

Developmental Testbed Center: Core Activities for HFIP

Kathryn Newman

DTC and NCAR/RAL/JNT

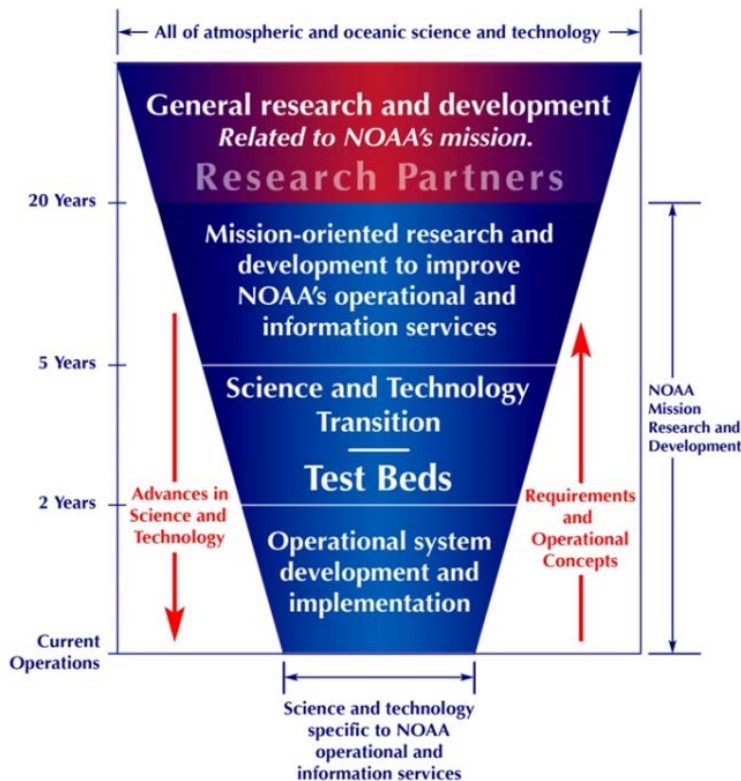
HFIP Annual Meeting

2015 November 18

DTC Strategies to promote HWRF R20

Purpose: Facilitate the interaction and transition of NWP technology between research & operations

Role of Testbeds in NOAA



1. Code management
2. User and developer support
3. Independent testing & evaluation
4. Visitor program

Code Management

- **Public release: HWRF v3.7a**
 - Released August, 2015
 - Includes 2015 operational (except for HWRF ensemble), idealized, 27/9/3 km support
 - **Stable, tested code**
- **Centralized HWRF repository**
 - SVN repositories house all the components of HWRF
 - Ensures developers have **access to the latest code** developments
 - Automated build for entire system, End-to-end python scripts, tools for automation (Rocoto workflow manager), source for components
 - Maintain integrity of code
- Unified scripts are **fully supported** by DTC for HWRF users & developers

User support

The screenshot shows the 'WRF for Hurricanes' website. The top navigation bar includes links for 'DTC home', 'Reference Configurations', 'Testing & Evaluation', 'Community Codes', 'Verification', 'Visitor Program', and 'Events'. Below the navigation is a search bar and a 'Search UCAR advanced' button. The main content area is titled 'WRF For Hurricanes' and contains several sections: 'Home', 'Terms of Use', 'Overview', 'User Support', 'Downloads', 'Documentation', 'Idealized', 'Tutorials & Workshops', 'Testing and Evaluation', 'HWRF Developers Info', and 'Additional Links'. The 'User Support' section is highlighted and contains a welcome message and a list of links. The 'Events' section lists a 'HWRF tutorial' from 01.25.2016 to 01.27.2016. The 'Announcements' section lists a release of 'v3.7a of the HWRF system' on 31 August 2015. The 'Organizations contributing to this website' section lists the 'Developmental Testbed Center (DTC)' and 'NCAR's Mesoscale & Microscale Meteorology Division (MMM)'. The 'Sponsors of WRF for Hurricanes' section lists 'NCAR' and 'NOAA'.

