The Developmental Testbed Center: Current Activities and Future Plan

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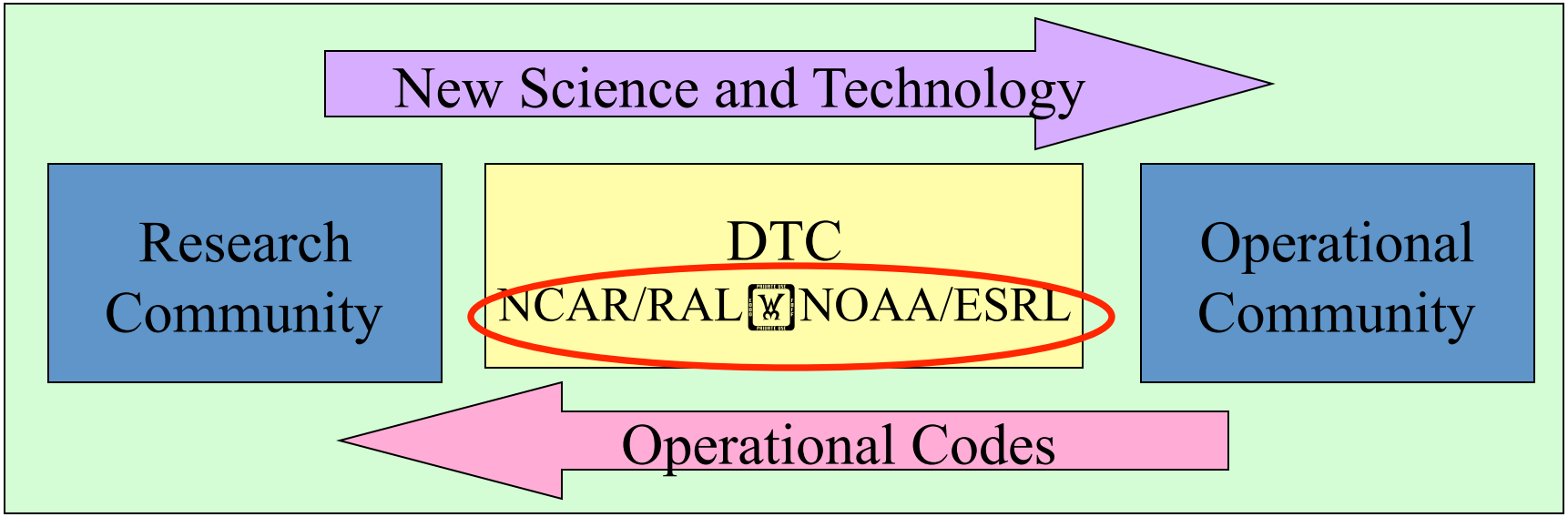
Developmental Testbed Center

1. National Center for Atmospheric Research
2. NOAA/Earth System Research Laboratory

Fundamental Purpose of DTC

To serve as a bridge between research and operations to facilitate the activities of both halves of the NWP Community

- **Research:** functionally equivalent operational environment to test and evaluate new NWP methods over extended retrospective periods
- **Operational:** benefits from DTC T & E of strengths and weaknesses of new NWP advances prior to consideration for operational implementation



