Hi all,

Friday map discussion for 28 Oct opened with a brief review of the Northeast snow event of 27 Oct by Philippe Papin and Lance. It was followed by a more substantive discussion of the continuing widespread autumnal warmth across much of the CONUS by Andrew Winters and Lance. Kyle Pallozzi and Lance discussed the continuing impact of the ET of TC Nicole and its subsequent reintensification as an explosive EC on the structure and evolution of downstream high latitude circulations across Eurasia and the North Pacific. Tomer Burg closed map discussion with a forecast for WS game #3. Discussion details and supporting graphics can be found here: http://www.atmos.albany.edu/mapdisco/20161028/

Please forgive more typos and disconnected or dangling sentences than usual. The text is being finalized while I am watching the Cubs-Indians WS game #4 (current score is 4–1 Indians in the middle of the 6th inning).

Lance

1. Northeast Snow Event of 27 October 2016:

Snow was slower to changeover to rain in the Hudson Valley than originally forecast. Accumulating snow resulted (1.7" officially at Albany Airport). The HRRR 2 h forecast sounding for ALB valid 1900 UTC (http://www.atmos.albany.edu/mapdisco/20161028/images/Philippe_sounding_breakdown.png) shows strong low-level warm-air advection below 700 hPa and saturated conditions (with respect to ice) in the dendritic growth zone between -12 and -17 C. The quasi isothermal lapse rate below 750 hPa suggests that melting snowflakes contributed to cooling the lower atmosphere and acted to offset warm-air advection. A radar reflectivity image from KENX at 1845 UTC shows that multiple bands of heavier precipitation were present across the region (http://www.atmos.albany.edu/mapdisco/20161028/images/KENX_1842z_27Oct2016.png). These heavier precipitation bands and the HRRR-forecast 1900 UTC sounding are suggestive that strong ascent was able to reach the dendritic growth zone. The associated cooling, reinforced by melting snow, acted to retard the eastward advance of the 0 C isotherm above the surface. Calm surface winds at KALB during mid afternoon (http://www.atmos.albany.edu/mapdisco/20161028/images/KENX_1842z_27Oct2016.png) were indicative of trapped low-level cold air in the Hudson Valley. The NCAR real-time ensemble forecast of SLP, 2-m temperature, and 10-m winds from 0000 UTC 27 Oct shows that secondary cyclogenesis began over southern Pennsylvania by 2100 UTC (https://ensemble.ucar.edu/images.php?d=2016102700&f=t2_mean&r=NE). This secondary cyclogenesis process provided a dynamical basis for the aforementioned retardation of the cold air over the Hudson Valley. A meteogram display from Voorheesville (a NY State mesonet station located ~20 km southwest of Albany) on 27 Oct 2016 nicely shows that pre-precipitation environmental conditions featured light easterly winds with gusts to 10 mph. Temperatures dropped to near 0 C and winds became very light northerly, indicative of trapped shallow cold air, after precipitation onset as the boundary layer stabilized (http://operations.nysmesonet.org/~nbassill/archive/2016/10/27/station/VOOR.png).

2. Widespread Continuing Autumnal Warmth:

Mean and anomaly maps of 300-hPa heights and 850-hPa temperatures for the NH for 1 Sep 25 Oct 2016 (http://www.atmos.albany.edu/mapdisco/20161028/images/300Z_NH_1Sep_25Oct16.gif; http://www.atmos.albany.edu/mapdisco/20161028/images/300Z_anom_NH_1Sep_25Oct16.gif; http://www.atmos.albany.edu/mapdisco/20161028/images/850T_NH_1Sep_25Oct16.gif; http://www.atmos.albany.edu/mapdisco/20161028/images/850T_anom_NH_1Sep_25Oct16.gif) suggest that the widespread warmth across the CONUS can be linked to anomalously strong flow at 300 hPa across the North Pacific, a time-mean trough near the Pacific Northwest, and anomalously high heights over eastern North America. This flow pattern enabled mild Pacific air to repeatedly overspread much of the CONUS. This Pacific air was further warmed and dried by subsidence east of the Rockies.

