

The NOAA Hazardous Weather Testbed

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Rapid science and technology infusion for the advancement of operational forecasting requires direct, focused interactions between operational forecasters, research scientists, numerical model developers, and information technology specialists. NOAA's Hazardous Weather Testbed (HWT) provides a unique setting to facilitate such interactions and allows participants to better understand the scientific, technical, and operational challenges associated with the prediction and detection of hazardous weather events.

The HWT is a joint facility managed by the National Severe Storms Laboratory (NSSL), the Storm Prediction Center (SPC), and the NWS Oklahoma City/Norman Weather Forecast Office within the National Weather Center building on the University of Oklahoma South Research Campus. This joint facility is composed of two primary overlapping program areas: the Experimental Forecast Program (EFP) and the Experimental Warning Program (EWP). The EFP branch of the HWT is focused on predicting hazardous mesoscale weather events on time scales ranging from a few hours to a week in advance, and on spatial domains ranging from several counties to the CONUS. More information about the EFP is available at <http://www.nssl.noaa.gov/hwt/>.

The EWP branch of the HWT is concerned with detecting and predicting mesoscale and smaller weather hazards on time scales of minutes to a few hours, and on spatial domains ranging from several counties to fractions of counties (<http://ewp.nssl.noaa.gov>) using real-time observations, including data from a variety of radar platforms. The objectives of the EWP and its three spring projects are the focus of this article. The EWP has two primary objectives: 1) to evaluate the accuracy and the operational utility of new science, technology, and products, and 2) to foster collaboration between NSSL scientists and operational meteorologists.

2008 Experimental Forecast Program

The HWT EFP conducted the 2008 Spring Experiment from mid April through early June. More than 60 participants, including a mix of research scientists, operational forecasters, numerical model developers, university faculty and graduate students, from across the U.S. and multiple foreign countries spent up to one week in the EFP. As in the last four Spring Experiments, the primary focus was on the examination of convection allowing (grid spacing = 2–4 km) configurations of the WRF model covering approximately the eastern three-fourths of the U. S. in a simulated severe-weather-forecasting environment. Output from various configurations of the WRF model were provided to the HWT during the experiment by the University of Oklahoma Center for Analysis and Prediction of Storms (CAPS), the NCEP Environmental Modeling Center (EMC), the National Center for Atmospheric Research (NCAR), and the NSSL.

As in previous experiments, these simulations were evaluated on their ability to predict the location and timing of thunderstorm initiation and evolution, and offer useful information on thunderstorm morphology and intensity (Fig. 1; Table 1). In addition, the experiment continued testing and refining a real-time, three-fourths U.S. domain 10-member convection-allowing storm scale ensemble forecast (SSEF) system provided by CAPS to gauge technical issues related to high performance computing, networking, data transfer and processing, product creation, and workstation display requirements for future high impact weather forecasting initiatives, and the potential benefits of uncertainty information provided by the SSEF.

New endeavors this year included 1) an exploration of the impact of assimilating radar reflectivity and velocity data into SSEF members on short-term forecasts of hazardous convective weather; 2) a real-time test of the NCAR WRF data assimilation system, and 3) a more detailed examination of the relationship between model forecasts of convective storms and model predictions of the mesoscale environment, focusing on boundary-layer thermodynamic structure, air mass boundaries, and sub-synoptic scale features in the free atmosphere. The goal of these endeavors is to provide specific information to model developers that can guide their efforts to improve various components of the WRF model.