Management Structure

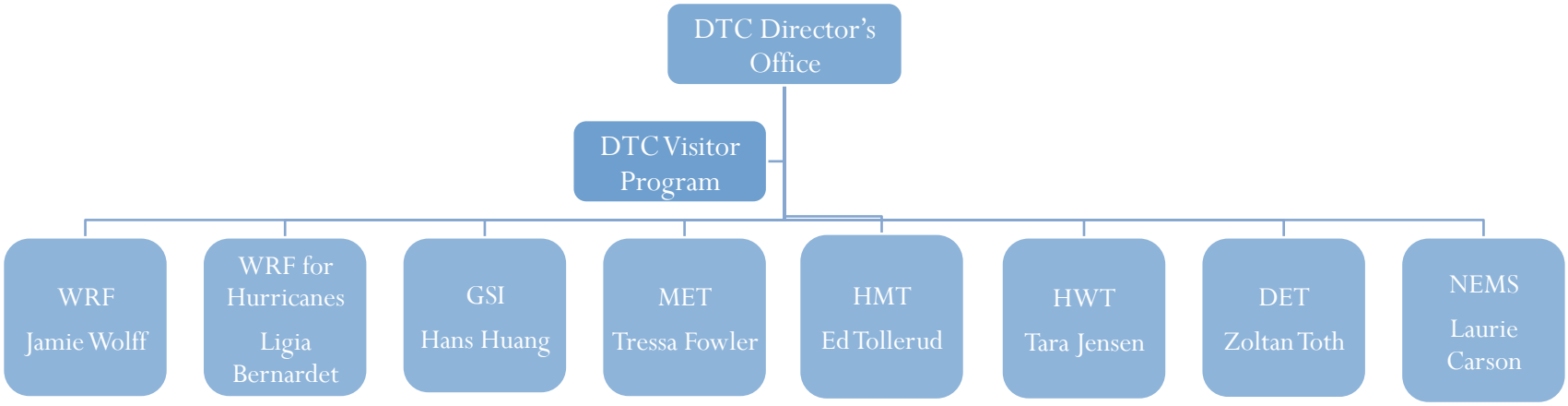
- Day-by-Day Operation managed by Bill Kuo (DTC Director), Louisa Nance (DTC Assistant Director), Steve Koch (GSD Director), and Barb Brown (JNT Director)
- NWS-DTC liaison: Naomi Surgi
- Priorities set by funding agencies (DTC Executive Committee) with guidance from DTC Management Board and Science Advisory Board

Executive Committee	Members from funding agencies	Appoints DTC director, executive oversight
Management Board	Director, deputy directors, members from funding organizations	Annual operating plan and budget, DTC management
Science Advisory Board	Members from operational and research communities	Strategic direction and objectives, Visitor program selection

DTC Status

- The DTC Charter, which describes the governance and operation of the DTC, was signed by 15 September 2009.
- The DTC Executive Committee and Management Board were established before the end of 2009.
- Candidates for the DTC Science Advisory Board have been nominated and approved, and will be established within a month.
- DTC sponsors include: NOAA, AFWA, HFIP, NSF, and NCAR
- The total budget for DTC for FY2010 is approximately $5M.
- DTC budget and planning process is carried out through the development of DTC Annual Operating Plan (AOP), which requires the approval by the DTC EC and MB.

DTC Organization & Tasks



WRF: WRF modeling system
WRF for Hurricanes: HWRF, HFIP
GSI: Grid-point Statistical Interpolation data assimilation system
MET: Model Evaluation Tools
HMT: Hydrometeorology Testbed collaboration
HWT: Hazard Weather Testbed collaboration
DET: DTC Ensemble Testbed
NEMS: NOAA Environmental Modeling System

Two major functions of DTC:

A. Provide support for community systems
B. Conduct testing and evaluation of community systems for research and operations

On-going Activities for FY 2010

- Provide support on community systems:
  - WRF
  - WRF for hurricanes
  - GSI
  - MET
- Conduct T&E activities on these community systems for research and operation.
- Establish a DTC Ensemble Testbed (DET)
- Participate in the development and implementation of NOAA Environmental Modeling System (NEMS) framework
- Conduct community workshops/meetings to facilitate collaboration between research and operation
- Conduct a DTC visitor program

Support for Community Codes

- A free and shared resource with distributed development and centralized support
- DTC currently supports the following software packages to the community:
  - WRF: NWP model + pre- and post-processors * *
  - Model Evaluation Tools (MET) – Verification package
  - Gridpoint Statistical Interpolation (GSI) Data Assimilation System*
  - WRF for Hurricanes (coupled atmosphere and ocean system) * *
- Provide direct assistance through an email helpdesk for each software package * *
- Facilitate community contributions to the respective code repositories
- Support community outreach events (tutorials/workshops) * *

