Developmental Testbed Center | DTC

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Transitions

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INSIDE THIS ISSUE

Director's Corner

By Barb Brown

The DTC was established a number of years ago to facilitate the transition of new capabilities in weather forecasting from research to operations (R2O), with a focus on the WRF model. Over the years, many things have changed – for example, the DTC now works with multiple sets of code (WRF, GSI, MET, HWRF, and so on) which will soon include global prediction systems – but that fundamental mission remains the same. The DTC accomplishes its goals through strong connections to the operational and research communities. These dual connections, forming the bridge between the communities, are what make the DTC unique.

In fact, the bridge is the key aspect of the DTC that has led to its success, and will lead to additional successes in the future as the DTC continues to grow and mature.

(Continued on next page.)

Barb Brown, *NCAR*

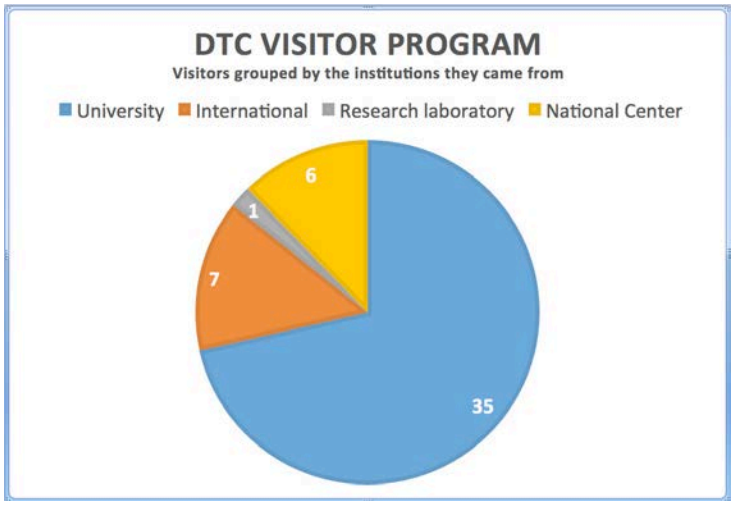
THE STATE OF THE DTC
ARTICLE BY BILL KUO, DTC DIRECTOR

DTC: The Next Ten Years

The transition of research advances into operations (abbreviated as R2O), particularly those operations involving numerical weather prediction, satellite meteorology, and severe weather forecasting, has always been a major challenge for the atmospheric science community.

With a preeminent mission to facilitate R2O in mind, NOAA and NCAR established the DTC in 2003. Since then, the DTC has worked toward this goal in three specific ways: by providing community support for operational NWP systems, by performing testing and evaluation of promising NWP innovations, and by promoting interactions between the research and operational NWP communities via workshops, a newsletter, and a robust visitor program. Early DTC activities, which were primarily focused on evaluation of opportunities afforded by the then-new Weather Research and Forecasting model (WRF), included the testing and evaluation of two WRF model dynamic cores (one developed at NCAR and the other at EMC), rapid refresh applications; and a real-time high resolution winter forecast experiment. As a neutral party not involved with the development of either core, the DTC played a vital, independent role in these tests, especially their planning, their evaluation, and the provision of statistical results to all parties.

In its other role, that of community support, the DTC began providing users of the operational NMME model with documentation, tutorials, and help desk access in 2005. Since then, this DTC activity has grown in extent and complexity, and today also includes community support for the HWRF end-to-end tropical cyclone prediction system, the Unified Post Processer (UPP), Gridpoint Statistical Interpolation (GSI) and GSI ensemble hybrid data assimilation systems, and the Model Evaluation Tools (MET) verification system. In April 2015, the DTC will host its first Nonhydrostatic Multiscale Model on the B-grid (NMMB) tutorial at College Park, MD. Since its inception, the DTC has in fact organized or co-sponsored



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(Director's Corner from page one.)

