Transitioning Research to Operations at NCEP's Hydrometeorological Prediction Center

Faye E. Barthold[1,2], David R. Novak[1], Michael J. Bodner[1], and Thomas E. Workoff[1,3]

[1] NOAA/NWS/NCEP Hydrometeorological Prediction Center, College Park, MD [2] I.M. Systems Group, Inc., Rockville, MD [3] Systems Research Group, Inc., Colorado Springs, CO

NOAA Hydrometeorological Testbed at the Hydrometeorological Prediction Center (HMT-HPC)

Established in 2009 to accelerate the transfer of scientific and technological innovations into operations to enhance HPC's products and services

http://www.hpc.ncep.noaa.gov/hmt/index.shtml

HMT-HPC Winter Weather Experiment

The Winter Weather Experiment was established to support improvements in HPC's winter weather forecasts. In its first two years the experiment has hosted 25 visiting forecasters, researchers, and model developers with 7 different HPC forecasters serving as weekly facilitators. The focus of the experiment has varied from exploring the role of high resolution convection allowing models in improving forecasts of precipitation type, snow and freezing rain accumulations, and mesoscale snowbands (2011), to exploring methods to better quantify and communicate uncertainty through an exploration of multiple ensemble systems (2012, 2013).

Operational Impacts:

- 4 km NAM CONUS nest added to the Winter Weather Desk blender
- Parallel SREF tested extensively prior to operational implementation
- 4 km convection-allowing ensemble from the Air Force Weather Agency (AFWA) available to NCEP centers
- Exposed forecasters to cutting-edge tools and techniques

Figure 1. Participants at the 2012 HMT-HPC Winter Weather Experiment.

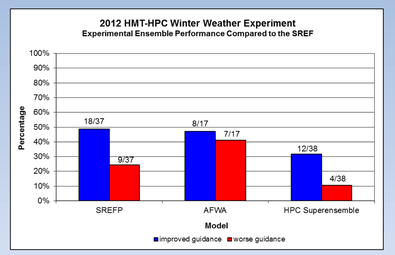


Figure 2. Subjective evaluation results from the 2012 Winter Weather Experiment. Participants were asked to compare the ensemble mean snowfall forecasts from the experimental ensembles to the ensemble mean snowfall forecast from the operational SREF.

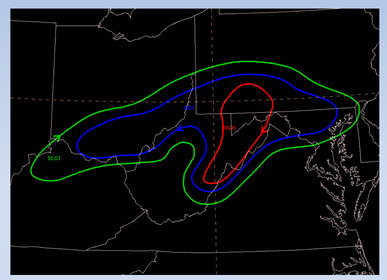


Figure 3. Example of an experimental probabilistic snowfall forecast.

QPF Component of the HWT Spring Experiment

Despite considerable model advances, warm season QPF continues to be a significant forecast challenge. In 2010 and 2011, HMT-HPC collaborated with the Hazardous Weather Testbed (HWT) to add a QPF component to their annual Spring Experiment. The QPF component explored the use of high resolution convection-allowing models and ensembles to improve warm season QPF.

Operational Impacts:

- Increased use of high resolution guidance by HPC QPF forecasters
- Increased availability of high resolution models at HPC
- High resolution "poor-man's" ensembles can be both operationally viable and provide valuable forecast guidance

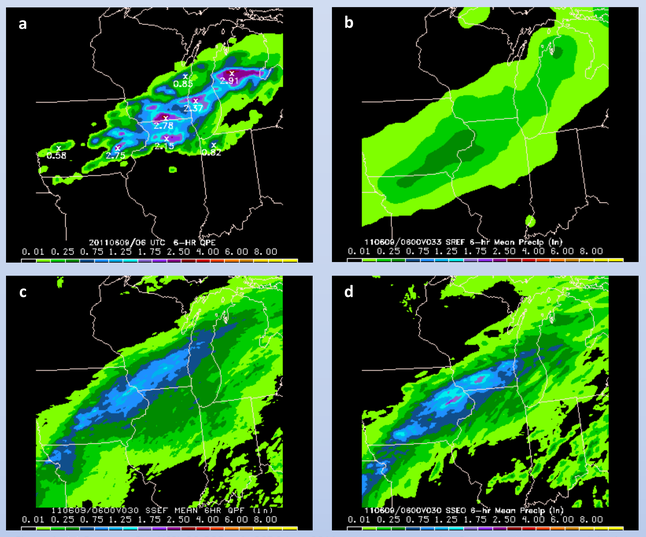


Figure 4. (a) Observed 6 hr NSSL Q2 QPE valid 06Z 9 June 2011 and the corresponding 6 hr ensemble mean precipitation forecasts from the (b) SREF, (c) Storm Scale Ensemble Forecast system (SSEF, 50 members), and (d) Storm Scale Ensemble of Opportunity (SSEO, 7 members).

Atmospheric River Retrospective Forecasting Experiment

In September 2012, HMT-HPC hosted the Atmospheric River Retrospective Forecasting Experiment. This experiment focused on the predictability of west coast heavy rain events at 3-5 day lead times with a particular focus on the utility of the 2nd generation reforecast dataset from the Earth Systems Research Laboratory (ESRL) and high resolution ensembles.

Operational Impacts:

- HPC actively pursuing real time access to reforecast dataset
- Use of high resolution guidance encouraged because of improved topographic representation

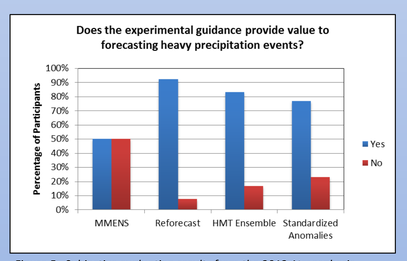
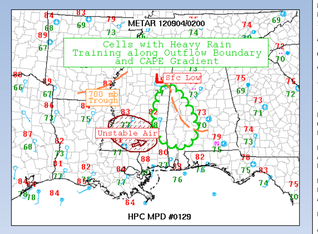


Figure 5. Subjective evaluation results from the 2012 Atmospheric River Retrospective Forecasting Experiment.

