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

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66th Interdepartmental Hurricane Conference

March 7. 2012

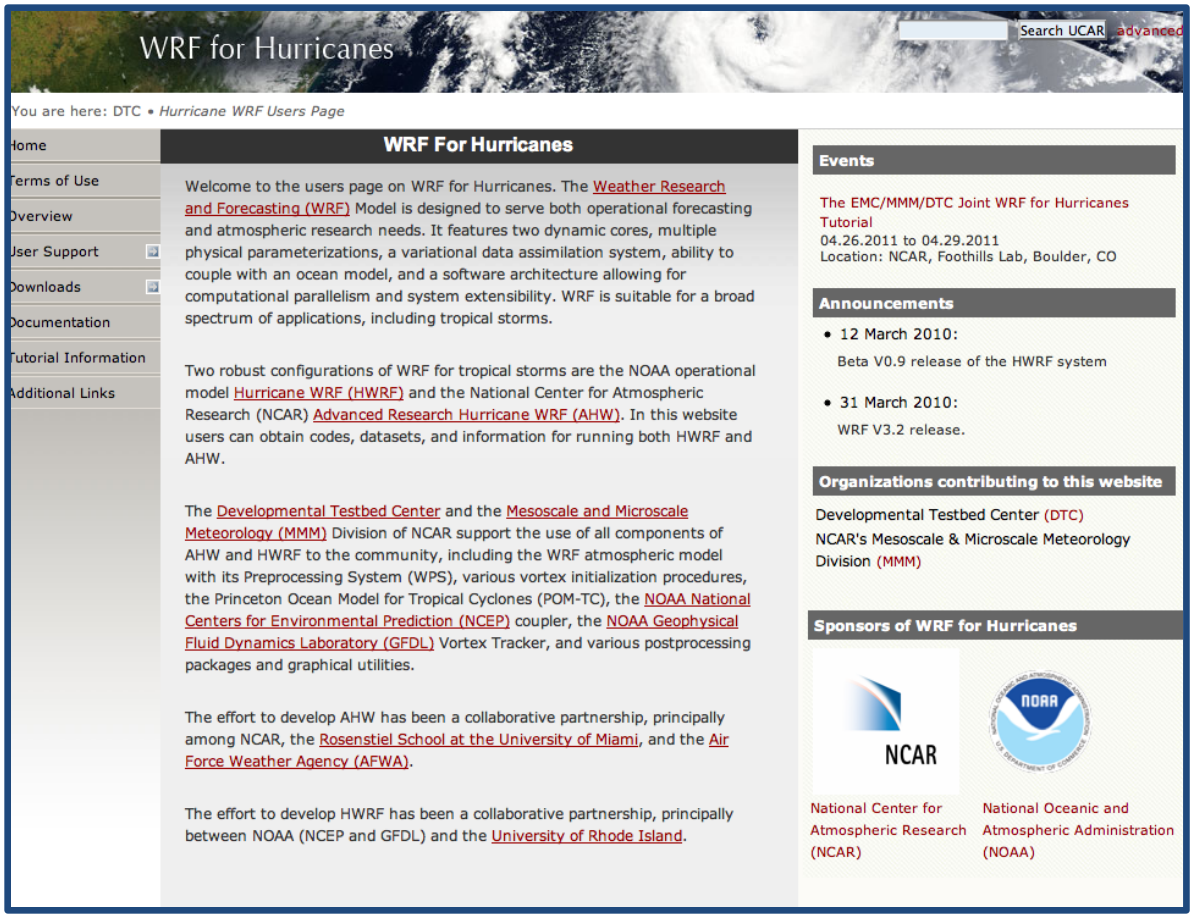
Goal: Tech Transfer to Hurricane NWP

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

www.dtcenter.org/HurrWRF/users

WRF for Hurricanes User Support



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**

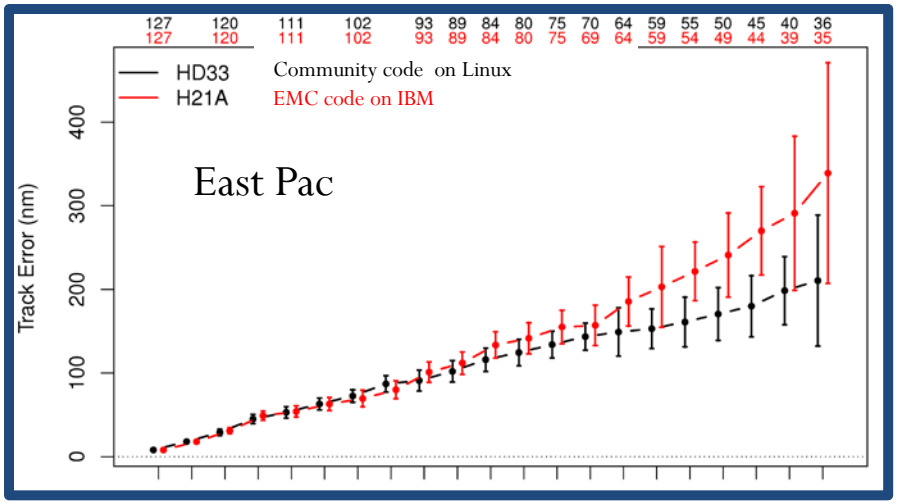
