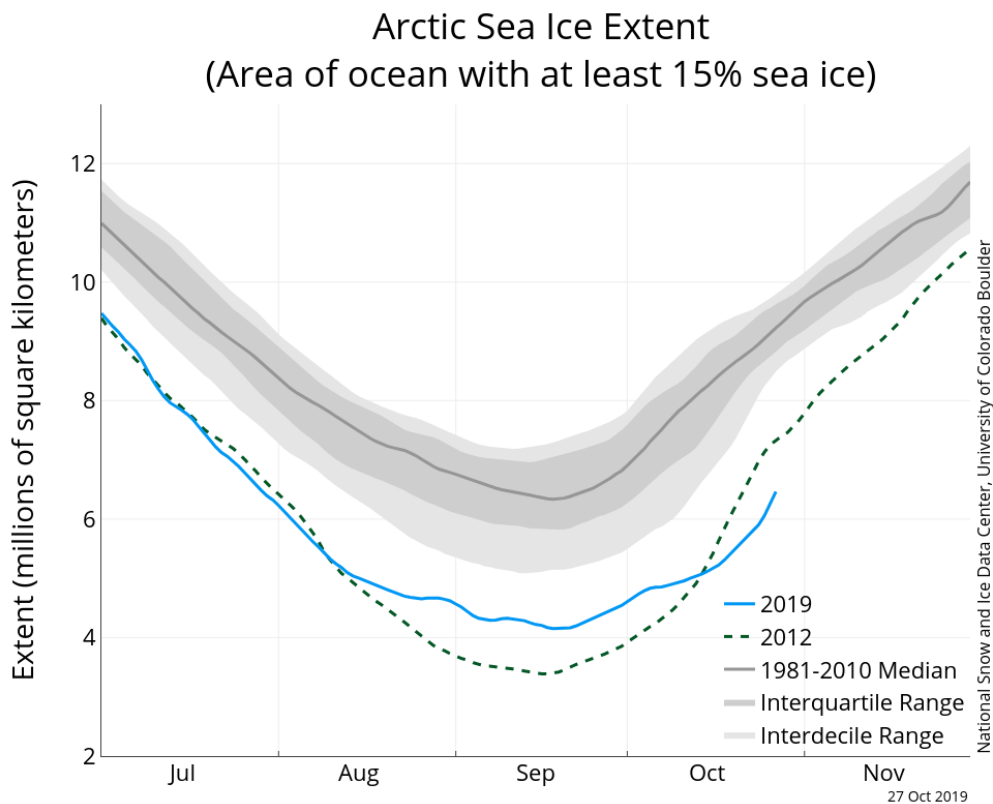


Figure iii. Observed daily Arctic sea extent through 27 October 2019. Also shown is the climatological values and the daily extent from 2012. Plot taken from <https://nsidc.org/arcticseaicenews/>

Snow cover is relatively extensive across the NH as seen in **Figure iv**. Snow cover is above normal both across Eurasia and North America. Based on my observational analysis this also favors high pressure in the Arctic with downstream troughing and cold temperatures across the continents. So, if you are considering Arctic predictors in your winter forecast, I would say that they are quite bullish for severe winter weather at least regionally and possibly on even larger scales if the stratospheric PV gets

involved. And in many ways this upcoming winter forecast is a good proxy or symbolic of the current debate whether accelerated Arctic warming is contributing to colder mid-latitude winters. The dynamical models clearly say no. I believe observational analysis says yes and it will be interesting to see if this winter is consistent with the modeling or observational/empirical analysis. Of course one winter alone does not prove a theory or analysis but rather is one data point in a series or collection of data points.

Daily Departure - October 27, 2019 (Day 300)

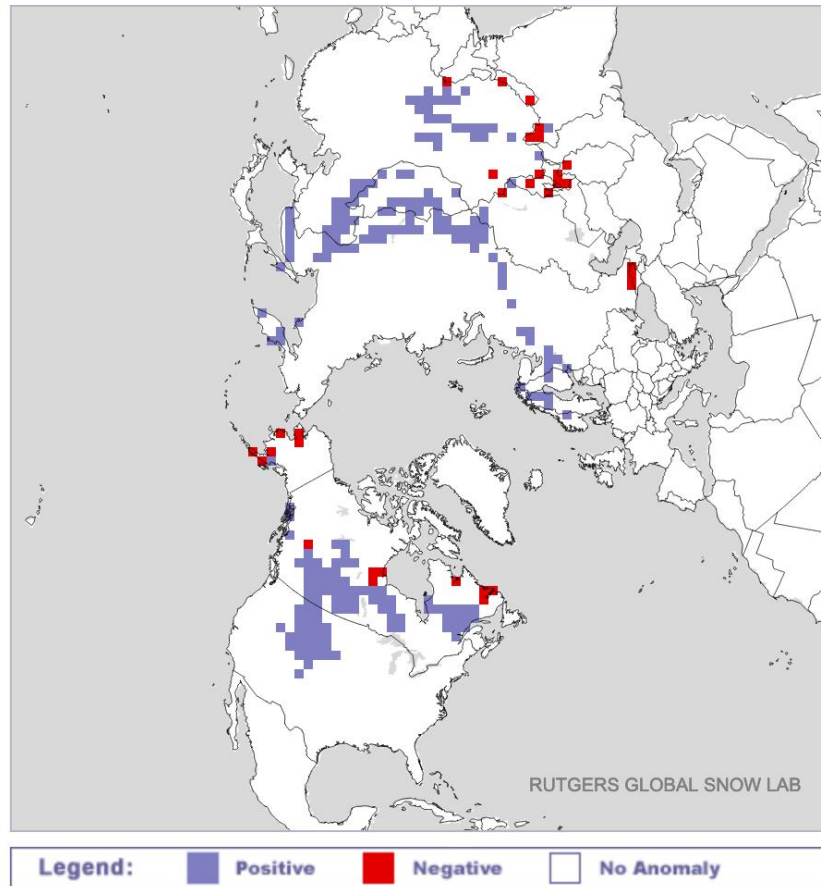


Figure iv. Observed snow cover extent anomalies through 17 October 2019. Plot taken from <https://climate.rutgers.edu/snowcover/>

As I have written many times previously, I do think Mother Nature likes to foreshadow the weather. So, here are some recent anomalies that have caught my attention and some initial thoughts but are not a forecast:

1. Snow cover is more extensive across Siberia this October relative to last October. I was surprised that cold temperatures were not more extensive across Northern

Asia last winter, but I expect this winter to be colder. More expansive cold across Siberia increases the risk for Arctic outbreaks to both East Asia and Europe.

