

7th NOAA TBPG Workshop

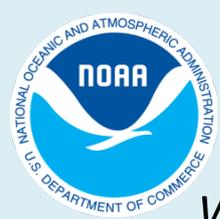
College Park, MD

April 5-6, 2016

Roundup Presentation

Hazardous Weather Testbed (HWT)

Alan Gerard (NSSL), Gabe Garfield (CIMMS/NWS), Israel Jirak (SPC)
and Steven Weiss (SPC)



Hazardous Weather Testbed

Where practitioners and researchers work together to enhance community collaboration and accelerate the transfer of research to operations...



Local NWS Forecast Office (OUN):
Regional responsibility

NCEP Storm Prediction Center (SPC):
Nationwide Responsibility



**Experimental
Warning
Program**

Detection/prediction of hazardous weather events up to several hours in advance

Warning
Research

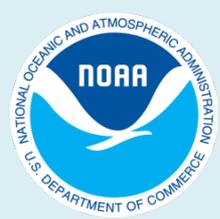
Forecasting
Research

Satellite-based
Research



**Experimental
Forecast
Program**

Prediction of hazardous weather events from a few hours to a week in advance



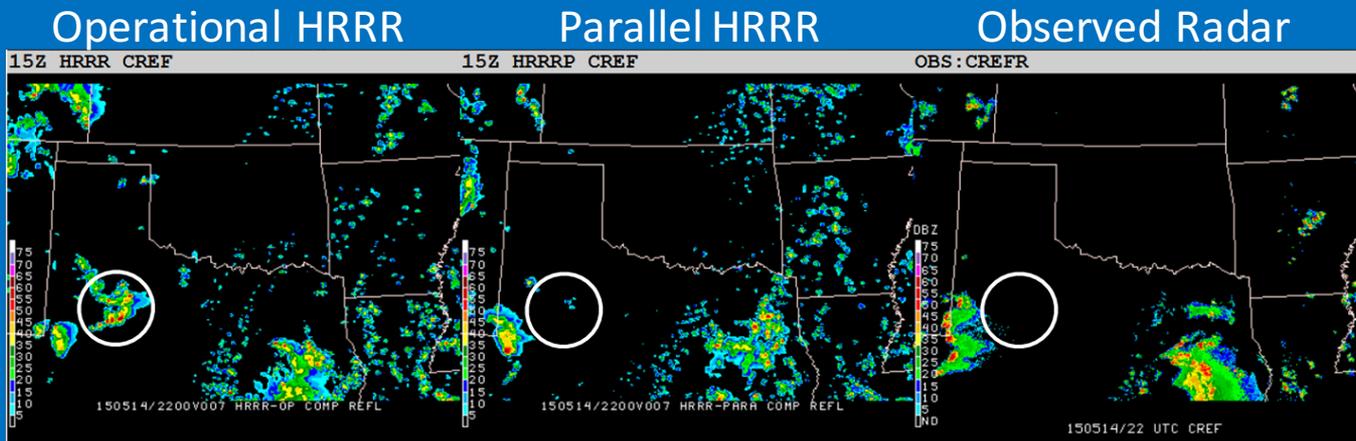
FY15 Highlights

HWT

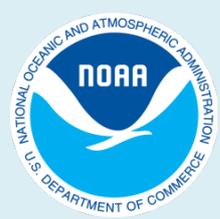
• Experimental Forecast Program

3. Operational CAM Implementations at EMC

- Subjective and objective evaluations of parallel HiResWindow ARW & NMMB; HRRR and NAM Nest
 - Recommended implementation of HiResWindow upgrades (occurred September 2015)
 - Identified improved guidance from parallel HRRR and NAM Nest; planned implementations for HRRRv2 (FY16 Q3) and NAM Nestv3 (FY17 Q1)