MetWatch Desk Prototype

During the summer of 2012, HMT-HPC helped prototype a new "meteorological watch" function at HPC. The proposed new forecast desk would be responsible for the 24/7 issuance of short-term event-driven Mesoscale Precipitation Discussions (MPDs), with the goal of providing enhanced situational awareness of potential flash flood events. The desk is currently scheduled to become operational in Spring 2013.



MESOSCALE PRECIPITATION DISCUSSION 0129
NWS HYDROMETEOROLOGICAL PREDICTION CENTER COLLEGE PARK MD
1115 PM EDT MON SEP 03 2012

AREAS AFFECTED...WESTERN AL/EASTERN MS

CONCERNING...HEAVY RAINFALL...FLASH FLOODING POSSIBLE

VALID 0403102 – 0407002

PROTOTYPE FORECAST ONLY – THIS IS ONLY A TEST

...EXCESSIVE RAINFALL THREAT FROM TRAINING CELLS IN WESTERN ALABAMA AND FAR EASTERN MISSISSIPPI...

HEAVY RAIN INGREDIENTS APPEARED POISED TO CONVERGE ON A RELATIVELY FOCUSED AREA IN WESTERN AL/FAR EASTERN MS. ONGOING CONVECTION HAD ESTABLISHED A N-S ORIENTED BOUNDARY RUNNING ROUGHLY PERPENDICULAR TO AN INFLUX OF UNSTABLE LOW LEVEL AIR FROM THE WEST. CORFIDI VECTORS FAVOR SOME BACKWARD PROPAGATION INTO THE INSTABILITY MAXIMUM OVER WEST CENTRAL/SOUTHWEST ALABAMA AND ADJACENT BORDER COUNTIES IN MISSISSIPPI THE NEXT FEW HOURS.

LIFTING WILL ALSO BE SUSTAINED BY A LOW TO MID LEVEL SHORT WAVE TROUGH...ROUGHLY 750 MB...WHICH APPEARED IN THE QPF SIGNAL FROM SEVERAL MODELS...AND WAS ANALYZED AT 002 MOVING OUT OF EASTERN ARKANSAS. THIS TROUGH MAY BE RESPONSIBLE FOR RECENT UPSWING IN ORGANIZATION NEAR PICKENS COUNTY WITH CELLS FEEDING IN FROM THE WNW. THE NSSL WRF DEPICTS THE CURRENT SCENARIO VERY WELL...AND TAKES A SWATH OF HEAVY RAIN SOUTHWARD ALONG THE STATE LINE.

INTENSE RAIN RATES ASSOCIATED WITH A TROPICAL-LIKE THERMODYNAMIC SETUP...RAISES CONCERNS FOR ORGANIZED LOCAL FLOODING...ESPECIALLY IN URBAN CENTERS...WHILE PROGRESSION OF THE SHORT WAVE AND CONTINUED COLD POOL PRODUCTION SHOULD PROVIDE SOME IMPETUS FOR HEAVY RAIN TO PERSIST NO LONGER THAN 1-2 HOURS AT ANY 1 LOCATION.

BURKE

ATTN...WFO...BMX...MOB...JAN...

Figure 6. Example of a Mesoscale Precipitation Discussion issued during the MetWatch Desk prototype.

Object-Oriented Verification

Since 2010, HMT-HPC has been using the Method for Object-Based Diagnostic Evaluation (MODE) tool to verify 24 hour precipitation forecasts. The MODE tool is an object-oriented verification technique developed by the Developmental Testbed Center (DTC) that provides additional information about why a forecast was correct or incorrect (spatial displacement, axis angle difference, etc.). MODE verification is available daily at HPC through an internal website.

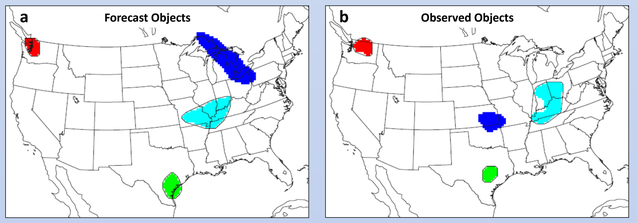


Figure 7. Example of precipitation objects identified in the (a) forecast and (b) observed fields. Dark blue objects are unmatched, indicating that a corresponding object could not be found in the other field. All other objects are matched with the object of the same color in the other field.

CSTAR Collaboration

Through the Collaborative Science, Technology, and Applied Research (CSTAR) Program, HMT-HPC is working with Stony Brook University (SBU) to identify tools to improve forecasts of high impact weather. As part of this collaboration, a Rossby Wave Packet tool developed by SBU has been transferred into HPC operations, and the 2013 Winter Weather Experiment will explore SBU's ensemble sensitivity analysis tool.

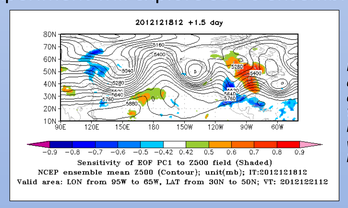


Figure 8. Example of SBU's ensemble sensitivity analysis tool indicating sensitive regions at Day 1.5 associated with a forecast low over western New York on Day 3 (not shown). Cool (warm) colors indicate that lower (higher) heights in that region will result in a shift in the position of the forecast low.