HMT-SE/Sept 26 – Oct 1, 2010 Carolinas Flooding Event Tele-meeting

Friday, October 15 2010: 10am MDT/12pm EDT

Meeting notes

1) Greetings/introductions, meeting purpose

a) HMTSE Planning Efforts Update: Tim Schneider
   i.) The HMT-SE effort is in the midst of developing science and implementation plans.
   ii.) The high-impact storms and associated flooding provide perspective to inform the HMT planning process, and good examples and material to support the plans.
   iii.) In addition to underscoring the need for the Hydrometeorology Testbed, this event provided the HMT community (operations and research) with an opportunity to come together and focus on a high-impact event (team-building).

2) Southeast WFO Perspective

NB: Some notes on remarks by J. Blaes and R. Bandy (recorded by T. Schneider).

a) WFO RAH: Jonathan Blaes (SOO), Darin Figurskey (MIC): Event summary, challenges and forecast issues
   i.) Extra staffing was required to handle this event, which included multiple rounds/waves of precip leading to river flooding (the lower basin was a challenge).
   ii.) Overall forecast guidance was good, but QPF amounts were in question
   iii.) Radar precip estimates struggled

b) WFO MHX: Richard Bandy (MIC): Effects of flooding; needs identified
   i.) This was a long-duration event that was split into two systems. It was clear that there would be widespread rain, but a key forecast challenge arose: Would the rain split and move inland or stay along the coast?
   ii.) Began with "areal warnings" and then switched to flash flood warnings; radar estimates were generally good; but the MM-EFS guidance was a somewhat unclear
   iii.) CI-FLOW output was evaluated – a lot of potential but was not robust enough. Also there are no rating curves for all locations and there were problems with the initializations (usually too high)
   iv.) Several river gages are in poor locations along Swift and Tanters Creeks. This led to confusion in actual water levels

c) WFO ILM: (Slide from Reid Hawkins, Rick Neuherz)
   i.) We have no tools that give multi-day basin precipitation estimates in real-time (FFMP does 24 hours or less, MPE does multi-day but there is a 30 minute to 1.5 hour delay depending on whether we use our MPE or SERFCs.
   ii.) We have no tools for forecasting or monitoring water level on most small streams or tidal creeks (Lockwood Folly River is essentially a large tidal creek) in the area.
   iii.) We need more accurate precip estimates, either from radar, gage, or both.

3) NOAA-ESRL event summary: Synoptic set-up and model performance

a) Tom Galarneau, Ben Moore (synoptic overview)
   i.) Strong, deep synoptic-scale trough over Appalachians provided deep, moist southerly flow and strong forcing for ascent over coastal regions setting the stage for heavy rains
   ii.) Heaviest rainfall focused near coastal zones in vicinity of well-defined coastal front
   iii.) Deep tropical moisture advected poleward ahead of the remnants of Nicole enhanced a second batch of precipitation over the NC/SC/VA region (a pseudo-predecessor rain event)

b) Tom Hamill (EnKF results/model performance)

i.) EnKF-based ensembles provided evidence of a major east-coast heavy precipitation event as early as 3–5 days prior
ii.) Short-lead EnKF ensembles did reasonable with maximum precipitation amounts, but tended to place the heaviest precipitation axis too far west
iii.) EnKF ensemble members tended to overdevelop either Nicole or the baroclinic cyclone along the NC/SC coast, whereas both systems remained weak in reality

4) RENCI: Local model performance

a) Brian Etherton: Model performance of 4km ensemble and 3km HUR-NC
   i.) 4km ensemble showed narrow bands of precipitation in eastern NC
   ii.) 3km HURNC projected large (10-inch) precipitation totals in eastern NC
   iii.) 3km DAILY-WRF showed large (6cm) precipitable water values in eastern NC

5) University Perspectives: NCSU, ECU: Event dynamics, research directions

a) Gary Lackmann (Moisture transport, PV analysis of event)
   i.) Event exhibited very similar moisture transport mechanism to Tennessee flood of May 2010, along with west-coast atmospheric river events- diabatically forced low-level jet key to moisture transport
   ii.) A key question how well did the models handle the moisture flux and diabatic PV forcing?
   iii.) Did this event have a PRE? We need to run a numerical experiment to isolate the PV (PV inversion) and remove it and then re-run the simulation The TC circulation was sufficiently weak that the event was not a PRE in the classic sense. Label is not all that important to dynamics of event anyhow.
   iv.) The GFS missed the remnants of TS Nicole, but surprisingly the NAM got it (usually reversed)

b) Tom Rickenbach (Rain gage/NEXRAD rain totals; flood photographs)
   i.) Both NEXRAD and gage rain totals for the six-day event gave a consistent picture of the large spatial gradient of rainfall across Pitt County (centered at Greenville).
   ii.) Suggests that the NEXRAD network captured mesoscale rain variability from this extreme rainfall event for inland eastern North Carolina.

6) Southeast River Forecast Center perspective

NB: Some notes on remarks by J. Dobur (recorded by T. Schneider).

a) Jeff Dobur (SERFC Senior Hydrologist)
   i.) Initial estimates were that this was a 50-100 year return period storm (some places worse): There were 10 minor, 2 moderate and 3 major river events. Generally they did well on the Neuse, but had two big challenges in Windsor (80% downtown underwater) and Lumberton, where they "chased the hydrographs up" (headwater points; gage calibration; and limited rain gage data were issues).
   ii.) A lot of rivers were at base (low) flow, this helped. Also, in the initial storm, the focus of the precip was in the lower basin so there was not much residual runoff.
   iii.) The RFC is receiving increased number of requests for forecasts in the coastal plain.