HRRR 7-hr
Reflectivity
Forecast Valid 22Z
14 May 2015

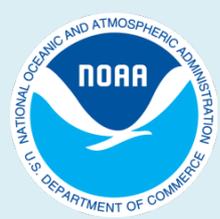


FY15 Transition Metrics

HWT

- Experimental Forecast Program

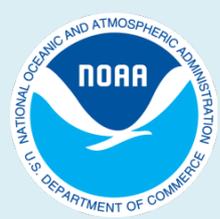
Major Tests Conducted	Transitioned to Operations	Recommended for Transition to Operations	Advanced to Experimental Testing Phase	Rejected for Further Testing	Decision Pending or Deferred on Advancement
Feasibility of 1-hr Outlooks for Total Severe					X
Feasibility of 4-hr Outlooks for Individual Hazards		X			
Multiple CAM Ensembles for Day 1 Severe Guidance			X		
Multiple CAM Ensembles for Day 2 Severe Guidance			X		
Parallel EMC HiResW ARW and NMMB	X				
Parallel EMC NAM Nest and GSD HRRR		X			
HAILCAST Embedded in NSSL-WRF					X
Hail Size Diagnostic in Microphysics					X
Environment Filters to NSSL EPS Tor. Fcsts.			X		
NSSL-WRF and UKMET CAMs					X
3-D CAM Visualization					X
MPAS Convection-Allowing Output					X
Totals	1	2	3	0	6



FY16 Activities

HWT

- **Community-Leveraged Unified Ensemble (CLUE) Configuration**
 - 65 Total members: CAPS 35, NSSL 15, UND 4, NCAR 10, GSD 1
 - WRF 3.7.1, 3 km grid-spacing, CONUS domain, 51 vertical levels
- **Experiments**
 - **ARW vs. NMMB Models** – A direct comparison of subjective and objective skill of two modeling systems, one developed at NCAR and the other NOAA's EMC
 - **Multi-Core vs. Single Core** – Three ensemble will be compared. One using 5 ARW and 5 NMMB members, one using 10 ARW members, and one using 10 NMMB members
 - **Single Physics vs. Multi-Physics** – An ensemble with perturbed ICs/LBCs will test whether there is a noticeable advantage when using varied physics vs. common physics in all members
 - **Ens. Radar vs. Ens. No Radar** - A single physics ensemble will test the influence of radar DA (An important question is whether the influence extends to longer forecast lengths relative to deterministic forecasts).
 - **3DVAR vs. EnKF** – These two methods for data assimilation will be compared
 - **GSD Radar vs. CAPS Radar** – Two members are configured identically, except one will use GSD's method for radar DA and one will use CAPS method.
 - **Microphysics Sensitivities** – The impact from different microphysical parameterizations on the resulting convective storm forecasts will be examined.
 - **Ensemble Size Comparisons** - A comparison of the mixed-core ensembles with equal contributions of NMMB and ARW members using 6, 10, and 20 members.



FY15 Highlights

HWT

• Experimental Warning Program

– Spring Warning Project

- Legacy Atmospheric Profiler (LAP) stability indices gave forecasters a heads up where storms most likely to form.
- ProbSevere continues to impress forecasters

– Probabilistic Hazards Information Experiment

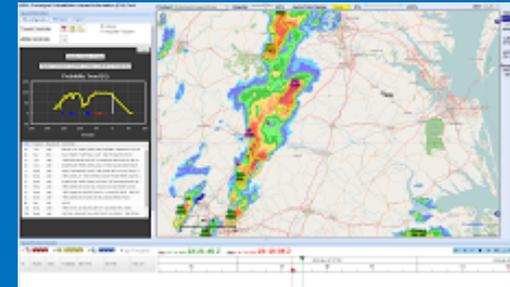
- Included emergency managers into the experiment
- Human-machine mix favored over automated probabilities

– Hydrology Experiment

- First experiment using Hazard Services

– Phased Array Innovative Sensing Experiment

- Eye-tracking methods viable for developing understanding of forecasters' cognition





