

The role of testbeds in NOAA for transitioning NWP research to operations

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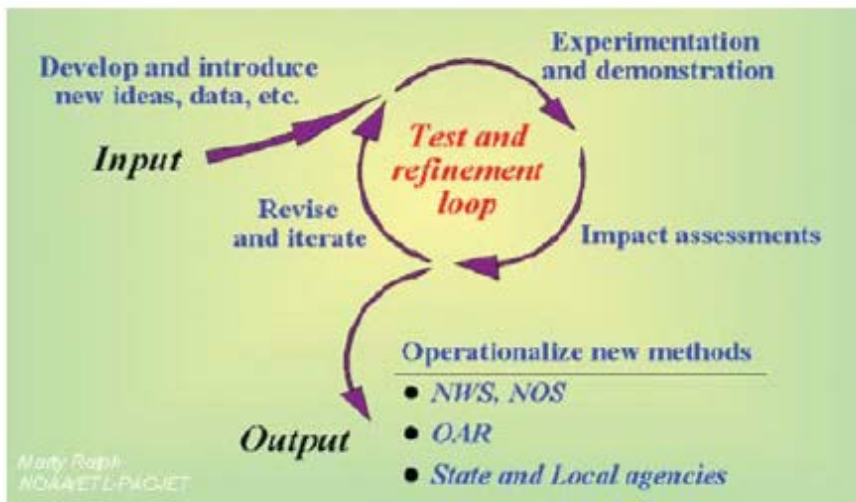
Several operational NWP suites

NOAA has several NWP suites that need ongoing improvement, including...

- Global
 - Global Forecast System (GFS)
 - Global Ensemble Forecast System (GEFS)
- Regional (subset)
 - North American Mesoscale (NAM)
 - Rapid Update (RAP)
 - Short Range Ensemble Forecast (SREF) System
 - Hurricane Weather Research and Forecasting (HWRF) model

Testbeds for model improvement

- Testbeds are one of NOAA strategies to improve NWP
- Facilities in which NOAA and the community
 - plan,
 - develop,
 - and test new concepts and tools.



From Dabberdt et al., 2005

Examples of NOAA Testbeds

Testbed

Aviation Weather Testbed

Developmental Testbed Center (regional Numerical Weather Prediction)

Hazardous Weather Testbed

Hydrometeorology Testbed (extreme precipitation, QPE, QPF, hydrology)

Joint Center for Satellite Data Assimilation

Joint Hurricane Testbed

Observation System Simulation Experiment Testbed

Space Weather Prediction Testbed

For more information, visit
<http://www.testbeds.noaa.gov>

This presentation

- JCSDA
- HMT
- DTC



Highlights from JCSDA

- **Inclusion of OSCAT scatterometer 10-m winds in the Gridpoint Statistical Interpolator (GSI)**
 - GSI is the data assimilation system used operationally at NCEP
 - Initial results neutral to positive
 - Now system is ready for further tuning
- **1st Joint DTC-JCSDA GSI tutorial and workshop**



