Developmental Testbed Center | DTC

Transitions

Newsletter Winter-Spring 2014

Courtesy of Toby Sinclair

ISSUE 4

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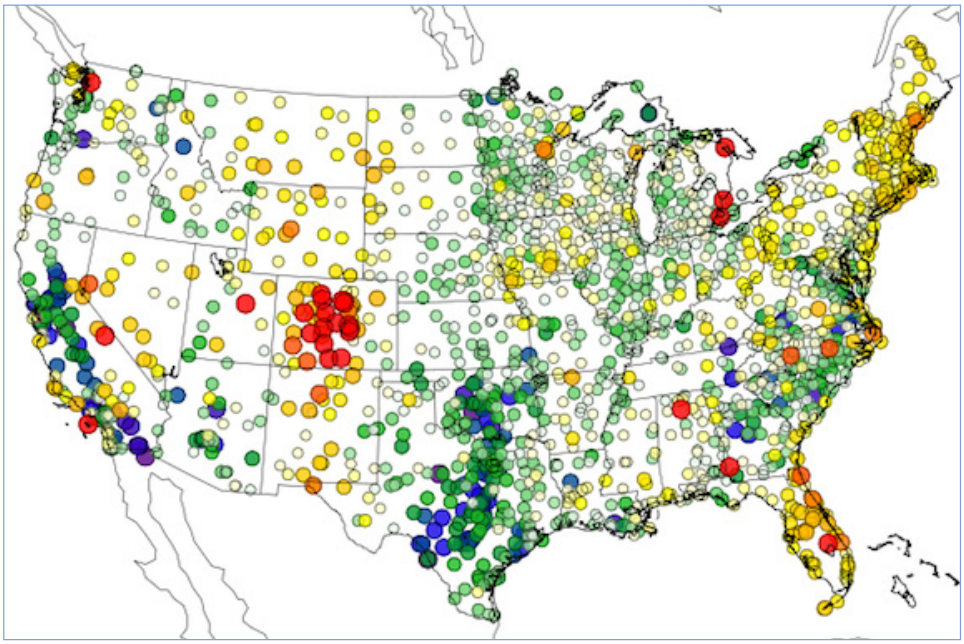
ASSISTING WITH THE TRANSITION OF PROMISING NWP TECHNIQUES FROM RESEARCH TO OPERATIONS

Keeping up with Model Testing & Evaluation Advances: New Verification Displays

As numerical model predictions and functions proliferate and move toward ever higher resolution, verification techniques and procedures must also advance and adapt.

The ability to consolidate and integrate numerous verification results that are increasingly differentiated in intent and type largely depends on the effectiveness of graphical displays. In response to these needs, several new kinds of displays have recently been added to the DTC and MET arsenal, or are in process of development and assessment at the DTC. An example is the regional display of verification scores in the figure above, where results from relatively long verification periods at point locations are shown (in this case, dewpoint temperature bias at surface observation sites). Although time resolution is sacrificed, these plots represent an important way to assess topographic, data density, and other geographic effects on model accuracy. In the first figure, for instance, the cluster of red symbols (portraying too-high dewpoints) in the mountains of Colorado, and along the east coast offer clues useful for assessing model inaccuracies. The opposite tendency (low-biased dewpoints, or too-dry forecasts) are pronounced over Texas and Oklahoma, and in the Central Valley of California. *(Continued on next page.)*



Director's Corner

One outcome of the DTC Science Advisory Board (SAB) meeting last September was establishment of an annually rotating SAB Chair. As the first to assume the role under this change, I welcome the future opportunity to address the DTC from the perspective of a researcher. Taking over from last year's chair Mark Stoelinga is no small task; Mark efficiently and effectively led our discussions and drew several points of consensus from among many disparate ideas and concerns. I encourage those interested to browse the report that resulted from our meeting last September (which can be found on the dtcenter.org website). Here I step aside from Chair duties, and instead put forth what I see as the DTC's key strengths, challenges, and opportunities.

