

Community support and testing of the Hurricane WRF model at the Developmental Testbed Center

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Goal: Tech Transfer to Hurricane NWP

Current focus in Hurricane WRF model (Weather Research and Forecasting)

1. Code Management

- Create a framework for NCEP and the research community to collaborate

2. User Support

- Support the community in using an operational hurricane model

3. Testing and Evaluation

- Perform tests to assure integrity of community code and evaluate new developments for potential operational implementation

WRF for Hurricanes User Support

The screenshot shows the 'WRF for Hurricanes' website. At the top, there's a search bar and the text 'WRF for Hurricanes'. Below that, a navigation menu lists: Home, Terms of Use, Overview, User Support, Downloads, Documentation, Tutorial Information, and Additional Links. The main content area is titled 'WRF For Hurricanes' and contains several sections: a welcome message, a list of two robust configurations (HWRWF and AHW), a list of organizations contributing to the website (DTC, NCAR, NOAA), and a list of sponsors (NCAR and NOAA). The 'Events' section lists two tutorials from 2011. The 'Announcements' section lists two releases from 2010.

Code downloads,
datasets,
documentation,
helpdesk

370 registered users

Yearly releases
corresponding to
operational model of
the year

Stable, tested code

Benchmarks available

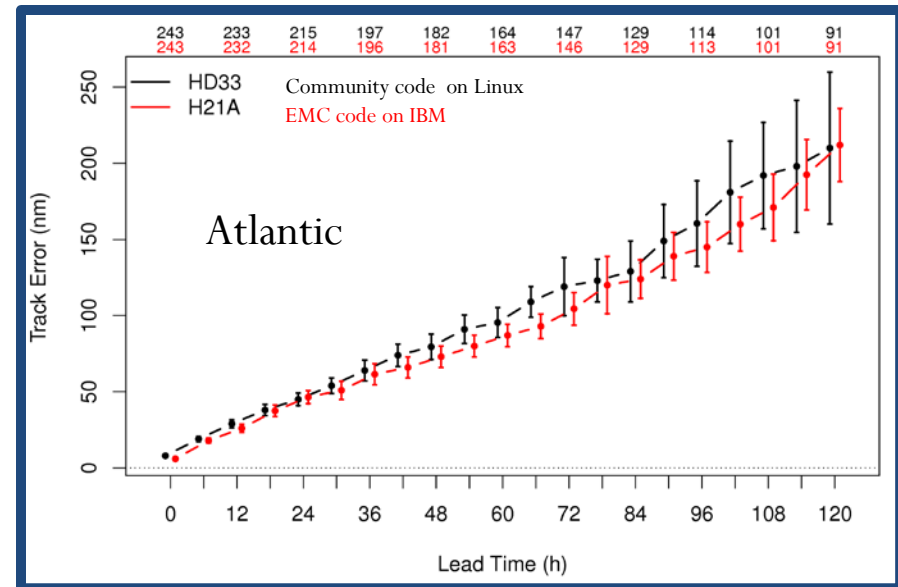
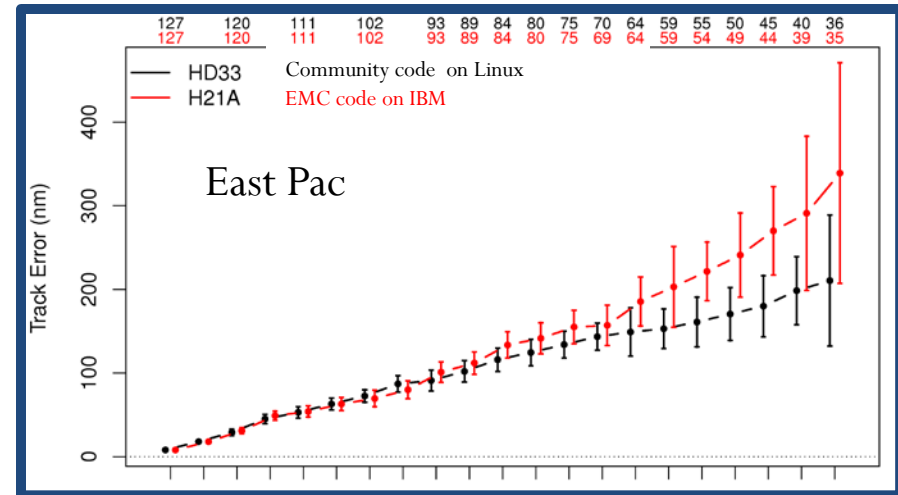
DTC provides developers with access to the centralized research/operations repository. Allows obtaining latest experimental code and adding contributions = **clear path to operations**