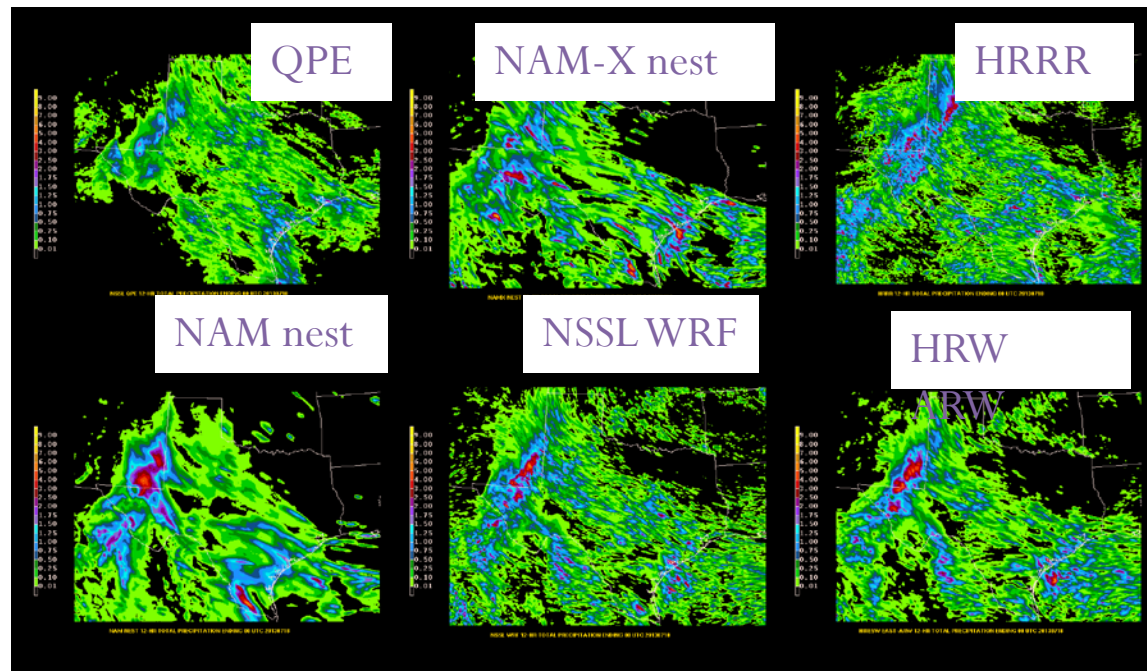
Participants in 2013 Summer GSI Tutorial and Workshop, organized jointly by DTC, NWS/NCEP, NESDIS/STAR and JCSDA in the NCWCP building, in College Park, MD. August 5-8, 2013. Courtesy of Hui Shao. UCAR/DTC.

Highlights from HMT

- **Flash Flood & Intense Rainfall Experiment (July 2013)**
- 26 forecasters, researchers and model developers brought together to explore challenges in short term QPF and flood
- Several operational and research models used

12-h mean QPF valid
7/18 00

Q: Does NAM-X, HRRR,
NSSL, and/or HRW
provide better guidance
than NAM-nest?



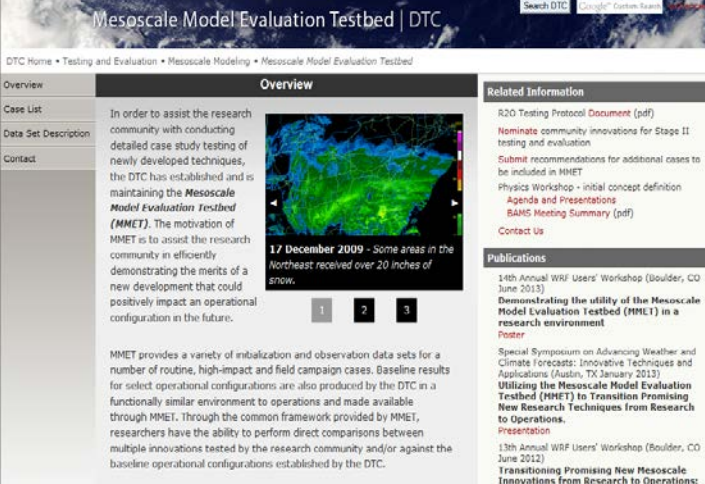
Developmental Testbed Center

DTC activities

- **O2R** transition: operational NWP systems are made available and supported to the research community
- **Interaction** between research & operations
 - organization of community workshops on important topics of interest to the NWP community
 - DTC Visitor Program
- **R2O** transition: NWP innovations are tested and evaluated
 - Work with both 1-2 year implementations and next-generation systems
 - Neutral position in order to provide unbiased assessment
 - Comprehensive testing for a broad range of weather regimes
 - Evaluation based on extensive objective verification statistics
- DTC is jointly sponsored by NOAA, Air Force, NSF, & NCAR