Current release: HWRF v3.7a

www.dtcenter.org/HurrWRF/users

- Users work with stable yearly release with known capabilities
 - 1100+ registered users
 - Code downloads, datasets, extensive documentation, online tutorial
- Helpdesk:
 - hwrf-help@ucar.edu
- In-person tutorials
 - Dec 1-2, 2015: Nanjing China
 - January 25-27, 2016: NCWCP
 - **Registration open!**

Developer Support

- DTC helps developers to access latest experimental code in repository
- HWRF Developer website
- Training offered
 - Rocoto workflow automation, code management, python for HWRF
- HWRF contrib repository
 - Hub for developers to exchange peer-supported code
- HWRF developers committee
 - Bi-weekly telecons
 - mailing list: hwrf_developers@rap.ucar.edu
- Helpdesk
- **Primary goal to facilitate R2O!**

Developers DTC has recently supported

J. Michalakes (EMC)

- WRF nest parallelization for multistorm

X. Zhang (HRD)

- End-to-end multistorm implementation

X. Wang (OU)

- Regional HWRF EnKF

R. Fovell (UCLA)

- WRF physics diagnostics, testing, and development

J. Otkin (CIMMS)

- Synthetic satellites added to UPP

R. Yablonsky (URI)

- MPIPOM-TC diagnostics and initialization in global basins

H.-S. Kim (EMC) and HFIP ocean team

- Diagnostic codes distributed through DTC's *hwrf-contrib* repository

G. Grell and J.-W. Bao (NOAA ESRL)

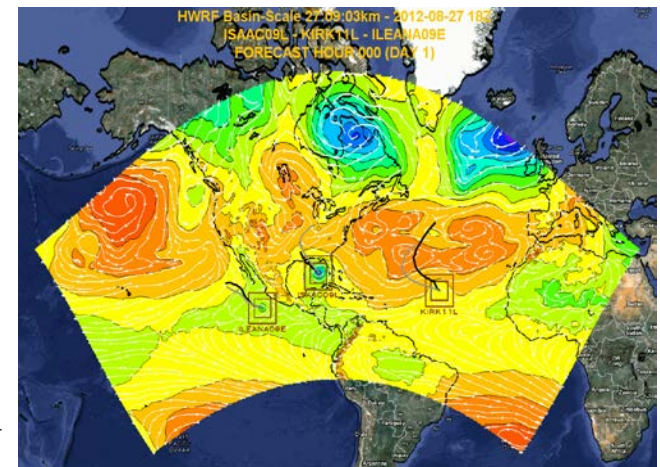
- Addition of Grell-Freitas cumulus scheme to HWRF



Multistorm capability

X. Zhang (HRD) & J. Michalakes (EMC): Example of development facilitated by DTC

- Close collaboration with HRD to implement the HRD method of running Basinscale HWRF using the new Python scripts
- WRF development for efficient nest parallelization: telescopic nests over each storm can be sent to different sets of processors
 - DTC conducted tests to improve code
- Multistorm capability (including nest parallelization) committed to HWRF trunk
 - Includes README documentation
 - Ongoing support and additional fixes/enhancements