Maps of the corresponding SST and OLR anomalies over the North Pacific (http://www.atmos.albany.edu/mapdisco/20161028/images/850T_anom_NH_1Sep_25Oct16.gif and http://www.atmos.albany.edu/mapdisco/20161028/images/OLR_anom_TropPac_1Sep_25Oct16.gif) show that SSTs were anomalously positive (warm) almost everywhere with the exception of from the vicinity of the Dateline eastward along the equator, and that anomalous deep convection (negative OLR anomalies) was present between 10–15 N across almost all of the North Pacific east of 160 E. The combined SST and OLR anomaly patterns are La Nina-like along the equator and El Nino-like almost everywhere else. So, are we "prisoners" of our equatorial-based ENSO definition which screams La Nina onset while the observed OLR and SST anomaly patterns scream some semblance of continuing El Nino conditions? Either way, the anomalously positive SSTs and anomalously negative OLR values across the central and eastern North Pacific in conjunction with anomalously positive (warm) 850-hPa temperatures over much of the central and eastern North Pacific suggest that Pacific air masses that have reached North America so far this fall have been further warmed by anomalous upstream diabatic process in the troposphere.

3. North Pacific Jet Phase Diagrams:

Andrew Winters introduced his North Pacific Jet (NPJ) phase diagrams (http://www.atmos.albany.edu/facstaff/awinters/realtime/Deterministic_NPJPD.php). Andrew created these phase diagrams, which are based on the GEFS runs from 0000 UTC, as part of a NOAA funded research project with Dan Keyser and me. The overarching idea behind NPJ phase diagrams was to do two things: (1) create a phase space defined by two principal components (PC1 and PC2) that measured NPJ extension and retraction (PC1) and the poleward and equatorward shift of the NPJ (PC2), and (2) and display the PC1-PC2 phase space alongside of maps of (a) 250-hPa winds/heights and standardized height anomalies, (b) SLP, 1000–500 hPa thickness, and standardized 850-hPa temperature anomalies, and (c) 24 h precipitation amount forecasts out to 9 days. I have to see something on a weather map before I am going to believe it. By plotting the PC1-PC2 phase space together with weather maps over the North Pacific and North America it's possible to obtain a greater understanding of what is happening than by examining wither the PC1-PC2 phase space or the weather maps alone.

An illustrative slide set prepared by Andrew that explains the computational basis for his NPJ phase space and references to original pioneering research on this subject by Athanasiadis et al. (2010), Jaffe et al. (2011), and Griffin and Martin (2016) can be found here: http://www.atmos.albany.edu/mapdisco/20161028/images/WintersPPT.pdf. The NPJ phase space analysis based on the GEFS run from 0000 UTC 29 Oct shows that the GEFS mean (white diamonds shifts poleward and then eastward over the next 9 days, indicative of a poleward-shifted and zonally extended NPJ in the GEFS forecast. A poleward-shifted and zonally extended NPJ is typically associated with above normal temperatures and below normal precipitation over the CONUS as is evident from the GEFS loops SLP/thickness and 24 h accumulated precipitation. The forecast probability of a point within the phase diagram lying within a radius of 0.25 PC units of the verification at any time in the 9-day forecast is shaded following the color bar on the right side of the PC1-PC2 phase space. The relatively tight clustering of the forecast probabilities through most of the forecast period is indicative of a relative high confidence forecast.

4. The Continuing Influence of TC Nicole's ET and Explosive Reintensification as an EC on the Downstream Flow over Eurasia and the North Pacific:

Alicia Bentley's NH maps of: (1) SLP, 1000–500 hPa thickness, and 150-hPa wind speeds (http://www.atmos.albany.edu/student/abentley/realtime/NH_mslp.php), dynamic tropopause potential temperature and winds, and 925–850 hPa layer-mean relative vorticity (http://www.atmos.albany.edu/student/abentley/realtime/NH_dt.php), and 500-hPa heights, winds, temperatures, ascent, and relative vorticity (http://www.atmos.albany.edu/student/abentley/realtime/NH_rel.php) can be used to follow the ET of TC Nicole and its subsequent explosive reintensificiation as an EC along the east coast of Greenland (17–20 Oct). This EC is reinforced from the south by a second EC that tracks northeastward across the Great Lakes and eastern Canada (18–21 Oct). Meanwhile, a new EC emerges from the eastern side of the original EC near eastern Greenland and transits the Arctic Ocean to northern Russia (20–24 Oct). The associated band of strong trans-Arctic flow in which this EC is embedded (best seen at 0000 UTC 22 Oct) displaces the polar vortex toward the north side of Alaska as a strong closed 576 dam blocking anticyclone forms along the coast of extreme northwest Russia by 1800 UTC 22 Oct (standardized 500-hPa height anomalies in this blocking anticyclone are between 3–4 sigma; http://www.atmos.albany.edu/student/abentley/realtime/NH_500ganom.php).

