Hi all,

Friday map discussion resumed last week. The focus was on a review of NH summer climate and TCS Jebi, Gordon, and Florence. Graduate students Will Flamholtz, Daniel Reese, and Minghao Zhou assisted with the discussion. The Friday map discussion web site is here: http://www.atmos.albany.edu/mapdisco/

1. Northern Hemisphere 2018 summer (JJA) climate (source: NOAA/ESRL/PSD):

NH 300-hPa mean and anomaly heights:
http://www.atmos.albany.edu/mapdisco/20180907/images/300Z_NH_JJA18.png and http://www.atmos.albany.edu/mapdisco/20180907/images/300Z_27_NH_JJA18_anom.png

NH 850-hPa mean and anomaly temperature:
http://www.atmos.albany.edu/mapdisco/20180907/images/850T_NH_JJA18.png and http://www.atmos.albany.edu/mapdisco/20180907/images/850T_27_NH_JJA18_anom.png

NH mean and anomaly SLP:
http://www.atmos.albany.edu/mapdisco/20180907/images/SLP_NH_JJA18.png and http://www.atmos.albany.edu/mapdisco/20180907/images/SLP_27_NH_JJA18_anom.png

The NH 2018 summer climate was dominated by above normal 300-hPa heights in higher middle latitudes and below normal 300-hPa heights over much of the Arctic. This height anomaly pattern is consistent with a poleward-shifted jet stream, persistent ridging in many areas to the south of the poleward shifted-shifted jet stream, and above normal temperatures over a wide swath of higher middle latitudes. The warmth was especially pronounced across southern Canada and the northern CONUS, and eastward from there to northern Europe.

A noteworthy aspect of the 2018 summer climate was the exceptionally high dew points in parts of the Northeast. A time series of the number of hours that the dew point temperature exceeded a certain temperature (courtesy of Iowa State University) shows that Albany exceeded 300 hours above the 70 F threshold in 2018. This number was the highest ever recorded in records that go back to 1973 (http://www.atmos.albany.edu/mapdisco/20180907/images/network_NY_ASOS__zstation_ALB__var_dwpf__dir_aoa__thres_70__month_all__year_2018__dpi_100.png). A similar 70 F dew point analysis at Montpelier (MPV), VT, shows that the 250+ hours of dew points at or above 70 F at this location in summer 2018 blew away the previous record of ~65 hours by a factor of four! So, if you know folks in that area of VT and they were complaining about how humid it was this summer they were not kidding (that said, a check of the dew point measurement from MPV might be in order, given the magnitude of this year's number of 70 F hours).

The NOAA NCEI depiction of the 2018 summer climate shows that the CONUS was 4th warmest on mean temperature, warmest on minimum temperature, and 11th warmest on maximum temperature, an ongoing pattern of warming at night relative to daytime with a consequent reduction in the diurnal temperature range. Precipitation was the 25th wettest nationally, but tended dry in the west and wet in the east with the biggest positive departure in the Northeast (12th wettest) thanks to very heavy summer rains in PA/WV/VA/DE.

NCEI CONUS temperature, precipitation, and drought:
https://www.ncdc.noaa.gov/temp-and-precip/ (choose national temperature and precipitation maps)

2. Tropical Cyclones:

We first focused on TC Jebi beginning with landfall in southern Japan on 4 Sep. TC Jebi subsequently underwent ET in conjunction with what looked to be a predecessor rain event over parts of Korea and coastal northern China. TC Jebi was also associated with multiple trough interactions during ET that also included trough-trough interactions. During ET, Jebi tracked poleward unusually far to the west (~ along 140 E). The remnants of Jebi reached the north coast of Russia on 8 Sep and entered the Arctic Ocean thereafter accompanied by a surge of 558–564 dam 1000–500-hPa thickness air. Jebi's poleward track contributed to downstream ridge building and discontinuous ridge retrogression over northeastern Russia on 9–10 Sep as is evident from Alicia Bentley's maps (http://www.atmos.albany.edu/student/abentley/realtime/standard.php?domain=pacific&variable=mslp_jet).

The downstream effects of the Jebi ET included trough development over the Gulf of Alaska, ridge development near 100 W, and downstream trough formation near 70 W during 7–9 Sep. The Jebi-induced downstream ridge development near 100 W and trough formation near 70 W resulted in a strong surface anticyclone development (~1030 hPa) over eastern Canada in a poleward jet-entrance region (http://www.atmos.albany.edu/student/abentley/realtime/standard.php?domain=northamer&variable=mslp_jet). By 10 Sep, a 1032+ hPa surface anticyclone center located over the Canadian Maritimes was emblematic of the strong atmospheric ridge building (aka "hurricane ridge" formation) that is forcing TC Florence to continue on a WNW track toward the U.S. mainland instead of recurving poleward. Hurricane ridges can act to preclude TC recurvature and ET in favor of a continued westward motion.