Real-time runs for 2015 Hurricane season using new Python scripts

DTC Visitor Program

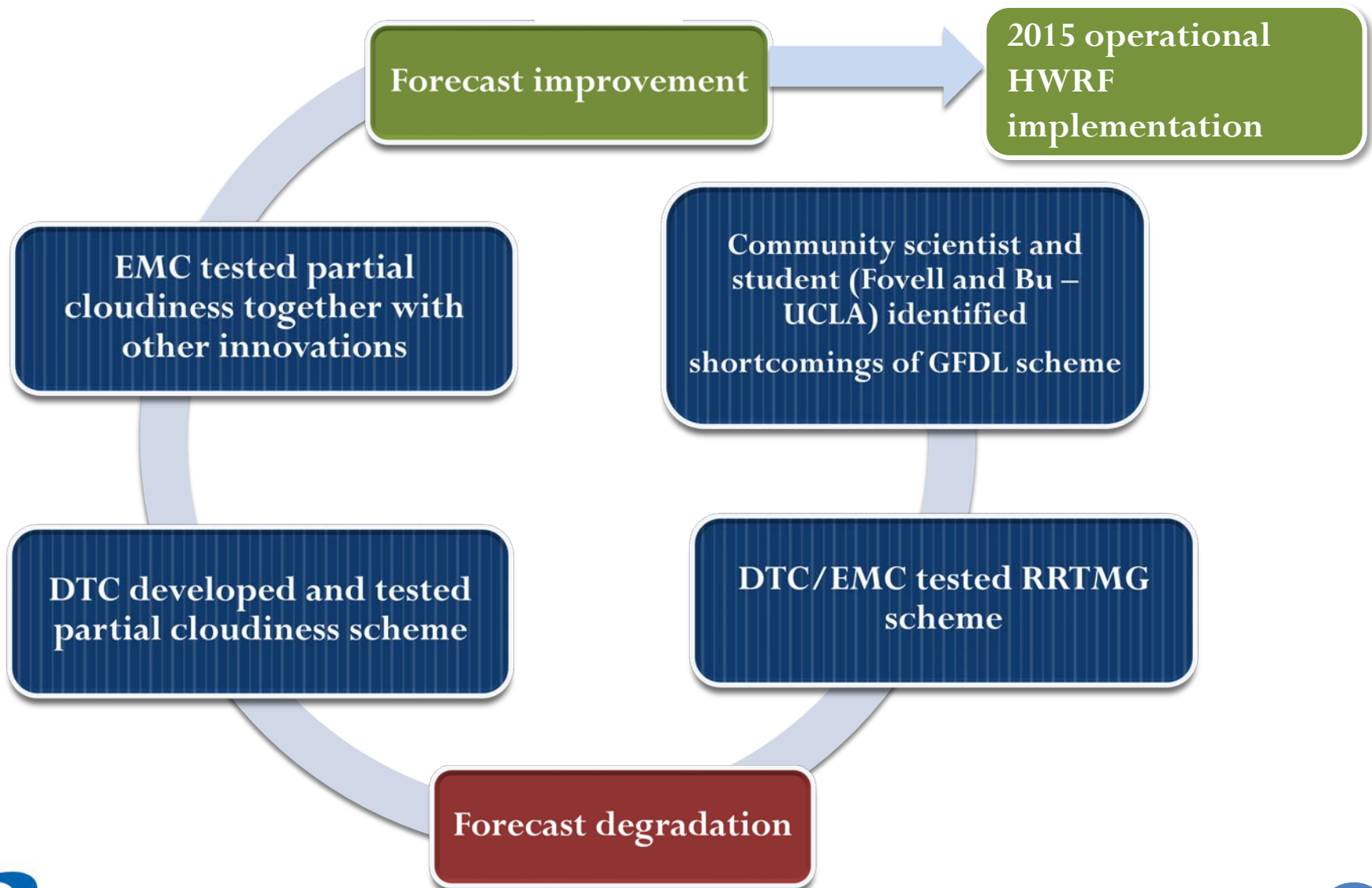
DTC Visitor Program – Recent hurricane-related work

Robert Fovell & Peggy Bu	UCLA	Improving HWRF track and intensity forecasts via model physics evaluation and tuning (2013)
Shaowu Bao	Coastal Carolina University	Evaluation of Two HWRF Microphysics/Radiation Configurations with Remote-sensing Data
Richard Yablonsky	University of Rhode Island	Developing and Supporting Global HWRF Ocean Coupling with Advanced Ocean Physics and Initialization Options and New Diagnostic Tools for Comprehensive Model Evaluation
Thomas Galarneau	NCAR	Diagnosing Tropical Cyclone Motion Forecast Errors in the 2014 HWRF Retrospective Test (H214)