Improving HWRF through porting

Code more robust due to use in multiple platforms and pre-release testing

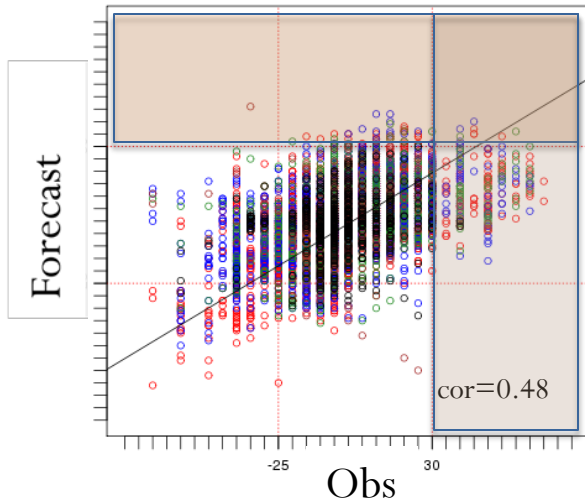
Community code: EMC 2011 pre-implementation Linux vs AIX (IBM)

- Expected similar average results
- Found difference in skill
- Investigation revealed bug with different behavior Linux vs IBM
- Fix was implemented operationally in June 2011



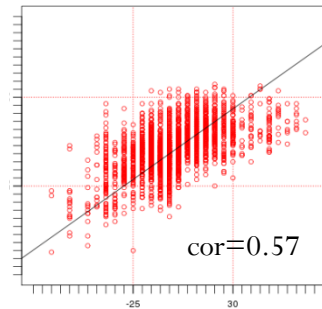
Non-traditional HWRF vx and diagnostics: Analysis of intensity change (dV / 24h)

dv/24hr scatter plot for all track errors

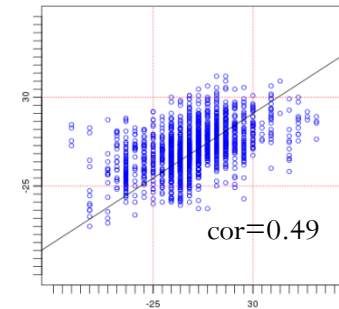


Stratification by track error (T) (nm)