-in collaboration with MMM* and EMC*

DTC Test and Evaluation Activities

- WRF Reference Configuration (RC) testing
- HWT-DTC: Verification of storm-scale ensemble systems for severe weather, QPF, and aviation weather forecasting
- HMT-DTC: Demonstration of real-time verification of QPF from mesoscale ensemble prediction system, probability forecast, assessing impacts of physics, and data types
- Hurricane: High-resolution hurricane (HRH) experiments to assess the impacts of resolution on forecast skills, HFIP related testing and evaluation
- HWRF: Testing HWRF configured from WRF repository codes (V3.2) for operational use at EMC

Example from
HWT 2010 Spring Exp.

EVENT PERFORMANCE for RETOP >=25.000 kfT GSS
CONSTANT INIT TIME 2010052000 – Region: VORTEX2

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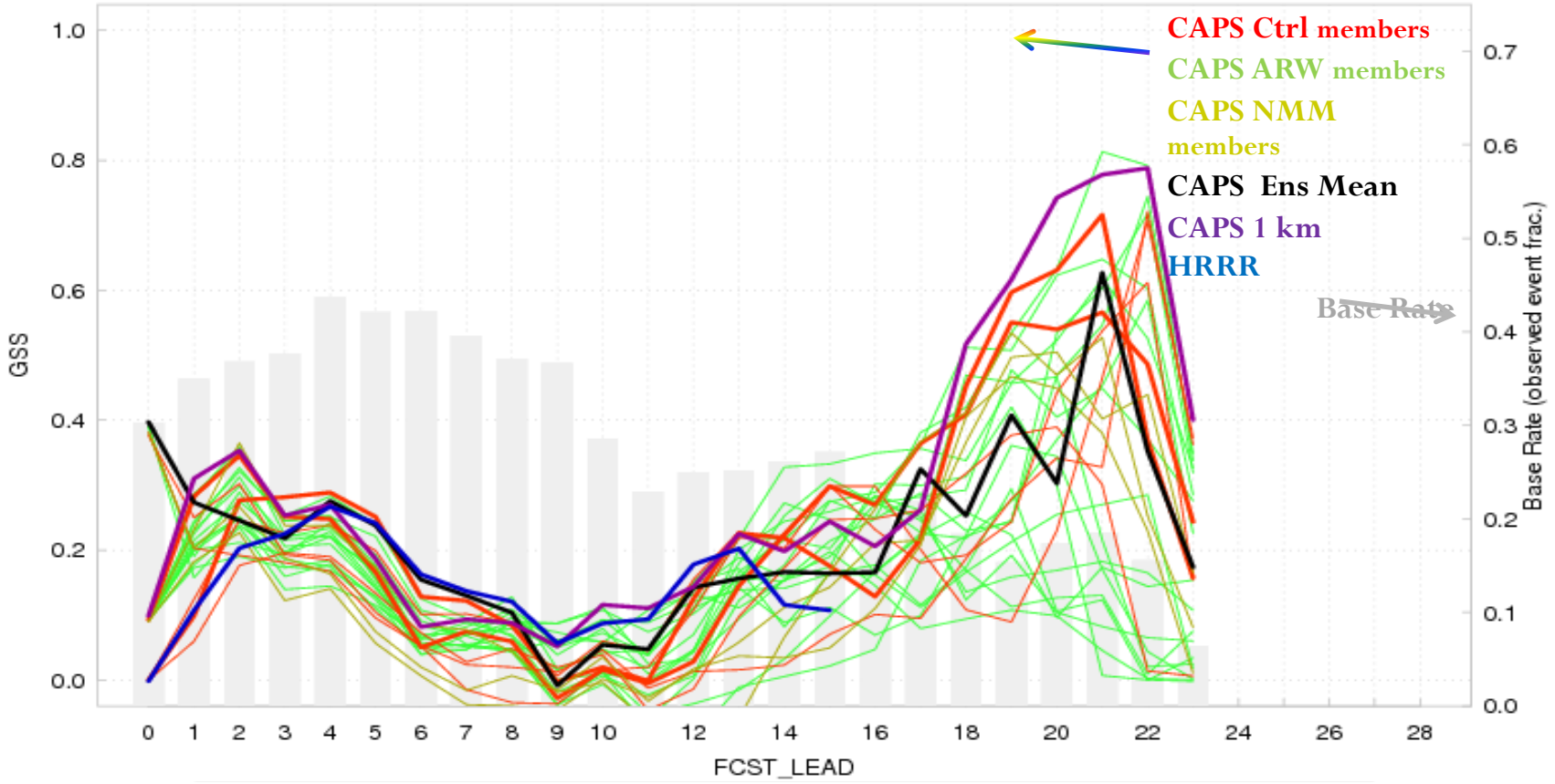
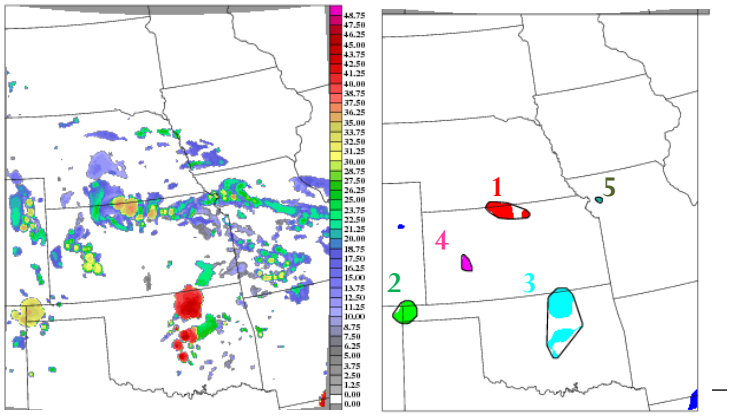
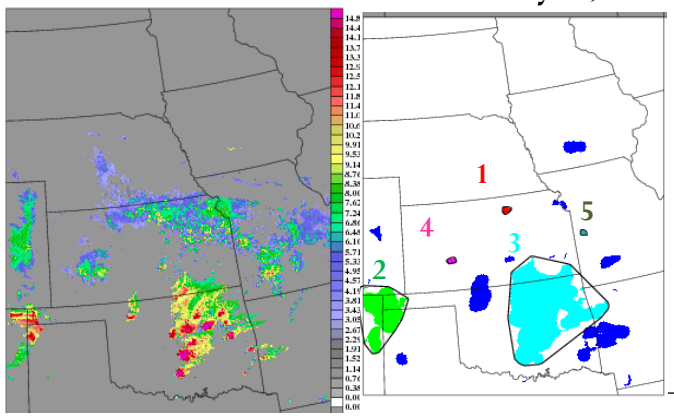


