



Courtesy of Paula McCaslin

ISSUE 8

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Transitions

Newsletter Spring-Summer 2015

Director's Corner

By Frederick Toepfer

The Next Generation Global Prediction System (NGGPS) project is a National Weather Service initiative to design, develop, and implement a next generation global prediction system to take advantage of evolving high performance computing architectures, to continue pushing toward higher resolutions needed to increase forecast accuracy at shorter timeframes, and to address growing



Frederick Toepfer, NOAA

service demands for increased skill at extended ranges (weeks to months). The NGGPS project goals are: (1.) expansion and implementation of critical weather forecasting research to operations (R2O) capabilities to accelerate the development and implementation of global weather prediction model advances and upgrades; (2.) continued improvement in data assimilation techniques; and (3.) improved software

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

NITE: NWP Information Technology Environment

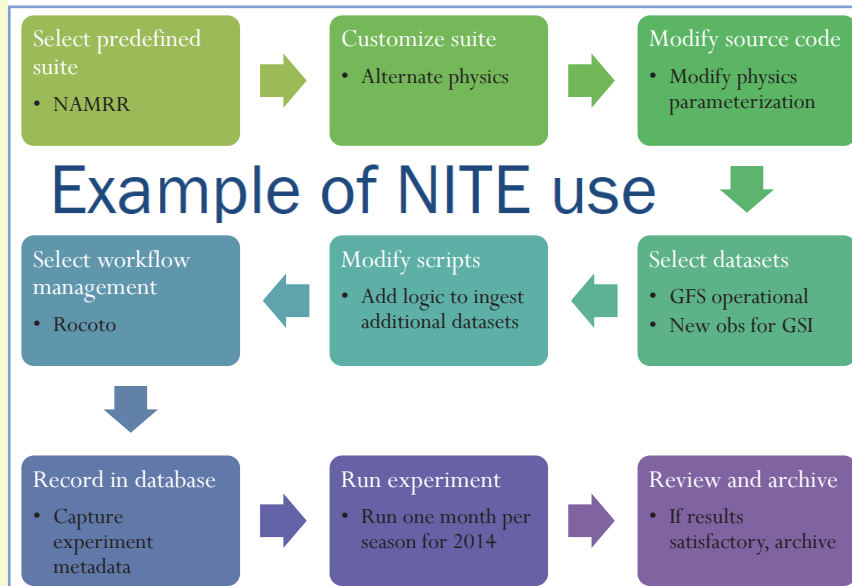
Over the years, the DTC has put in place several mechanisms to facilitate the use of operational models by the general community, mostly by supporting operational codes (for data assimilation, forecasting, postprocessing etc.) and organizing workshops and tutorials.

elements that can be used to facilitate this collaborative environment.

During the past year, the DTC received funding from NOAA to create a design for an infrastructure to facilitate development of NCEP numerical models by scientists both within and outside of EMC. Requirements for NITE are based on a survey of potential users and developers of NCEP models, information obtained during site visits to the NOAA Environmental Modeling Center, the

By stimulating the use of operational codes by the research community, composed of

UK Meteorological Office, and the European Centre for Medium-Range Weather Forecasting, discussions with focus groups, and reviews of various existing model development systems.



universities, NCAR, and government laboratories, several new NWP developments have been transitioned to NCEP operations. However, in spite of the relative success of the DTC, there are still significant gaps in the collaboration between the research and operational groups. The NITE project focuses on infrastructure design

The NITE design has been developed with the following goals in mind:

- modeling experiments easier to run;
- a single system available to NCEP and collaborators;
- results relevant for R2O;
- reproducibility and records of experiments; and
- general to any NCEP modeling suite.

(Continued on next page.)

(Director's Corner from page one.)

architecture and system engineering to support broad community interaction with the system. The introduction of Community Codes for all major components of the NGGPS and the establishment of a Global Modeling Test Bed (GMTB) to oversee community interaction with the codes are significant changes to the National Weather Service business model to advance numerical weather prediction skill in the US. Over the next five years, contributions from a wide sector of the numerical weather prediction community including NCEP, NOAA and other agency laboratories and private sector and universities, will be incorporated into an upgraded operational system to deliver a NGGPS that meets the evolving national prediction requirements.

Major work areas in the NGGPS project include selecting and further developing a new atmospheric dynamic core and improving model physics to better describe phenomenon at global to regional scales. Additional work will be conducted to accelerate development and implementation of weather prediction model components such as ocean, wave, sea ice, land surface and aerosol models, and improve coupling between these various components of the model system.