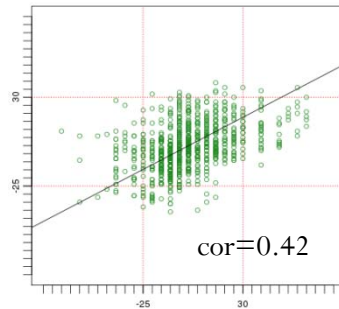
$T < 50$ nm



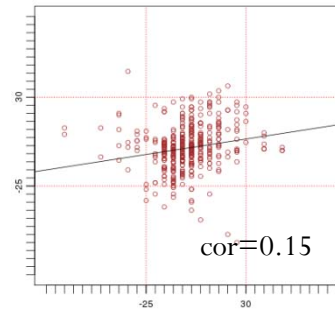
$50 < T < 100$



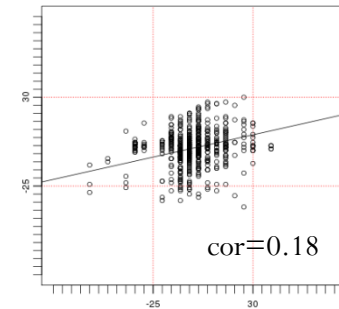
$100 < T < 150$



$150 < T < 200$



$150 < T < 200$



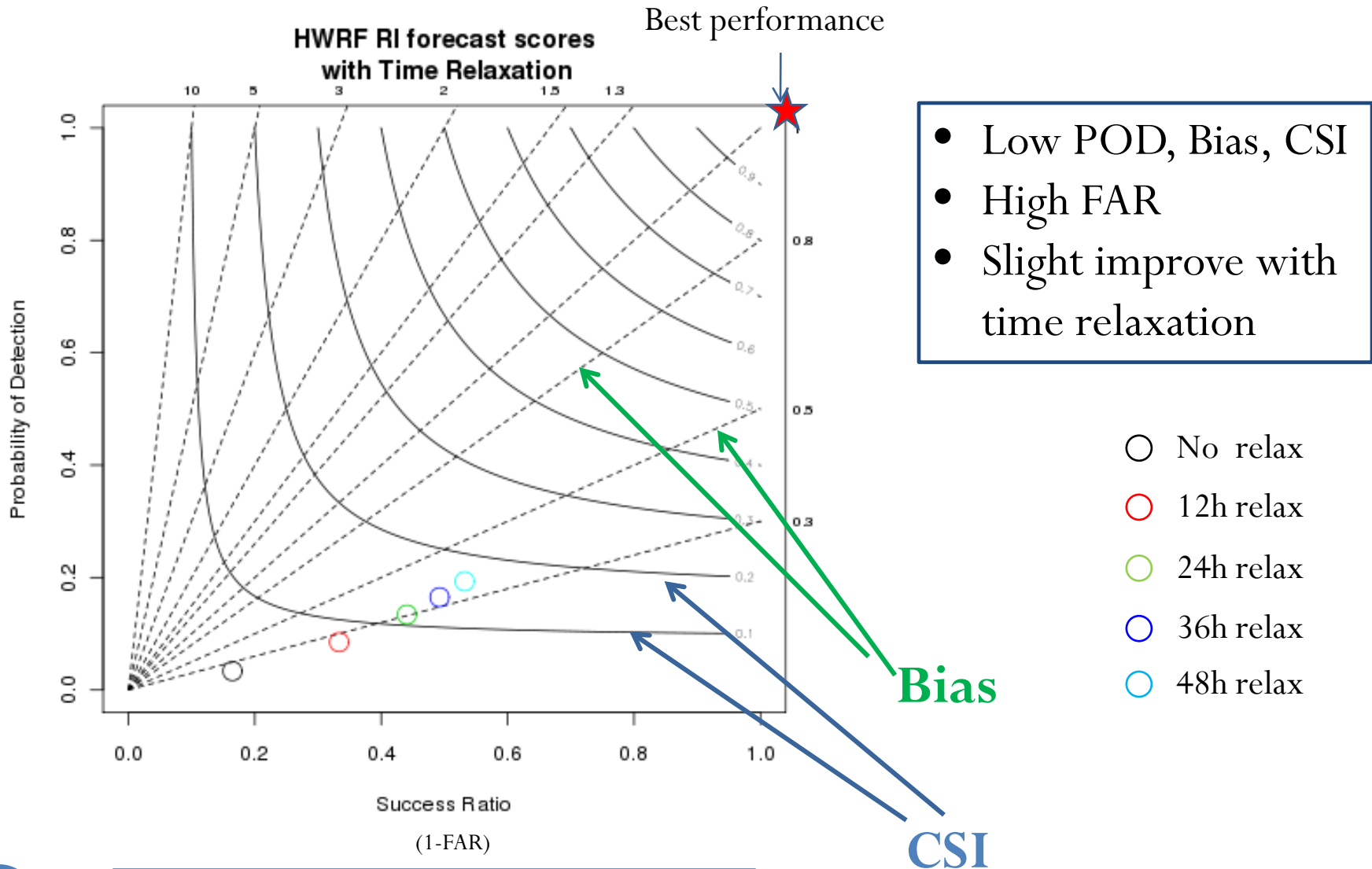
Low correlation
between forecast
and observed
intensity change

Correlation
better for low
track error

Poor forecast of
RI and RW

HWRF 2012 baseline (500 cases) – from EMC – these are not the final pre-implementation tests

T&E: HWRF Rapid Intensification



- Low POD, Bias, CSI
- High FAR
- Slight improve with time relaxation

HWRF 2012 baseline (500 cases)

HWRF Testing, Evaluation, Diagnostics

Comprehensive testing

DTC home Reference Configurations Testing & Evaluation Community Codes

DTC Reference Configurations | DTC

DTC Home • WRF Reference Configurations • WRFv3.3 HWRF PS:85.98.98.88.88.2.84

Overview HWRF PS:85.98.98.88.88.2.84 (H3RC) Overview

Configuration Description
The HWRF PS:85.98.98.88.88.2.84 (H3RC) is the second HWRF Reference Configuration published by the DTC. It corresponds to the HWRF model as operational at the end of the 2011 season, that is, it contains changes that were implemented operationally mid-season.

