

August 26, 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 positive and is predicted to oscillate between positive and negative over the next two weeks.
- The current positive AO is reflective of mostly negative pressure/geopotential height anomalies across the Arctic and mostly positive pressure/geopotential height anomalies across the mid-latitudes. The North Atlantic Oscillation (NAO) is also positive as negative pressure/geopotential height anomalies are spread across Greenland and is predicted to remain positive to neutral over the next two weeks as geopotential height anomalies are predicted to remain negative or weak across Greenland over the next two weeks.
- Ridging/positive geopotential height anomalies with above normal temperatures currently dominate much of Europe including the United Kingdom (UK) and are

predicted to transition to troughing/negative geopotential height anomalies with seasonable and even below normal temperatures over the next two weeks.

- Ridging/positive geopotential height anomalies with above normal temperatures are predicted to dominate much of Asia with the exception of troughing/negative geopotential height anomalies and below normal temperatures across Western Asia and parts of East Asia over the next two weeks.
- In general, a pattern of ridging/positive geopotential height anomalies with normal to above normal temperatures are predicted across western North America with downstream troughing/negative geopotential height anomalies with seasonable to below normal temperatures across Southeastern Canada and the Eastern United States (US) over the next two weeks.

Impacts

I just returned today from vacation, so I am easing into my normal routine including writing the blog, so I plan to keep my thoughts short today. End of August represents the transition of summer to fall and I just have a couple of thoughts to share.

In *Figure i* plotted the observed surface temperature anomalies through August 21, 2019 and compare with the AER forecast posted in late May. No new themes have emerged since the last blog with the headline being widespread warmth across the NH. The two areas where temperatures are below normal are Western Canada and Western Russia. These are two regions where the model forecasted normal temperatures, but the observed temperatures in those regions are cooler than predicted. There are pockets of below normal temperatures in the US Plains but those may not survive when including the last ten days of August. Once the summer is over, I will also include the same plots with the dynamical forecasts for comparison.

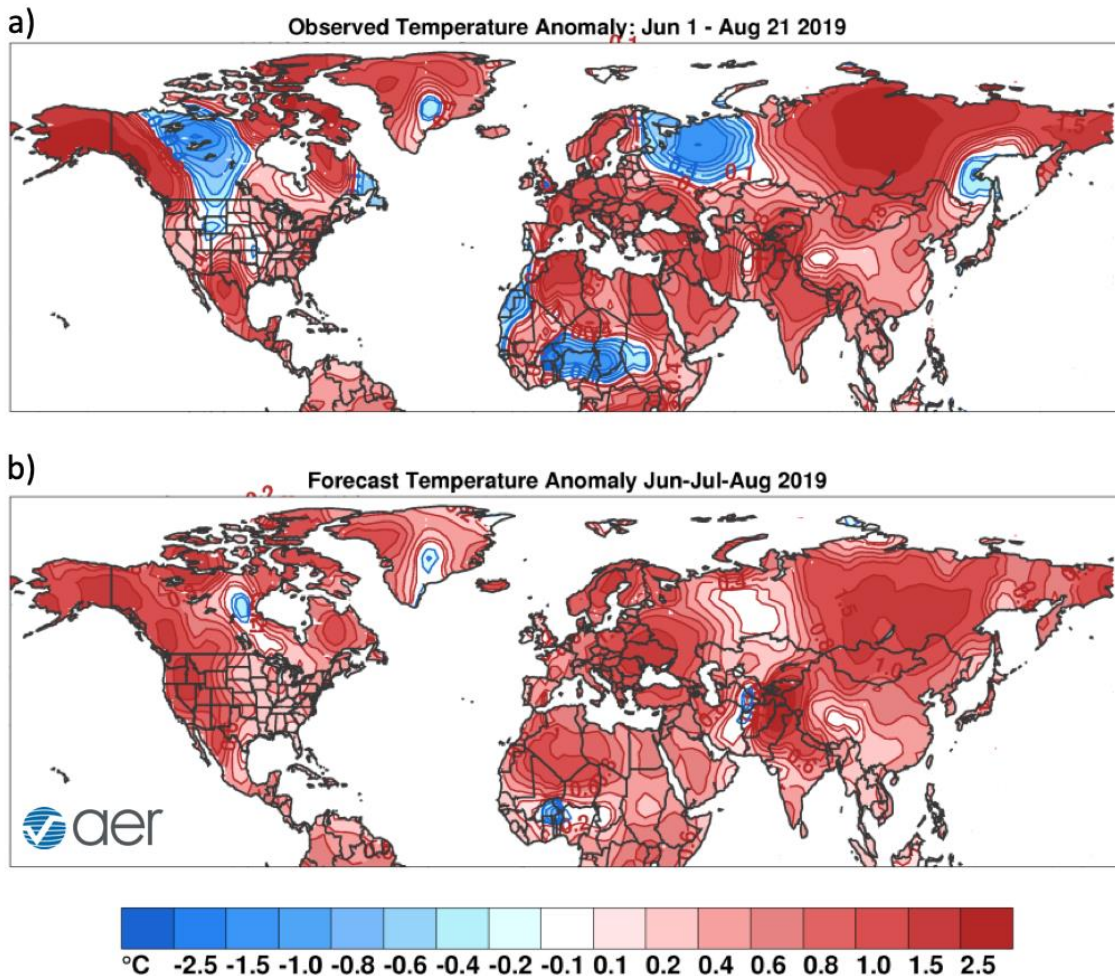


Figure i. a) Observed surface temperature anomalies ($^{\circ}\text{C}$; shading) across the Northern Hemisphere from 1 June – 21 August 2019. b) Predicted surface temperature anomalies ($^{\circ}\text{C}$; shading) across the Northern Hemisphere from 1 June – 31 August 2019.