Improving HWRF through porting

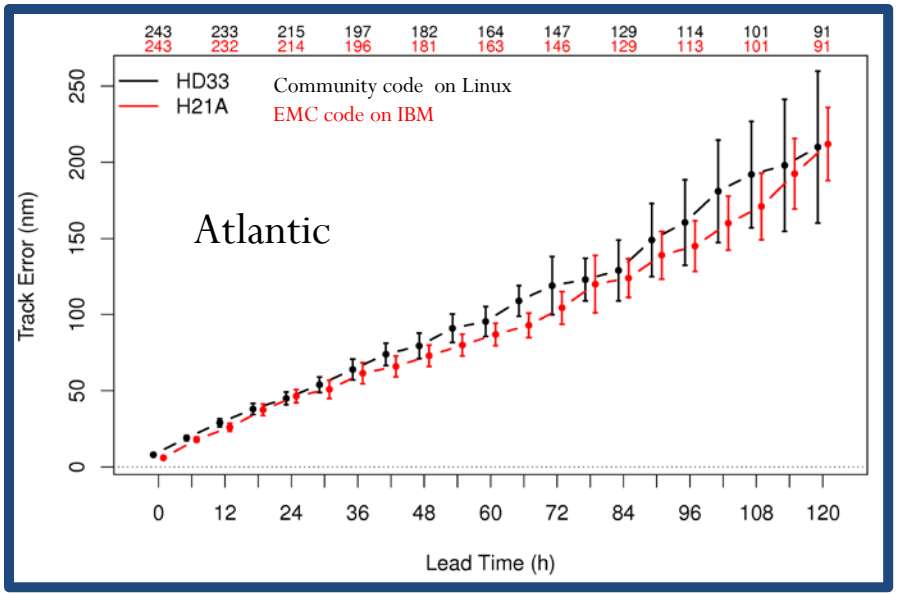
Code more robust due to use in multiple platforms and pre-release testing

Community code: EMC 2011 pre-implementation

Linux vs AIX (IBM)

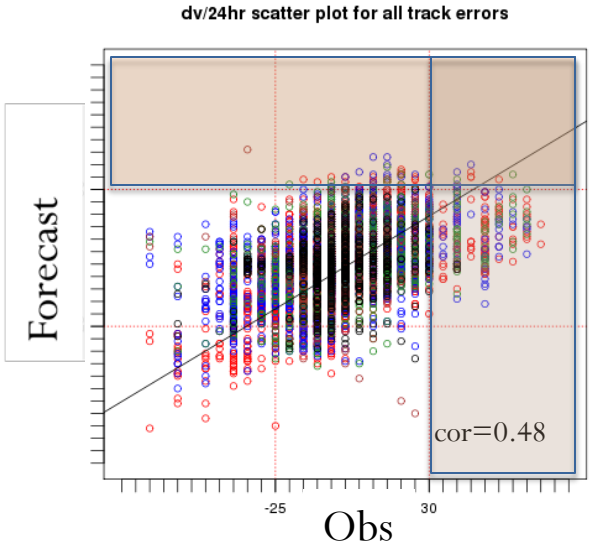
- Expected similar average results
- Found difference in skill
- Investigation revealed bug with different behavior Linux vs IBM
- Fix was implemented operationally in June 2011