Connecting the research and operational communities through workshops (e.g., the recent physics workshop, see page 4), support and training on operational codes, and the DTC visitor program provide the keys to developing relationships that will lead to new successes in R2O. Moreover, the DTC's independent testing and evaluation of new innovations developed by the research community, and its efforts to enable such testing by the research community (e.g., through the Mesoscale Modeling Evaluation Testbed, MMET) help speed the identification and transfer of new capabilities across that bridge. These key factors have the potential to lead to a vibrant and well connected R2O process.

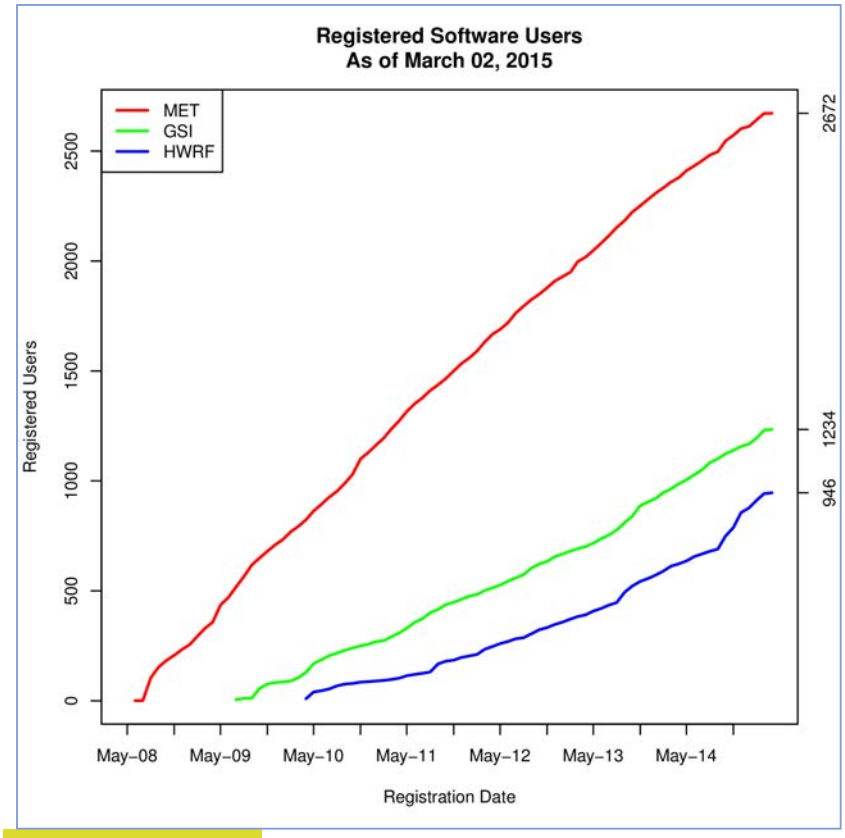
It has been a great pleasure for me to work closely with the DTC over the last six years as a member of the Management Board and as the Director of NCAR's Joint Numerical Testbed Program (JNTP). I feel lucky to be part of this grand effort to improve forecasting for our nation through community activities, and will enjoy watching the success of the DTC in the years to come. It is with pleasure that I hand over the reins of the JNTP to Dr. Joshua Hacker, who will bring new leadership, ideas, and energy to the DTC effort. ■

(DTC Next Ten Years from page one.)

27 community workshops, and has hosted 49 visitor projects selected on the basis of their potential to facilitate interaction between the operational and research NWP communities. The accompanying figures illustrate the distribution and evolution of DTC visitors and users of DTC-supported systems.

These activities have so far been primarily focused on regional and national weather modeling. Now, with continued advances in computing technology, global operational NWP using nonhydrostatic models at cloud-permitting resolution is within reach. With this possibility in mind, all major international operational centers are actively developing advanced global models. The United States National Weather Service, for example, initiated a major R2O project in 2014 to develop a Next-Generation Global Prediction System (NGGPS) that would reach mesoscale resolution. The boundary between regional and global modeling at these scales becomes murky indeed, and previous work of the DTC (testing of model physics in regional models, for example) becomes very relevant to global models as well. Recognizing this opportunity, the DTC Executive Committee unanimously voted earlier this year to expand the DTC's scope to include global modeling. This decision marks a change that will have a profound impact on the direction of the DTC for the next ten years. Here, I offer my perspective on what, in this new context, the DTC should be focusing on in the future.