Signs of fall are emerging. Yesterday I was in Washington DC for the day and was comfortable walking around in a sweater! That is not what you expect in August. It is currently hot in Europe, but temperatures will cool there as well. Snow is predicted for the Central Arctic and may even fall over Siberia the next two weeks. Also, the pace of Arctic sea ice has slowed and as I tweeted earlier today, I think a new record low minimum looks unlikely, but the minima will likely be the second or third lowest over the satellite era.

The coupling between the low Arctic sea ice and the atmosphere will be something I will be watching closely. I will as always be focusing on the behavior of the polar vortex (PV). The PV should start to form in the coming days and weeks. Based on the Paul Newman's website https://acd-ext.gsfc.nasa.gov/Data_services/met/ann_data.html the

PV looks to be weaker than normal out of the gate. This may be related to the weak PV last May associated with the Final Warming or the nearly continuous high latitude summer blocking. To be honest I am not sure how significant a weak start to the PV is for the remainder of the PV season, but at least for now I expect an interesting upcoming PV season.

There was a paper that received some publicity how low Arctic sea ice does not favor colder mid-latitude winters while I was on vacation. I haven't had a chance to read the paper yet but maybe I will share some of my own thoughts in an upcoming blog.

Near Term Conditions

1-5 day

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

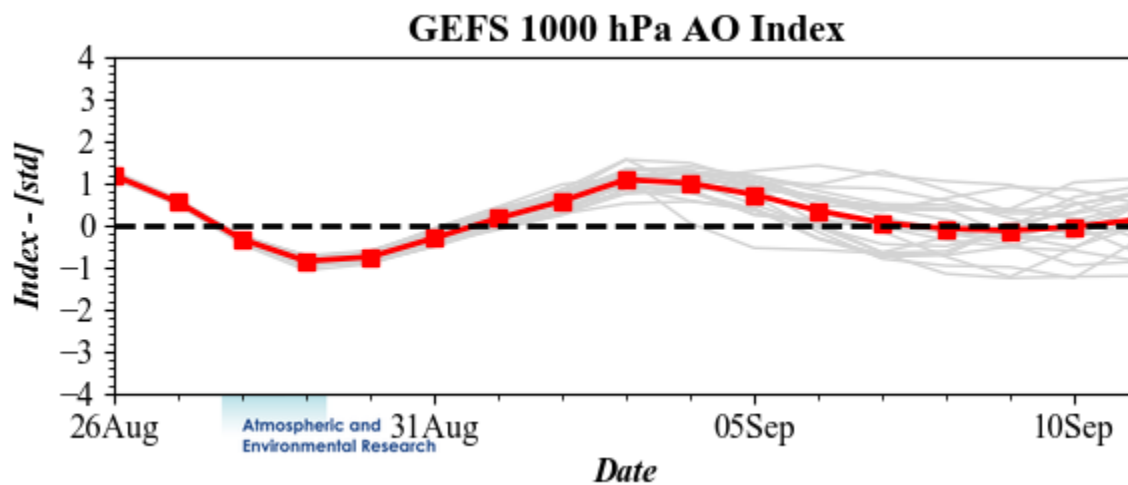


Figure 1. The predicted daily-mean AO at 10 hPa from the 00Z 26 August 2019 GFS ensemble. Gray lines indicate the AO index from each individual ensemble member, with the ensemble-mean AO index given by the red line with squares.

Deep troughing/negative geopotential height anomalies centered near Iceland favor ridging/positive geopotential height anomalies downstream across Europe (**Figure 2**) resulting in normal to above temperatures across much of Europe including the UK (**Figure 3**). Currently troughing/negative geopotential height anomalies in Western Asia and East Asia bookend ridging/positive geopotential height anomalies across Central Asia (**Figure 2**). This is predicted to yield normal to above normal temperatures for

much of Asia including Central Asia and Siberia with normal to below normal temperatures in much of Western Asia but especially Western Russia and parts of East Asia especially Northeast China (**Figure 3**).