The DTC will play an important role in the NGGPS project. The new GMTB has been established as an extension of the current DTC. The GMTB is initially funded by the NGGPS project to assist in the development and testing of a Common Community Physics Package, as well as provide code management and support for an associated interoperable physics driver. The GMTB will also assist the NGGPS project in the development and testing of a sea ice model.

Active community participation in the development of the NGGPS is considered key to the success of the project. The DTC is perfectly positioned to assist in this aspect of the project. As the NGGPS Project Manager, I am excited about the DTC's role, through the GMTB, in the project and anticipate a productive and successful relationship going forward. ■

(NITE Project continued from page one.)

The following elements are included in the system design:

Data management and experiment database Scientists need access to input datasets (model and observations), a mechanism for storing selected output from all experiments, and tools for browsing, interrogating, subsetting, and easily retrieving data. To facilitate sharing information, key aspects of the experiment setup, such as provenance of source code and scripts, configuration files, and namelist parameters, need to be recorded in a searchable database.

Source code management and build systems Source code repositories for all workflow components need to be available and accessible to the community. Fast, parallel build systems should be implemented to efficiently build all workflow components of a suite before experiments are conducted.

Suite definition and configuration tools All configurable aspects of a suite are abstracted to files that can be edited to create the experiments. Predefined suites are provided as a starting point for creating experiments, with scientists also having the option to compose their own suites.

Scripts The scripting is such that each workflow component (e.g., data assimilation) is associated with a single script, regardless of which suite is being run.

Workflow automation system The workflow automation system handles all job submission activity. Hence, the scripts used to run workflow components do not contain job submission commands.

Documentation and training Documentation and training on all workflow components and suites are readily available through electronic means.

In addition to the elements above, standardized tools for data visualization and forecast verification need to be available to all scientists.

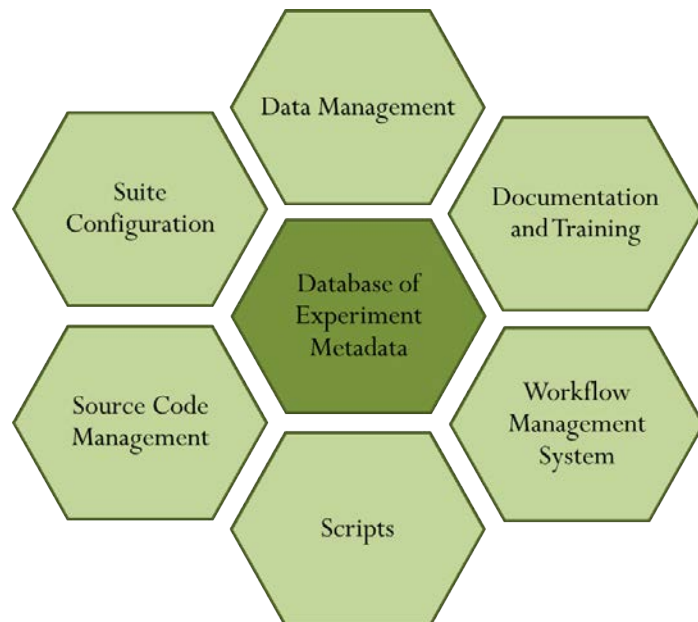
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"NWP Information Technology Environment (NITE): an infrastructure to facilitate development of NCEP numerical models."
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Next steps for NITE: Modernization of the modeling infrastruc-

ture at NCEP is very important for community involvement with all NCEP suites, and with the Next Generation Global Prediction System (NGGPS) in particular. The recommended implementation approach for NITE includes several phases, to minimize disruption to operational systems, and limit implementation costs, while providing useful, incremental capabilities that will encourage collaboration. Ongoing discussions between EMC and DTC, especially in the context of NGGPS infrastructure modernization, will likely lead to NITE implementation in the coming years.

