7B.8

Supplemental NWP for the Hydrometeorological Testbed Project

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1. Introduction

The Hydrometeorological Testbed (HMT) project is a NOAA activity aimed at developing observation and modeling strategies for high-impact hydrological events. Please refer to http://hmt.noaa.gov. The current field phase of HMT is focused on the American River Basin (ARB) above Sacramento, CA (Fig. 1). The ARB is on the windward (westward-facing) slopes of the Sierra Nevada mountain range, and precipitation that falls there is the primary water supply for a substantial portion of the agricultural Central Valley of California, as well as the city of Sacramento.

The role of the Global Systems Division (GSD) of ESRL is to provide real-time numerical model support to complement the NAM, RUC, and GFS services provided by the National Weather Service. In particular, HMT provides a platform to test the quality and value of multiple high-resolution mesoscale models (i.e., various configurations of the WRF model) and ensemble postprocessing methods to generate unbiased quantitative precipitation forecasts (QPF) and well-calibrated probabilities of precipitation (PQPF) in excess of multiple thresholds.

This winter marks the second season of GSD participation in the HMT project. In the first season, also conducted in the ARB, the model forecasts and verifying precipitation observations from several IOPs were used to retrospectively test various combinations of physical parameterizations, initializations, and lateral boundary sources to optimize the ensemble makeup. This was also the process for computing the weights on the ensemble members which were used in real time for this winter's operations.

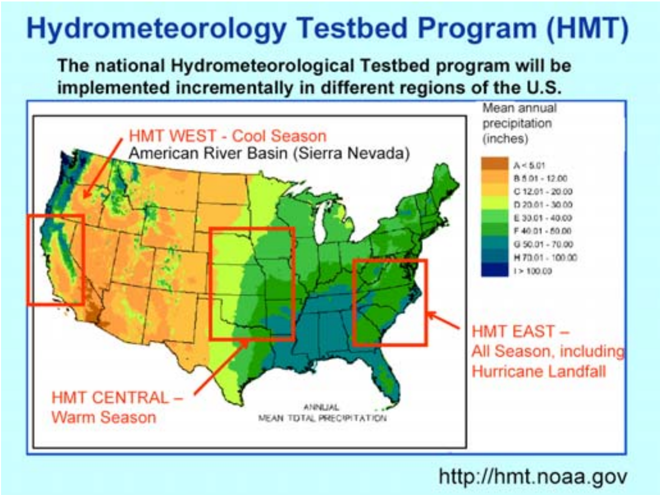

Figure 1. Areas of activity in the HMT program. The current focus is the western region (outlined), which encompasses the American River Basin.

This talk focuses on ensemble modeling strategies for specific regional phenomena, using the HMT experience along with the results from other fields projects to guide the development of tailored numerical predictions systems.