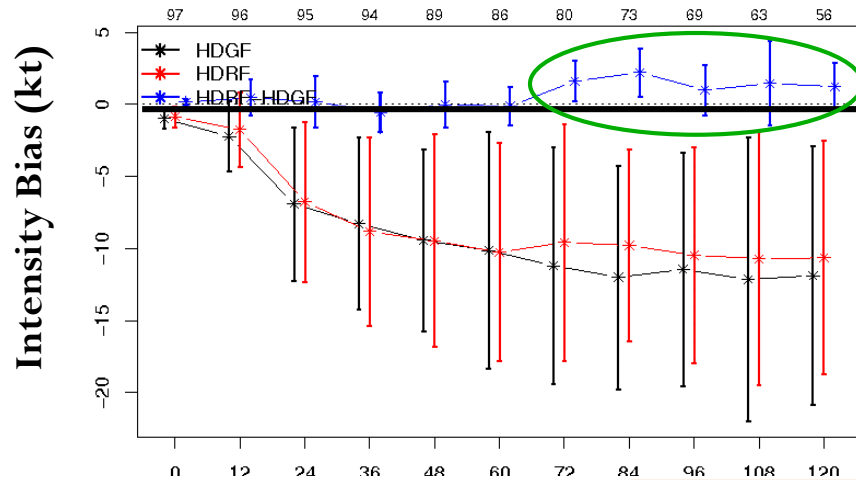
- **Fovell/Bu:** Changes to vertical mixing (PBL) that improve storm size and motion were *accepted for operations in 2015*
- **Yablonsky:** Development of alternate ocean data initialization, expansion of POM-TC to all global basins, Matlab & Fortran diagnostic tools. *Now in HWRF trunk.*
- **Bao:** Large-scale verification using remote-sensing data. *Addition to contrib repository*

Research funded via DTC visitor program successfully contributing to HWRF development, HFIP goals

DTC's role in HWRF physics development

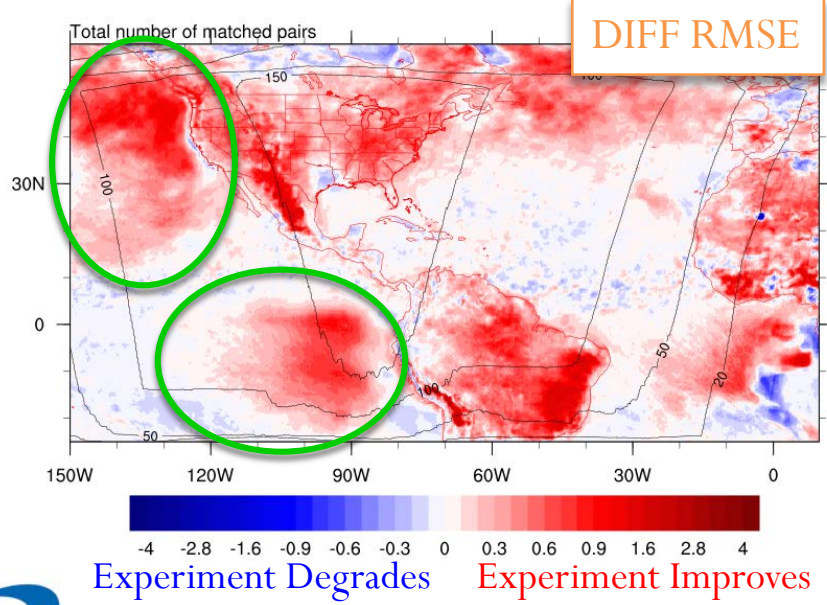


RRTMG & Partial Cloudiness



DTC tested 200 cases in Atlantic and East Pacific basins

Intensity bias for East Pac reduced 3-5 day
HDGF = control;
HDRF=innovation



Large scale verification
In addition to verification of track/intensity, DTC conducted large-scale verification against GFS analyses