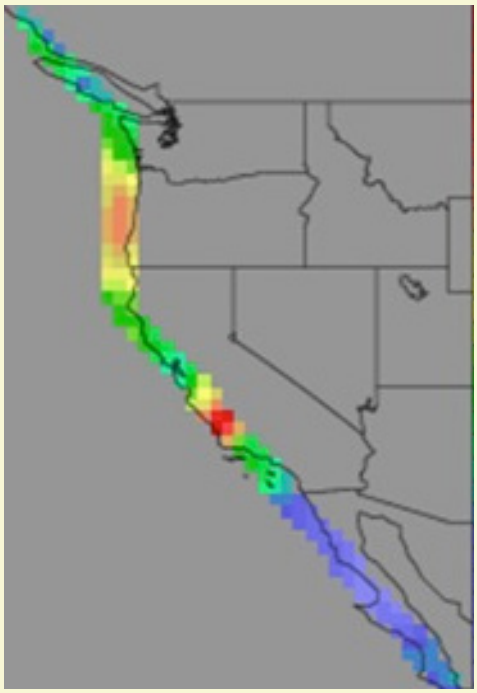
During my short two years on the SAB, the DTC has made noteworthy improvements in its ability to disseminate and support operational codes, such as the WRF-NMM and the GSI. Although many point out that the DTC's primary goal is capability transfer from research to operations,

(Continued on page 4.)

Josh Hacker
NCAR

Did you know...

During California field exercises of the Hydrometeorological Testbed (HMT), a key objective has been to improve longer-range forecasts of so-called 'atmospheric rivers' or ARs (narrow streams of mid- to low-level moisture) and other meteorological patterns that produce very heavy rainfall. During efforts to evaluate model forecasts for these exercises the DTC has explored methods that can provide more meaningful verification than standard scores. One such method represents