See <http://dtcenter.org/eval/NITE>

Contributed by L. Carson and L. Bernardet. ■



NITE design a software infrastructure

Data Assimilation Study for TC Intensity

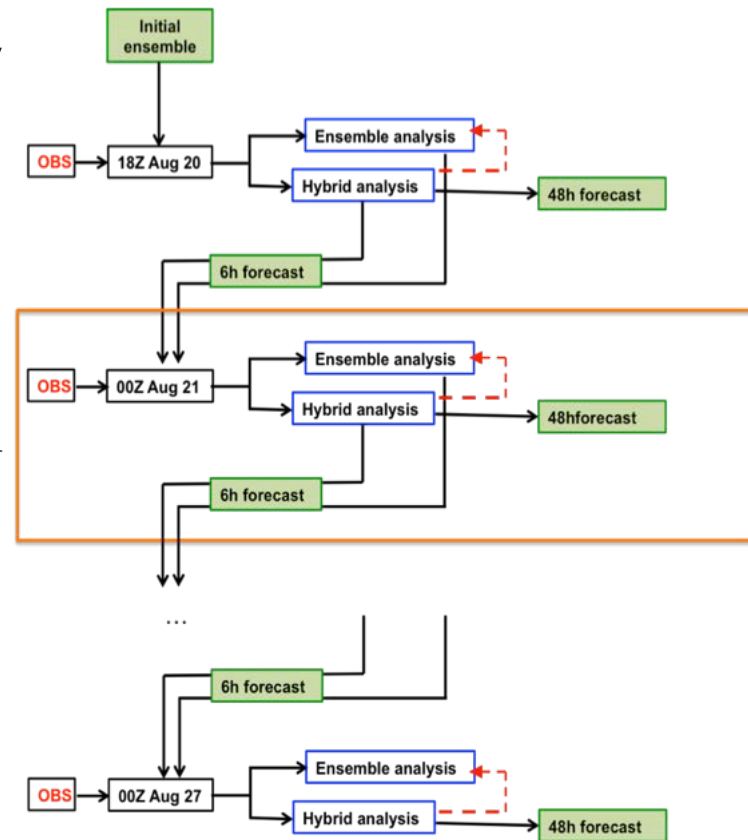
The hybrid Ensemble Kalman Filter (EnKF)-Gridpoint Statistical Interpolation (GSI) data assimilation system was implemented at NCEP for its Global Forecasting System (GFS) in May 2012.

This implementation led to significant improvements to global forecasts, including those of tropical storms. It can be noted that this improvement occurred while most current operational regional applications still use global rather than regional ensembles in their hybrid system. To bridge this gap, the DTC investigated the improvement of tropical storm intensity forecasts by using a regional ensemble in the GSI-hybrid data assimilation system.

A complete hybrid EnKF-GSI for the Hurricane WRF (HWRF) system was developed for the regional ensemble experiments, and results were compared to those obtained with the 2014 HWRF system. A two-way hybrid system was set up based on the GFS data assimilation scheme, using the GSI deterministic analysis to re-center the ensemble members at each analysis time. This re-centering step was found to reduce the ensemble spread for tropical cyclone (TC) center locations and intensity, so a one-way hybrid system that skipped the re-centering step was also developed.

Results showed that the operational system (Figure below, green) generated the lowest bias at the analysis time, but over time the bias showed a rapid “spin-down” from stronger to weaker wind forecasts than observed. (A similar spin-down issue was also noted using the 2015 HWRF system, but with smaller biases.) The one-way hybrid system (red), which used a regional ensemble, performed better than the two-way hybrid system (blue), and also outperformed the 2014 operational configuration and the GSI hybrid system using GFS ensemble (without vortex initialization, cyan), for TC intensity forecasts beyond the 12-hour forecast lead time.