GEFS 1-5 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 08/26/19 FCST: 08/27/19 to 08/31/19

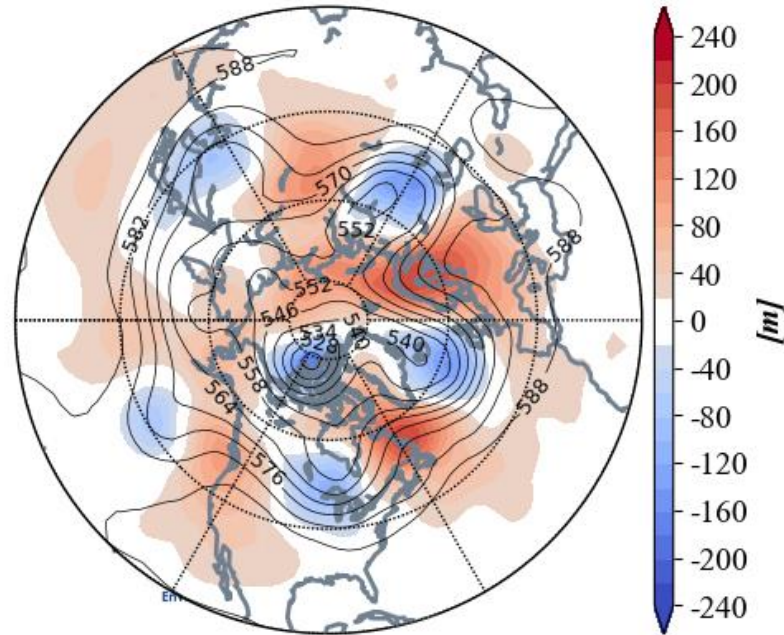


Figure 2. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 27 – 31 August 2019. The forecasts are from the 26 August 00z GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to stretch from Alaska down along the west coast of North America with troughing/negative geopotential height anomalies downstream across and Central Canada and the Eastern US with more ridging/positive geopotential height anomalies in Northeast Canada (**Figure 2**). This pattern is predicted to deliver normal to above normal temperatures in Alaska, the West Coast of Canada and the Western US with normal to below normal temperatures for much of Central Canada and the US east of the Rockies (**Figure 3**).

GEFS 1-5 Day Forecast T2m Anomaly
INIT: 00Z 08/26/19 FCST: 08/27/19 to 08/31/19

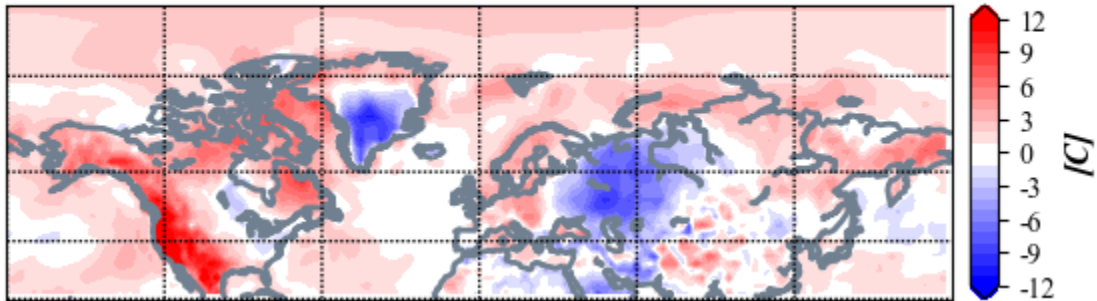


Figure 3. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 27 – 31 August 2019. The forecast is from the 00Z 26 August 2019 GFS ensemble.

Much of Eurasia is predicted to receive below normal precipitation with the exception of above normal rainfall near troughs in Spain and Western Russia (**Figure 4**). Troughing is predicted to bring above normal rainfall to the monsoon regions of India, East Asia and Mexico (**Figure 4**). Troughing will bring above normal precipitation to parts of the Eastern US (**Figure 4**).

GEFS 1-5 Day Forecast PCP Anomaly
INIT: 00Z 08/26/19 FCST: 08/27/19 to 08/31/19

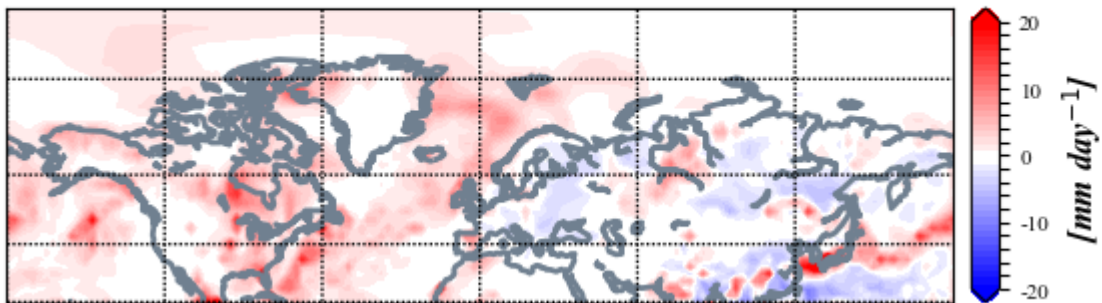


Figure 4. Forecasted rainfall anomalies (mm/day; shading) from 27 – 31 August 2019. The forecast is from the 00Z 26 August 2019 GFS ensemble.