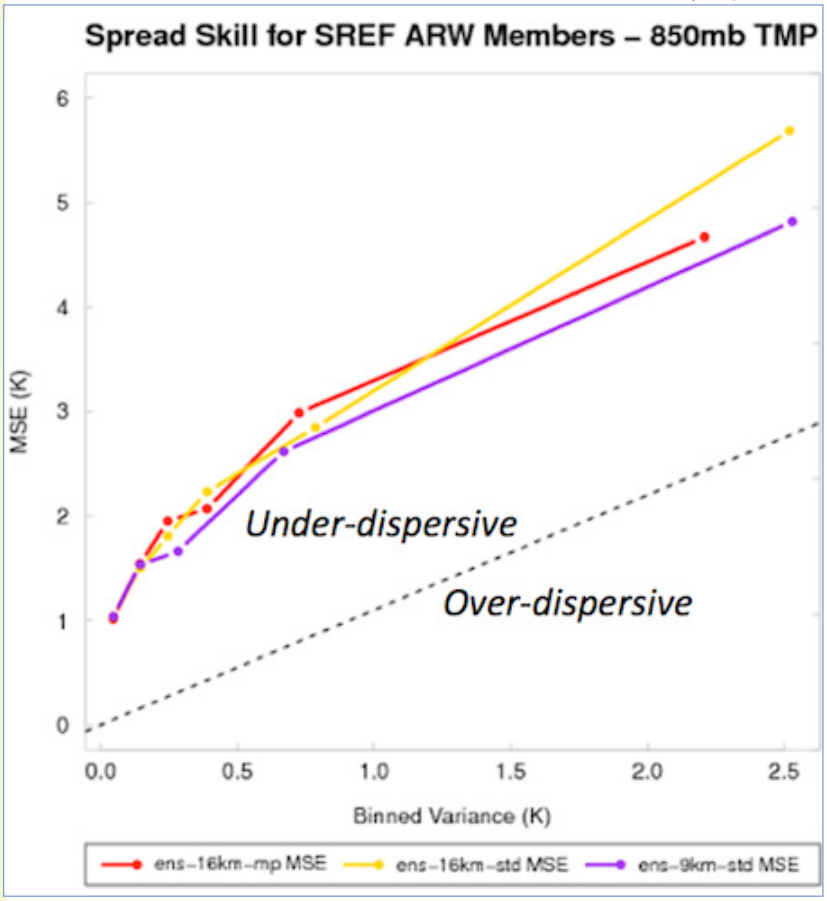


regions of, say, precipitation in model forecasts and observed fields as spatial objects and then quantitatively compares attributes of these objects such as size, location, geographical overlap, etc. Since the landfall of moisture on the Western U.S. coastline is a key factor in AR forecasts, a novel approach for this project has been to define objects within thin domains that follow the coastline (as in the figure), and to choose actual moisture transport as a basis for the fields from which to define objects. The narrow coastline-hugging domain allows the MODE (the Method for Object-Based Diagnostic Evaluation) evaluation to focus on actual landfall of moisture, a key factor in the effort to forecast severe precipitation in California and other regions vulnerable to ARs.

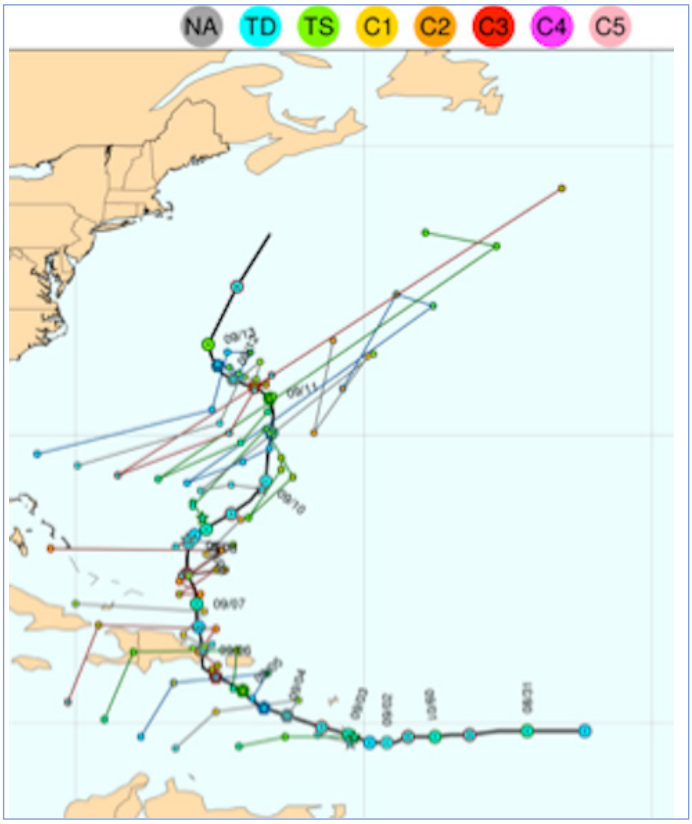
Contributed by Wally Clark and Ed Tollerud. ■

(Continued from previous page)

The figure below is an example of new utilities used by the Ensemble Task to compute and display ensemble-relevant verification results. In this case, it is one way to present the spread-skill relationship, an important characteristic of ensemble systems. As is commonly seen, these particular CONUS-based ensemble members display an under-dispersive relationship; the struggle to create ensemble systems that accurately represent the natural variability is a difficult one still.



Among ongoing and future product directions are display options for time series evaluation of forecast consistency, in particular for 'revision series' of hurricane track locations (figure below). The objective of this kind of graphic is to examine the consistency of a model's track prediction with its own prior forecasts at the same location and time. For many users, this consistency in forecasts through time is a desirable quality; if updating forecasts change much or often, a user may believe they are of low quality, possibly even random. For instance, in the figure, the model shows consistent updates in the Caribbean, and inconsistent (zigzagging) ones as the storm moves northward. These latter forecasts of hurricane location might thus be considered less reliable.