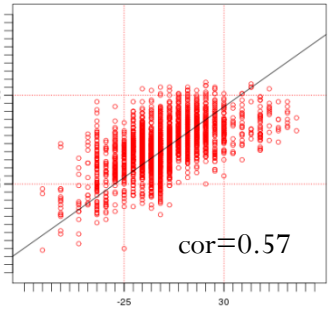
Non-traditional HWRF vx and diagnostics:

Analysis of intensity change (dV / 24h)

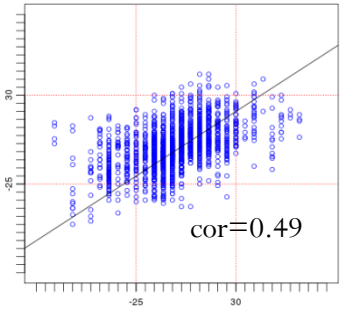


Stratification by track error (T) (nm)

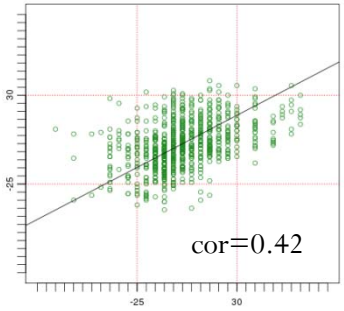
T< 50 nm



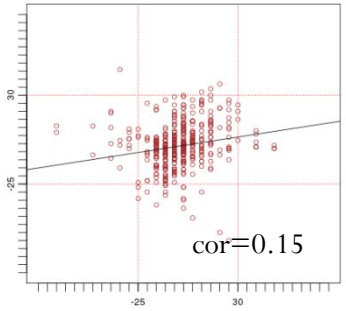
50< T < 100



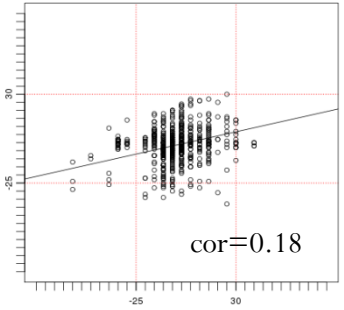
