

# NOAA TESTBED

## news

LINKING RESEARCH & OPERATIONS TO IMPROVE WEATHER FORECASTS FOR THE NATION

### What's news at NOAA Testbeds

Welcome to the second edition of the NOAA Testbed News –and thank you to everyone who provided the positive feedback on our inaugural publication! In this edition, we've expanded our scope with a feature report from the Hazardous Weather Testbed highlighting their dynamic spring 2009 experiments. We've also added a new section called 'Collaboration Corner' to sweep in all of the many cross testbed efforts and activities --you'll find that there are many connections, new and continuing. We envision this as an ongoing newsletter column as the testbeds find news way to work collaboratively to advance their myriad goals. As the seasons progress, we'll be highlighting other testbed activities that have are ramping up, underway, or winding down. As always, we appreciate your contributions, comments, and feedback in our goal of providing a productive communication tool serving our testbed community. Enjoy!

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### NOAA Hazardous Weather Testbed Spring 2009 Experiments



Each year, the National Severe Storms Laboratory (NSSL), the Storm Prediction Center (SPC), and the NWS Forecast Office in Norman, Oklahoma lead experiments designed to study, collect data, and test new concepts and technologies to improve severe weather forecasts and warnings.

During the spring of 2009, three experiments were conducted and coordinated by the NOAA Hazardous Weather Testbed (HWT) --where over 140 participants from NOAA, academia, NCAR, NASA, DoD and the international community took part. The HWT facilitates the collaboration of field forecasters with laboratory/academic researchers and developers. The forecasters are exposed to the leading edge experimental research and technology, and the researchers and developers are provided information about

operational requirements. The feedback helps improve technologies and forecast techniques and readies them for transition to NWS operations.

#### HWT Experimental Warning Program (EWP)

Eighteen visiting NWS meteorologists (representing all six NWS regions) and international forecasters (from Canada, Australia, and Finland) served as evaluators of new technologies designed to improve severe weather threat assessment and decision making. The visitors worked with scientists from the NSSL, the U. of Oklahoma (OU), U. of Massachusetts, U. of Virginia, U. of Maryland, Florida St., NASA-Huntsville, and U. of Colorado. Check out the EWP online, including the EWP Blog, which was used to communicate feedback via live updates during real-time events (<http://ewp.nssl.noaa.gov>).

*At HWT, forecasters & developers work together to improve forecast techniques & technology.*

Through a series of real-time events and playback of archived data sets, the evaluators combined their knowledge of traditional severe



OS&T Director Don Berchhoff visits the NOAA Hazardous Weather Testbed in action, June 2009.

weather warning threat assessment with the additional input from the experimental data sets. The Advanced Weather Interactive Processing System (AWIPS) was utilized to display many of the experimental data, and forecasters issued experimental severe weather warnings using WarnGen during live events. The AWIPS system at the HWT provided the flexibility to be localized for any CONUS WFO, and live events from the CONUS NWS regions were represented during the spring experiment from 27 April – 12 June 2009.

The EWP conducted a six week program evaluating the following technologies:

- **Multiple-Radar / Multiple-Sensor (MRMS) severe weather algorithms:** This is the 7th year of real-time MRMS algorithm evaluation with NWS meteorologists at various venues. MRMS has been identified as the technology most ready for transition to NWS operations.
- **3D Lightning Mapping Array (LMA):** Real-time LMA data were available from networks in Oklahoma, Alabama, and the Washington, DC areas. LMA data was used to augment other data sets so that the meteorologists could evaluate their usefulness for severe weather threat assessment. Testing of the LMA data sets will continue for 2010 and beyond.
- **Phased Array Radar Innovative Sensing Experiment (PARISE) and Collaborative Adaptive Sensing of the Atmosphere (CASA):** Phased Array Radar and CASA offer rapidly-refreshing radar data, typically with refresh rates 5-10 times faster than the WSR-88D. This allows forecasters to more-rapidly analyze the evolution of storm signatures such as downbursts and tornado vortex signatures, with the goal of providing more lead time. Operations in 2010 may include a component to study experimental radar data assimilation techniques to support Warn On Forecast.