Contributed by Jamie Wolff, Isidora Jankov, and Tressa Fowler. ■

Who's who

Tim Brown

If you still harbor a notion that software engineers live narrow lives, a few minutes with Tim will quickly persuade you otherwise. Between his present 3-year stint with DTC's hurricane task and graduate school in Perth, Australia, Tim has worked in Toronto with the Ontario Institute for Cancer Research; Australia with the Center for Water Research; Switzerland, the UK and Antarctica. He declines to speculate where his next career move might take him.

In Boulder, he has taken on a varied set of responsibilities, including teaching at recent DTC & EMC sponsored Hurricane WRF tutorials and preparing numerical model documentation for HWRF. His most recent task, however, has been the collaboration with EMC in the conversion of the hurricane model scripts into Python, which he says will unify the operational and research communities thus enabling greater O2R and R2O. Outside of work, he greatly appreciates Colorado's opportunities for backcountry skiing and bicycling. Perhaps that will help keep him in the DTC fold for a while! ■

COMMUNITY CONNECTION

Community Software Maintenance and Support

One function of the DTC has been to archive and maintain important model-related code, and to make it available to operational and research segments of the meteorological community.

As Laurie Carson describes it, the code maintenance and support function has important objectives in both O2R and R2O arenas: for the former, providing operational software to the research community, and for the latter, facilitating transfer of research capabilities to operational software packages. DTC's approach is based on a philosophy that community software is a resource shared with a broad community of (distributed) developers specifically including the capabilities of operational systems. Two keys to its success are periodic public releases that include new capabilities and techniques, and effective user support. The chart summarizes present and planned DTC software support activities in five principal areas: WRF model updates and support, data assimilation (GSI) code releases and support, the end-to-end operational hurricane forecast system (HWRF), verification package maintenance and support (MET), and planning for a future community package of the NOAA Environmental Modeling System (NEMS) that includes the NMMB model. Some community code now supported in this way has derived from DTC visitor projects; an example is the field alignment technique described in the 2012 visitor project of Sai Ravela (summary available at http://www.dtcenter.org/visitors/year_archive/2012/). For further description of the DTC community software efforts, see http://www.dtcenter.org/code/.

Software	Code Releases	Tutorials	Registered Users	Help Questions	Collaborators
WRF	2x per year	2x per year	25,000+	400+/month	MMM
GSI	1 per year	1 per year	963	40/month	NCEP/EMC
HWRF	1 per year	1-2 per year	736	25/month	MMM & NCEP/EMC
MET	1 per year	1 per year	2360	15/month	
NEMS/NMMB	n/a	Friendly User Package available; Tutorial in early 2015			

"The DTC software maintenance task has both O2R and R2O objectives."

As the chart indicates, another community outreach-related DTC activity involves arranging and contributing to workshops and tutorials to facilitate use of these community model and analysis packages. A future issue of Transitions will summarize recent and upcoming events of this kind.