Forecast **RETOP > 25kFT** Observation **Valid 01 UTC May 20, 2010**





Units in Grid Squares

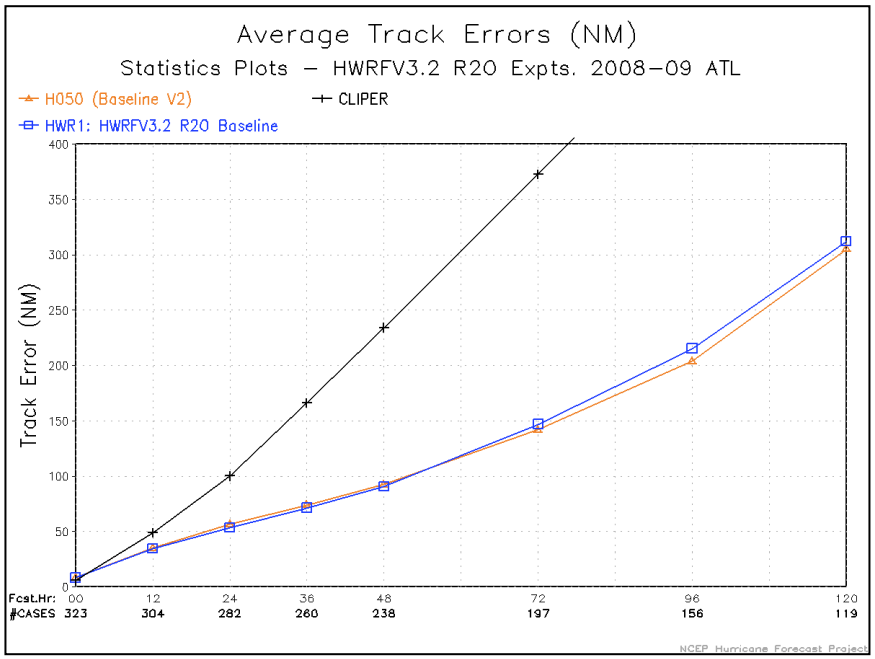
CLUS PAIR	CEN DIST	ANG DIFF	FCST AREA	OBS AREA	INTER AREA
1	25.04	30.07	340	52	6
2	11.95	38.14	318	1534	318
3	11.86	22.84	826	4783	826
4	9.41	78.52	107	46	8
5	37.69	0.14	31	35	0

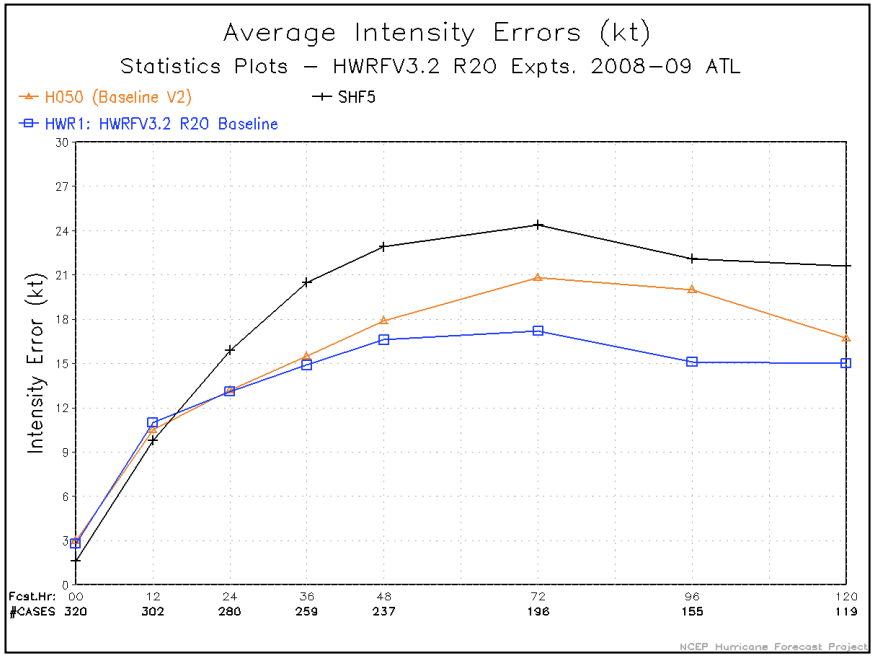
40-160 km displacement

Fcst too Small for large objects
Fcst too Big for small objects

HWRF Preliminary Results

R1 test: run by EMC on code prepared jointly by DTC & EMC over 600 runs to compare V3.2+ results against H050 baseline.