2. Scandinavia has been surprisingly cold this fall, and snow cover extent has also been above normal. This could be an early sign that this winter will be colder across Scandinavia than last winter, which could expand to include more of Northern Europe. This coupled with Greenland blocking since the summer could be suggestive of an overall negative winter NAO.
3. I am surprised that pressure/heights have been as low as they have been in the Barents-Kara Seas this October. This coupled with the cold in Scandinavia could be a sign blocking in the North Atlantic basin could be favored more towards Greenland and less towards Scandinavia/Urals/Barents Kara Seas. Though Greenland blocking is strongly correlated with colder winter temperatures across Northern Europe and the Eastern US it is also less favorable for a major disruption of the stratospheric PV. I believe that widespread cold is difficult without a significant disruption of the stratospheric PV.
4. Snow cover has been above normal across Canada and the lower 48 of the US and below normal across Alaska. Could be an early sign that ridging and warm temperatures are favored in and around Alaska with downstream troughing and cold temperatures in parts of Canada and the US lower 48.
5. Sea surface temperatures are well above normal around Alaska and the eastern North Pacific. This favors, ridging over Alaska and the eastern North Pacific but I see mixed signals where the main axis of the ridging sets up. If it is along the West Coast like 2013/14 and 2014/15 the cold is focused in the central and eastern North America but if it is offshore like 2017/18 then the cold is focused more in western and central North America.

Of course, the dynamical models don't agree with me and say ignore all that is going on in the extratropics. All that is important is that the Arctic is warm and if anything, that the warm anomalies will spread to the lower latitudes.

Near Term Conditions

1-5 day

The AO is currently negative (**Figure 1**) with mostly positive geopotential height anomalies across the Arctic and mixed geopotential height anomalies across the mid-latitudes of the NH (**Figure 2**). And with positive geopotential height anomalies across Greenland (**Figure 2**), the NAO is negative.

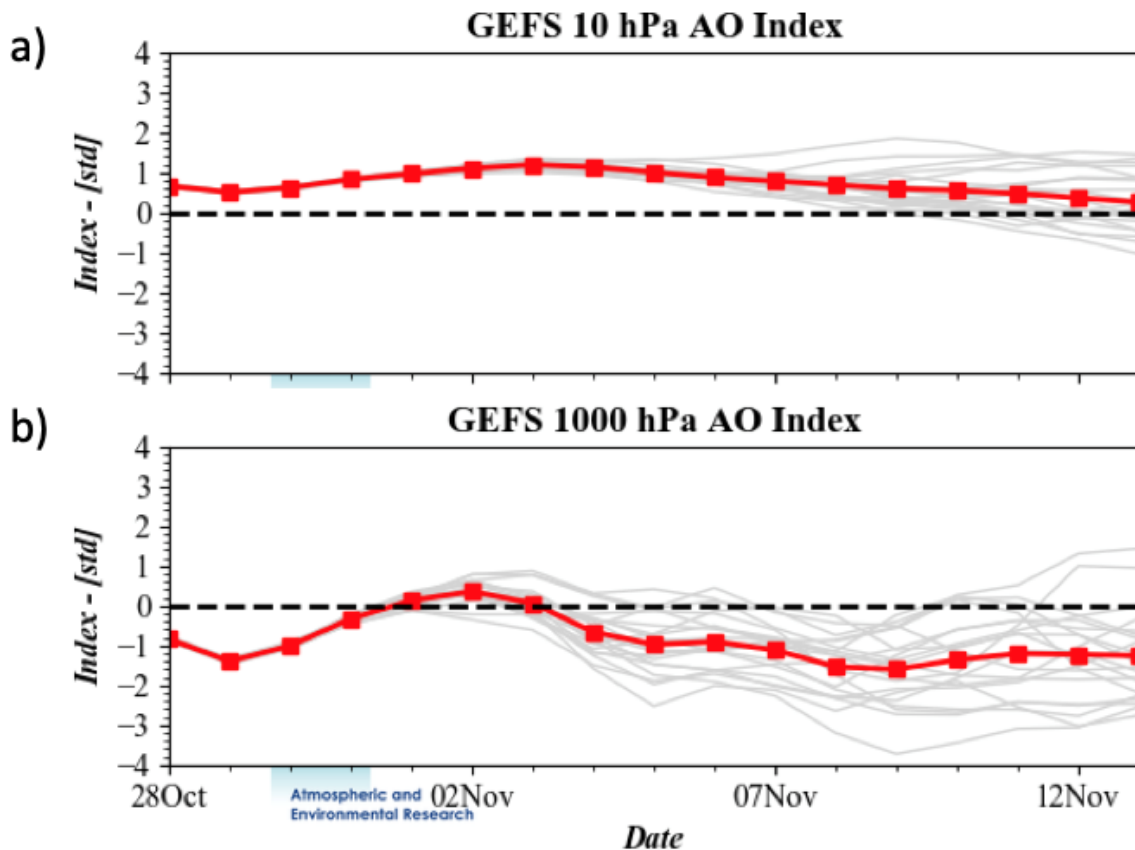


Figure 1. (a) The predicted daily-mean AO at 10 hPa from the 00Z 28 October 2019 GFS ensemble. (b) The predicted daily-mean near-surface AO from the 00Z 17 October 2019 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble-mean AO index given by the red line with squares.

Trouching/negative geopotential height anomalies are predicted to dominate much of Europe with ridging/positive geopotential height anomalies predicted to be confined across far Western Europe during the week (**Figure 2**). This will result in normal to below temperatures across much of Europe with the exception of normal to above normal temperatures across far Western Europe including the UK (**Figure 3**). This week ridging/positive geopotential height anomalies are predicted to dominate much of Asia with trouching/negative geopotential height anomalies confined to Northwest Russia (**Figure 2**). This is predicted to yield normal to above normal temperatures for much of Asia including the Middle East and East Asia and East Asia with normal to below normal temperatures confined to Western Russia (**Figure 3**).

GEFS 1-5 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 10/28/19 FCST: 10/29/19 to 11/02/19

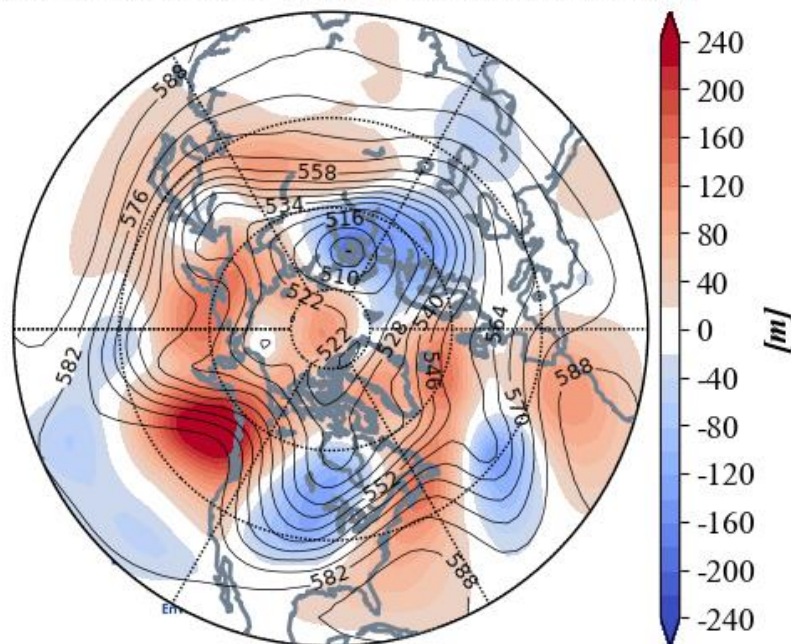


Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 28 October – 2 November 2019. The forecasts are from the 28 October 00z GFS ensemble.