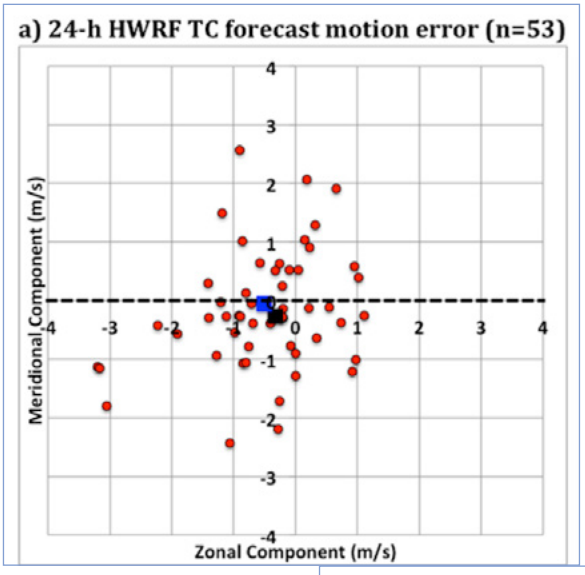
Contributed by Laurie Carson. ■

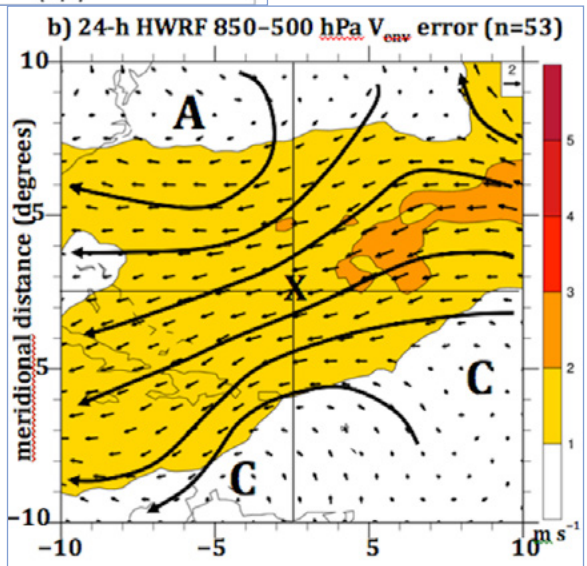
Diagnosing Tropical Cyclone Motion Forecast Errors in HWRF

As a DTC visitor in 2013, Thomas Galarneau has applied a new diagnostic method for quantifying the phenomena responsible for errors in tropical cyclone (TC) storm tracks to an inventory of recent hurricanes.

The method is founded on the notion that errors in storm motion at relatively short lead times (12-48 h) lead to large position errors at later times. The objective of his DTC Visitor Project was to diagnose sources of error in TC motion forecasts from the HWRF model. Of particular interest was the impact of model errors in forecasts of the environmental steering flow at different stages of Atlantic Basin TC evolution. By isolating the vortex structure from the larger-scale flow in a TC-relative framework, he has been able to show (as in the scatterplot in the figure below) that during the northeastward-moving (post-curvature) phase, TC motion errors are generally southwestward. As illustrated in the TC-relative geographical plot of the figure below, this error can be attributed to a northeasterly environment wind error larger than 1.0 m/s, which in turn appears to be associated with an anticyclonic error to the northwest, and a cyclonic error to the southeast, of the forecasted TC. Further details of his project will be available soon at http://www.dtcenter.org/visitors/year_archive/2013/ when DTC visitor reports are posted.

Contributed by Thomas Galarneau. ■





(Directors Corner--continued from page one.)

that goal cannot be realized without first opening the doors for the research community to adopt operational codes and methods. The ARW is well established in the research community, and may be difficult to supplant at any significant level. The GSI may prove more successful, and the DTC's experience and support of the GSI opens a plausible path to a success in research to operations. Consider the following scenario: university investigators continue to expand use of complex data assimilation codes, and university use of the ARW-compatible GSI grows commensurately. With NCEP and AFWA invested in the GSI for some years to come, a viable opportunity for research to operations transfer emerges. With convection-allowing forecasts offering several important science challenges, it is not a stretch to think that a university investigator with sufficient computational resources would find a RAP or HRRR-like system desirable to facilitate research in the near future. NCEP and AFWA may see tangible contributions that follow.

In the present environment defined by funding uncertainty, the DTC continues to face the challenge of balancing its core mission against funding opportunities that may redirect limited staff time. A step into global modeling could present one such difficulty. Suppose an opportunity emerges to begin testing global models. In the absence of increased total funding, staff would necessarily be diverted away from valuable mesoscale model testing, and from supporting operational codes to the community. It is unlikely that large numbers of university investigators will, in the next few years, be running operations-grade global models with regularity and resolution needed to inform operational centers. Maintaining focus on growing strength in mesoscale model testing, especially at convection-allowing scales, should position the DTC for future research to operations transition opportunities.