Another player in the aforementioned southeastern Canada ridging is the remnant of TC Gordon in the form of a weak surface cyclone located over Ohio at 1200 UTC 10 Sep. Warm-air advection ahead of the TC Gordon remnant beneath an equatorward jet-entrance region over New England and eastern Canada on 10–11 Sep will further amplify

the downstream southeastern Canada anticyclone. Cyclonic wave breaking over the Gulf of Alaska on 9–10 Sep is facilitating the warm-air advection ahead of the TC Gordon remnant in conjunction with a weak but progressive downstream low-amplitude Rossby wave train across the northern CONUS and southern Canada.

Map discussion concluded with a discussion of various ensemble model forecasts of the likely track and impacts on the U.S. The consensus was that a Florence landfall as a major hurricane on the southeastern coast of the U.S. was probable late this week. The forecast absence of any strong upstream trough anywhere near TC Florence and the presence of a hurricane ridge to the north to keep the storm tracking westward has huge inland flooding implications in addition to wind- and surge-related damage near and north of the coastal landfall location. Epic rains look to be possible in parts of the Middle Atlantic region later this week and weekend if TC Florence stalls over the region as predicted. Look for some state rainfall records to be approached or even exceeded with the potential for catastrophic inland flooding.

3. Science Issues:

a) TC Jebi ET:

Unusually complex trough-trough and TC-trough interactions look to have been associated with the ET of TC Jebi. Test the hypothesis that one outcome of these multiple interactions was that TC Jebi tracked unusually far to the west during ET and that the depth of the northern trough associated with the ET process permitted the remnants of TC Jebi to reach the Arctic Ocean.

b) Linkage of the Jebi ET to southeastern Canada ridge development:

Downstream ridge building over far eastern Russia, the Bering Sea, and western Alaska result from the ET of TC Jebi. Test the hypothesis that Jebi ET-induced omega block formation over far eastern Russia in conjunction with discontinuous ridge retrogression facilitated downstream trough development in the eastern Gulf of Alaska and the establishment of a weak, low-amplitude flow regime across the northern CONUS and southern Canada.

c) Role of TS Gordon remnant:

Weak flow established along the Canada-CONUS border in response to trough development in the eastern Gulf of Alaska resulted in a low amplitude ridge over Saskatchewan, a weak trough over the upper Midwest, and an amplifying ridge over eastern Canada by 1200 UTC 10 Sep. Test the hypothesis that weak trough formation over the upper Midwest facilitated the east-northeastward movement of the remnants of TC Gordon and the amplification of the downstream (hurricane) ridge over southeastern Canada through diabatically enhanced ridging.

d) Simultaneous active TCs across the Pacific and Atlantic basins:

The current level of TC activity in the Pacific and Atlantic Basins strikes me as somewhat unusual, although I don't have the data at my fingertips to quantify "somewhat unusual." That said, The North Atlantic seems to have woken up in conjunction with the arrival of a favorable phase of the MJO (but weak amplitude) and a relaxation of the anomalously cold SSTs in the MDR. Test the hypothesis that anomalously weak upper-level flow across lower middle latitudes in conjunction with an anomalously poleward-shifted jet stream favored a reduction of vertical wind shear in the MDR due to PV streamer activity (and the associated higher vertical wind shear) being displaced farther northward than usual. Test an additional hypothesis that non-MJO processes in the tropics may have facilitated late-summer TC development across the tropical and subtropical Pacific and Atlantic Oceans.

e) Florence epic rains:

Although the ultimate track and forward speed of TC Florence after landfall on the southeastern U.S. coast is still unknown, it seems to safe to say that the storm will meander between the coast and farther inland for days in conjunction with exceptional flood-producing rainfall that may challenge state rainfall records. Test the hypothesis that the presence of an intense "hurricane ridge" enveloping TC Florence and the absence of any significant "kicker" upstream trough will greatly facilitate what likely will be epic rains in parts of NC/VA/WV (and possibly elsewhere) due to the absence of strong steering currents on the southern and western side of the aforementioned hurricane ridge.

f) Arctic warm air intrusion:

The remnants of TC Jebi reached the Arctic Ocean by 8 Sep in conjunction with positive 850-hPa temperature and precipitable water anomalies between 3–4 sigma. Test the hypothesis this this surge of abnormally warm and moist air into the Arctic Ocean may have contributed to further late summer arctic sea ice loss north of far northeastern Russia and northwestern Alaska.

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