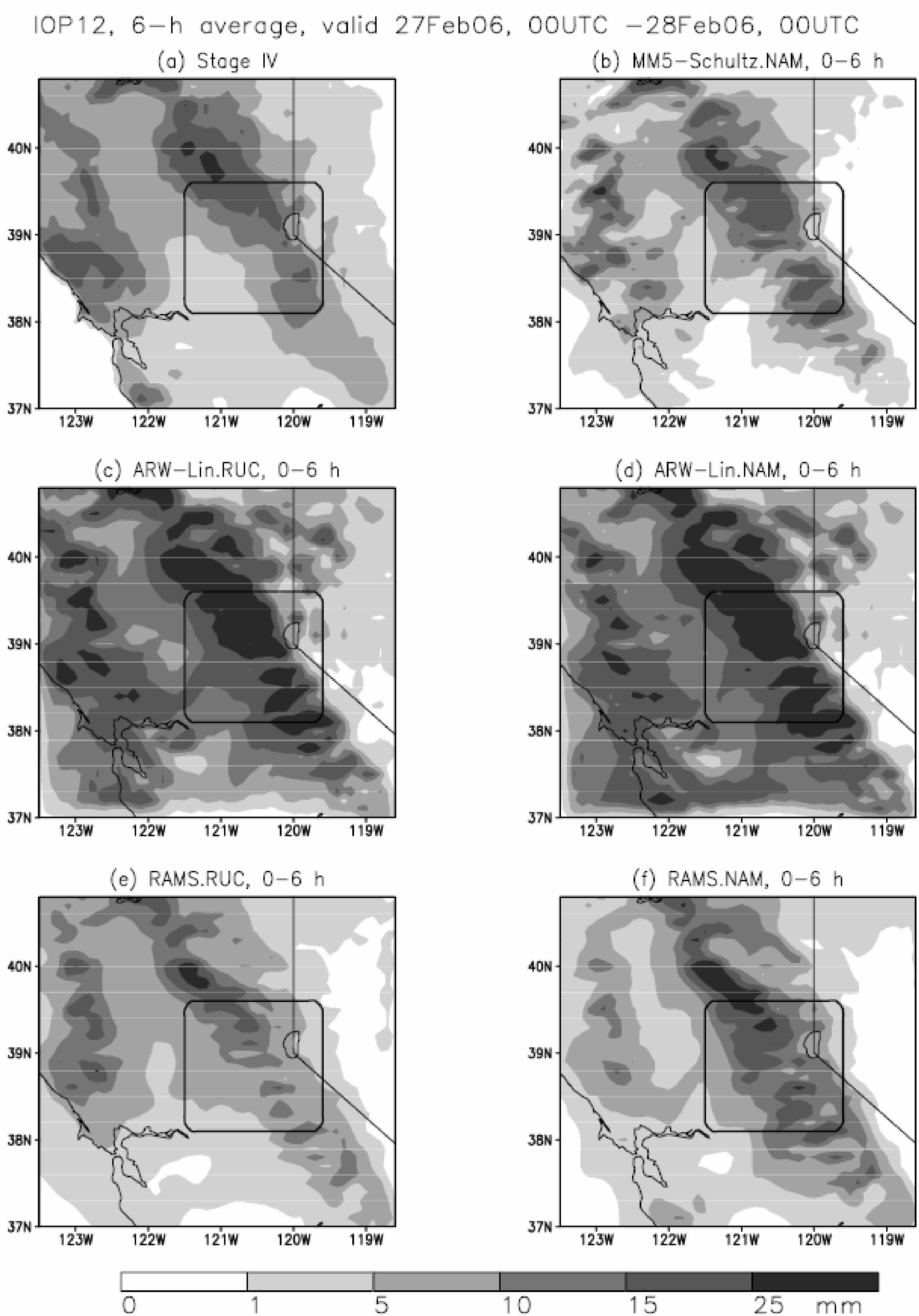
IOP12, 6-h average, valid 27Feb06, 00UTC -28Feb06, 00UTC
(a) Stage IV
(b) MM5-Schultz.NAM, 0-6 h
(c) ARW-Lin.RUC, 0-6 h
(d) ARW-Lin.NAM, 0-6 h
(e) RAMS.RUC, 0-6 h
(f) RAMS.NAM, 0-6 h
40N
39N
38N
37N
123W
122W
121W
120W
119W
0
1
5
10
15
25
mm

Figure 2. Model output for a case study from HMT-West 2006. a) 6-hr precipitation analysis, b-f) 6-hr precipitation forecasts from the ensemble models. The labels on panels b-f identify the model, the microphysics option used, and the model that provided the lateral boundary conditions.

2. Modeling strategy for HMT-West 2006

For the first field campaign, which ran from December 2005 to March 2006, the ensemble consisted of members based on MM5, RAMS, and WRF (Fig. 2). The models all used the same 3-km grid increment, grid size and geometry, and initialization. The ensemble dispersion was provided by a variety of microphysics parameterizations, two different boundary layer parameterizations, and two different lateral boundary sources (RUC and NAM, as provided by NCEP). The ensemble was run out to 15 hours, to provide 12-h forecast service after postprocessing time delays, and executed every three hours. Time-lagging methods were used to increase the ensemble size.

One of the important goals of the supplemental NWP effort for HMT is developing probabilistic QPF (PQPF) products and verification tools. Fig. 3 is an example of the graphics developed for verification of the ensemble. The two curves represent the correspondence between forecast probability of precipitation in excess of 15 mm per 6 h and the observed relative frequency of precipitation in excess of that threshold. The dashed curve is the “raw” ensemble probability, i.e., the ensemble relative frequency, and the dashed curve represents the results of calibration procedures designed to improve the statistical reliability of this forecast product. The goal is for the forecast probability of precipitation to match the observed relative frequency as closely as possible; the straight diagonal line in this figure represent perfect performance (Yuan et al. 2007).

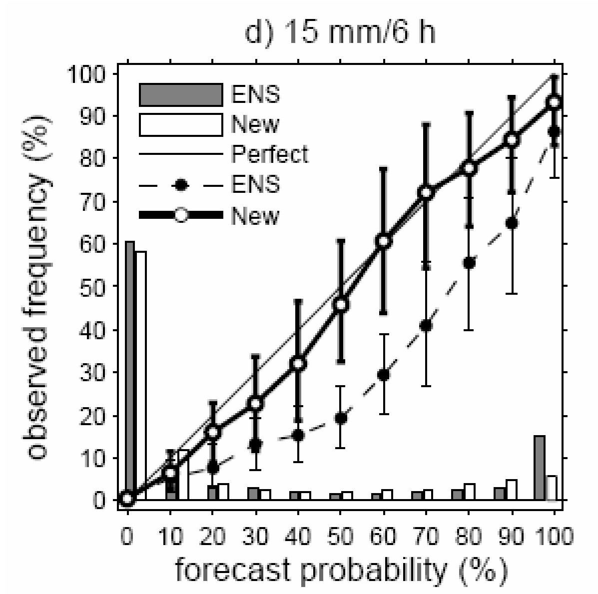

Figure 3. The attributes diagrams for 6-h precipitation accumulations from the HMT-West IOPs for the 15-mm / 6h threshold. Similar plots are routinely generated for several other precipitation thresholds as well. Reliability curves before (dashed line) and after (solid line) the probability bias correction.