Mid-Term

6-10 day

The AO is predicted to first dip negative and then bounce back to positive this period (**Figure 1**) as geopotential height anomalies vary across the Arctic with mixed geopotential height anomalies across the mid-latitudes of the NH (**Figure 5**). And with

weak geopotential height anomalies across Greenland (**Figure 5**), the NAO will also remain close to neutral.

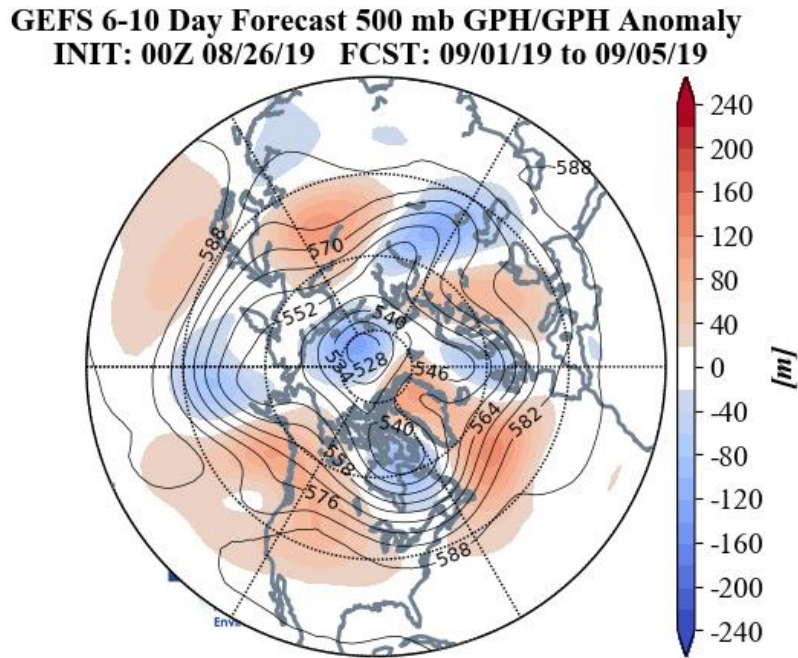


Figure 5. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 1 – 5 September 2019. The forecasts are from the 26 August 00z GFS ensemble.

Trouching/negative geopotential height anomalies from the previous period centered near Iceland will move across Western and Northern Europe with ridging/positive geopotential height anomalies now confined to Eastern Europe (**Figure 5**). This pattern favors normal to below normal temperatures across Western Europe including the UK with normal to above normal temperatures in Eastern Europe (**Figure 6**). The - what seems to be semi-permanent - trough/negative geopotential height anomalies in Western Russia is predicted to slide east this period into Kazakhstan with ridging/positive geopotential height anomalies on either side in Western Russia and Northeast Asia and with more troughing/negative geopotential height anomalies in Southeast Asia (**Figure 5**). This is predicted to yield widespread normal to above normal temperatures for much of Asia including the Middle East with normal to below normal temperatures confined to Kazakhstan and surroundings and Southeast Asia (**Figure 6**).

GEFS 6-10 Day Forecast T2m Anomaly
INIT: 00Z 08/26/19 FCST: 09/01/19 to 09/05/19

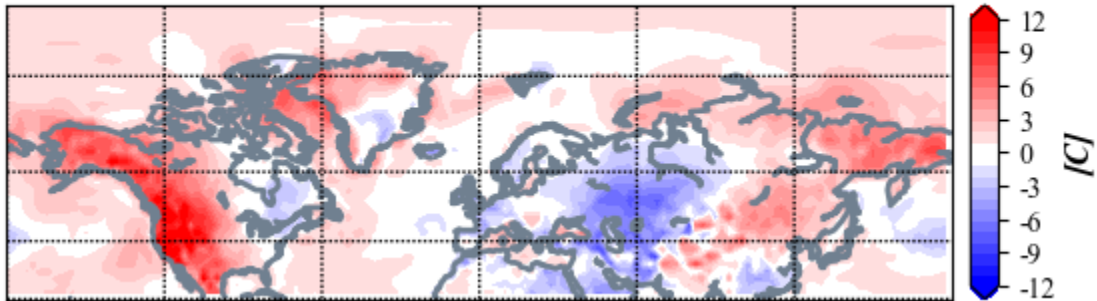


Figure 6. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 1 – 5 September 2019. The forecasts are from the 00Z 26 August 2019 GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to persist in Alaska, Western Canada and the Western US with downstream troughing/negative geopotential height anomalies in Eastern Canada and in the Northeastern US (**Figure 5**). This pattern is predicted to bring normal to above normal temperatures across Alaska, Western Canada and the Western US with normal to below normal temperatures for Eastern Canada and the US east of the Rockies (**Figure 6**).