This week ridging/positive geopotential height anomalies centered across Alaska and the Gulf of Alaska are predicted to force downstream troughing/negative geopotential height anomalies with normal to below normal temperatures across Southwestern Canada, the Western and Central US with more ridging/positive geopotential height anomalies and normal to above normal temperatures along the East Coasts of the US and Canada (**Figures 2 and 3**). Ridging over Alaska and Northwestern Canada is predicted to yield normal to above normal temperatures (**Figure 3**).

GEFS 1-5 Day Forecast T2m Anomaly
INIT: 00Z 10/28/19 FCST: 10/29/19 to 11/02/19

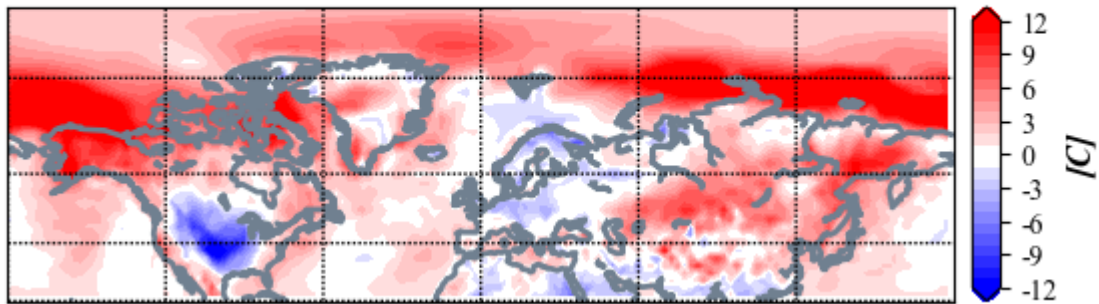


Figure 3. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 28 October – 2 November 2019. The forecast is from the 00Z 28 October 2019 GFS ensemble.

Trouching and/or cold temperatures are predicted to bring new snowfall across Siberia, Northwestern Russia and Northern Scandinavia (**Figure 4**). However, intrusion of warm air on southerly winds will melt snow in southcentral Siberia (**Figure 4**). Trouching and cold temperatures are predicted to bring new snowfall to Canada from the Rockies eastward and the Northcentral US (**Figure 4**).

GEFS 1-5 Day Forecast Mean 24-hour Snow Depth Change
INIT: 00Z 10/28/19 FCST: 10/29/19 to 11/02/19

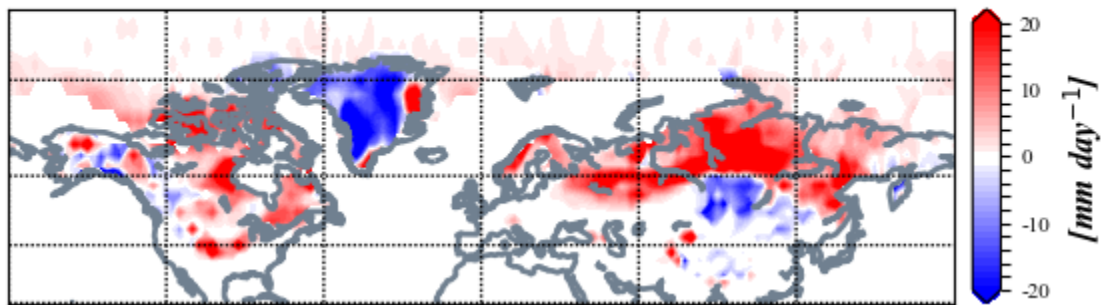


Figure 4. Forecasted snowdepth anomalies (mm/day ; shading) from 28 October – 2 November 2019. The forecast is from the 00Z 28 October 2019 GFS ensemble.

Mid-Term

6-10 day

The AO and NAO are predicted to briefly turn positive this period (**Figure 1**) as an area of negative geopotential height/pressure anomalies crosses Greenland and Iceland as it traverses from Hudson Bay to Europe (**Figure 5**).

GEFS 6-10 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 10/28/19 FCST: 11/03/19 to 11/07/19

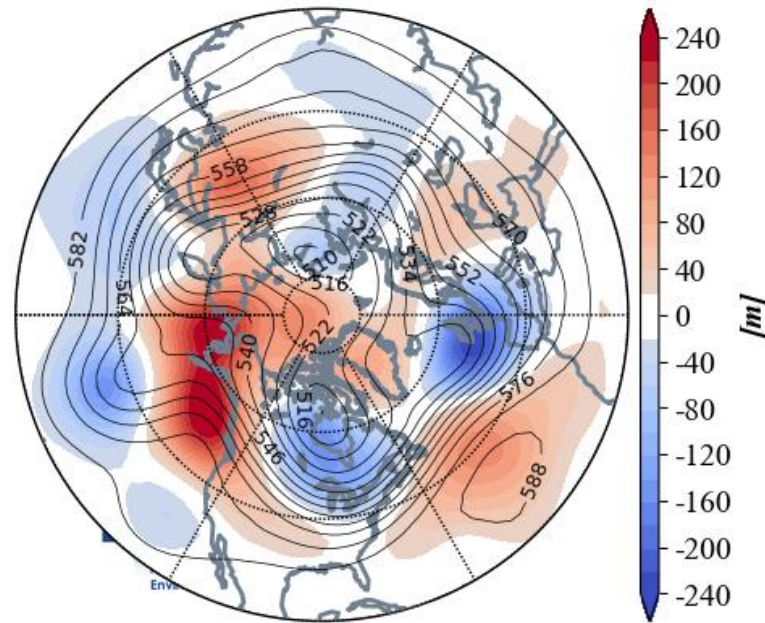


Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 3 – 7 November 2019. The forecasts are from the 28 October 00z GFS ensemble.

Trouching/negative geopotential height anomalies previously in Canada will approach Western Europe (**Figure 5**) kicking up southwesterly flow across most of Europe ushering in normal to above normal temperatures across much of Europe including the UK (**Figure 6**). One exception could be normal to below normal temperatures across Scandinavia as mostly northerly flow help to persist cold temperatures from the previous period (**Figure 6**). Trouching/negative geopotential height anomalies confined to Northwest Russia during the previous period are predicted to become more widespread across Western Asia as ridging/positive geopotential height anomalies are predicted to persist across East Asia (**Figure 5**). This is predicted to yield more widespread normal to below normal temperatures for Western Asia and into parts of Central Asia with normal to above normal temperatures for the Middle East and much of Southern and East Asia (**Figure 6**).

