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.)
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.

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.
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!

Who’s who

Tim Brown

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 NMME 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 Sri 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/.

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.
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 experi-
ence and support of the GSI opens a plausible path
to a success in research to operations. Consider the
following scenario: university investigators con-
tinue to expand use of complex data assimilation
codes, and university use of the ARW-compatible
GSI grows commensurate. 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 of-
erfering 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 chal-
lenge 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 commu-
nity. It is unlikely that large numbers of university
investigators will, in the next few years, be running
operations-grade global models with regular-
ity 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 probabi-
listic forecasting at AFWA, give the DTC its great-
est 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 suc-
cess.

After what some perceive as struggles during its
first few years, the DTC has laid a solid founda-
tion. 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.
A report on the implementation of Greg Thompson’s microphysical software package in WRF and NMMB

DTC Outreach: community workshops and tutorials

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.

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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