"The DTC has organized or co-sponsored 27 community workshops and has hosted 49 visitor projects."



Storm-scale NWP. While significant progress has been made in NWP over the past decade, society's expectations have often exceeded improvements. An excellent example is the recent January blizzard forecast for New York City, for which the inability to adequately convey forecast uncertainties in numerical guidance was widely recognized. In a previous but related report, the UCAR Community Advisory Committee for NCEP (or UCACN) pointed out that NCEP does not have an operational ensemble prediction system at convection-permitting (that is, storm-scale) resolution. The development and operation of a prediction system of this kind is a major undertaking, with significant computing demands and challenging scientific and technical issues. Among them are questions concerning initial condition perturbations, model perturbations, calibration, post-processing, and verification, just to name a few. These are also areas of active research attracting the interest of a significant fraction of the 24,000 registered WRF users. Since convection-resolving ensemble prediction is in fact a theme that cross-cuts all its current task areas, the DTC should be well positioned to facilitate R2O toward this end that is useful to both operations and research.

Unified modeling. From an R2O perspective, it is highly beneficial to reduce the number of operational systems, thereby allowing the research community to focus on a smaller number of systems. Unified modeling (UM), which seeks to limit the proliferation of competing modeling elements, has been recognized worldwide as the most cost-effective approach to deal with the increased number and complexity of numerical weather, climate and environmental prediction systems at all space and time scales. A UM framework also allows sharing of modeling efforts (e.g., improvements in physical parameterizations) across different modeling systems. The UCACN has urged NCEP to migrate toward a UM approach for its future model development, and has suggested an interim goal of reducing NCEP modeling systems to only two: A global weather and climate system (GFS/CFS) and a very-high resolution convection resolving system. With nesting capability, the global high-resolution nonhydrostatic model planned

(Continued on page four.)

Who's who **Ming Hu**

Ming is one of several DTC scientists with cross-Pacific ties, with early roots in central China (near Xian) and school and work experience in Jiangsu (where his parents live), the Nanjing Institute of Meteorology, Beijing, and the University of Oklahoma, where he earned his PhD in 2005. Since 2007 he has been working at ESRL/GSD in Boulder. One of the go-to people for data assimilation work at the DTC and at GSD with the RAP/HRRR, he is called upon not only for development work on data assimilation products and applications, but also for community GSI support and for help at tutorials and workshops. These teaching experiences are in fact high on his list of favorite activities. Although he enjoys a good relationship with developers at EMC, he admits to feeling a bit daunted when he compares the scope of the effort at GSD with the 30 or so scientists working on GSI at EMC. He and his family are clearly settled here in Boulder (his wife also works at GSD), but he does seem a bit nostalgic when he talks about the Yellow Mountains, maybe his favorite spot in China. ■

COMMUNITY CONNECTION

New HWRF Developers Website: R2O for Hurricane Model Development

The mission of the DTC is to accelerate the rate of transition of new research and development to operational numerical weather prediction models. To that end, the DTC makes NCEP operational models, such as the Hurricane WRF, available to the general community through yearly releases of stable, well-tested, and well-documented codes, which are supported through a help desk.

While the DTC has hundreds of registered HWRF users, only a small subset of them actually contribute innovations, raising questions about the return on the DTC's investment.

To address this concern, an additional type of support, targeted to this select group of active developers, has been launched by the DTC with support from the Hurricane Forecast Improvement Project (HFIP). Through the HWRF developers website (http://www.dtcenter.org/HurrWRF/developers), scientists external to EMC can request access to the HWRF code repositories, giving them access to retrieve and contribute to experimental codes. They can also obtain information about the HWRF code management process and the steps to get their code made available for consideration by EMC. Finally, scientists can get training on advanced HWRF aspects not made available to the general community, such as the HWRF build system and HWRF automation with the Rocoto Workflow Manager System.