GEFS 6-10 Day Forecast T2m Anomaly
INIT: 00Z 10/28/19 FCST: 11/03/19 to 11/07/19

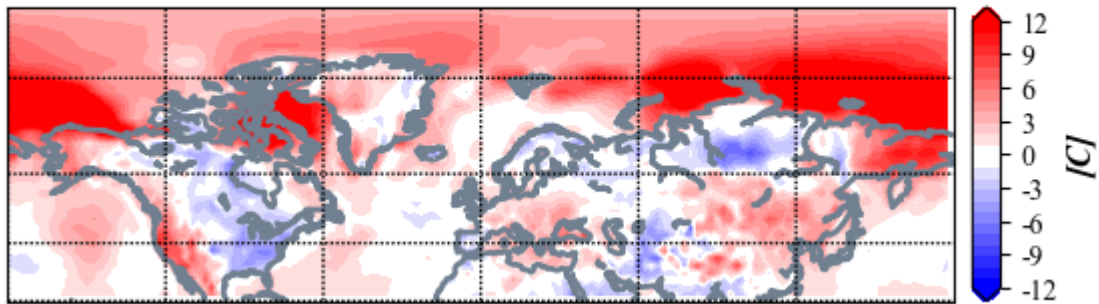


Figure 6. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 3 – 7 November 2019. The forecasts are from the 00Z 28 October 2019 GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to remain across Alaska and the Gulf of Alaska and long the west coast of North America forcing downstream troughing/negative geopotential height anomalies in Canada and the US east of the Rockies (**Figure 5**). This pattern is predicted to bring normal to above normal temperatures across Alaska, the West Coasts of the US and Canada with normal to below normal temperatures stretching across Canada and the US east of the Rockies (**Figure 6**).

GEFS 6-10 Day Forecast Mean 24-hour Snow Depth Change
INIT: 00Z 10/28/19 FCST: 11/03/19 to 11/07/19

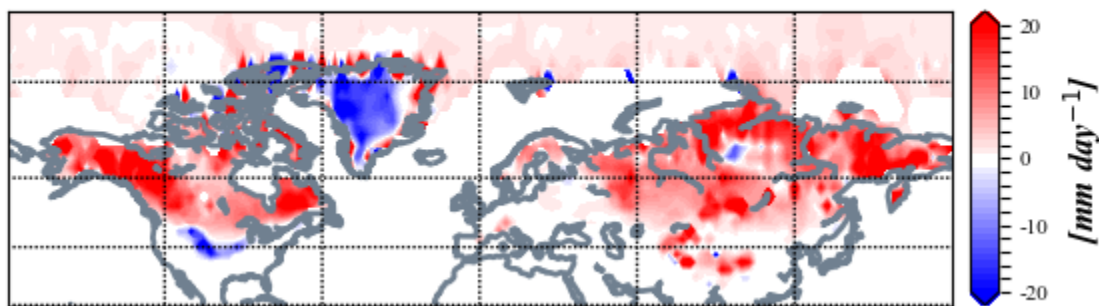


Figure 7. Forecasted snowdepth changes (mm/day ; shading) from 3 – 7 November 2019. The forecasts are from the 00Z 28 October 2019 GFS ensemble.

Troughing and/or cold temperatures will support the potential for new snowfall across much of Siberia, Scandinavia, Northwest Russia, the Tibetan Plateau, Alaska and much of Canada (**Figure 7**). Some snowmelt is predicted in Western Siberia and the Northcentral US (**Figure 7**).

11-15 day

With a return of mostly positive geopotential height anomalies predicted for the Arctic (**Figure 8**), the AO is likely to transition back to negative this period (**Figure 1**). With predicted weak positive pressure/geopotential height anomalies across Greenland (**Figure 8**), the NAO is likely to remain close to neutral this period.

GEFS 11-15 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 10/28/19 FCST: 11/08/19 to 11/12/19

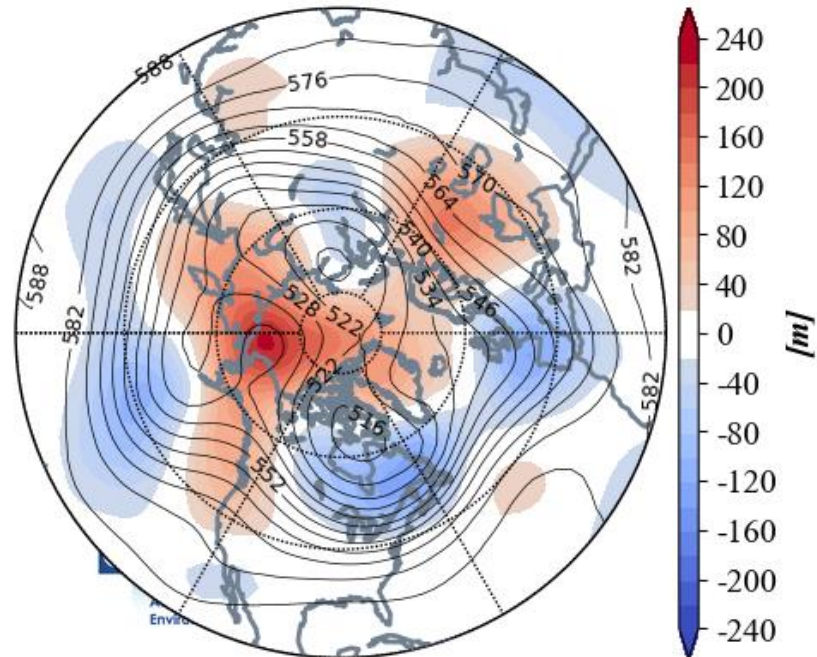


Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 8 – 12 November 2019. The forecasts are from the 28 October 00z GFS ensemble.

Trouching/negative geopotential height anomalies are predicted to continue to move east across Europe this period with ridging/positive geopotential height anomalies retreating into Eastern Europe (**Figure 8**). This pattern is predicted to result in seasonable to below normal temperatures for Western Europe including the UK and Scandinavia with seasonable to above normal temperatures across Eastern Europe (**Figure 9**). Ridging/positive geopotential height anomalies in Western and Eastern Asia are predicted to bookend troughing/negative geopotential height anomalies in Central Asia (**Figure 8**). This pattern favors normal to above normal temperatures across Southern, West and East Asia including the Middle East, the Indian subcontinent and Southeast Asia with normal to below normal temperatures widespread across Central Asia including much of Siberia (**Figure 9**).

GEFS 11-15 Day Forecast T2m Anomaly
INIT: 00Z 10/28/19 FCST: 11/08/19 to 11/12/19

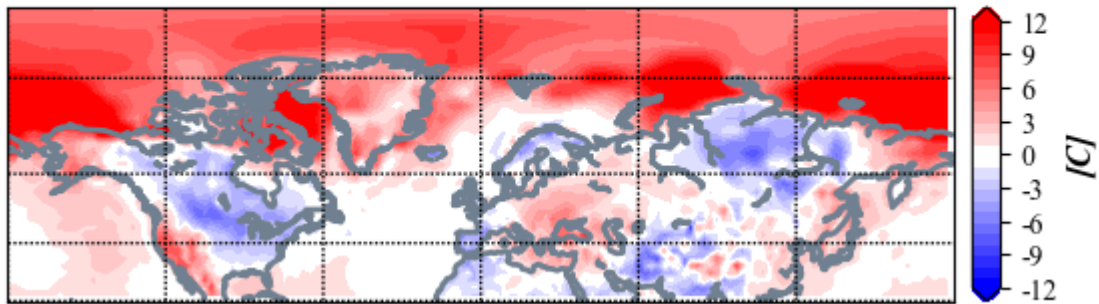


Figure 9. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 8 – 12 November 2019. The forecasts are from the 28 October 00z GFS ensemble.