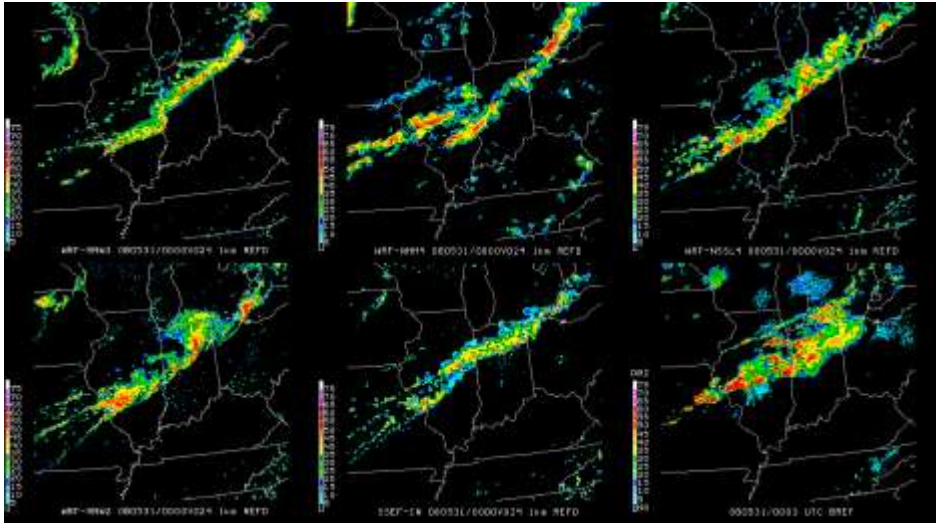


Figure 1. Daily forecasts from five different convection-allowing WRF model configurations were tested and examined as part of EFP activities. Shown here are 24 hr forecasts of model simulated reflectivity (lower left, lower middle, and upper row) and observed radar reflectivity (lower right) valid 00 UTC 31 May 2008.

| MODEL | GROUP | CORE | GRID | VERTICAL LEVELS | IC | LBC | RADAR DATA |
|---------|-------|------|------|-----------------|---------------------|-------------------|------------|
| ARW3 | NCAR | ARW | 3 km | 39 | 12h WRF 3DVAR cycle | 12 Z GFS forecast | NO |
| NMM4 | EMC | NMM | 4 km | 35 | 32 km NAM | 00Z NAM forecast | NO |
| NSSL4 | NSSL | ARW | 4 km | 35 | 40 km NAM | 00Z NAM forecast | NO |
| SSEF-CN | CAPS | ARW | 4 km | 51 | 12 km NAM + 3DVAR | 00Z NAM forecast | YES |
| ARW2 | CAPS | ARW | 2 km | 51 | 12 km NAM + 3DVAR | 00Z NAM forecast | YES |

Table 1. Some characteristics of the five different convection-allowing WRF model configurations exhibited in the Figure above. The core refers to the two dynamic cores available from the model, either the advanced research WRF (ARW) core or the Non-hydrostatic Mesoscale Model (NMM) core. All models used various forms of the operational North American Model (NAM) analyses and forecasts for the initial and lateral boundary conditions, except for the ARW3 from NCAR, which used a 12 h data assimilation system using the 12 Z Global Forecasting System (GFS) analysis and forecast as a background. The two models provided by CAPS shown above assimilated radar reflectivity and radial velocity data into the NAM initial conditions.

2008 Experimental Warning Program

During 28 April – 6 June 2008, 26 visiting forecasters (4 – 5 per week) participated in three projects focused on preliminary testing of experimental radar platforms and ideas for severe weather warning applications, including 1) the National Weather Testbed Phased Array Radar (NVRT PAR), 2) the Collaborative Adaptive Sensing of the Atmosphere (CASA) radar network, and 3) Gridded Probabilistic Hazard Information Project (Fig. 2).

NVRT PAR Project

The NVRT PAR project invited visiting forecasters to evaluate the operational utility of S-band PAR technology during simulated and real-time operational warning situations. Simulated warning situations provided forecasters with the opportunity to gain experience interpreting rapid-update (≤ 1 min), volumetric PAR data from archived cases prior to real-time operations. To help forecasters better assess the potential operational use of PAR in their county warning area, simulated warning situations showed weather events common to regions outside of the Southern Plains, such as wet microbursts and mini-supercells that formed in a tropical environment. Forecasters completed questionnaires evaluating 1) the strengths and limitations of PAR and NEXRAD data in the analysis of severe storms, 2) how characteristics of PAR scanning strategies might improve the understanding of severe storms, 3) how using PAR data to make warning decisions might increase severe weather warning lead-time, and 4) how PAR data may be of benefit to NWS operational responsibilities and to the public. Information about the findings from this experiment and related PAR research are available at <http://www.nssl.noaa.gov/project/pardemo>.

CASA Project

The primary objective of the CASA Project (<http://www.casa.umass.edu>) was to evaluate the operational utility of CASA radar networks which consist of densely spaced, low power, X-band radars with overlapping coverage that can observe the lower troposphere at high spatial (100's of meters) and temporal (60 s) resolution, and provide 3DVAR-derived wind fields. To achieve this objective, forecasters analyzed data from the 4-node CASA X-band radar network located in southwest Oklahoma, between the Twin Lakes and Frederick NEXRAD weather radars, through playback of archived cases and real-time observations. CASA scientists observed and recorded forecasters as they analyzed CASA data and compared it to NEXRAD data. Forecasters also completed questionnaires evaluating how CASA data might improve severe weather warning decision-making, the strengths and limitations of CASA's technical capabilities and adaptive scanning strategies, and how forecasters might incorporate real-time 3-DVAR-derived wind fields into warning decision making.