3. Modeling strategy for HMT-West 2007

Verification results from the 2006 IOP model runs (and re-runs) were used as the basis for changes to the ensemble model configuration implemented for HMT-West 2007. The statistical methods of Jankov et al (2007a, b) were used for this purpose. Fig. 4 is an example of graphic output from one of the methods employed.

4. Discussion

The specific choices of ensemble members were determined on the basis of the particular type of meteorology encountered in California’s Sierra Nevada mountain range. Future HMT exercises will be conducted in the

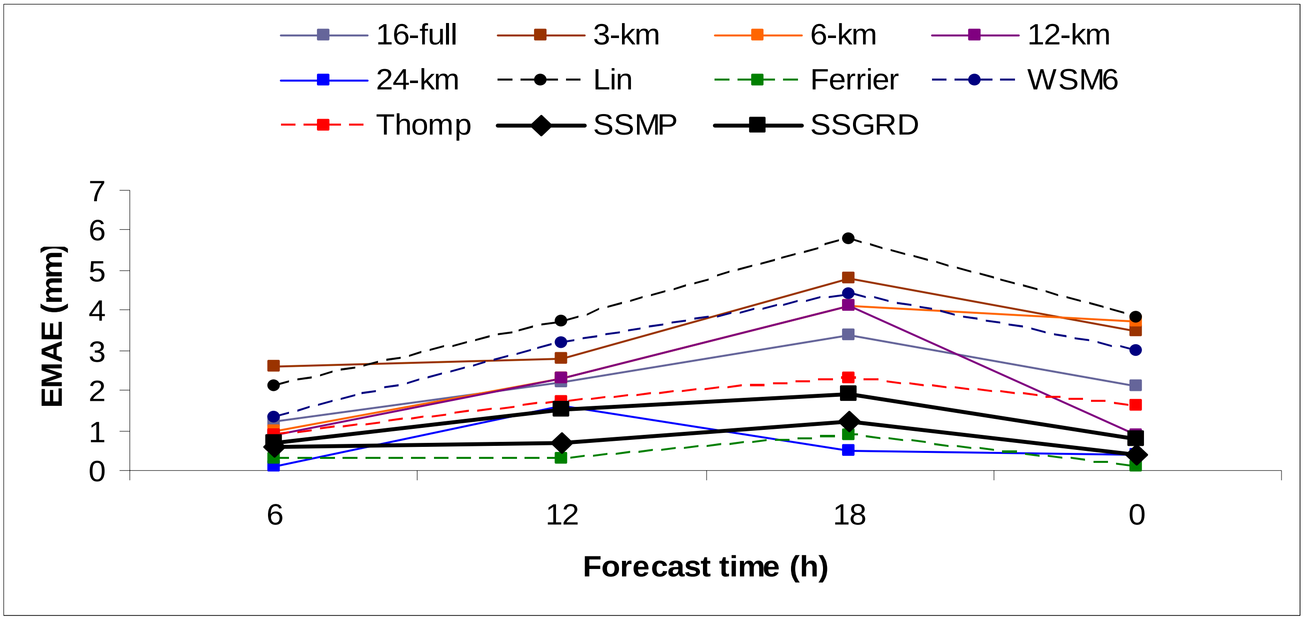

Figure 4. An example of ensemble member performance analysis, which was used to select members to be used in the HMT-West 2007 ensemble. Candidate ensembles are tested consisting of only models using 3-km grid increment, only models using particular microphysics schemes, etc.

Carolinas, to capture hurricane events and other significant precipitation event types encountered in the eastern U.S.; and in the "tornado alley" area of central U.S., to capture precipitation and flooding events related to large, organized convection. Both of these types of event will require ensemble construction that is quite different from the one we found appropriate for the stable onshore and upslope flow of air influenced only moderately by baroclinic processes and convective instability.

5. References

Yuan, H., J.A. McGinley, P. Schultz, C.J. Anderson, and C. Lu, 2007: Evaluation and calibration of short-range PQPFs from time-phased and multimodel ensembles during the HMT-West-2006 campaign. Submitted to *J Hydromet.,* in revision.

Jankov, I., P. Schultz, S. Koch, and C.J. Anderson, 2007a: The impact of different physical parameterizations and their interactions on cold season QPF. Accepted by *J. Hydromet.*

Jankov, I., P. Schultz, and C.J. Anderson, 2007b: Application of ensemble design methods to cold-season QPF. Submitted to *J. Hydromet.,* in revision.