This new DTC service, which goes well beyond what is provided to the general community through public releases, has been extensively used by many HWRF developers, and has been particularly helpful to the principal investigators funded by HFIP.

Contributed by Ligia Bernardet. ■

BRIDGES TO OPERATIONS

Did you Know

Research and Operational Communities Gathered for Physics Workshop Recently

A successful workshop on Parameterization of Moist Processes for Next-Generation Weather Prediction Models was hosted by NOAA and DTC at the NOAA Center for Weather & Climate Prediction (NCWPC) in College Park, MD, Jan 27-29, 2015. A large number of participants from NOAA, the international operational community, and the research community gathered to discuss topics including microphysics, sub-grid scale clouds and turbulence, and deep convection. The first day of the workshop included two keynote presentations and several foundational presentations on the state-of-the-science and current operational status at NCEP for the three topic areas. The second day consisted of breakout discussions allowing for in-depth conversation and idea sharing. A plenary wrap-up session was held on the morning of the third day. A list of the participants, along with the agenda and links to the presentations are available on the workshop website at: http://www.dtcenter.org/events/workshops15/moist_phys/

Contributed by Jamie Wolff. ■

(DTC Next Ten Years continued from page two.)

for the NGGPS project could be a suitable candidate for a UM framework at NCEP. It is true that migration toward UM is a significant challenge for any operational center, involving as it does a major culture change in addition to numerous technical issues. In its capacity for testing and evaluation, the DTC can help facilitate such a transition at NCEP.

Earth system modeling. When fully developed, the NGGPS will be an earth modeling system with fully coupled atmosphere, ocean, ice, land, waves, and aerosol components. The interactions between these components will require compatibility within the NOAA Environmental Modeling System (NEMS) and the Earth System Modeling Framework (ESMF). The NGGPS is expected to provide improved forecasts at a wide range of time scales, from a few hours to 30 days. For this major undertaking to be successful, the community at large will have to contribute at every step of its development. The DTC can encourage and facilitate these contributions to NGGPS code development by managing that code in a way that allows effective access by external developers, and by performing independent testing and evaluation of system upgrades proposed by the external community.

> "When fully developed, the global system will be an earth modeling system with fully coupled atmosphere, ocean, ice, land, waves, and aerosol components."

NWP IT Environment. For each NWP system it supports, the DTC typically maintains a community repository separate from the repository maintained at operational centers. Maintaining a separate community repository is a mixed blessing. On the one hand, a separate repository shields operations from potentially problematic code changes that have not been fully tested. On the other hand, ensuring proper synchronization between the two repositories (a necessary step if the research community is to take advantage of the latest developments at operational centers) becomes a greater challenge. Taking advantage of experience at other operational centers (e.g., ECMWF and UKMO), the DTC in collaboration with EMC has started exploring the possibility of developing an NWP IT Environment (NITE) concept for community support for operational systems. The basic idea of NITE is to maintain an IT infrastructure at the operational center itself (i.e., at EMC) that supports the development, testing, and evaluation of operational models by scientists both within and outside the center. Given the complexity of the NGGPS system, maintaining duplicate systems (repositories) for its many modeling components is neither feasible nor cost effective. This leaves a NITE infrastructure as perhaps the only viable option. The DTC should continue to work with EMC to support NITE development, with the potential of a profound impact on how R2O in NWP is conducted for the coming decade.

Contributed by Bill Kuo. ■

Workshop attendees for the workshop on Parameterization of Moist Processes for Next-Generation Weather Prediction Models
(large photo is split on pages 4 and 5).

Announcements, Publications, Award and More

VISITOR PROGRAM

The DTC is now accepting proposals to its visitor program. It is not anticipated that an official call will be posted; rather, the DTC will keep the application process open and encourage interested potential visitors to submit proposals at any time. See www.dtcenter.org/visitors/. ■

WORKSHOPS, TUTORIALS, EVENTS

The 6th NOAA Testbed Workshop will be held April 14-16, 2015 at the David Skaggs Research Center, Boulder, Colorado. This year's workshop will feature a special science theme session on Advances in Environmental Intelligence. Further information is available at http://www.testbeds.noaa.gov/news/.