## HWT Experimental Forecast Program (EFP)

The Experimental Forecast Program of the HWT (<http://www.nssl.noaa.gov/projects/hwt/index.html>), consisting primarily of NSSL and the SPC, conducted the 2009 Spring Experiment (SE2009) from 4 May – 5 June 2009. Nearly 50 participants from the operational, research, and academic communities in the U.S., Canada, and the U.K. spent one week testing and evaluating guidance from a variety of convection-allowing numerical models. A key component of the experiment assessed the value of high resolution guidance to provide severe weather forecasters with unique information on convective initiation, intensity, mode, and evolution. Each day the participants created two experimental, higher temporal resolution probabilistic severe weather forecasts for 4-hr periods, initially in the morning and then updated in the afternoon as guidance and observational data became available. Feedback was provided to model developers about the strengths and limitations of the model guidance under various severe weather situations. The experiment involved three important branches of collaboration with external partners:

- Cutting edge numerical guidance products were contributed by the OU Center for Analysis and Prediction of Storms (CAPS), NCEP/EMC, NCAR, the Air Force Weather Agency, and ESRL/GSD, in addition to local products from NSSL. Utilizing this variety of guidance products, a number of topics were investigated, including, convection-allowing ensembles and sensitivity to data assimilation techniques, model initialization time, initial conditions, and grid spacing.
- Collaboration with DTC: As part of SE2009, the DTC and HWT continued to strengthen their working relationship. DTC development efforts provided cutting edge near-real time statistical and graphical verification data for the assessment of data-assimilation impacts in key CAPS and HRRR forecasts. Furthermore, DTC scientists actively participated in SE2009 on a weekly basis, providing important leadership in the interpretation and optimal usage of new verification strategies. This effort represented an important commitment from the DTC and reflected a vision for a sustained collaboration between the DTC and HWT.
- Collaboration with the VORTEX2 field program: SE2009 scientists and forecasters worked in close collaboration with VORTEX2 scientists in the preparation and assessment of various forecast products that were relevant to VORTEX2 field ops. This effort laid the foundation for a solid working relationship between the HWT and VORTEX2, with the possibility of working together in 2010, the second year of VORTEX2.

## HWT GOES-R Proving Ground

The GOES-R Proving Ground at the SPC held its initial pre-operational demonstration of high impact weather products in conjunction with the 2009 Spring Experiments, EFP and EWP. The proving ground demonstration provided a unique opportunity to interact with forecasters and assess new products to be provided by the next generation GOES-R satellite in an operational framework. Products focusing on detecting and forecasting convection, lightning and severe weather were studied this year in a broad range of forecasting

strategies, from short-term convective outlooks to real-time nowcasting exercises. Initial results include facilitating data flow from core product developers of the GOES-R Proving Ground to make sure current and future products will flow consistently such that integration into SPC and WFO operations can be made possible. Basic display improvements on all products were made based on forecaster suggestions through interaction within the HWT during the Spring Experiment. Successes and limitations in product performance were discovered through detailed daily forecasting exercises. This information is essential for forecaster education prior to integrating products into forecast operations. Plans to include select products ready for operational testing into NWS operations are underway.

– Greg Stumpf and Susan Cobb

## Testbeds at a Glance

### Hazardous Weather Testbed

<http://www.nssl.noaa.gov/hwt/>

NOAA's Hazardous Weather Testbed (HWT) develops, tests and evaluates techniques to improve NWS severe weather forecast and warnings. 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 (OUN) located at the National Weather Center in Norman, Oklahoma. The HWT facilities include a combined forecast and research area placed between the operations areas of the SPC and OUN, and the NSSL Development Lab located nearby. Researchers, forecasters and developers use these facilities to evaluate new platforms and techniques, using past data and during real-time operations. Collaboration among these diverse groups provides valuable feedback that can immediately be applied to the research and development process, streamlining technology transfer.



### Climate Testbed

<http://www.cpc.noaa.gov/products/ctb/ctb-home.shtml>

NOAA has formed the Climate Test Bed (CTB) to accelerate the transfer of research and development into improved NOAA operational climate forecasts, products, and applications. The CTB will routinely serve as a conduit between the operational, academic and research communities. This facility is located at the National Centers for Environmental Prediction in Camp Springs, MD. CTB personnel include scientists from NCEP and from other NOAA and non-NOAA organizations participating in the CTB.



## Did you know...

That WRF is the world's most widely used model for weather prediction –and shows no signs of slowing down. All told, more than 10,000 people in more than 120 countries are registered to use the model. More than 90% of them are employing the Advanced Research WRF (ARW) system, maintained by NCAR. The annual WRF Users' Workshop, that was held this year on 23–26 June, drew over 250 people to Boulder, CO. For those who can't make it to a training session, there are ample resources at <http://www.wrf-model.org> where most of the material presented is online including practice exercises.

