2007 HWT Spring Experiment
Experimental Forecast Program
Preliminary Summary

The NOAA Hazardous Weather Testbed (HWT) conducted multiple collaborative activities during its 2007 inaugural spring season in the new National Weather Center. The HWT has two separate, but overlapping program areas: The Experimental Forecast Program (EFP) and the Experimental Warning Program (EWP). A brief summary of 2007 EFP activities is provided below.

The EFP conducted a major collaborative Spring Experiment in which organizers from the SPC (NOAA/NWS/NCEP/Storm Prediction Center) and the NSSL (NOAA/OAR/National Severe Storms Laboratory) partnered with scientists from CAPS (University of Oklahoma's Center for Analysis and Prediction of Storms), NCAR (the National Center for Atmospheric Research), and EMC (the NOAA/NWS/NCEP/Environmental Modeling Center). The Experiment was conducted from April 19 through June 8, Monday-Friday in the HWT. It drew strength from the participation of a broad spectrum of individuals, including a total of 63 research scientists, forecasters, university faculty, graduate students, and administrators from government agencies, academia, and the private sector (see Fig. 1 for assorted snapshots of daily activities and the appendix for a complete list of participants). Most participants spent an entire week in the program and many external visitors presented seminars to the

Fig. 1. Assorted pictures from daily activities during the 2007 HWT Spring Experiment.

broader National Weather Center community during their visit.

The primary scientific objectives of the Experiment were to 1) explore the utility of a high resolution (convection permitting) ensemble prediction system, based on the WRF model, as forecast guidance for severe convective weather, and 2) identify strengths and weaknesses of individual high resolution WRF configurations to provide feedback and guidance for model developers.

The mere production of the WRF Storm Scale Ensemble Forecast (SSEF) was a significant technological achievement - spearheaded by CAPS, but with significant contributions from the other partners. The collaborative effort began with design of the ensemble system. From their position as primary developers of the ensemble's WRF-ARW model, NCAR scientists provided expert advice on the strategic choice of physical parameterizations in the different ensemble members. On a daily basis during the experiment, EMC scientists provided the initial condition perturbations and lateral boundary conditions for the ensemble and worked closely with CAPS scientists to ensure timely and reliable delivery of these data to the Pittsburgh Supercomputing Center (PSC). CAPS scientists, utilizing resources from the NOAA CSTAR program and the National Science Foundation (NSF) Linked Environments for Atmospheric Discovery Large (LEAD) ITR project, used the EMC data to initialize the 10-member high resolution, large domain (see Fig. 2) ensemble forecasts at PSC. They used the NSF TeraGrid and National Lambda Rail networks to transmit the ensemble output (over 1 Tb per day) from PSC to Norman, where automated programs developed by SPC and NSSL scientists grabbed and post-processed the data. All in all it was a remarkable collaborative effort that epitomizes the community wide appeal of the HWT mission - and the process was reliable: 99.6% of the ensemble guidance was available for morning experimental forecast activities in the HWT.

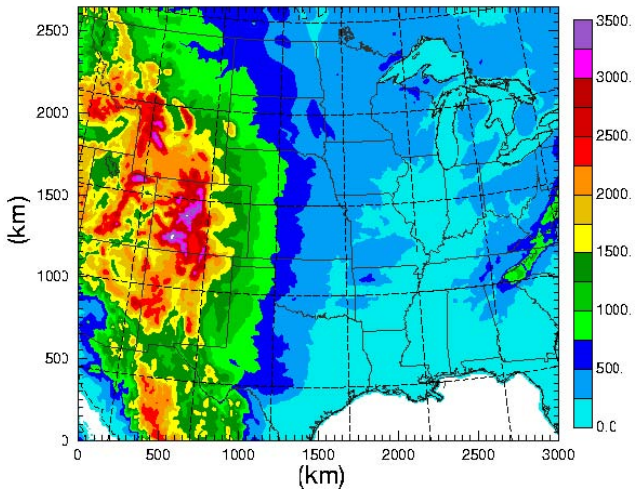

Fig. 2. Computational domain for the high-resolution ensemble forecasts, using 4 km grid spacing.