Gridded Probabilistic Hazardous Information Project

The main objective of the Gridded Probabilistic Hazardous Information Project was to evaluate the utility and effectiveness of high temporal and spatial resolution severe convective weather guidance before consideration into NWS warning operations. To attain this objective, forecasters were asked to evaluate and provide feedback about uncertainty information (Fig. 3) for different severe weather threats such hail, wind, and tornadoes. The interaction between researcher and forecasters during the early stages of this project will guide how this information may eventually be implemented into NWS services. Forecasters also provided feedback on the



best uses of uncertainty information in the short-fused NWS warning environment, and how gridded probabilistic information may be of benefit to users of severe convective weather hazard information.



Figure 2. Visiting forecasters and project leads participating in the CASA (far left), PAR (corner), and Gridded Probabilistic Severe Weather Warning Guidance Projects.

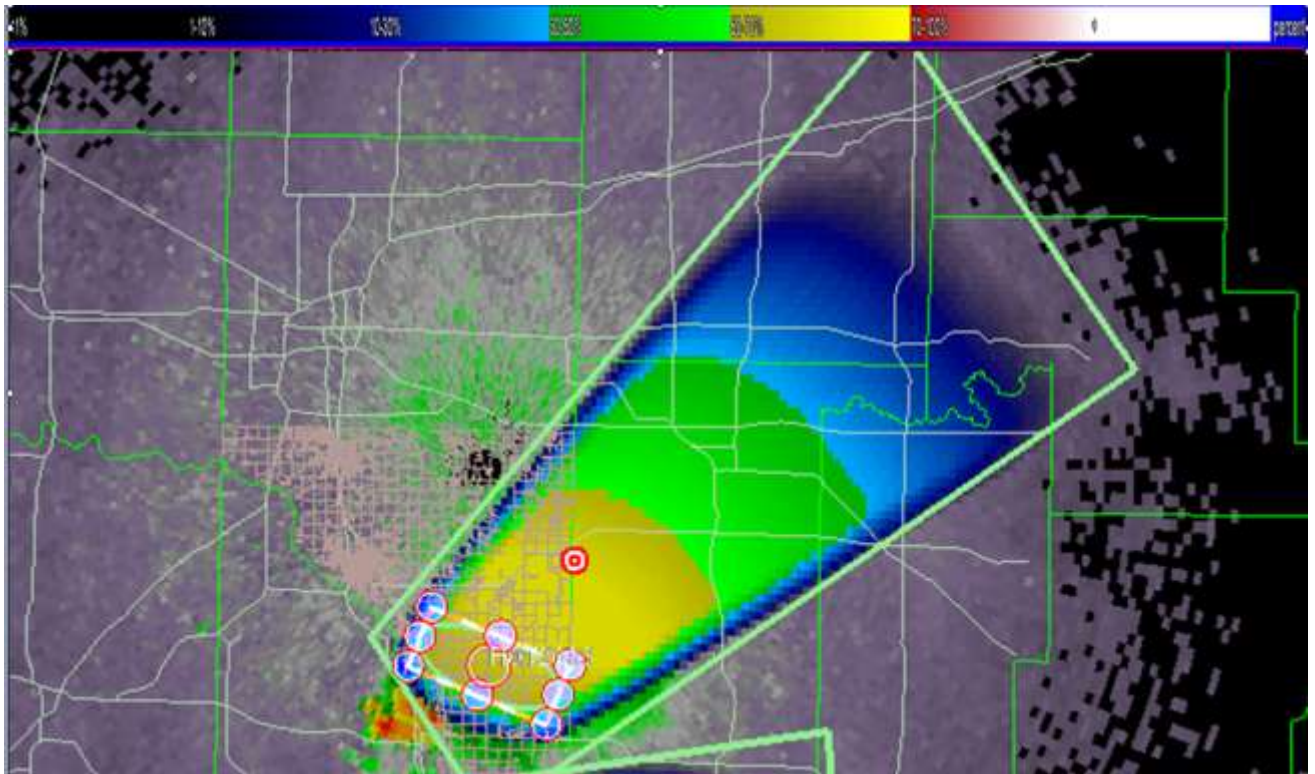


Figure 3: Probabilistic hail threat information for a hail storm in central Oklahoma that occurred during the spring EWP experiment. The light-green polygon shows the outer boundary of the threat area issued by a forecaster, and the probability of hail occurring during the next 60 minutes is shown by the yellow (50% to 70%), green (30% to 50%) and blue (10% to 30%) imagery overlaid on radar reflectivity data.