100< T < 150



150 < T < 200



150 < T < 200



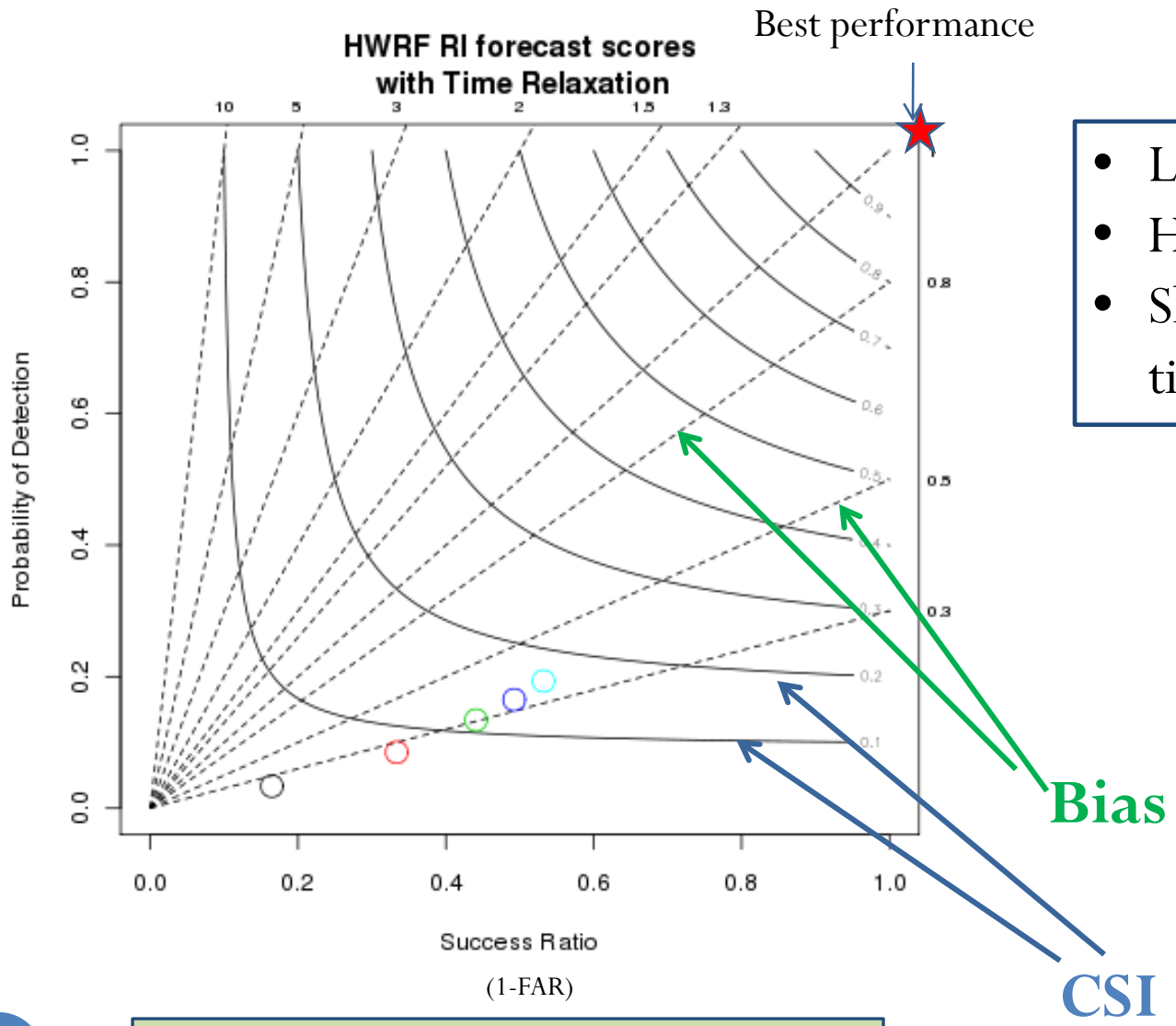
Low correlation between forecast and observed intensity change

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



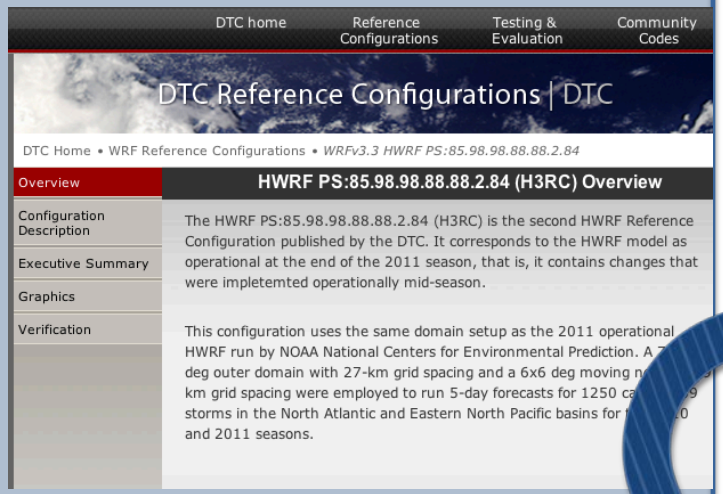
- Low POD, Bias, CSI
- High FAR
- Slight improve with time relaxation