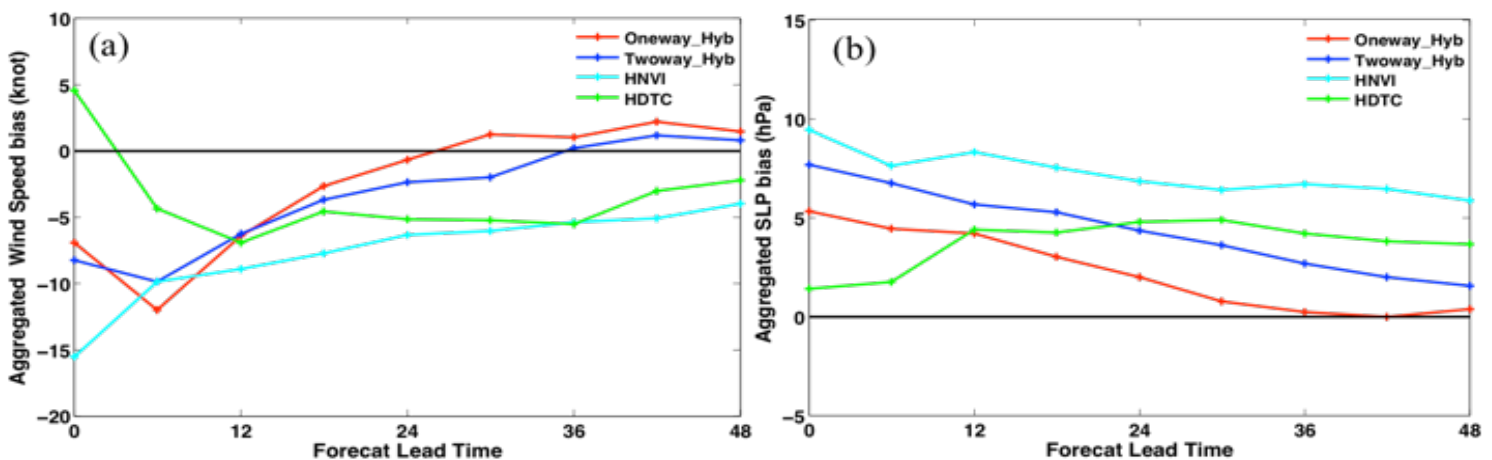
The DTC also performed experiments to further investigate the initial spin-down issue and found that it is related to an imbalance issue triggered by data assimilation. Experiments show that applying dynamic constraints could help ease such an imbalance. However,



Schematic illustration of the hybrid EnKF-GSI data assimilation procedure. Dashed line indicates the optional re-centering step in the hybrid system.

more research is required to find an optimal solution that reduces such imbalance-induced noise while still achieving desirable analysis increments.

Contributed by Hui Shao. ■



Bias of (a) Maximum surface wind speed, and (b) Minimum sea level pressure for all the forecasts as a function of forecast lead time

Who's who **Jeff Beck**



Some people feel comfortable staying close to home, but Jeff Beck has been across the country and across the ocean, with more experience already than many people have in a lifetime.

Jeff received his B.S. in Meteorology from Penn State University, then moved on to Texas Tech to obtain his Master's and Ph.D. in Atmospheric Science, completing his studies in 2009.

After a year working at a wind energy company in Austin, Texas, Jeff moved across the Atlantic, taking up a post-doctoral position at Meteo-France. "I knew some basic French at that point, and I thought it would be a good experience for me." The position lasted for three and a half years, when Jeff returned to the U.S. to work at NOAA's Global Systems Division in September 2014.

Jeff quickly moved into duties with the Developmental Testbed Center. He is an integral part of the team that developed the NOAA Environmental Modeling System (NEMS) Nonhydrostatic Multi-

scale Model on the B-grid (NMMB) Tutorial that took place at the NCWPC in April 2015, taking on tasks ranging from managing the tutorial website and creating an NMMB User Guide, to testing the scripts and code for the tutorial's practical session and helping with the practical on day 2 of the tutorial. Jeff is now the lead for the second NMMB tutorial coming in Spring 2016. Jeff also works on the North America Rapid Refresh Ensemble (NARRE) physics package, developing a stochastic suite that will over time outperform the current mixed-physics suite.

When he's not busy with all his work tasks, Jeff enjoys the outdoors of Colorado, and spends time skiing, hiking and running. So if you happen to meet Jeff on the trails around the Foothills, be sure to say "Bonjour!" ■



NEWS FROM THE DTC

Announcements, Publications, Award and More

SOFTWARE ANNOUNCEMENTS

The Developmental Testbed Center (DTC) announced the release of the following community data assimilation systems:

- Version 3.4 of the Community Gridpoint Statistical Interpolation (GSI) data assimilation system
- Version 1.0 of the Community Ensemble Kalman Filter (EnKF) data assimilation system (first official release)
- The released package for GSI and EnKF and their documentation can be accessed through the system homepage as follows:

GSI home page:

<http://www.dtcenter.org/com-GSI/users/index.php>

EnKF home page:

<http://www.dtcenter.org/EnKF/users/index.php>

Questions and inquiries can be sent to either:

gsi_help@ucar.edu or enkf_help@ucar.edu.

WORKSHOPS, TUTORIALS, EVENTS

DA Tutorial and Committee Meeting — Following the code release, a joint GSI and EnKF community tutorial was hosted by the DTC at NCAR, Boulder, CO. This was a 4-day event with both lectures and practical sessions. The tutorial reached its maximum capacity. The representatives of the GSI and EnKF developers from the major development teams also met during the week of the tutorial for the joint Data Assimilation Review Committee (DTC) meeting. This meeting is hosted periodically for GSI and EnKF development coordination. ■

Hurricane WRF China Tutorial — December 1-2, 2015 in Nanjing, China. Organized jointly with the NOAA Environmental Modeling Center and the Nanjing University of Information Science & Technology.