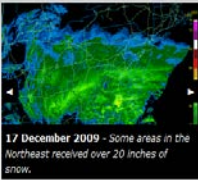
Mesoscale Model Evaluation Testbed

- Facilitates testing of new innovations by community
 - DTC provides model input and observations for case studies
 - Community tests their own innovations
 - Allows for quick comparisons against published baseline results
 - Provides a common framework for testing
 - Allows for direct comparisons among community results
- Promising capabilities nominated for extensive T&E performed by DTC
- Established data sets for nine cases
 - Open solicitation for more cases



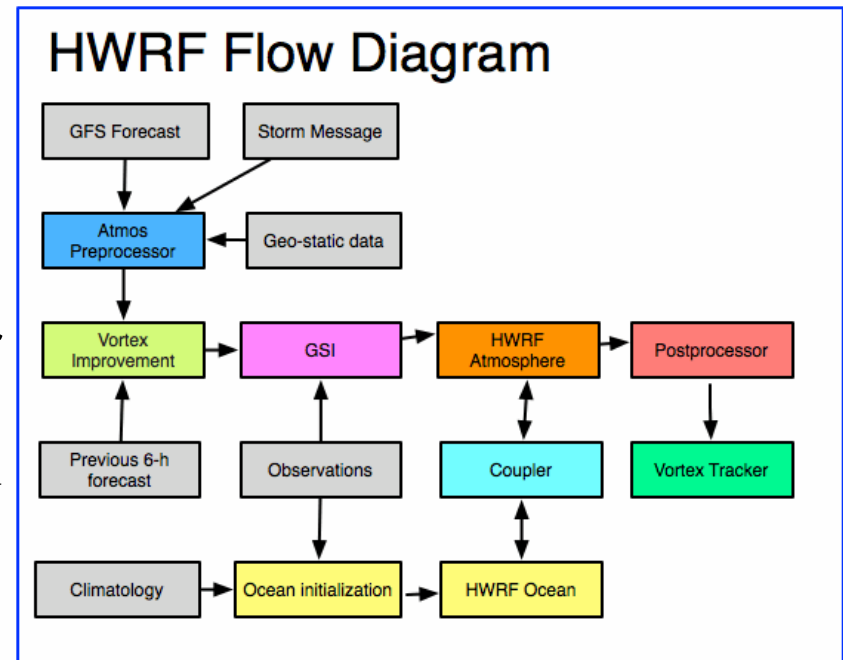
Mesoscale Model Evaluation Testbed | DTC

DTC Home • Testing and Evaluation • Mesoscale Modeling • Mesoscale Model Evaluation Testbed

Overview	Overview	Related Information
Case List	In order to assist the research community with conducting detailed case study testing of newly developed techniques, the DTC has established and is maintaining the Mesoscale Model Evaluation Testbed (MNET) . The motivation of MNET is to assist the research community in efficiently demonstrating the merits of a new development that could positively impact an operational configuration in the future.	R20 Testing Protocol Document (pdf) Nominating community innovations for Stage II testing and evaluation Submit recommendations for additional cases to be included in MNET Physics Workshop - initial concept definition Agenda and Presentations BAMS Meeting Summary (pdf) Contact Us
Data Set Description	 <p>17 December 2009 - Some areas in the Northeast received over 20 inches of snow.</p>	Publications 14th Annual WRF Users' Workshop (Boulder, CO June 2013) Demonstrating the utility of the Mesoscale Model Evaluation Testbed (MNET) in a research environment Poster Special Symposium on Advancing Weather and Climate Forecasts: Innovative Techniques and Applications (Austin, TX January 2013) Utilizing the Mesoscale Model Evaluation Testbed (MNET) to Transition Promising New Research Techniques from Research to Operations. Presentation 13th Annual WRF Users' Workshop (Boulder, CO June 2012) Transitioning Promising New Mesoscale Innovations from Research to Operations
Contact	MNET provides a variety of initialization and observation data sets for a number of routine, high-impact and field campaign cases. Baseline results for select operational configurations are also produced by the DTC in a functionally similar environment to operations and made available through MNET. Through the common framework provided by MNET, researchers have the ability to perform direct comparisons between multiple innovations tested by the research community and/or against the baseline operational configurations established by the DTC.	