Improvements seen in various fields - 1000-hPa T shown here

Included in 2015 operational HWRF

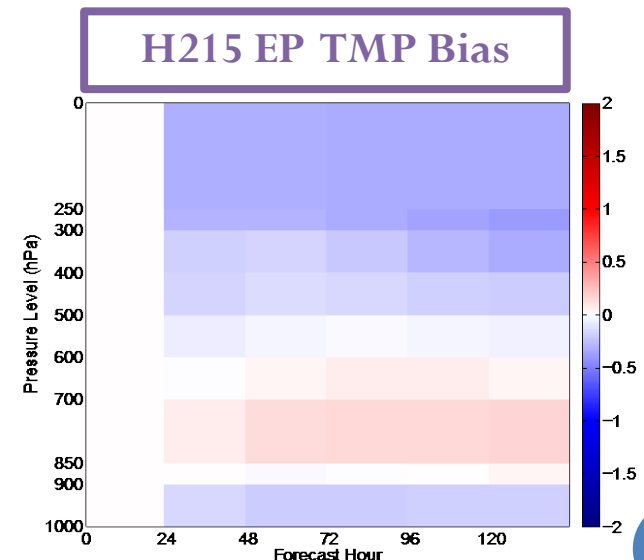
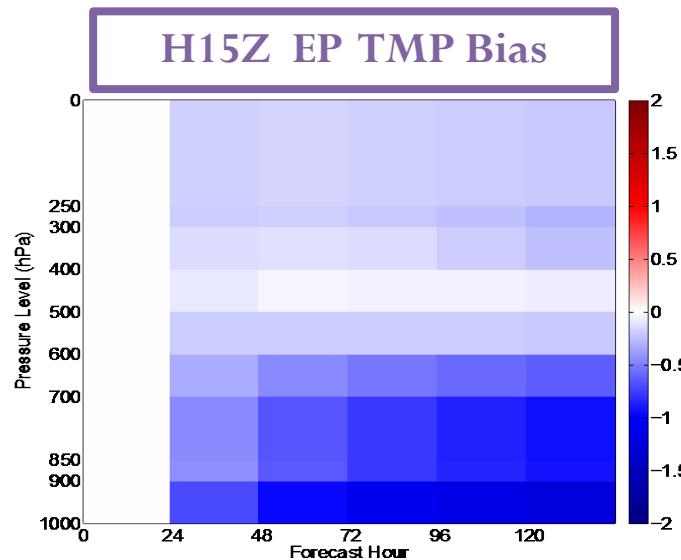


DTC Testing & Evaluation



- DTC conducts independent testing and evaluation (T&E)
 - Impartial evaluations
- QPF, RI/RW, large scale evaluation tools and methodology all available in MET v5.1
 - Model Evaluation Tools – Tropical Cyclone (MET-TC)
 - Developed to replicate NHC verification tools, funded by HFIP