Hurricane WRF USA Tutorial — January 25-27, 2016 in College Park, MD ■
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Did you know...

Establishing a Functionally Similar Operational Environment for the Hourly-Updating NAM Forecast System

As a bridge between the research and operational NWP communities, one of the fundamental purposes of the DTC is to provide the research community access to functionally similar operational environments. Through this effort, promising new NWP techniques from the research community can be transferred more efficiently to an operational environment. One system that is currently under development and in the plans for operational implementation is the North American Mesoscale Rapid Refresh (NAMRR) system. The NAMRR is an hourly-updating version of the North American Mesoscale (NAM) forecast system, which is based on NOAA's Environmental Modeling System (NEMS) Nonhydrostatic Multiscale Model on the B-grid (NMMB). In addition to the deterministic forecast guidance provided by NAMRR, it will also be a major contributor to the future Standard Resolution Ensemble Forecast (SREF) and High Resolution Ensemble Forecast (HREF) systems, along with the Rapid Refresh (RAP) and High Resolution Rapid Refresh (HRRR) systems, which are based on the Weather Research and Forecasting (WRF) model. The NAMRR system is being actively ported to the DTC. The configuration currently includes a 12-km North American parent domain and a 3-km CONUS nest, with plans to add a 3-km Alaska nest (Figure center of page). Future plans include providing support to the research community to run a functionally similar NAMRR environment.

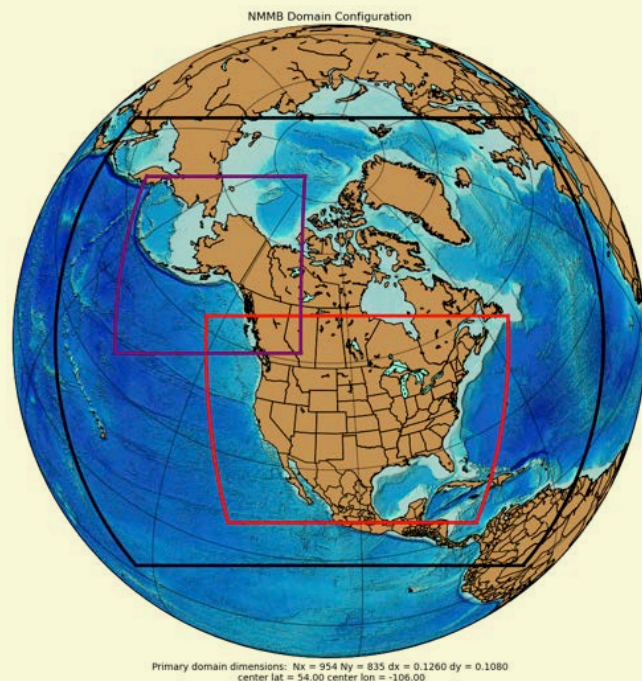
Contributed by Jamie Wolff. ■

(Announcements continued from previous page.)

PUBLICATIONS

L. Bernardet, V. Tallapragada, S. Bao, S. Trahan, Y. Kwon, Q. Liu, M. Tong, M. Biswas, T. Brown, D. Stark, L. Carson, R. Yablonsky, E. Uhlhorn, S. Gopalakrishnan, X. Zhang, T. Marchok, B. Kuo, and R. Gall, 2015: Community Support and Transition of Research to Operations for the Hurricane Weather Research and Forecasting Model. *Bull. Amer. Meteor. Soc.*, 96, 953–960. <http://dx.doi.org/10.1175/BAMS-D-13-00093.1>

Newman, K. M., C. S. Schwartz, Z. Liu, H. Shao, and X.-Y. Huang, 2015: Evaluating Forecast Impact of Assimilating Microwave Humidity Sensor (MHS) Radiances with a Regional Ensemble Kalman Filter Data Assimilation System. Accepted and in press, *Weather and Forecasting*, see <http://dx.doi.org/10.1175/WAF-D-14-00091.1> ■



Establishing a Functionally Similar Operational Environment for the Hourly-Updating NAM Forecast System

Sponsors

DTC's primary sponsors are the National Oceanic & Atmospheric Administration (NOAA), the Air Force, 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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