The overall pattern across North America is predicted to persist with ridging/positive geopotential height anomalies stretching from Alaska into the Gulf of Alaska and along the West Coasts of Canada and the US with downstream troughing/negative geopotential height anomalies in eastern North America (**Figure 8**). This will favor normal to above normal temperatures across Alaska, the West Coasts of Canada and the US with normal to below normal temperatures across much of Canada and the US from the Rockies eastward (**Figure 9**).

GEFS 11-15 Day Forecast Mean 24-hour Snow Depth Change
INIT: 00Z 10/28/19 FCST: 11/08/19 to 11/12/19

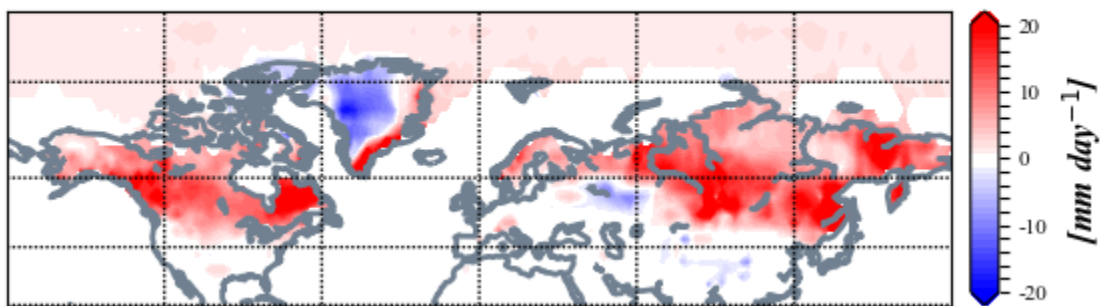


Figure 10. Forecasted snowdepth changes (mm/day ; shading) from 8 – 12 November 2019. The forecasts are from the 28 October 00z GFS ensemble.

Troughing and/or cold temperatures will support new snowfall across much of Siberia, Northwest Russia, Scandinavia, the Alps, Alaska, much of Canada and even possibly New England (**Figure 10**). Milder temperatures could result in snowmelt in parts of Western Russia (**Figure 10**).

Longer Term

30-day

The latest plot of the polar cap geopotential height anomalies (PCHs) currently shows normal to below normal PCHs in the stratosphere and normal to above normal PCHs in the troposphere (**Figure 11**). Currently the lower troposphere PCHs are above normal, but are predicted to turn neutral, consistent with the predicted positive AO before turning positive once more increasing the likelihood of a return of a negative AO (**Figure 1**).

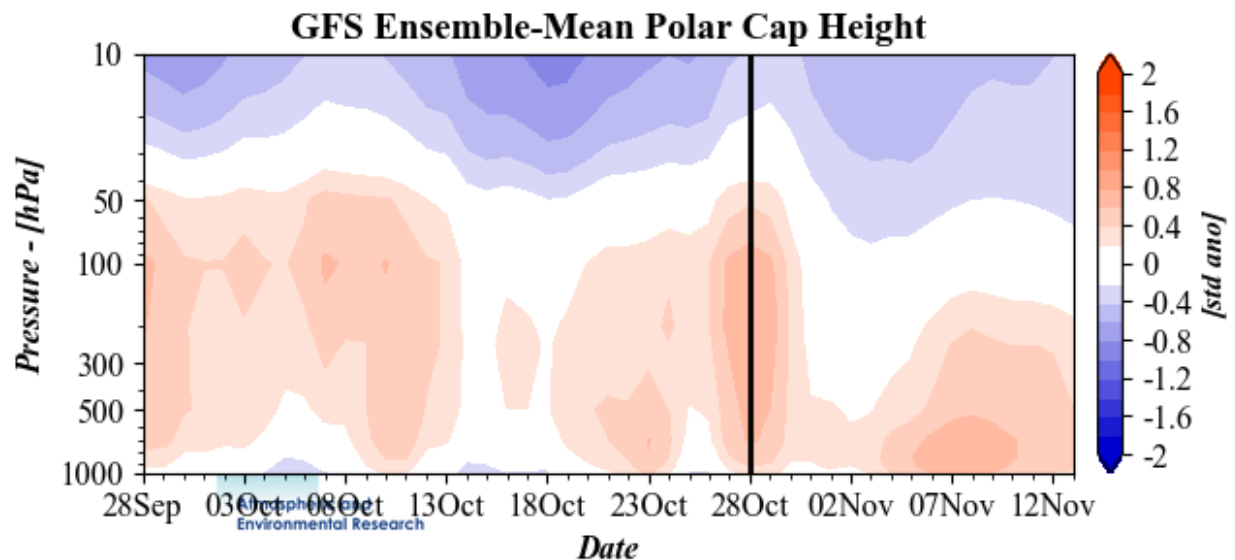


Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecasts are from the 00Z 28 October 2019 GFS ensemble.

The plot of Wave Activity Flux (WAFz) or poleward heat transport shows the first meaningful pulse of the season going on right now (**Figure 12**). The weak positive pulse of WAFz is then predicted to be followed by negative WAFz values for the end of this week and into the weekend. Despite the minor disruption of the PV, as seen by the relative warming of stratospheric PCHs, the stratospheric AO is predicted to remain positive (**Figure 1**).