FY15 Transition Metrics

HWT

- Experimental Warning Program

Major Tests Conducted	Transitioned to Operations	Recommended for Transition to Operations	Advanced to Experimental Testing Phase	Rejected for Further Testing	Decision Pending or Deferred
CIMSS ProbSevere guidance		X			
Probabilistic Hazard Information Prototype tool			X		
Flash Flood Recommenders			X		
Legacy Atmospheric Profiler stability indices		X			
Phased Array Radar data					X
Dangerous Thunderstorm Alerts				X	
FLASH hydrologic modeling products		X			
Totals	0	3	2	1	1



FY16 Activities

HWT

- **Experimental Warning Program**
 - **GOES-R and JPSS Proving Ground Experiment**
 - April 18 – May 13
 - 4 weeks
 - **PHI - Hazard Services Experiment**
 - May 2 – June 4
 - 3 weeks
 - **PHI - Prototype Experiment**
 - May 9 – June 10
 - 3 weeks
 - **Hydro Experiment**
 - June 20 – July 11
 - 3 weeks



Best Practices/Lessons Learned

HWT

- Early community/stakeholder collaboration and engagement is a key
 - Most effective when partners work together on topics of mutual interest
 - Forecasters, model developers, researchers, emergency managers, broadcasters
- Close interaction between researchers, forecasters, and training groups are critical to R2O
 - Researchers better under real-world forecasting and workload challenges
 - Forecasters provide feedback on next-generation tools and better understand research challenges
 - Training groups ensure more effective transition to operational practices
- Real-time forecast experiments are conducted in simulated operational environments
 - Replicates operational challenges with real-world requirements and constraints
 - No one knows the forecast “answer” ahead of time
- Project testing and R2O is an incremental process over multiple years that builds upon results from prior experiments



Supplemental Slides



HWT History Timeline

Selected Milestones

1997: SPC moves from Kansas City to Norman.

2000-01: Spring Program formalized.

- Decision made to focus on SPC-specific forecast problems.
- Visiting scientist from EMC co-funded by NSSL and SPC helped jump-start inter-agency working relationships

2006: NSSL and SPC move to the NWC and the HWT is created.



1970s– 1990s: *Culture of Collaboration* established between NSSL and the local WFO.

- Doppler radar demonstrations, data collection/forecasting for field programs, experimental modeling.
- Experimental Forecasting Facility

2003-04: Initial testing of “storm-scale models”

- Models with high enough resolution to explicitly depict storms.
- Forecasters excited: **“A turning point in the use of model output”**
- EMC starts year-round runs for SPC and includes storm-scale models in 5-10 year production-suite plans.

2007-present: Focus on using storm-scale ensembles.

- Innovative data mining and visualization techniques.
- Numerous R2O and O2R successes.



Testbeds are Diverse

Tools

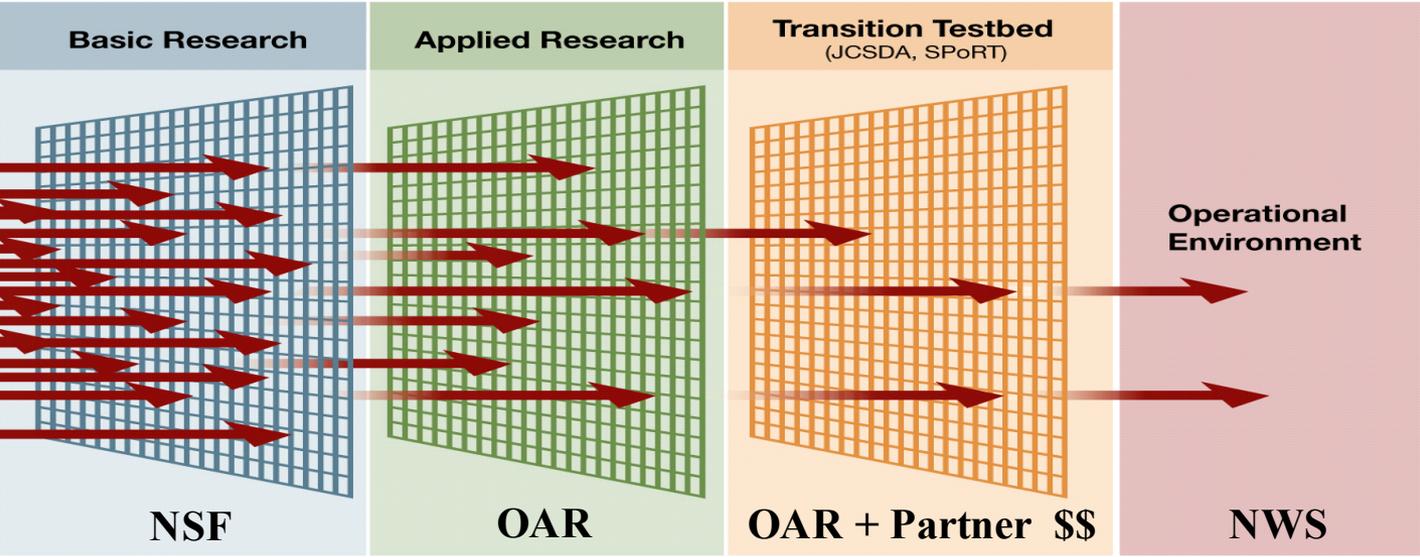
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HWT Engagement