---

7) Discussion

a) How does this event fit into the goals of HMT-SE?
b) What were the key forecast issues/challenges?
c) What are the most pressing scientific questions that a case like this highlights?
d) Where is research best directed with respect to numerical modeling?
e) If future observations and research are to be focused on similar events, what are some good strategies for doing so?

8) Future directions

- Overall agreement that event was generally well-forecast, well-observed – no need to over-analyze this particular case, but rather can use it as a good example of a recent representative high-precip event; may be useful to HMTSE planning focusing/feedback .
- Future modeling studies may evaluate kinematic vs. thermodynamic role of TC Nicole, possible presence of a PRE, identification/quantification of various moisture sources.

9) Post –meeting thoughts, input:

a) Possible to evaluate the QPF's more quantitatively? (Marty Ralph) (Ellen Sukovich has been working on QPF verification…)

b) Follow-up thoughts from Brian Colle (SUNY - Stony Brook):

i.) Medium range predictability:

(1) This event was triggered in part as a result of a wave packet that started with TC Malakas. How the global models handled this packet for the day 5 forecast was critical. ECMWF was not bad, but GFS had a spike in the 500Z day 5-6 error for the end of Sept with this event.
(2) Stony Brook working with automated Rossby wave packet tracking code to investigate whether these wave packets improve or hurt predictability on the medium range, and should forecasters pay attention to these larger-scale features (in addition to other features such as TC Nicole, etc...).

ii.) No mention of NCEP SREF on call:

(1) Unsure of SREF performance in NC, but SREF did a very good job for the heavy qpf up in the mid-Atlantic region even for t ~48 h, with probabilities greater than 2" > 60-70%, which yielded confidence for a high qpf event, especially combined with Rich Grum's anomaly stats: http://nws.met.psu.edu/severe/2010/30Sep2010Flood.pdf
(2) Sure, the SREF can not get the 15-20" amounts observed, but this is really a function of grid resolution and some other bias issues, which brings up my next point.

iii.) Ensembles have biases

(1) … and thus need to be calibrated. This case represents the classic problem in which we have no good data to calibrate, since it is such an extreme event. At Stony Brook, we run an ensemble bias correction (Hamill's CDF approach) and Bayesian Model Averaging calibration, but when run in the typically past 40-d mode, it actually made the ensemble QPF slightly worse for this flooding event.
(2) For the community to get a more realistic ensemble post-processing for extreme events, it will require running at least 10-15 (preferably more) heavy precip events from the past to

calibrate. As it stands now, there are some serious under- and over- predictions for the ensemble members, which do not magically cancel, and thus the ensembles are severely underdispersed. We have shown that this underdispersion can be fixed using BC and BMA, but it requires an appropriate training dataset.

iv.) Real-time operational ensemble concerns

(1) It is neat that many offices are contributing members for HMT-SE, but as Tom Hamill noted, we may be causing more harm than good at times. Boundary cond. issues are huge, plus the whole idea of just randomly throwing ensemble members into the pot and hoping for a diverse solution is sort of like shooting in the dark, and likely results in underdispersion. The largest benefit is that this gets forecasters thinking about ensembles and allows them to contribute, but the ensemble may not verify well when put up against some probabilistic verification over several events. We'll see I guess...

v.) ALPS software

(1) We have collaborated with a few forecast offices to get ALPS working on a Linux workstation in their offices. The instructions link are on the front of our CSTAR page: http://dendrite.somas.stonybrook.edu/CSTAR/cstar.html

(2) We also have a recorded go-to-meeting tutorial given by Paul Schultz, which is on our CSTAR site: http://dendrite.somas.stonybrook.edu/CSTAR/Tutorials.html

(3) As far as I understand, AWIPS-II release will NOT have any ensemble stats capabilities for the foreseeable future, so it will be ALPS. However, the big problem now is that the WFO bandwidth is not large enough to get the SREF data and other ensembles. We now have to wait to March2011 for this next bandwidth upgrade. The other option is to truncate the grids so they come in faster. At those WFO's co-located with universities, this may be less of an issue, but for most WFOs, bandwidth is probably the top three reasons why ensembles are not used in operations as much as they could be.

vi.) Additional interesting science and operational questions:

(1) This would be a good case to look at ensemble data assimilation and therefore ensemble sensitivity as done by Ryan Torn and others. We plan to look at some snow banding sensi up here in the NE with our CSTAR, but it would be nice to collaborate with getting this tool working for other extreme events as well on the East Coast. As you know, forecast sensitivity analysis provides an objective means of evaluating how initial condition errors affect a forecast and where to gather additional observations to reduce forecast errors.

(2) When some of the multi-sensor sfc precip maps were shown, it seemed like the precip enhancement began right at the coast and seemed to follow the coastline. Perhaps this was an artifact of the processing, but it seemed to suggest some sort of land-water frictional convergence lifting, rather than just the coastal frontal circulation. We have found up here on LI that differential friction can be important in enhancing the coastal precip: Colle, B. A., and S. E. Yuter, 2007: The impact of coastal boundaries and small hills on the precipitation distribution across southern Connecticut and Long Island, New York. Mon. Wea. Rev., 135, 933954. http://journals.ametsoc.org/doi/pdf/10.1175/MWR3320.1

(3) We had an extensive CSTAR exchange on this event for the PA, NJ, and NY areas. There were lots of forecaster temptations to do deterministic model chasing and argue for flip-flopping, etc... when in reality the ensembles had a pretty good handle. Rich Grumm and Jun Du came up with the following forecaster chant during the event: "May my mind grant the the serenity

to know that no model is perfect and grant me the serenity to leverage the probabilities and the ability to know where ALL the possibilities are and not chase any single model or model cycle or single outcome." Clearly, more training and WES cases are needed for these high QPF events and ensembles.