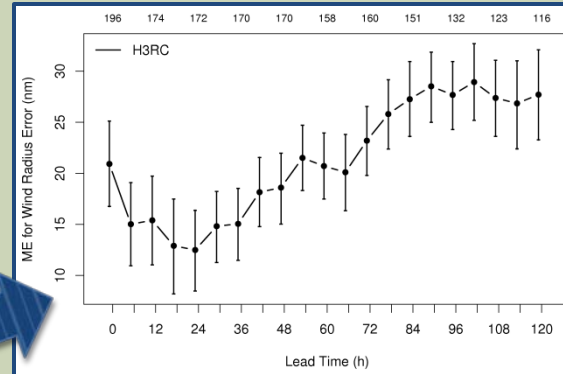
Executive Summary

Graphics

Verification
This configuration uses the same domain setup as the 2011 operational HWRF run by NOAA National Centers for Environmental Prediction. A 7 deg outer domain with 27-km grid spacing and a 6x6 deg moving nest with 11 km grid spacing were employed to run 5-day forecasts for 1250 cases of 9 storms in the North Atlantic and Eastern North Pacific basins for the 2010 and 2011 seasons.

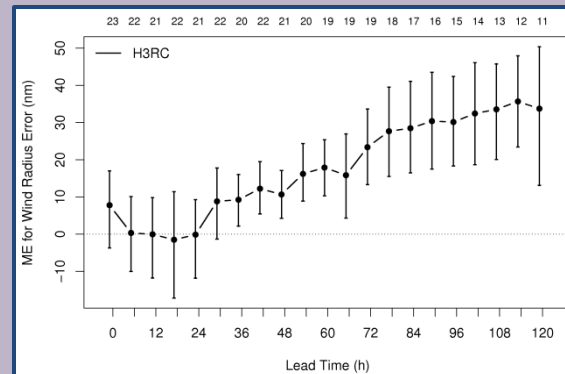
- Results available at dtcenter.org
- Functionally-equivalent testing suite
- Multi-season tests, thousands of runs
- Benchmarks of community code
 - Inform future development
 - Control to test improvements

Summary Statistics



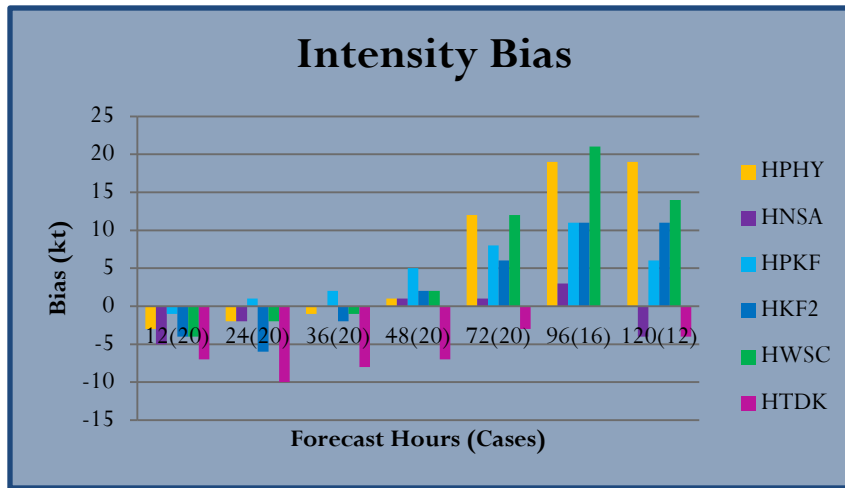
Average wind radii error for 64 kt threshold (NE):
Inner core too large; contracts during first day

Case Studies / Small tests



Irene average wind radii error for 64 kt threshold (NE):
Forecast radii 30 nm larger than observed