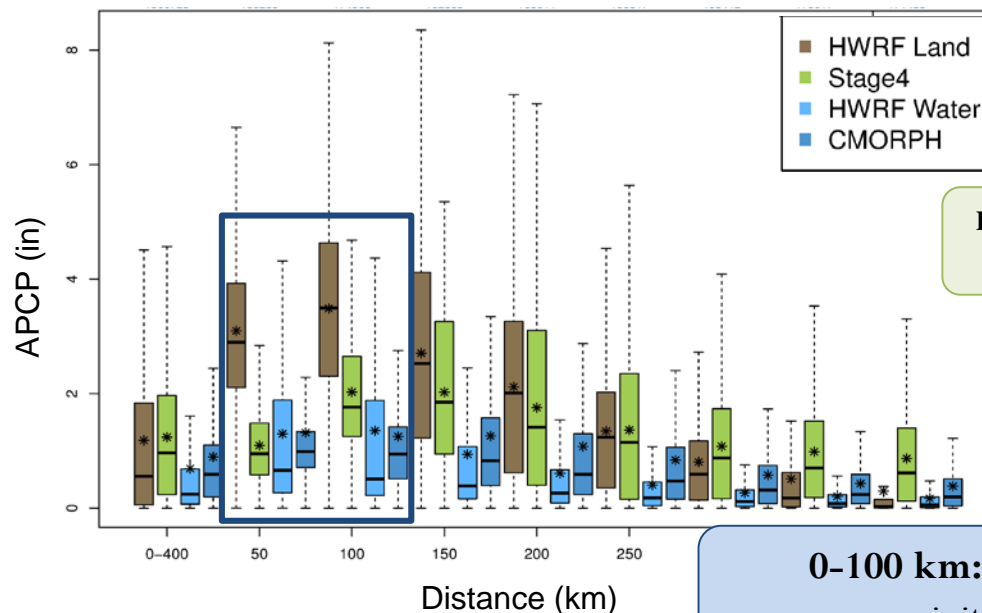
Large scale evaluation using MET to evaluate 2014 and 2015 HWF model versions, both using new GFS



HWRF QPF evaluation

- Gain insight into performance of HWRF QPF (baseline evaluation)
- Three approaches applied:
 1. Large-scale assessment (compared to GFS) for QPF accumulated over 24-hr
 2. 24-hr accumulations for storm centric precipitation forecasts (accounting for track location differences)
 3. Run-total storm-scale QPF for 3-km inner domain

Arthur (01L, 2014)



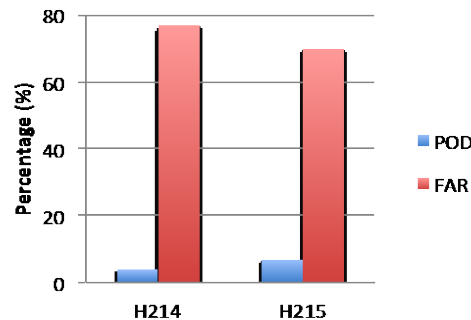
Precip boxplots are in bands around forecast or observed track