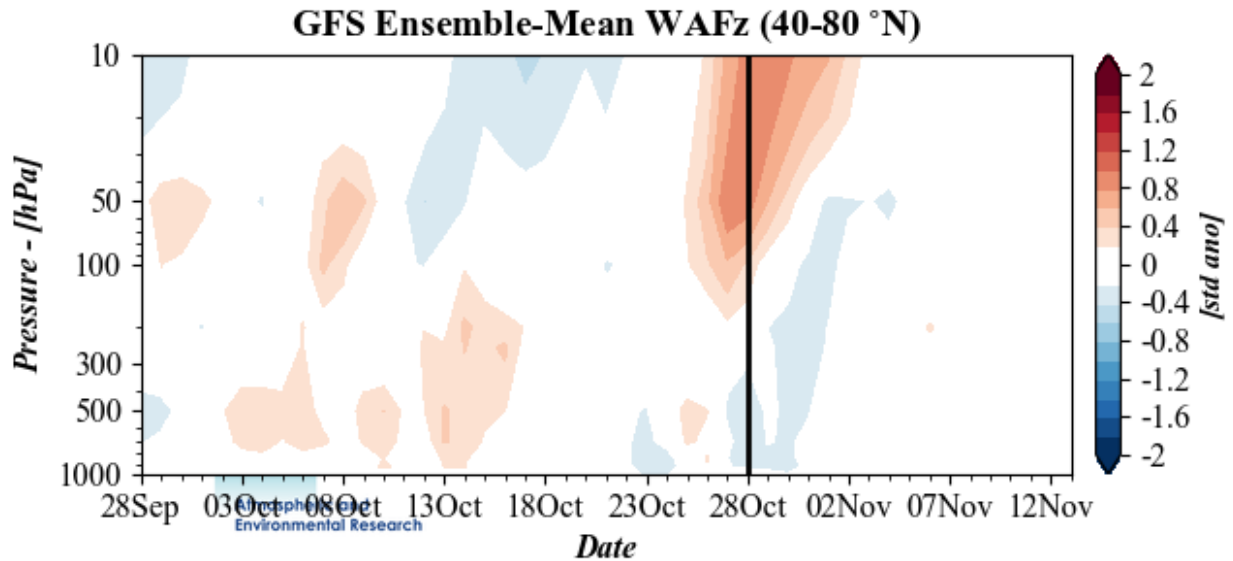
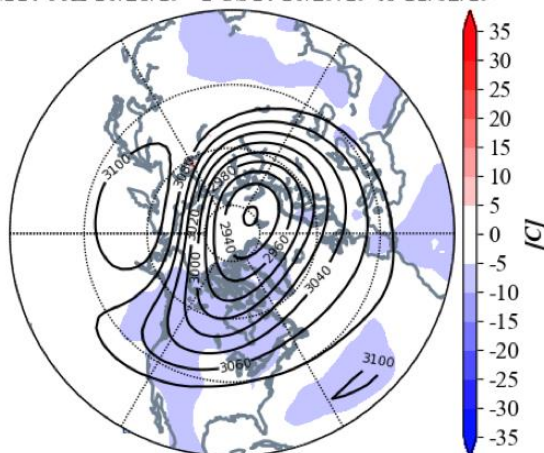


Figure 12. Observed and predicted daily vertical component of the wave activity W_{ux} (WAFz) standardized anomalies, averaged poleward of 40-80°N. The forecast is from the 00Z 28 October 2019 GFS ensemble.

The minor perturbation of the PV looks to be a reflective event which is characterized by positive anomalies of WAFz quickly followed by negative anomalies (**Figure 12**). The WAFz pulse is predicted to promote some warming and ridging in the northern North Pacific sector and an elongation of the PV with northerly flow from Siberia into Western Canada (**Figure 13**).

a) GEFS 1-5 Day Forecast 10 mb GPH & T Anomaly
INIT: 00Z 10/28/19 FCST: 10/29/19 to 11/02/19



b) GEFS 11-15 Day Forecast 10 mb GPH & T Anomaly
INIT: 00Z 10/28/19 FCST: 11/08/19 to 11/12/19

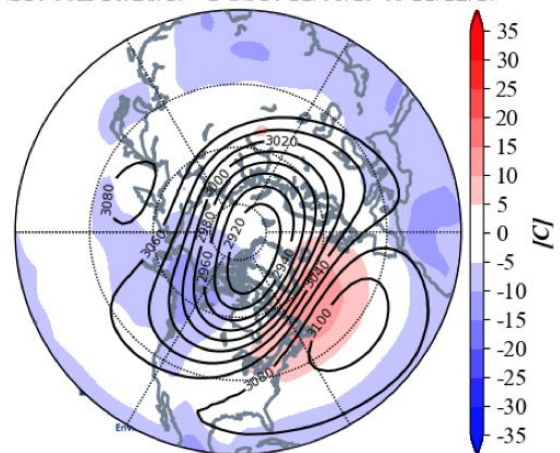


Figure 13. (a) Forecasted 10 mb geopotential heights (dam; contours) and temperature anomalies ($^{\circ}\text{C}$; shading) across the Northern Hemisphere for 29 October – 2 November 2019. (b) Same as (a) except forecasted averaged from 8 – 12 November 2019. The forecasts are from the 00Z 28 October 2019 GFS operational model.

During these reflective PV perturbations, the pattern couples quickly with the troposphere with ridging near Alaska and downstream troughing across central and eastern North America as seen in the entire two week 500 hPa geopotential height forecast (**Figure 8**). This is predicted to drive cold air south across North America east of the Rockies in early November.

Interestingly enough the GFS predicts a second warming in the northern North Atlantic sector (**Figure 13**). The warming of the North Pacific sector followed by warming in the North Atlantic sector can also be seen in the PV animation that I tweeted out earlier today. The warming in the North Atlantic sector is likely related to the storm crossing the North Atlantic that briefly causes the NAO to pop into positive territory next week. This scenario of warming first in the North Pacific sector followed by warming in the North Atlantic sector is a classic precursor of a stratospheric PV split. This is not yet predicted by the GFS but could evolve in the model forecasts in the coming days and weeks. A major PV split is highly unusual before January, so if a PV split does occur, I expect it to be minor and of short duration. Still it could be sufficient to kick off some early winter weather across the NH.

**CFS 500 hPa Forecast Anomaly Nov 2019
Valid as of 28 Oct 2019**

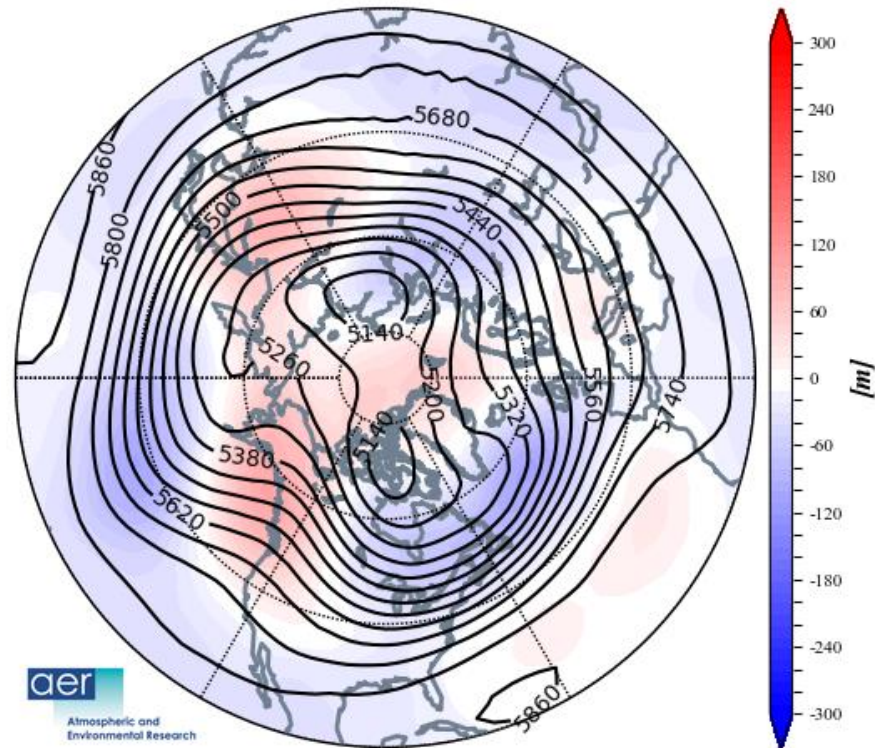


Figure 14. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for November 2019. The forecasts are from the 28 October 2019 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 14**) and the surface temperatures (**Figure 15**) forecast for November from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging centered across the Central Arctic, Central Europe, East Asia and Western North America with troughs in Western Europe, Western Asia, Eastern Siberia, west of the Aleutians, Eastern Canada and the Eastern US (**Figure 14**). This pattern favors relatively warm temperatures for much of Europe and Asia, Alaska, Western Canada and the Western US with seasonable to relatively cold temperatures for Western Europe, Central Siberia, Southeast Canada and the Eastern US (**Figure 15**).