DTC Highlight: Hurricane WRF

- HWRF provides guidance to the National Hurricane Center (NHC) for the North Atlantic and Eastern North Pacific basins
- Regional model 27/9/3 km
- HWRF has 8 components, many used in other applications
- Developmental Testbed Center works in
 - Support code to community
 - Code management
 - Testing and evaluation (R2O)



Operational forecasts

http://www.emc.ncep.noaa.gov/gc_wmb/vxt/

Developmental Testbed Center support

The screenshot shows the 'WRF for Hurricanes' website. At the top, there's a search bar and a navigation menu. The main content area is divided into several sections: 'Home', 'Terms of Use', 'Overview', 'User Support', 'Downloads', 'Documentation', 'Tutorial Information', 'Testing and Evaluation', and 'Additional Links'. The 'Home' section contains a welcome message and a list of links to various resources. The 'Events' section lists several dates and events, including '18 January 2013 HD12 Reference Configuration: 2012 operational capability in community code' and '4 January 2013 HWRF 2012 FLUX testing and evaluation'. The 'Announcements' section lists several dates and announcements, including '11 December 2012 HWRF V3.4a Online Tutorial Release' and '29 August 2012 Release V3.4a of the HWRF system'. The 'Organizations contributing to this website' section lists 'Developmental Testbed Center (DTC)', 'NCAR's Mesoscale & Microscale Meteorology Division (MMM)', and 'Sponsors of WRF for Hurricanes'.