SPC SSB

Ideas



Challenges

pathway for operational assessment and feedback

NWP

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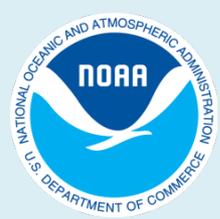
HWT Engagement

EMC NCO



HWT Funded Grant Projects

- NOAA/NWS: *Round 1 of Research to Operations Initiative* (NOAA-NWS-NWSPO-2015-2004117) – HWT EFP projects:
 - Information Extraction and Verification of Numerical Weather Prediction for Severe Weather Forecasting by Jirak (SPC), Melick (CIMMS/SPC), Brooks (NSSL), and Pyle (EMC)
 - Improvement of Convective/Severe Weather Prediction through an Integrative Analysis of WRF Simulations and NEXRAD/GOES Observations over the CONUS by Dong, Kennedy, and Gilmore (UND)
 - Test and Evaluation of Rapid Post-Processing and Information Extraction From Large Convection Allowing Ensembles Applied to 0-3hr Tornado Outlooks by Correia (CIMMS/SPC), LaDue (OU/CAPS), Karstens, Wheatley, and Knopfmeier (all CIMMS/NSSL)
- NOAA/OAR: *Office of Weather and Air Quality Hazardous Weather and Hydrometeorology Testbed Competitions* (NOAA-OAR-OWAQ-2015-2004230) – HWT EFP projects:
 - Developing and Evaluating GSI-based EnKF-Variational Hybrid Data Assimilation for NCEP NAMRR to Improve Convection-Allowing Hazardous Weather Forecast by Wang (OU), Carley (EMC) DiMego (EMC), Jirak and Weiss (SPC), Kain and Clark (NSSL)
 - Convection-Permitting Ensemble Forecast System for Prediction of Extreme Weather by Romine, Schwartz, and Sobash (all NCAR), and Coniglio (NSSL)
 - Information Extraction and Verification of Convection-Allowing Models for Severe Hail Forecasting by Jirak (SPC) and Melick (CIMMS/SPC)
 - Improving Initial Conditions and their Perturbations through Ensemble-Based Data Assimilation for Optimized Storm-Scale Ensemble Prediction in Support of HWT Severe Weather Forecasting by Xue, Kong, Jung, and Snook (all OU/CAPS)



HWT Funded Grant Projects

- NOAA/NWS: NOAA/OAR: NOAA/OAR: *Office of Weather and Air Quality Internal Research to Operations Transition Competitions (NOAA-OAR-OWAQ-2015-2004230)* – HWT project:
 - Probability of What? Understanding and Conveying Uncertainty Through Probabilistic Hazard Services by Rothfus, Gurley, and Brooks (NSSL), Hansen (GSD), Manross (CIRA/GSD), Schneider and Jirak (SPC), Smith and Karstens (CIMMS/NSSL), Stumpf (CIMMS/MDL), Smith (MDL), Novak (WPC), Ripberger and Silva (OU), and Ling (U. Akron)