The potential utility of the SSEF was evaluated in several ways during the experiment. Scientists from the SPC and NSSL developed a wide array of ensemble forecast products, including derived probabilities of various parameters, unique presentations of the range of possible solutions, and plots of maximum values for various characteristics of thunderstorms (e.g., see Fig. 3). The potential value of these products was assessed first during experimental forecasting activities and again during next-day systematic subjective verification exercises. Preliminary results indicate that the SSEF shows great promise to provide unique information to severe weather forecasters, but clearly this effort is in its infancy. Much work remains to be done, especially with regard to

ensemble design, including generation of initial-condition perturbations, data assimilation strategies, and model diversity (physics and dynamics). These topics will be investigated during the 2008 and 2009 Spring Experiments.

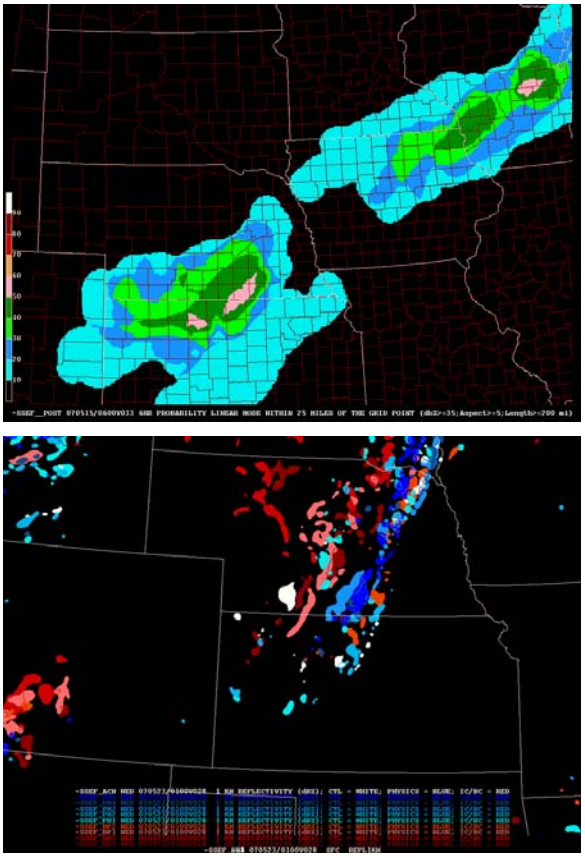

Fig. 3. Examples of new guidance products derived from the high resolution ensemble. Top figure shows the probability of a linear configuration of thunderstorms (e.g., a squall line), while the bottom depicts the area covered by simulated reflectivity cores (> 40 dBz), color coded to represent the different ensemble members.

Regardless of the specific strategies employed, any ensemble system can only be as useful as the model at its core. For this reason, the 2007 ensemble was designed to include systematic variations in model physics, allowing us to assess strengths and weaknesses of various model configurations both in realtime and in post-experiment analysis. Additional diversity was found outside of the 10 member SSEF. For example, CAPS made a separate WRF run with 2 km grid spacing over the same computational domain as the ensemble runs, enabling a straightforward assessment of the sensitivity to horizontal grid spacing. NCAR ran over a larger domain with 3 km grid spacing and a promising new microphysical parameterization, while EMC, and NSSL each produced separate WRF forecasts with slightly coarser resolution (4 km grid lengths), but domains that were larger still. The combination of these forecasts provides us with unique information related to experimental physics packages and sensitivities to different formulations for physics and dynamics. Examination of these data is underway. It is anticipated that detailed analyses will lead to improvements to the WRF model and advances in high-resolution ensemble strategies.