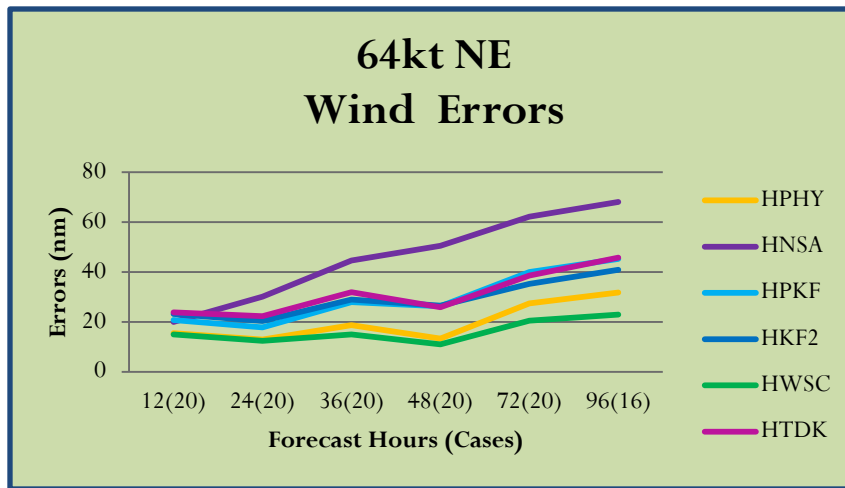
Sensitivity to cumulus schemes: Irene (Aug 21 –25)



Cumulus Schemes

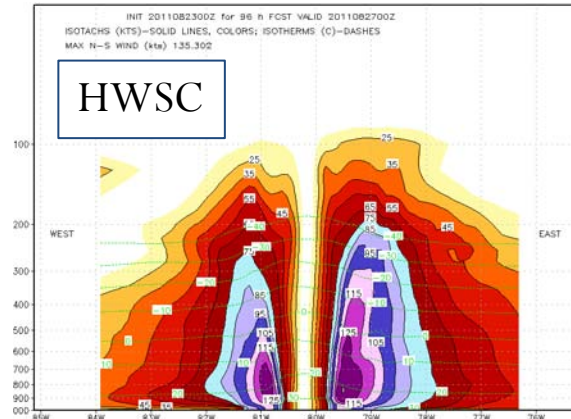
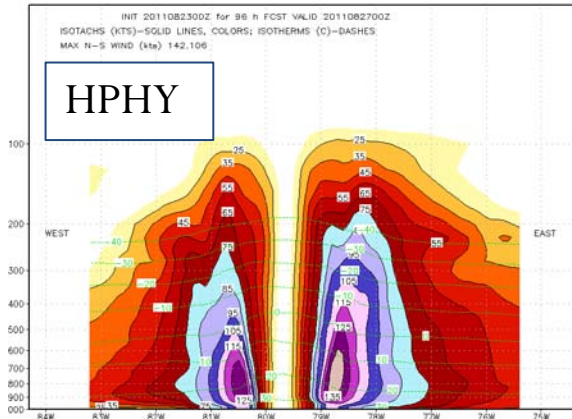
- HPHY** – 2011 operational HWRF SAS (no SC)
- HWSC** – 2011 operational HWRF SAS (w/ SC)
- HNSA** – YSU implementation SAS (w/ SC)
- HPKF** – Kain-Fritsch
- HKF2** – Kain-Fritsch w/ moist adv trigger
- HTDK** - Tiedke

HPHY and HWSC have larger over intensification. HNSA and HTDK keep storm weaker.

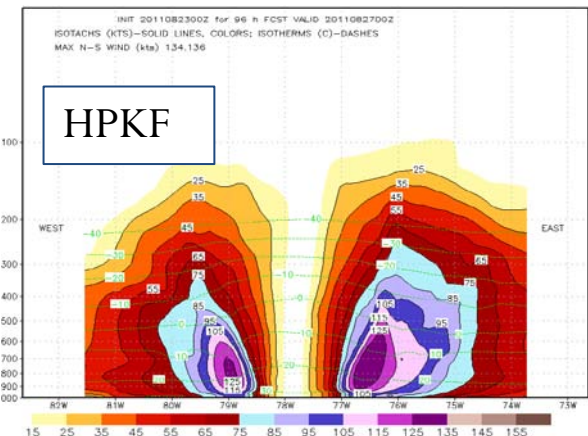
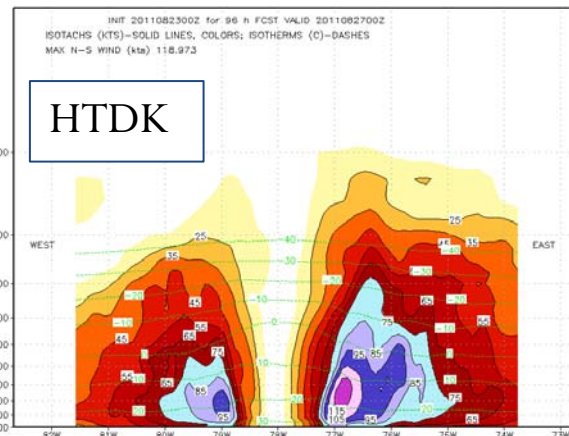
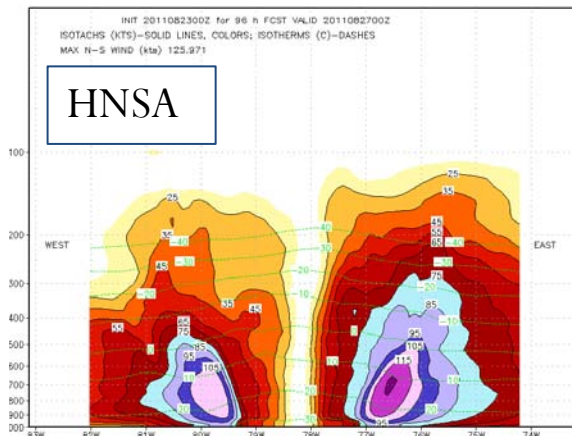