0-100 km: HWRF concentrates excessive precipitation near the storm center

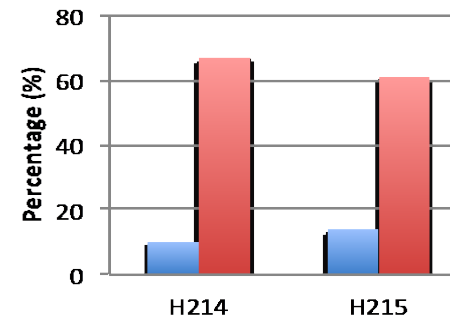
HWRF RI/RW Evaluation

Rapid Intensification performance H214 vs. H215

30 kt in 24 h



25 kt in 24 h



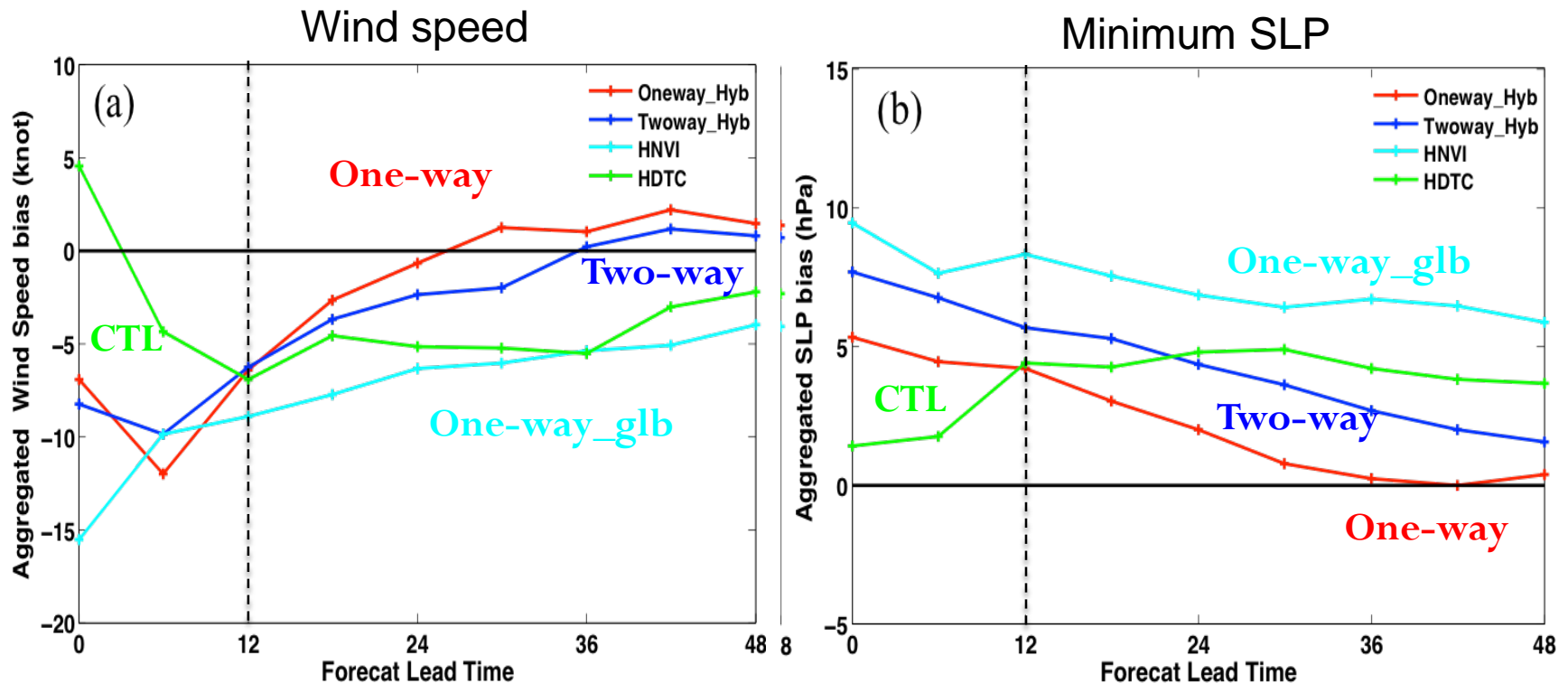
H215 reduces FAR and increases POD

This evaluation provides a baseline for future improvements

- RI/RW methodology now included in MET-TC
 - Community support via MET v5.1 public release
 - Flexibility of defining intensity change (+20, 25, 30, etc. kt)
 - Flexibility of defining time interval (12h, 24h, etc.)
 - Flexibility to allow match in different time window
 - E.g., if model captures an event at wrong time

DTC DA: GSI hybrid using regional ensemble

- T&E aimed at improving tropical cyclone (TC) intensity forecasts using regional ensembles in the GSI-hybrid DA system



Using regional ensemble in GSI hybrid system (**one-way**, **two-way**)

- Smaller bias than CTL between 12-48 hours
- One-way relatively better than two-way beyond 12 hours

Future plans

- Continued code management and maintain unified code
- Continued user & developer support
 - Support for public release and active HWRF developers (HFIP PIs)
 - Support for priority areas: data assimilation
 - Potential new avenue for enhanced focus (e.g. multistorm effort)
- R2O potential through testing and evaluation
 - Improved physics: clouds-radiation, PBL/surface layer
 - Model agnostic focus
- Satellite data assimilation
 - Current efforts at NCAR (non-DTC) that could provide fruitful collaborations
 - NCAR data assimilation initiative
 - All-sky radiance assimilation