CFS T2m Forecast Anomaly Nov 2019
Valid as of 28 Oct 2019

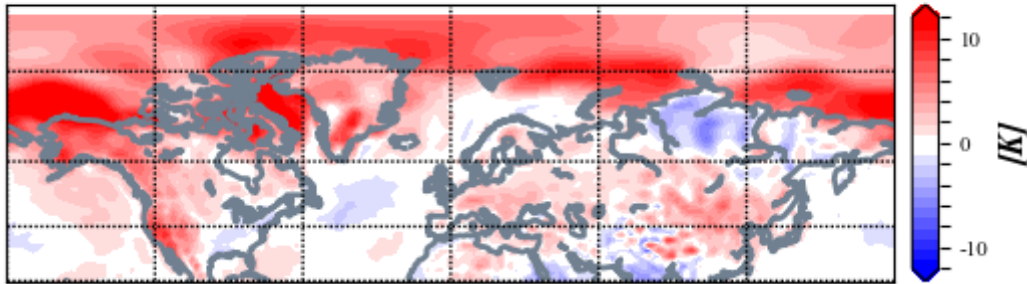


Figure 15. Forecasted average surface temperature anomalies ($^{\circ}\text{C}$; shading) across the Northern Hemisphere for November 2019. The forecasts are from the 28 October 2019 CFS.

Surface Boundary Conditions

Arctic sea ice extent

Arctic sea ice growth rate continues at a slow rate and remains well below normal. Large negative sea ice anomalies exist in two regions: the Chukchi-Beaufort and Barents-Kara Seas (**Figure 16**). Below normal sea ice also exists in and around Greenland and the Canadian Archipelagos, which may favor a negative winter NAO. Based on recent research low sea ice anomalies in the Chukchi and Bering seas favor cold temperatures in central and eastern North America while low sea ice in the Barents-Kara seas favor cold temperatures in Central and East Asia, however this topic remains controversial. Recent research has shown that 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. However so far this fall coupling with the atmosphere has been stronger in the Chukchi, Beaufort and Bering seas.

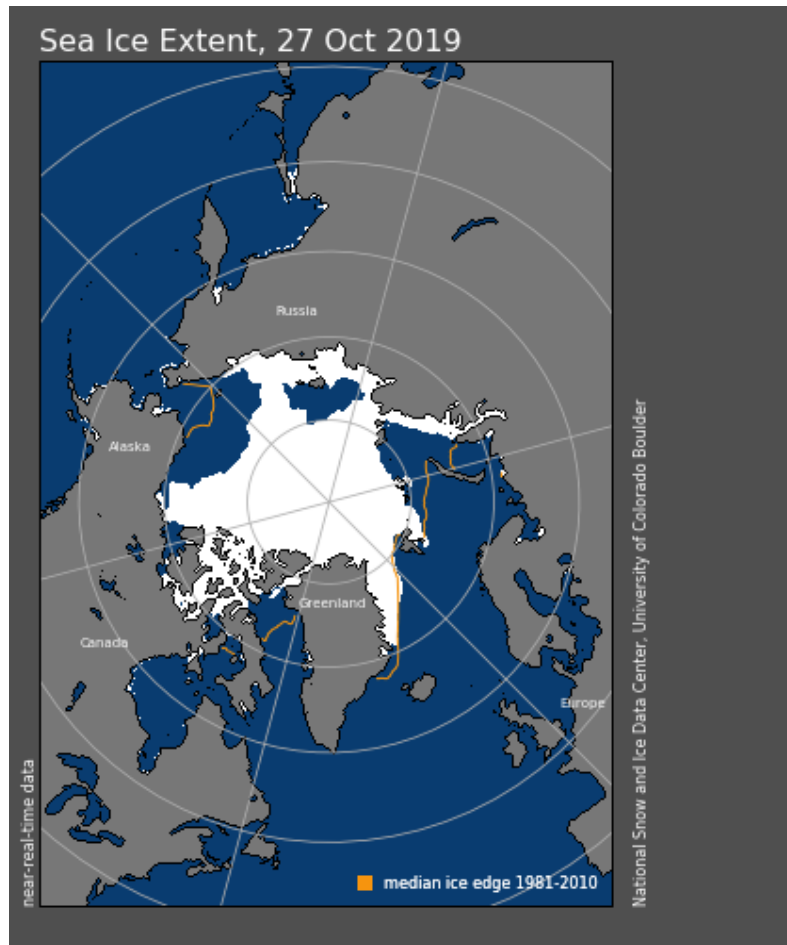


Figure 16. Observed Arctic sea ice extent on 27 October 2019 (white). Orange line shows climatological extent of sea ice based on the years 1981-2010. Image courtesy of National Snow and Ice Data Center (NSIDC). Snow and Ice Data Center (NSIDC).

SSTs/El Niño/Southern Oscillation

Equatorial Pacific sea surface temperatures (SSTs) anomalies have cooled and whether El Niño conditions will continue has become questionable especially now that that SSTs in the eastern equatorial Pacific are cool to normal (**Figure 17**). Observed SSTs across the NH remain well above normal especially near Alaska and along the north slope of Asia though below normal SSTs exist regionally especially west of South America.