GEFS 6-10 Day Forecast PCP Anomaly
INIT: 00Z 08/26/19 FCST: 09/01/19 to 09/05/19

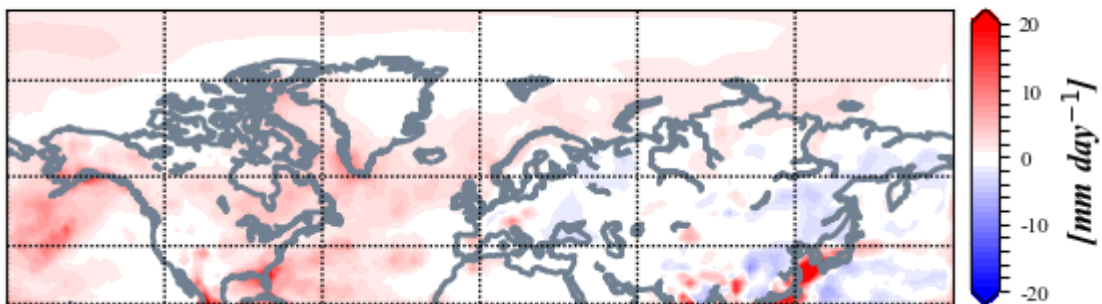


Figure 7. Forecasted rainfall anomalies (mm/day ; shading) from 1 – 5 September 2019. The forecasts are from the 00Z 26 August 2019 GFS ensemble.

Much of Eurasia is predicted to receive below normal precipitation however above normal precipitation in parts of Southern Europe (**Figure 7**). Troughing is predicted to bring above normal rainfall to the monsoon regions of Southeast Asia, Mexico, Southwestern US and the Southeastern US (**Figure 7**).

11-15 day

With weak geopotential height anomalies predicted for the Arctic (**Figure 8**), the AO is likely to remain near neutral this period (**Figure 1**). With predicted weak pressure/geopotential height anomalies across Greenland (**Figure 8**), the NAO is likely to be near neutral this period as well.

GEFS 11-15 Day Forecast 500 mb GPH/GPH Anomaly
INIT: 00Z 08/26/19 FCST: 09/06/19 to 09/10/19

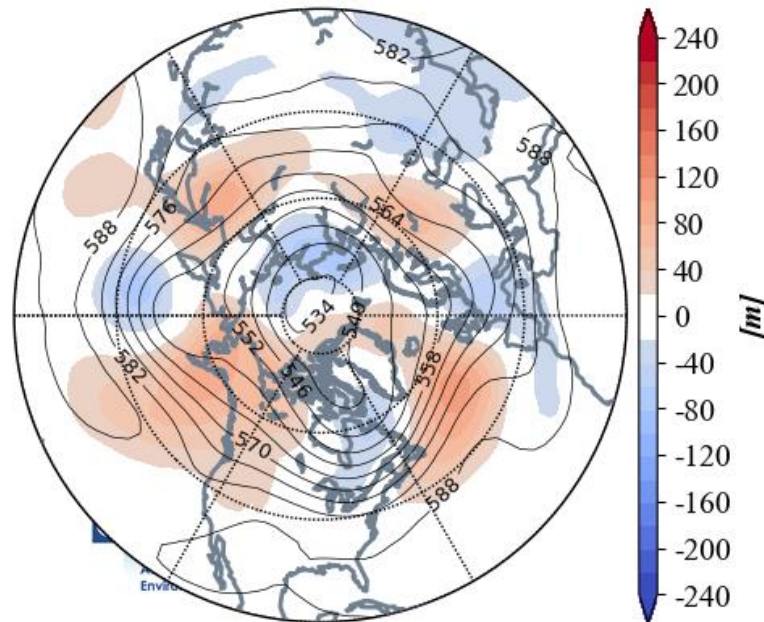


Figure 8. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere from 6 – 10 September 2019. The forecasts are from the 26 August 00z GFS ensemble.

Trouching/negative geopotential height anomalies are predicted to become more widespread across Europe this period now extending into Eastern Europe (**Figure 8**). This pattern is predicted to result in more seasonable to below normal temperatures for most of Europe including the UK except for normal to above normal temperatures in far Southeastern Europe (**Figure 9**). The predicted pattern across Asia this period consists of ridging/positive geopotential height anomalies in Northwestern and Northeastern Asia with troughing/negative geopotential height anomalies in Southern Asia and along the Arctic coast (**Figure 8**). This pattern favors normal to above normal temperatures for most of Asia including the Middle East and East Asia with normal to below normal temperatures in Northern Siberia and Southwestern Asia (**Figure 9**).

GEFS 11-15 Day Forecast T2m Anomaly
INIT: 00Z 08/26/19 FCST: 09/06/19 to 09/10/19

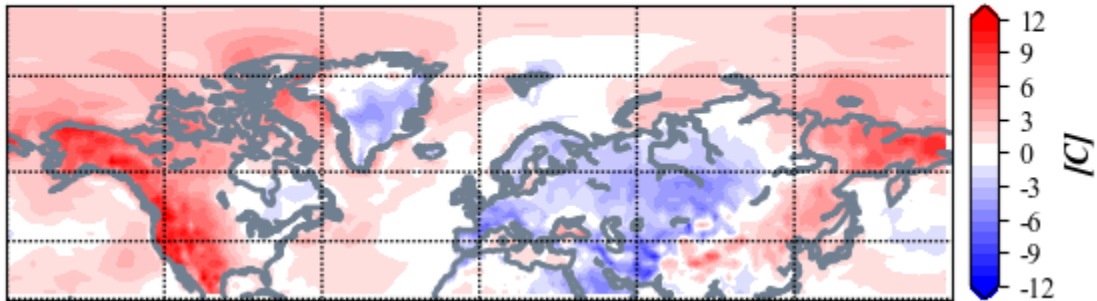


Figure 9. Forecasted surface temperature anomalies ($^{\circ}\text{C}$; shading) from 6 – 10 September 2019. The forecasts are from the 00Z 26 August 2019 GFS ensemble.