# VORTEX2

The 2nd Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2, or V2 for short) is the largest and most ambitious field experiment in history to explore tornadoes. The V2 teams are looking to understand how, when and why tornadoes form. Answers to these questions will give researchers a better understanding of tornadoes and should help increase warning time for those in the path of these deadly storms. The first data collection effort occurred from May 10–June 13, 2009, and will be repeated for a six-week period during the spring of 2010 -- NSF is funding an extra 3 weeks of operations next year.

The V2 armada traveled over 10,000 miles during the 5 week experiment. Out of a possible 35 operational days, there were only 3 down days--which represents an extraordinary dedication by the participants in the experiment, including the NOAA entities involved (NSSL, WDTB, and the NWS).

Via the V2 Operations Center (VOC), co-located next to the Hazardous Weather Testbed (HWT), information between the NWS and armada was communicated very quickly. NWS helped work some non-meteorological issues as well for the armada, including interacting with the local officials and community.

Nearly 150 scientists and students from sixteen different universities and various other academic organizations in the U. S. and other countries took part in the experiment. V2 also involved forecasters from the NWS forecast offices, the NOAA Storm Prediction Center, Environment Canada, the Australia Bureau of Meteorology and the Finnish Meteorological Institute. V2 is funded by NSF and NOAA. Partners included Rasmussen Systems, NSSL, Penn State, Univ. of Oklahoma, North Carolina State Univ., Texas Tech Univ., NCAR, Lyndon State College, U. Massachusetts, Univ. of Illinois, Univ. Nebraska, and Purdue U.

– Lou Wicker



# Publications Round-Up

Lazo, J.K., D.M. Waldman, B.H. Morrow, and J.A. Thacher, forthcoming: Assessment of Household Evacuation Decision Making and the Benefits of Improved Hurricane Forecasting. *Weather & Forecasting*

Demuth, J.L., B.H. Morrow, J.K. Lazo, forthcoming: Weather Forecast Uncertainty Information: An Exploratory Study with Broadcast Meteorologists. *Bulletin of the American Meteorological Society*

Lazo, J.K., R.E. Morss, and J.L. Demuth, 2009: 300 Billion Served: Sources, Perceptions, Uses, and Values of Weather Forecasts. *Bulletin of the American Meteorological Society*, 90(6):785-798

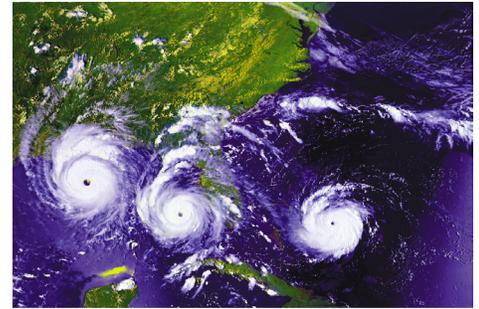
Jankov, I., J-W Bao, P. Neiman, P. Schultz, H. Yuan, A. White, 2009: Evaluation and Comparison of Microphysical Algorithms in WRF-ARW Model Simulations of Atmospheric River Events Affecting the California Coast. *J. Hydrometeor.*, 10, 847-870

Junker, N.W., M.J. Brennan, F. Pereira, M. Bodner, 2009: Assessing QPF Forecast Uncertainty With Standardized Anomalies and Ensemble Guidance at the Hydrometeorological Prediction Center. *Bull. Amer. Meteor. Soc.*, 90, 445-453



## HWRF in High Gear

Over the past several decades hurricane track prediction has dramatically improved. With the exception of erratically moving storms, models can now nail down the tracks of most hurricanes with reasonable success, since the steering of the storm is governed by larger scale environmental flow that is normally well forecast. In fact, over the past decade, the official NHC 48 hour track forecast has been reduced by 50% and our 72 hour track forecast error is now what our 48 hr track error was a decade ago. The progress in improving track prediction has been a result of the combined successful efforts that include advanced satellite and in situ observations by aircraft, the development of sophisticated global and regional hurricane modeling systems that take advantage of these observations, and the advancement of supercomputing technology to support these computationally intensive numerical systems.