A 500-hPa trough embedded in this trans-arctic flow deepened equatorward into an existing 500-hPa trough located near 90 E between 23–24 Oct. This trough, situated over northern Russia, marked the western end of a persistent cold pool that has been present over higher latitude central and eastern Asia since late September. The aforementioned 500-hPa trough also served as a catalyst and western anchor for a progressive Rossby wave train (RWT) that emanated eastward along 50 N after 25–26 Oct as a closed anticyclone became established over the North Pole by 1200 UTC 28 Oct. The establishment of this progressive RWT near 50 N looks to be associated with the onset of a strong zonally oriented jet stream that steadily elongates eastward across the North Pacific. This zonally oriented jet stream is forecast (GFS run from 0600 UTC 29 Oct) to reach the west coast of North America near 0000 UTC 3 Nov while a massive upper-level anticyclone is forecast to strengthen over central North America in the middle and latter part of next week. This flow pattern, if it verifies, will continue the warm and dry regime over much of the CONUS that has persisted this autumn (recall section 2 above). This observed sequence of high-latitude flow pattern events raises the question as to whether a weak sudden stratospheric warming (SSW) event could occur next week and, if so, whether it would be one of the earliest SSW events on record. An obvious science question is what role former TC Nicole played in catalyzing this unfolding sequence of events and how well these events were forecast. TC Nicole (the "I ain't got no respect TC" with apologies to Rodney Dangerfield) played second fiddle to TC Matthew, weakened subsequently and then restrengthened into a TC again, brought heavy rain into parts of coastal eastern Greenland, absorbed one EC, birthed another, and then catalyzed the formation of the aforementioned trans-arctic flow and associated high-latitude blocking anticyclone. Sure sounds like an interesting multiscale research project opportunity to me.

5. World Series Game 3 Forecast:

Tomer Burg led a brief discussion of the forecast for WS game #3. The weather would be fine and there would be a SW wind of 10–15 kt. A SW wind at Wrigley Field is blowing out, I, and a few unnamed others, predicted there would be lots of home runs with the wind blowing out. Game result: Indians 1 and Cubs 0. I should stick to trying to forecast the weather.

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6. A South American Postscript:

A cyclogenesis event occurred over central South America between 23–28 October (see Alicia Bentley's maps (http://www.atmos.albany.edu/student/abentley/realtime/southamer.php) provided a comparatively rare opportunity to examine terrain-influenced phasing of two troughs (PV anomalies). [A longer loop of 500-hPa geopotential heights, temperatures, winds, and relative vorticity can be found here: http://www.atmos.albany.edu/student/abentley/realtime/southamer.php]. Be ginning around 16 Oct, a series of upper-level disturbances/subsynoptic scale cutoff cyclones, formed off the northern coast of Chile, and crossed the Andes. One of these disturbances weakened as it crossed the Andes and sheared out in zonally oriented flow east of the Andes (e.g., 19–20 Oct) while another disturbance survived the transit across the Andes relatively intact (e.g., 25–26 Oct). The latter disturbance is of interest because once it was east of the Andes the upstream large-scale flow amplified as a high-latitude ridge formed over southern South America. Tis ridge amplification enabled a weak disturbance that crossed the Andes near 50 S near 1800 UTC 25 Jan to deepen northeastward along the coast of Argentina. By 1200 UTC 26 Oct, this northeastward-moving disturbance was strengthening as it began to interact with the aforementioned subsynoptic-scale cutoff cyclone located to the north near 30 S.

Between 1200 UTC 26 and 27 Oct, these two 500-hPa disturbances quasi-phased with one another and resulted in a strong sub 984 hPa surface cyclone just east of Uruguay. The evolution of potential temperature on the DT (2 PVU surface) nicely shows the interaction and quasi-phasing of the two aforementioned disturbances in what was a cyclonic wave breaking event. The convectively driven nature of the cyclogenesis event is readily apparent in the strongly divergent ("starburst") pattern of the 300–200 layer-mean irrotational wind vectors at 1200 and 1800 UTC 27 Oct (maximum PW values were between 50–55 mm, indicative of the importance of Amazonian moisture transport associated with the northern sub synoptic-scale cutoff cyclone to the cyclogenesis process). Interestingly, the coupling index (850 hPa equivalent potential temperature minus the potential temperature on the DT) was between 0 and -5 (-5 and -10) for the southern (northern) disturbance, indicative of deep instability. For anyone interested in studying topographic influences on the quasi-phasing of two PV anomalies east of a major mountain barrier in the presence of deep instability and tropical moisture this would be an excellent case to scrutinize in detail. A testable hypothesis is that the quasi-phasing of the two PV anomalies was facilitated by a northern disturbance that provided a source of tropical moisture, modest baroclinicity, and unstable air and by a southern disturbance that provided a stronger baroclinic environment, additional unstable air, a lower DT height, and more concentrated cyclonic vorticity.

Lance