Ridging/positive geopotential height anomalies are predicted to dominate much of western North America yet again with some persistent weak troughing/negative geopotential height anomalies in the eastern North America (**Figure 8**). This will favor normal to above normal temperatures across Alaska, Western Canada and the Western US and possible the US East Coast with normal to below normal temperatures for Eastern Canada and the Central US (**Figure 9**).

GEFS 11-15 Day Forecast PCP Anomaly
INIT: 00Z 08/26/19 FCST: 09/06/19 to 09/10/19

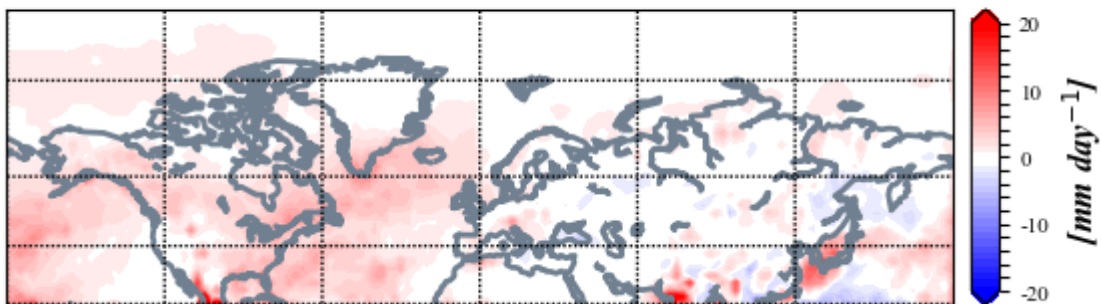


Figure 10. Forecasted rainfall anomalies (mm/day; shading) from 6 – 10 September 2019. The forecasts are from the 00Z 26 August 2019 GFS ensemble.

Much of Asia is predicted to receive near normal precipitation but above normal precipitation is predicted for Southern Europe as troughing enters the region (**Figure 10**). Troughing is predicted to bring above normal rainfall to the monsoon regions of Southeast Asia, India and Mexico and the Eastern US (**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 mid to upper troposphere (**Figure 11**). In the lowest troposphere PCHs are weakly below normal, consistent with the positive AO (**Figure 1**).

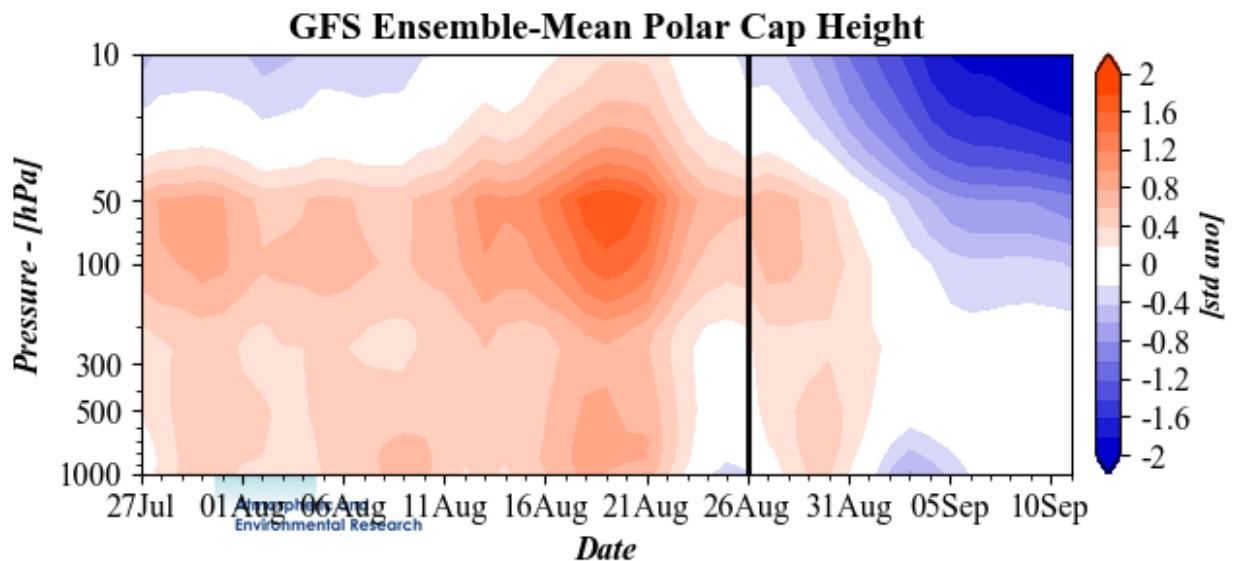


Figure 11. Observed and predicted daily polar cap height (i.e., area-averaged geopotential heights poleward of 60°N) standardized anomalies. The forecasts are from the 00Z 26 August 2019 GFS ensemble.