Intensity forecasts are another matter. While the track problem is dominated by larger scale flow, intensity forecasts are a scale interaction problem between the smaller hurricane scale circulation and the surrounding environmental flow in which the storm is imbedded. Even after years of research, today's forecasts have little skill at predicting the evolution of a hurricane's life cycle through the processes of intensification and weakening. Even more baffling to hurricane scientists, modelers and forecasters is the rapid intensification scenario that has never been adequately observed at any level of detail.

In 2007, NOAA's adaptation of the WRF model, the Hurricane WRF (HWRF), became operational for NHC after years of development and testing at NOAA's Environmental Modeling Center (EMC) in collaboration with NOAA's GFDL and the University of Rhode Island. In spite of two promising inaugural hurricane seasons for the HWRF, this past year of highly sheared storms severely challenged not only the HWRF but also most of the numerical guidance received by the NHC forecasters.

*The first hurricane workshop is being planned by NOAA, NCAR & DTC for 22-26 February 2010 at NCAR.*

"We have known for some time now that models have great difficulties in forecasting weakening in sheared environments," says NCEP's Naomi Surgi, leader of the HWRF development team.

This past season was no exception. In fact, much of the Atlantic regions of development were dominated by strong westerly shear that disrupted the heating necessary for further storm development that, not only inhibited further strengthening of some storms, but, completely wiped others out.

"There are many very difficult problems ahead, but we're ramping up our efforts at the DTC that will join both the research and operational modeling communities in a close collaborative effort to accelerate progress in improving these difficult hurricane prediction problems," says Surgi. Surgi arrived at the DTC in fall of 2008, where variations of WRF and other models are explored in a setting that serves both research and operational needs.

In support of this pioneering effort, the first hurricane workshop and the first WRF tutorial for hurricanes is being planned for 22 - 26 February 2010 and will be held at the NCAR Foot-hills Lab in Boulder, CO. This will be a five day joint venture shared by NCAR MMM Divi-

sion, NOAA/NCEP Environmental Modeling Center and the DTC. You'll find additional information at <http://www.dtcenter.org>.

The week will begin with two days of invited scientific talks on the evolution of hurricane science, the advancement of observations and modeling systems that has occurred over the past two decades. These will include a summary of the major challenges remaining in numerical hurricane prediction. Invited speakers from the National Hurricane

Center will also provide the operational forecast perspective on the improvement of hurricane forecast skill derived from the community scientific and modeling contributions over the past couple decades that has markedly benefited the NWS hurricane watch and warning program. Needed future improvements in hurricane forecast skill will also be discussed.

## New Mobile Atmospheric River Observations Deployed on the Washington Coast

The NOAA Earth System Research Laboratory (ESRL) deployed a newly developed Mobile Atmospheric River Monitoring System (MARMS) to Westport, Washington, roughly 250 km upwind of the Cascade foothills, in a data poor area. MARMS, a form of an "Atmospheric River Observatory" (ARO) will monitor the wind speed, direction, snow level and water vapor content in real-time above the earth's surface to help researchers better understand Atmospheric Rivers (AR); the phenomenon that fuels potentially dangerous winter storms on the West Coast of the U.S. Data from MARMS began flowing to researchers and others, such as the Seattle Weather Forecast Office starting November 1, 2009, via the Internet. This deployment is an extension of NOAA's Hydrometeorology Testbed (HMT) program and ESRL's weather and climate/water cycle research already being performed in California. The Westport deployment is a first step in assessing the role of ARs in flooding in the Pacific Northwest, and the

potential of new observing capabilities. Another component that will support this effort is ESRL's Reforecast Model. This model is a compilation of historical observations and their corresponding 2-day forecasts, which are rerun using today's current forecasting model (i.e., reforecasts). The reforecasts represent an additional tool for anticipating heavy precipitation and is being evaluated in the context of the AR phenomenon.

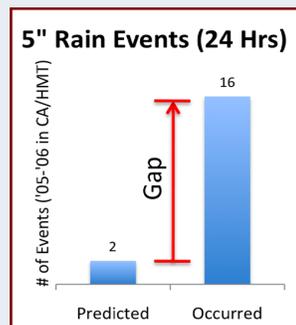


– Barb DeLuisi

## Collaboration Corner

### HMT-DTC

The HMT Program and DTC are establishing a collaborative effort that addresses several important topics of common interest to both programs. These topics are fundamental areas of concern for both testbeds as they work toward the transfer of new research results into NOAA operational forecasting capabilities. Specifically, this collaborative effort will address the following four areas: (1) implementation and demonstration of new verification capabilities for high resolution numerical weather prediction (NWP) forecasts, (2) initial development of DTC capabilities for high resolution ensemble prediction, (3) data impact studies (e.g., data denial), and (4) evaluation of the impacts of model physics and parameterizations on NWP fore-



casts that are relevant to the HMT. Regular meetings between the two groups began in late July and have become weekly to prepare for the HMT-West 2009-2010 season. In particular, areas (1) and (2) and their application in the HMT-West domain have become primary focal points such that a demonstration of the HMT/WRF/DTC collaborative effort can be in place for the 1 December 2009 HMT-West start.