- No relax
- 12h relax
- 24h relax
- 36h relax
- 48h relax

HWRF 2012 baseline (500 cases)

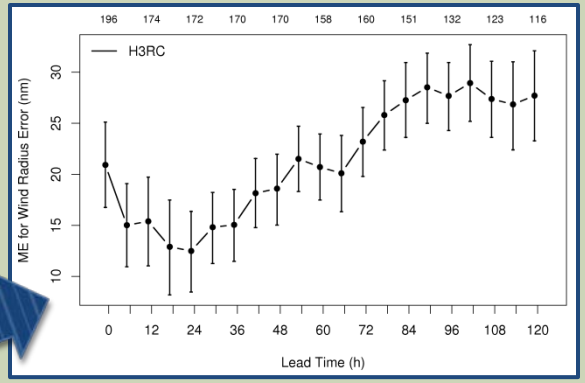
HWRF Testing, Evaluation, Diagnostics

Comprehensive testing



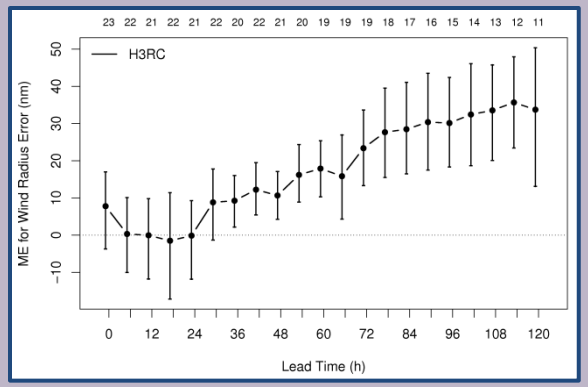
- Results available at dtcenter.org
- Functionally-equivalent testing suite
- Multi-season tests, thousands of runs
- Benchmarks of community code
  - Inform future development
  - Control to test improvements

Summary Statistics



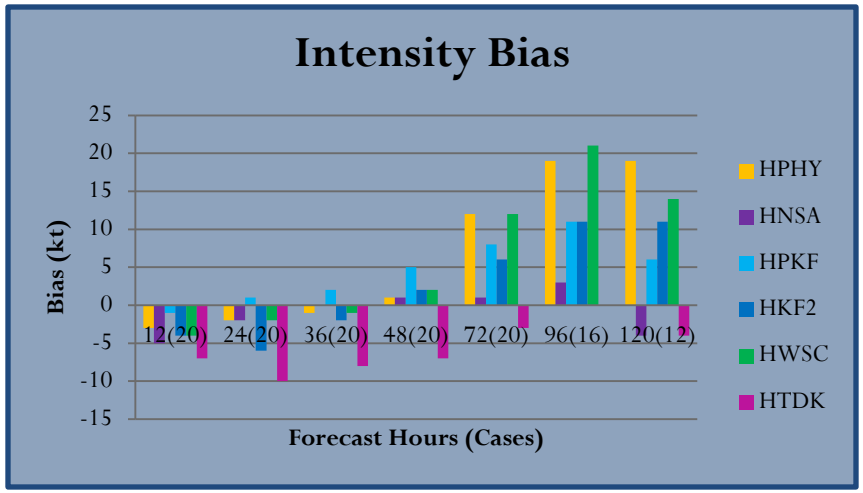
Average wind radii error for 64 kt threshold (NE):
Inner core too large; contracts during first day