Positive PCHs in the mid to lower troposphere are predicted to descend into the lower troposphere (**Figure 11**). This should cause the AO to trend negative and into negative territory at least a short period. However, for September the GFS is predicting the negative PCHs to descend through the troposphere. This has been a rare occurrence so far this summer, so I would consider this a low confidence forecast.

**CFS 500 hPa Forecast Anomaly Sep 2019
Valid as of 26 Aug 2019**

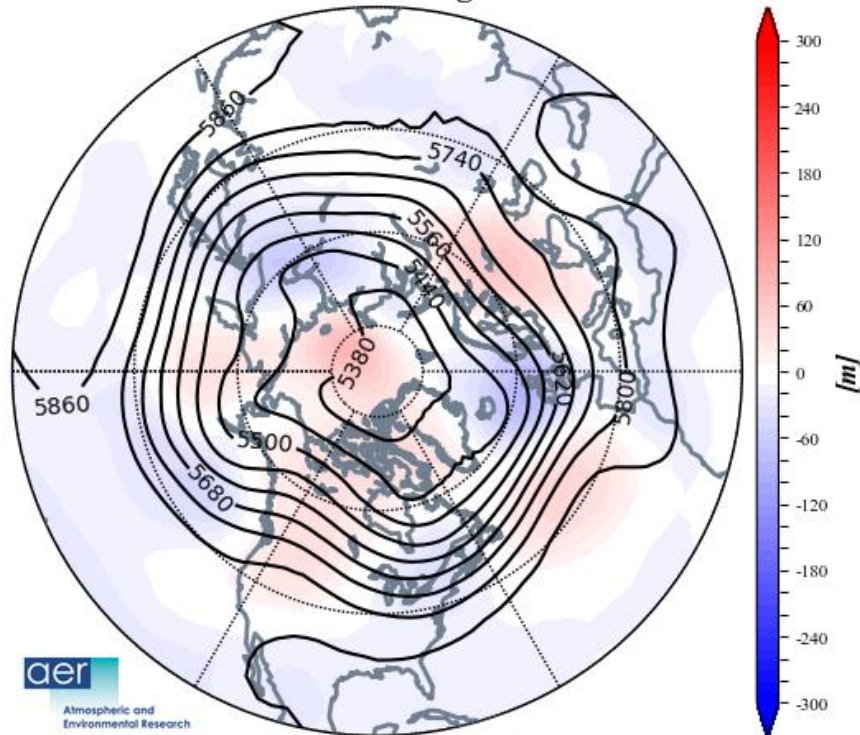


Figure 12. Forecasted average 500 mb geopotential heights (dam; contours) and geopotential height anomalies (m; shading) across the Northern Hemisphere for September 2019. The forecasts are from the 26 August 2019 CFS.

I include in this week's blog the monthly 500 hPa geopotential heights (**Figure 12**) and the surface temperatures (**Figure 13**) forecast for September from the Climate Forecast System (CFS; the plots represent yesterday's four ensemble members). The forecast for the troposphere is ridging centered across Eastern Europe, Western Russia and Western North America with troughs in Northern Europe, Central Siberia, East Asia, the Aleutians, and eastern North America (**Figure 12**). This pattern favors relatively warm temperatures for Eastern Europe, Western Russia, Western Canada and the Western US with seasonable to relatively cool temperatures for Western Europe, Southern Siberia, East Asia, Southeast Canada and the Northeastern US (**Figure 13**).

CFS T2m Forecast Anomaly Sep 2019 Valid as of 26 Aug 2019

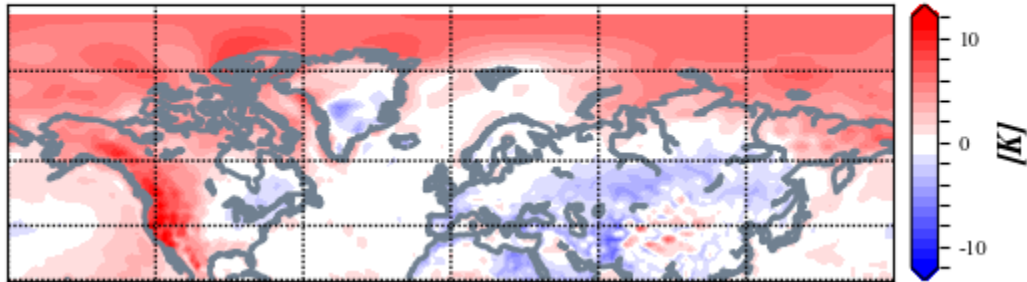


Figure 13. Forecasted average surface temperature anomalies ($^{\circ}\text{C}$; shading) across the Northern Hemisphere for September 2019. The forecasts are from the 26 August 2019 CFS.