Schemes with weakest intensity produce largest storm. HNSA has the largest storm structure (too large)

Irene init Aug 23, 00 UTC: 96-h isotachs (kt), isotherms (C)



Configurations with higher intensity are vertically stacked



Storm is too deep when it is weakening

GSI Hybrid activities

- Initiative supported by HFIP
- Short term (spring 2012) - Enablement of the GSI-EnKF-Hybrid
 - Partnership of DTC with AOML, EMC, and ESRL/PSD
 - Technical support (bug fixes, improved scripting)
 - Targeted testing and evaluation (partial cycling)
- Long term (remainder of 2012)
 - Community Involvement in GSI-EnKF-Hybrid development
 - EnKF Code repository at DTC
 - Unified plan for a regional GSI-Hybrid system that is suitable for research and operational hurricane prediction
 - Develop HWRF ensemble system to be part of GSI-Hybrid data assimilation

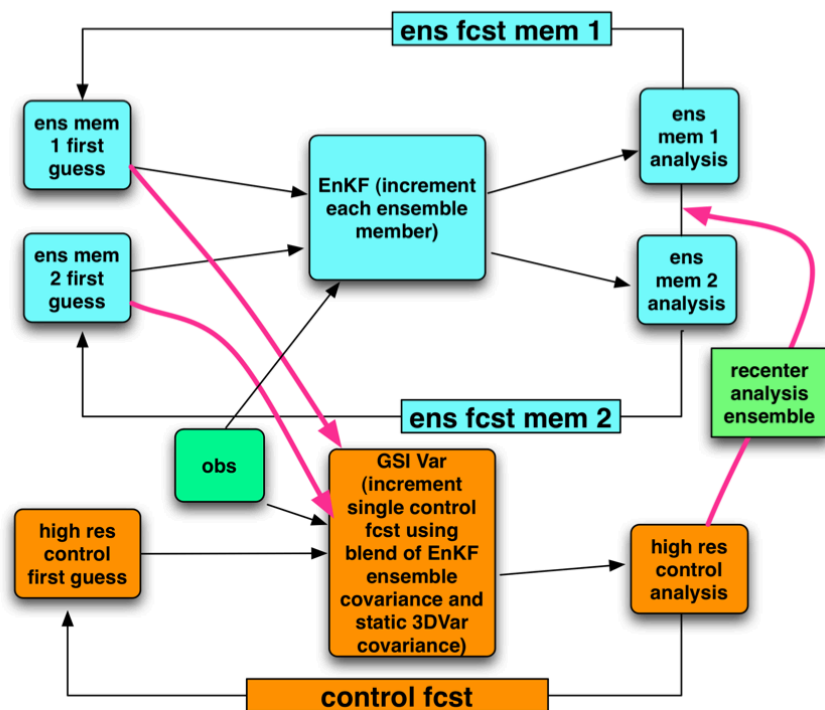


Figure courtesy of Jeff Whitaker,
NOAA/ESRL/PSD

Outcomes:

Short term: Working system

Long term: Community system (EnKF path to operations)

Summary and next steps

Current DTC capabilities

- Code management, user support and testing suite consolidated

Next steps

- Identify research innovations that can be tested in HWRF for potential operational implementation
- Partner with developers to add innovations to centralized code
- Pending developers demonstrating promising results...
 - conduct comprehensive testing and evaluation
- Transition new capabilities to operations
- Continue with support to HWRF developers and general community