Goals for FY 2010

- Having a HWRF V3.2 that can effectively serve research and operation:
  - Allow NCEP to configure its operational HWRF from the WRF repository for FY11 implementation
  - Community will be able to conduct research experiments using the same HWRF V3.2 code
  - Work with EMC and HFIP HWRF developers to test and evaluate new capability for NCEP operation
- Develop an effective and functioning GSI Boulder Community Repository to serve research and operation
- Develop a functioning DTC Ensemble Testbed – with input from research and operational communities
- Develop expertise in NEMS and prepare DTC for NEMS community support
- Conduct testing and evaluation of community systems (e.g., WRF, HWRF, GSI, MET) to support research and operations (e.g., HFIP, AFWA, EMC, … etc)

DTC Presentations at WRF Workshop

- **3A.8** Preliminary Testing and Evaluation of the GSI Data Assimilation System. **Kathryn Crosby** (NCAR), Hui Shao, Ming Hu, Hans Huang, and Louisa Nance
- **5A.4** Recent enhancements to the Model Evaluation Tools (MET), including spatial cloud verification. **Tressa L. Fowler** (NCAR), Randy Bullock, John Halley Gotway, Paul Oldenberg, Tara Jensen, Barb Brown, and David Ahijevych
- **5A.11** WRFv3.1.1 QNSE Test and Evaluation. **J. Wolff** (NCAR), Louisa Nance, John Halley Gotway, and Paul Oldenberg
- **P.5** Hurricane WRF support by the Developmental Testbed Center. **Ligia Bernardet** (NOAA/CIRES), Shaowu Bao, Donald Stark, Christopher Harrop, and Laurie Carson
- **P. 48** The Developmental Testbed Center (DTC) Objective Evaluation Performed During the Hazardous Weather Testbed (HWT) 2010 Spring Experiment. **Tara Jensen** (NCAR), Steve Weiss, Jack Kain, Michelle Harrold, Barb Brown, Ming Xue, Fanyou Kong, Patrick Marsh, Mike Coniglio, and Russ Schneider
- **P.54** The Model Evaluation Tools: Community Code for Verification. **Tressa L. Fowler** (NCAR), John Halley Gotway, and Randy Bulloc
- **P.57** 2010 HMT Forecast Demonstration Project, Verification Using the Model Evaluation Tools (MET). **John Halley Gotway** (NCAR), Tara Jensen, Ed Tollerud, Paul Oldenburg, Huiling Yuan, and Isidora Jankov
- **P.70** Verification Dataset Choices and their Impact on WRF QPF forecasts for the HMT Winter Exercise. **Edward Tollerud** (NOAA/ESRL), Tara Jensen, John Halley Gotway, Paul Oldenburg, Huiling Yuan, and Isidora Jankov
- **P.72** Implementation of WRF Reference Configurations. **Jamie Wolff** (NCAR), Louisa Nance, Ligia Bernardet, and Barbara Brown

DTC ENSEMBLE TESTBED (DET)*

- Objectives
  - Provide access to operational codes to community
  - Test and evaluate new methods developed by community
  - Support other testbeds / programs with their ensemble work
- Initial focus
  - National meso-scale ensemble system
- Organization
  - NCAR & GSD participation, with EMC/NCEP collaboration
- Status
  - Work started on two components
    - Ensemble configuration (NEMS based – new hire to be based at EMC)
    - Initial perturbations (Collaborative work with EMC)

Linking DET with the Ensemble Community

- Engage WRF Ensemble WG (chaired by David Stensrud and Cliff Mass) to provide advice on the development of DET
- Mesoscale Ensemble Workshop
  - Sponsored by DTC, to be held at NCAR, 19-20 August 2010
  - Back-to-back with NUOPC global ensemble research workshop
  - Two objectives
    - Review & solicit input on DET development and plan
    - Review community research for potential testing in FY11-12
  - WRF Ensemble WG meeting following workshop
    - Solicit technical advice and guidance on the continued development of DET and testing and evaluation of ensemble components

DTC 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).
- Two types of visitor projects:
  - 1) projects undertaken by the Principal Investigator (PI)
    - Two months salary support plus travel, per diem
  - 2) projects undertaken by a graduate student under direction of the PI.
    - one year of temporary living per diem stipend and travel expenses for the graduate student, and travel and per diem support for PI
- Announcement for Opportunity will be released this week
- Deadline for proposal: 1 August 2010
- Proposals will be reviewed by the DTC Science Advisory Board
- Selection will be made by DTC Management Board
- Project can start as early as 1 October 2010