Code downloads,
datasets,
documentation,
online tutorial,
helpdesk

500 registered users

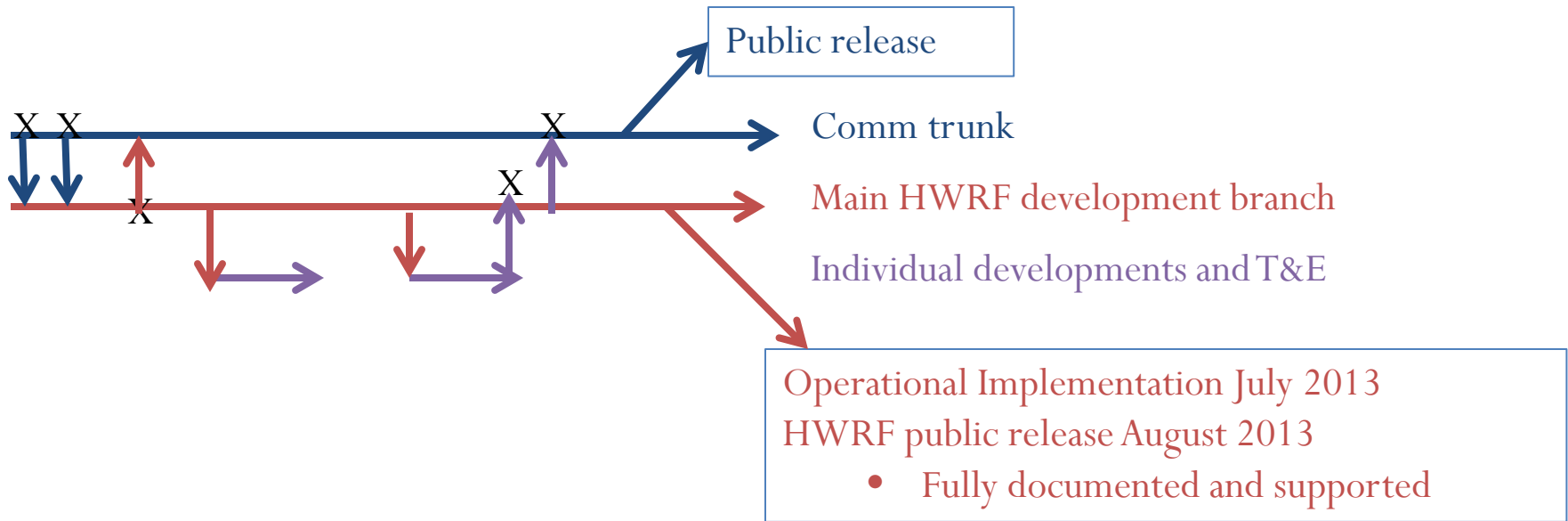
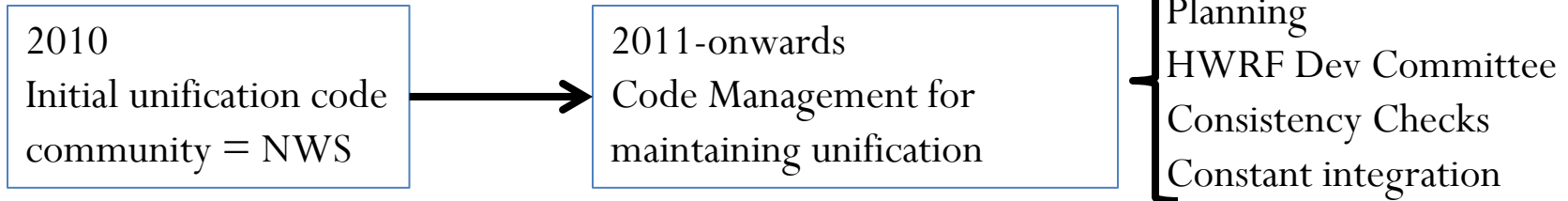
Yearly releases
corresponding to
operational model of
the year

Stable, tested code

Benchmarks available

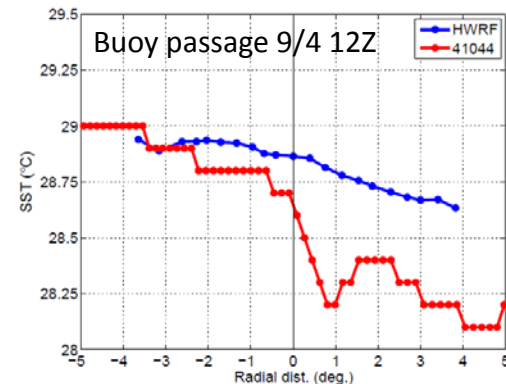
Current release: HWRF v3.5a (2013 operational)
Next tutorial: January 14-16, 2014 in College Park, MD USA

Code management supports T&E



Example of collaborative testing

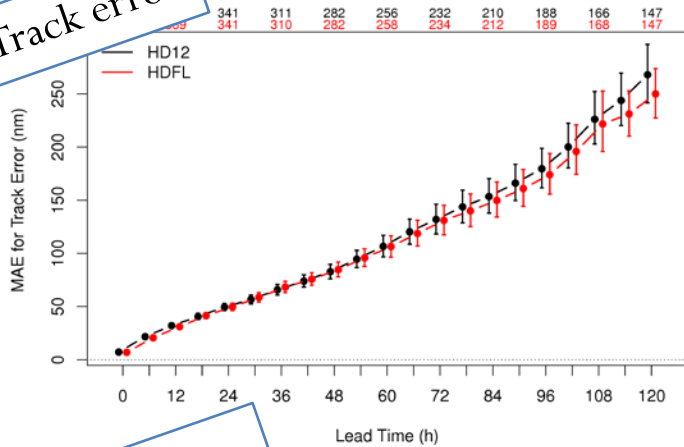
- Coupled HWRF tests (2007 and 2010) indicated POM-TC **over-cooling**
- To minimize over-cooling, atmos fluxes to POM-TC were reduced 25%
- NOAA Research (2012): POM-TC under-cools
 - Change due to higher resolution and updated physics in atmos model
- Hypothesis (University RI): flux reduction in HWRF not necessary (and should be eliminated as it is mostly non-physical)
- Comprehensive DTC by test: 2012 HWRF with and without flux reduction. Cases: entire 2012 season
- Diagnostics by DTC and NOAA Hurricane Research Division