In addition to these quite obvious benefits, the Spring Experiment has intrinsic value in more subtle, but equally important ways. Visitors often comment that the most rewarding aspect of the experiment is the highly collaborative atmosphere. The HWT provides a unique framework that focuses attention the common interests of a broad spectrum of meteorologists, including research scientists, teachers, modelers, and forecasters. Each of these groups brings a different background and perspective to the table and each individual comes away with a better understanding of ways to contribute to, and extract from, the broader meteorological community.

APPENDIX: Participants in the 2007 HWT Spring Experiment (by affiliation)

Academia

Mike Baldwin (Purdue University, West Lafeyette, IN)
Ben Baranowski (North Carolina State Univ., Raleigh)
Lance Bosart (Univ. at Albany - SUNY)
Fred Carr (University of Oklahoma, Norman)
Ken Crawford (Oklahoma Climatological Survey/OU, Norman)
Brian Etherton (Univ. of North Carolina, Charlotte)
David Flagg (York Univ., Toronto)
Adam French (North Carolina State Univ., Raleigh)
Tom Galarneau (Univ. at Albany - SUNY)
Bill Gallus (Iowa State Univ., Ames)
Gary Lackmann (North Carolina State Univ., Raleigh)
Kelly Mahoney (North Carolina State Univ., Raleigh)
Steve Mullen (Univ. of Arizona, Tucson)
Russ Schumacher (Colorado State Univ., Ft. Collins)
Nelson Seaman (Penn State Univ., State College, PA)
Jeff Trapp (Purdue Univ., West Lafeyette, IN)
Matt Wandishin (Univ. of Arizona, Tucson)

NOAA/NWS/NCEP

David Bright (SPC, Norman)
Keith Brill (HPC, Washington DC)
Greg Carbin (SPC, Norman)
Greg Dial (SPC, Norman)
Mark Darrow (SPC, Norman)
Bruce Entwistle (AWC, Kansas City)
Andy Fischer (AWC, Kansas City)
Zavisa Janjic (EMC, Washington, D.C.)
Bob Johns (retired SPC, Norman)
Jason Levit (SPC, Norman)
Geoff Manikin (EMC, Washington, D.C.)
Corey Mead (SPC, Norman)
Jeff Peters (SPC, Norman)
Matthew Pyle (EMC, Washington DC)
Steve Weiss (SPC, Norman)

NOAA/OAR

Chris Anderson (ESRL/GSD, Boulder)
Harold Brooks (NSSL/FRDD, Norman)
John Brown (ESRL/GSD, Boulder)
J. J. Gourley (NSSL/WRDD, Norman)

Tom Hamill (ESRL/PSD, Boulder)
Jack Kain (NSSL/FRDD, Norman)
Paul Schultz (ESRL/GSD, Boulder)
Dave Stensrud (NSSL/FRDD, Norman)

NOAA/NWS Local Forecast Offices

Matt Bunkers (Rapid City, SD)
Randy Graham (Salt Lake City, UT)
Kenny James (Norman, OK)
Eric Platt (Midland, TX)
Paul Sisson (Burlington, VT)
Steve Zubrick (Sterling, VA)

NOAA Administrative

Paul Hirschberg (NWS/OCWWS, Silver Spring, MD)
Bernard Meisner (NWS/SRH, Ft. Worth)
Louis Uccellini (NWS/NCEP, Washington, D.C.)

NCAR

George Bryan
Jimy Dudhia
Jenny Sun
Stan Trier
Morris Weisman

Environment Canada

Arnold Ashton (Toronto, ON)
Dan Fulton (Winnipeg, MB)
Jim Goosen (Vancouver, BC)
Jason Milbrandt (Dorval, QC)
Isabel Ruddick (Toronto, ON)
Neil Taylor (Edmonton, AB)

Cooperative Institutes

Mike Coniglio (CIMMS/NSSL, Norman)
Bill McCaul (USRA, Huntsville, AL)

Private Industry

Paul Janish (Merrill Lynch, Houston)
Peter Manousos (First Energy Corp., Akron, OH)

UK Met Office

Ken Mylne