Transition to Operations: Successes & Challenges

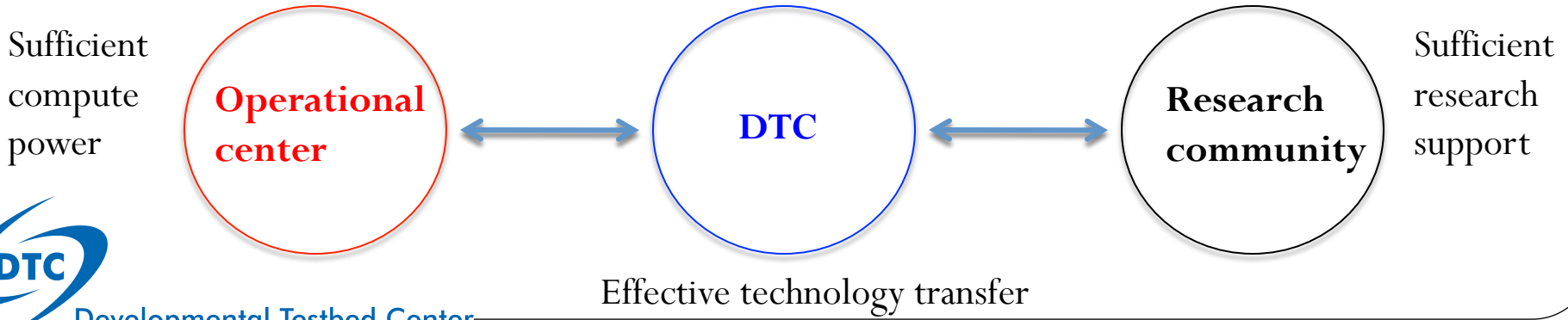
- **Successes:**
  - DTC early test and evaluation contributed to WRF operation at EMC
  - NCEP operational systems are available to the research community via DTC (O2R)
  - DTC and EMC have developed excellent partnership in:
    - Community support (e.g., GSI, hurricane tutorial, WRF workshops)
    - Testing and evaluation (e.g., HWRF V3.2 for operation)
  - DTC's participation in HWT and HMT have been valuable to operational centers such as: SPC, WFO, RFC, and HPC
- **Challenges:**
  - Use of community codes for operation is not trivial
  - DTC is NOT an operational center (and should not pretend to be one)
  - Facilitate closer partnership between research and operational communities on future systems and model framework
  - Execute effective code management plan in collaboration with EMC to facilitate R2O
  - Different requirements (and constraints) of research and operational communities
    - Operations: robustness, efficiency, easy maintenance
    - Research: flexibility, multiple-choices, community support

Future Direction

- **Modeling framework: WRF, NEMS, and ESMF**
  - NCEP is migrating all its systems to NEMS
  - The WRF system remains on its framework
  - How to effectively share modeling system components between research and operation?
- **Global modeling:**
  - Several new global models are being developed with unstructured grids that show great promises
  - These models are expected to run at cloud-/mesoscale resolutions
- **Data assimilation:**
  - The community is moving toward advanced systems: 4D-Var, EnKF, and hybrid
- **Ensemble prediction:**
  - There is a strong need to quantify forecast uncertainties with probabilistic forecasts from cloud to global scales
- **Develop a DTC Strategic Plan**
  - DTC should develop a DTC strategic plan with the help of DTC Science Advisory Board and the broad science community

American Version of ECMWF

- U.S. culture: Competition stimulates advances and innovations in science and technology
- Research and development of NWP is distributed in the U.S., and this is unlikely to change in the foreseeable future
- American version of ECMWF:
  - Close collaboration between research and operation, to allow fast implementation of research advances into operation.
  - U.S. has the biggest atmospheric research community in the world
- DTC can facilitate and accelerate transfer of new advances in NWP R&D into operation, through collaboration with operation and the research community



THANK YOU!

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