Finally, the rising importance of the HRRR and HRRRE, and the continued emphasis on probabilistic forecasting at AFWA, give the DTC its greatest opportunity to realize research to operational transitions. The HRRR, and nearly all of AFWA's operational NWP, are based on the widely used ARW. As noted above, the recent success in hosting GSI workshops, and supporting the code to the research community, positions DTC for future success.

After what some perceive as struggles during its first few years, the DTC has laid a solid foundation. Independent testing of operational models continues to be valuable, particularly to AFWA; the visitor program remains popular and effective at offering operational-relevant problems to the community. By remaining focused on its strengths while continuing its work making operational codes available to the research community, the DTC should realize more future success in line with its core mission. ■

OPPORTUNITIES

DTC and Our Community

There are several ways to connect with the DTC. Here are a few.

1 Meet us at an event

2014 events

WRF Users' Workshop (Boulder, CO) Jun 23-27
Hurricane WRF Tutorial (Taipei) May 22-23

2 Ask a question

Brian Colle asked this question

Q: Is it possible for the DTC to make available relatively long (seasonal perhaps) periods of model fields and observations to outside users?

A: The DTC has conducted several extensive (seasonal length and longer) testing and evaluation (T&E) activities since its inception (see http://www.dtcenter.org/eval/ for details). All of these datasets, including model output fields and observations used for the evaluation, are archived and can be made available to the community. Answer contributed by Jamie Wolff.

3 Become part of the visitor program

The DTC Visitor Program supports visitors to work with the DTC to test new forecasting and verification techniques, models and model components for numerical weather prediction (NWP). See at www.dtcenter.org/visitors

Q & A

Get Involved! *Help us identify and communicate information that we may not have thought of — ask a question about the DTC and its activities, a few of which we will provide answers to in this section.*

4 Visit the website

See ***www.dtcenter.org*** for information about the DTC-related presentations, DTC Visitor Program, the DTC newsletter archive, DTC directory listing and more.

5 Submit an article or question for the Newsletter

Please contact ***dtc-editor@noaa.gov*** to send questions and ideas for articles. We also welcome comments/reactions/questions about information in this newsletter at the same email address. ■

NEWS FROM THE DTC

Announcements and Publications

WORKSHOP ANNOUNCEMENTS

5th NOAA Testbeds & Proving Grounds Workshop 16–18 April 2014, College Park, MD

Hurricane WRF Tutorial 22-23 May 2014, Taipei, Taiwan. See http://www.dtcenter.org/HurrWRF/users/tutorial/2014_Taiwan_tutorial/2014.php ■

USER ANNOUNCEMENT

MODE website, On 14 Feb 2014 the Weather Prediction Center unveiled a MODE verification website at http://www.hpc.ncep.noaa.gov/verification/mode/mode.php. The website displays both graphical and statistical comparisons of 24 hr precipitation forecasts and is updated daily. ■

PUBLICATION

Sandgathe, Scott, Barbara Brown, Brian Etherton, Edward Tollerud, 2013: ***Designing Multimodel Ensembles Requires Meaningful Methodologies***. Bull. Amer. Meteor. Soc., 94, ES183-ES185 http://dx.doi.org/10.1175/BAMS-D-12-00234.1 ■

In the next issue

- *A report on the implementation of Greg Thompson's microphysical software package in WRF and NMMB*
- *DTC Outreach: community workshops and tutorials*

Sponsors

DTC's primary sponsors are the National Oceanic & Atmospheric Administration (NOAA), the Air Force Weather Agency (AFWA), the National Center for Atmospheric Research (NCAR), and the National Science Foundation.

The DTC is a distributed facility where the NWP community can test and evaluate new models and techniques for use in research and operations.

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Developmental Testbed Center
P.O. Box 3000
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www.dtcenter.org

Editors: Edward Tollerud and Paula McCaslin