Surface Boundary Conditions

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 14**). 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 25 Aug 2019

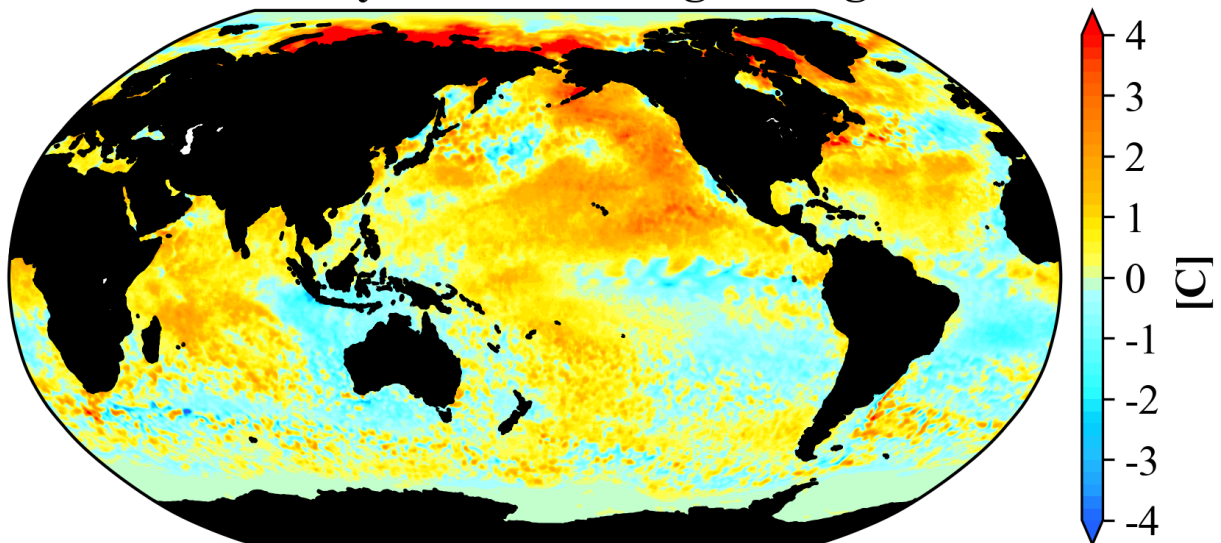


Figure 14. The latest weekly-mean global SST anomalies (ending 25 August 2019). Data from NOAA OI High-Resolution dataset.

Currently no phase of the Madden Julian Oscillation (MJO) is favored (**Figure 13**). The forecasts are for no phase of the MJO to be favored over the next two weeks. Little influence from the MJO is expected over the upcoming two weeks.

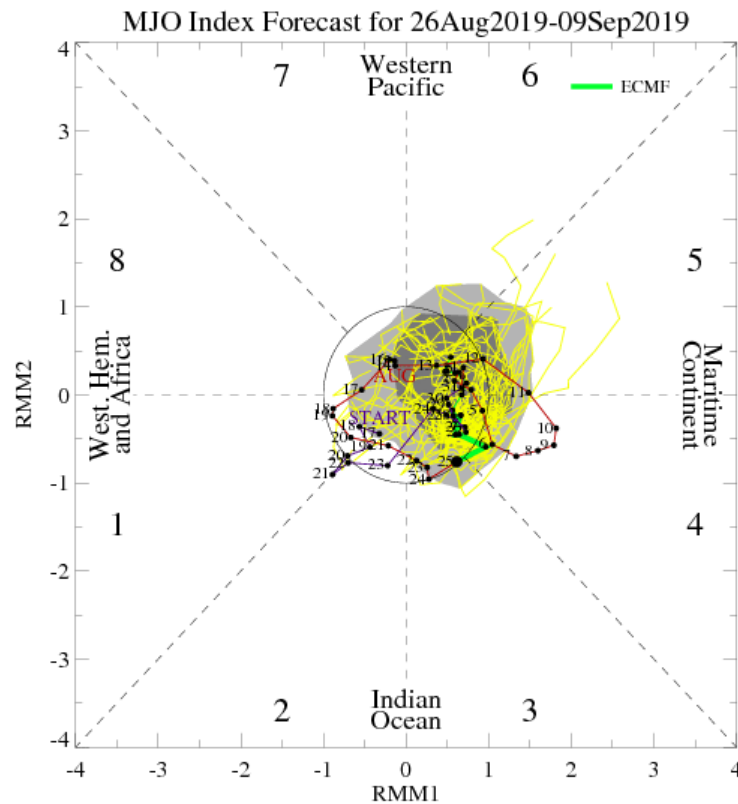


Figure 13. Past and forecast values of the MJO index. Forecast values from the 00Z 26 August 2019 ECMWF model. Yellow lines indicate individual ensemble-member forecasts, with the green line showing the ensemble-mean. A measure of the model "spread" is denoted by the gray shading. Sector numbers indicate 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>