The 2015 summer WRF Users Workshop will be held in Boulder on June 15-19.

The first ***Nonhydrostatic Multiscale Model on the B-grid (NMMB) user tutorial*** will be a two-day event starting on April 1, 2015 at the NOAA Center for Weather & Climate Prediction (NCWCP), College Park, Maryland. The objective of the tutorial is to provide an introduction to the model and to the NEMS system. In addition to a practical session on executing the model, the tutorial will include invited talks from NMMB developers and advanced users. For more information and an agenda, see
http://www.dtcenter.org/nems-nmmb/users/tutorial/. ■

Workshop attendees for the workshop on Parameterization of Moist Processes for Next-Generation Weather Prediction Models.

SOFTWARE ANNOUNCEMENTS

The DTC is pleased to announce the ***beta release of version 1.0 of the NOAA Ensemble Kalman Filter (EnKF) system.*** This first release of this operational system is intended for friendly users only. The beta code and a draft Users Guide can be downloaded at
http://www.dtcenter.org/com-GSI/users/docs/index.php.

The DTC will start full user support (helpdesk, webpage, documentation, onsite tutorial) upon its official release, currently scheduled for the summer of 2015. A joint tutorial for GSI and EnKF is scheduled for August 10-14, 2015. ■

PUBLICATIONS

Bernardet, L. and coauthors, 2014. ***Community support and transition of research to operations for HWRF.*** Bulletin of the American Meteorological Society, see
http://dx.doi.org/10.1175/BAMS-D-13-00093.1.

Biswas, M., L. Bernardet, and J. Dudhia, 2014. ***Sensitivity of hurricane forecasts to cumulus parameterizations in the HWRF model.*** Geophysical Research Letters, see
http://dx.doi.org/10.1002/2014GL062071.

Fang, X., and Y.-H. Kuo, 2015: ***A new generic method for quantifying the scale predictability of the fractal atmosphere: Applications to model verification.*** Journal of the Atmosmospheric Sciences, see
http://dx.doi.org/10.1175/JAS-D-14-0112.1, in press.

Wolff, J., M. Harrold, T. Fowler, J. Halley Gotway, L. Nance, and B. Brown, 2014: ***Beyond the basics: Evaluating model-based precipitation forecasts using traditional, spatial, and object-based methods.*** Weather and Forecasting, see
http://dx.doi.org/10.1175/WAF-D-13-00135.1, in press.

Yablonsky, R. M., I. Ginis, B. Thomas, V. Tallapragada, D. Sheinin, and L. Bernardet, 2014. ***Description and analysis of the ocean component of NOAA's operational HWRF model***, see
http://dx.doi.org/10.1175/JTECH-D-14-00063.1. ■

AWARD

Based on her work as a visitor to the DTC during summer of 2014 and her work with Rob Fovell at UCLA, Peggy Bu recently received the Jacob Bjerknes Memorial Award. Her citation for the departmental award: For creatively explaining how and why cloud-radiative feedback influences tropical cyclone structure, helping to improve the nation's operational hurricane forecasting capability. ■

OPPORTUNITIES

DTC and Our Community

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

1 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.

2 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 ***www.dtcenter.org/visitors/***

3 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. ■

Winter Picture: Hoar Frost

Under clear frosty nights in winter soft ice crystals might form on vegetation or any object that has been chilled below freezing point by radiation cooling. This deposit of ice crystals is known as hoar frost and may sometimes be so thick that it might look like snow. The interlocking ice crystals become attached to branches of trees, leafs, hedgerows and grass blades and are one of the most prominent features of a typical 'winter wonderland' day. However, the fine 'feathers', 'needles' and 'spines' might also be found on any other object that is exposed to supersaturated air below freezing temperature.

Photo credit: Robert Berdan.

Article credit: www.weatheronline.co.uk

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

- *Summary of recent projects*
- *Contribution by EMC Director, Hendrik L. Tolman*

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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