SST Anomaly - Week Ending 26 Oct 2019

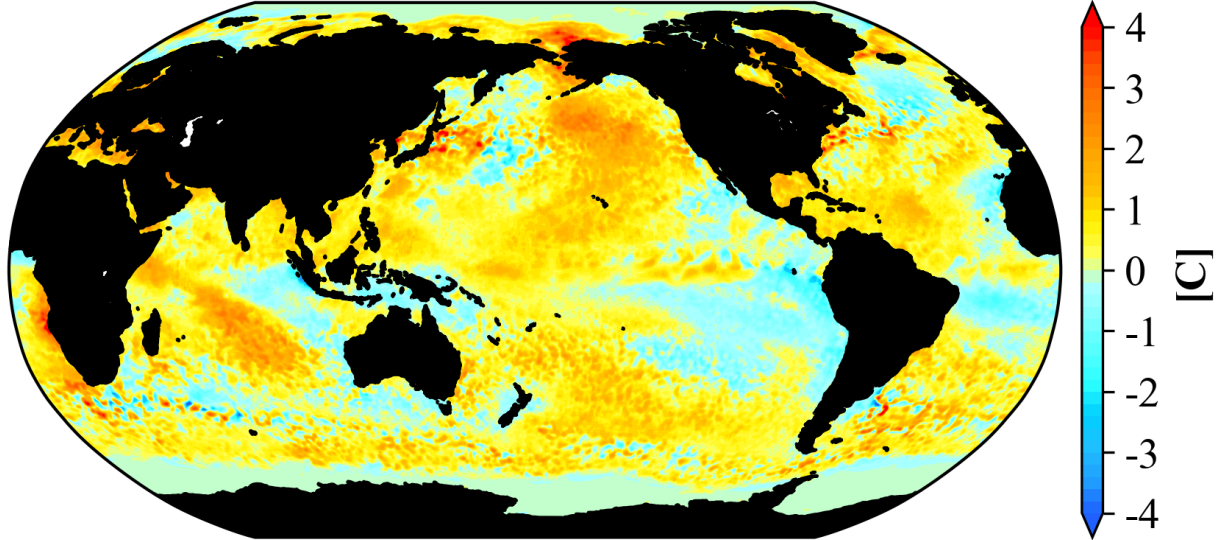


Figure 17. The latest weekly-mean global SST anomalies (ending 26 October 2019).
Data from NOAA OI High-Resolution dataset.

Currently no phase of the Madden Julian Oscillation (MJO) is favored (**Figure 18**). The forecasts are for the MJO to remain weak where no phase is favored over the next two weeks. Little MJO influence is expected on North American weather over the next two weeks.

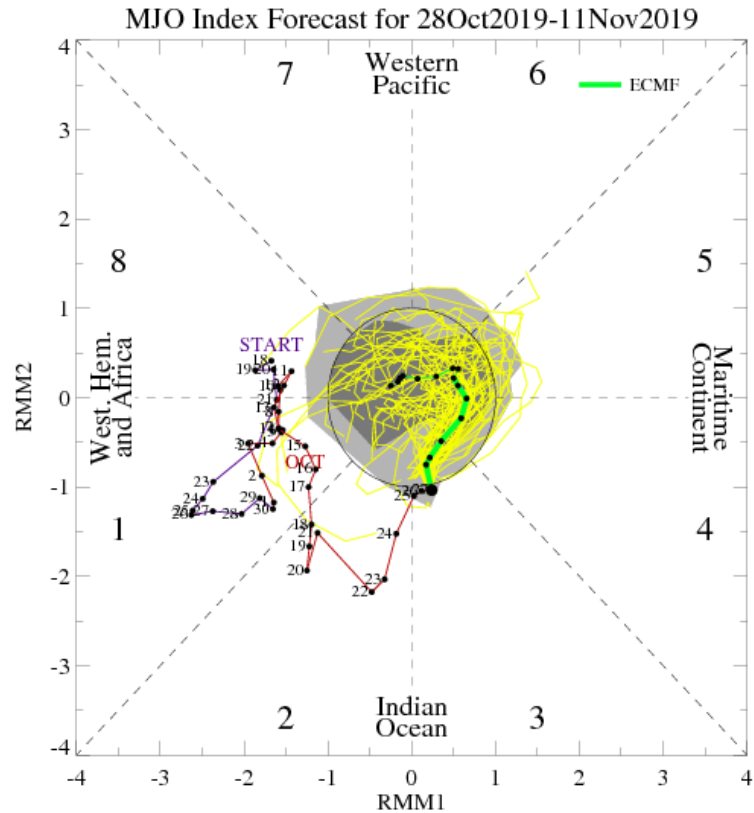


Figure 18. Past and forecast values of the MJO index. Forecast values from the 00Z 7 October 2019 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model “spread” is denoted by the gray shading. Sector numbers indicate 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 advance continues its climb across Eurasia and is currently near decadal highs. Snow cover advance will likely continue to advance especially across Western Asia next week as troughing and cold temperatures spread across the region. 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

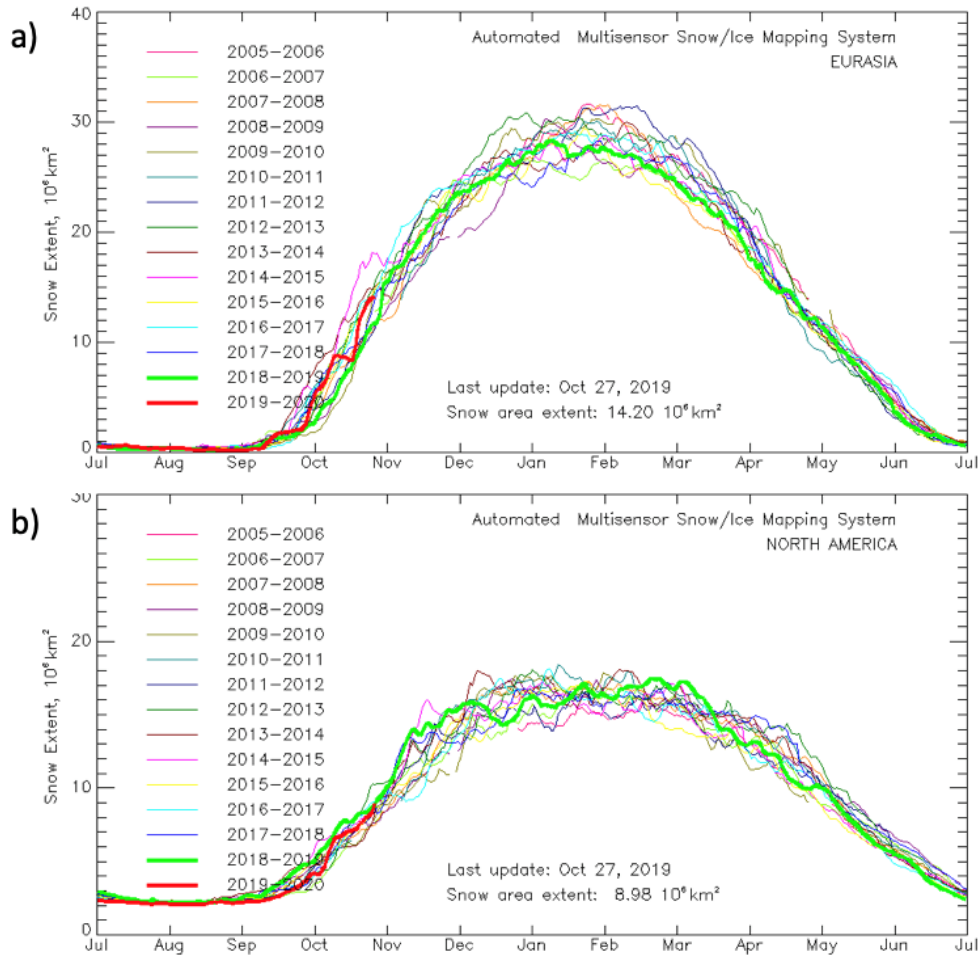


Figure 19. Observed Eurasian (top) and North American (bottom) snow cover extent through 27

October 2019. Image source:

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

North American snow cover is also steadily advancing to near decadal highs and is comparable to last year at this time. The early advance of snow cover across Canada this fall, has likely contributed to an early start of cold temperatures across the Western US.