### DTC-NCEP/EMC

The HWRF program is a showcase of how NCEP/EMC is working with DTC (including NCAR/RAL/JNT and ESRL/GSD) to make its operational hurricane prediction system available to the broad scientific community. There are a lot of exciting activities in this area:

- HWRF is being incorporated into the general WRF repository, and will be available to all WRF users. This includes vortex initialization, ocean, and coupler.

## Recent & Upcoming Events

**DTC Verification Workshop:** August 26-28, 2009, Boulder, CO. <http://www.dtcenter.org/verification/dtcworkshop2009.php>

**International Workshop on the Assessment of Socio-economic Benefits of Meteorological and Hydrological Services:** September 21-25, 2009, Nanjing, China.

**National Workshop on Mesoscale Probabilistic Prediction:** September 23-24, 2009, Boulder, CO. <http://www.dtcenter.org/ensemble.php>

**HFIP Workshop:** November 9-10, 2009, Florida International University and National Hurricane Center, Miami, FL.

**Hurricane WRF Workshop and Tutorial:** 22-26 February 2010, Boulder, CO. <http://www.dtcenter.org/>

## Awards & Recognition

### Two NOAA/OAR 2009 Outstanding Scientific Paper Awards in the Weather & Water Category:

- Pamela Heinselman, David Prieznitz (CIMMS), Kevin Manross (CIMMS), Travis Smith (CIMMS), and Richard W. Adams (CIMMS) of the National Severe Storms Laboratory are being honored for their study on rapid sampling of severe storms by the National Weather Radar Testbed phased array radar. The team evaluated the performance of phased array radar technology that has the potential to produce faster scan times than the Doppler radar systems used in weather forecasting today. The radar was used to scan three Oklahoma storms – a supercell thunderstorm, a microburst producing thunderstorm and a hailstorm – to compare data gathered by the phased array and Doppler radar systems. Further testing and development of phased array radar technology could ultimately bring about longer lead times for severe storm warnings and provide people in a storm's path extra time get to safe shelter.
- Paul Neiman (CIRES), Marty Ralph, and Gary Wick of the Earth System Research Laboratory, and their colleagues at the University of Washington and Scripps Institute of Oceanography are being honored for their study on atmospheric rivers — long, narrow plumes of water vapor that travel toward the South and North Poles, which impact snow and rain patterns along the west coast of North America. The study, published in the Journal of Hydrometeorology described for the first time how these “rivers” are increasing snowfall in the winter and decreasing rainfall in the spring. The findings are expected to improve weather forecasting and flood prediction, water management and policy.

### *Collaboration Corner cont.*

- A Hurricane WRF workshop and tutorial (including NMM and ARW) is planned for 22-26 February 2010.
- The DTC has submitted a proposal to NCAR's Director for hosting an NCAR summer colloquium on "Advancing Hurricane Modeling and Prediction". Decision is pending.

### HMT-NIDIS

Tim Schneider (HMT Project Manager) attended the NIDIS Southeast (SE) Pilot Planning Meeting in Chapel Hill, NC in July 2009.

A follow-up NIDIS workshop is planned for Dec. 2-3, 2009 in Lake Blackshear, GA, focusing on a drought early warning system for the Apalachicola-Chattahoochee-Flint River Basin.



### DTC-HWT

The HWT and DTC discussed plans for the SE2010 collaboration at a planning meeting held in Boulder during September 2009. Plans include a continued focus on the CAPS ensemble and HRRR, expansion to evaluation of additional models, adding evaluation of aviation related forecast variables, and completion of retrospective evaluations. Discussions during the winter will better define what can be accomplished this year.

*Send in your collaboration activities!*

**NOAA Testbed news** is a publication from the NOAA USWRP Executive Committee, Dr. F.M. Ralph, Chair

Design/Layout by: Barb DeLuisi & Janet Intrieri.

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