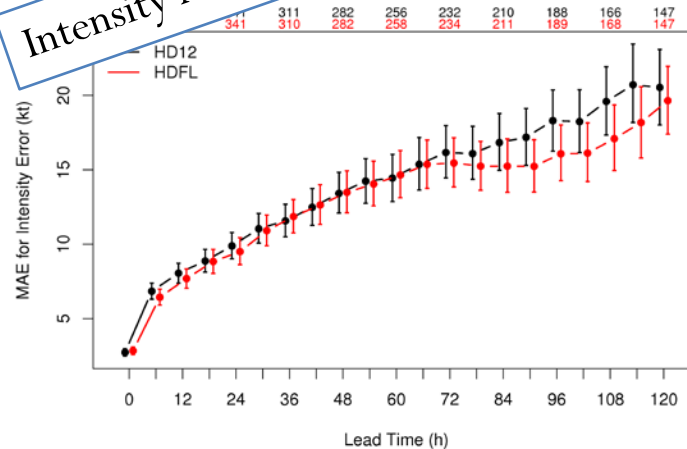
Katia (from Cione and Uhlhorn)

Atlantic track and intensity

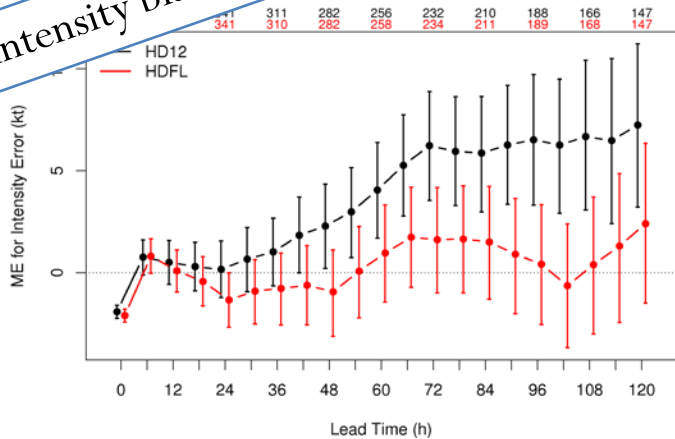
Track error



Intensity MAE



Intensity bias



Track ME: HD12 and HDFL very similar
Int MAE: HDFL SS better at 3 lead times
Int bias: HDFL lowers intensity and helps overintensification at long lead times
Pacific impact is much smaller (POM-TC 1D)

Positive results led to implementation in the 2013 operational HWRF model

DTC challenges and opportunities - I

- Code unification and management
 - Operational codes grow organically and are rarely re-designed
 - Variety of expectations regarding software development
 - Best software practices overlooked in fast development phases
 - Software modularity is often lost
 - Periodically, we should rewrite parts of system
 - However, funding for software engineering is scarce
- Seeking solutions to facilitate code management and modularity

I am very interested in learning from this community

DTC challenges and opportunities - II

- Business model for interacting with the research community
- Academic community would like to easily
 - Be able to run an operational system in any computational platform
 - Reproduce previous operational and research runs
 - Access variety of datasets: input, verification, other models runs
- Involves code management, databases, data service, scripting, user interfaces, documentation, training etc.
- Might involve rewriting some code in modular way

I am very interested in learning from this community, including OOPS and PrepIFS