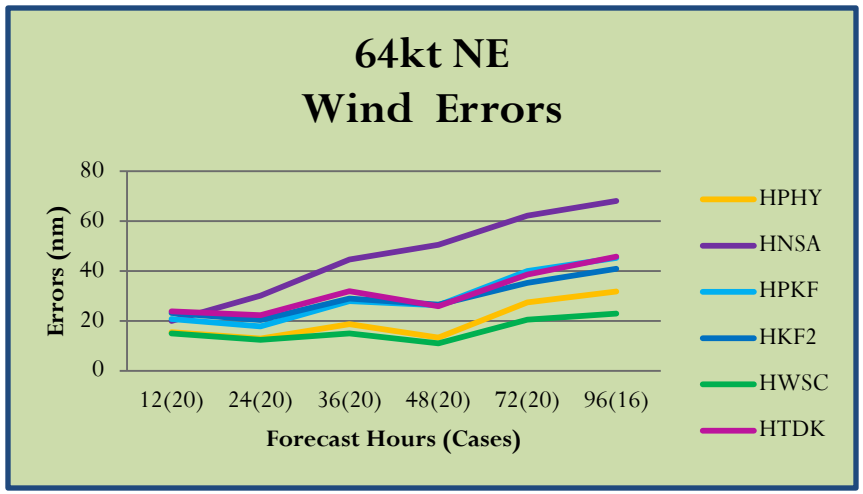
Case Studies / Small tests



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)





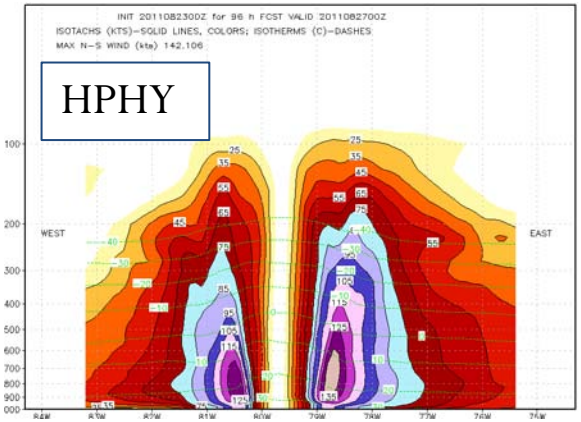
Cumulus Schemes

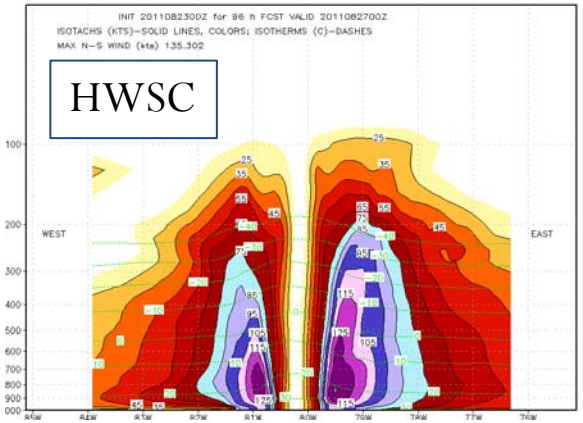
HPHY – 2011 operational HWRF SAS (no SC)
HWSC – 2011 operational HWRF SAS (w/ SC)
HNSA –YSU implementation SAS (w/ SC)
HPKF – Kain-Fritsch
HKF2 – Kain-Fritsch w/ moist adv trigger
HTDK - Tiedke

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

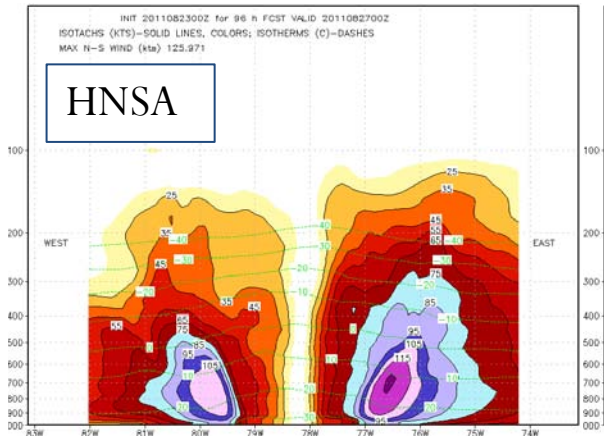
Schemes with weakest intensity produce largest storm.
HNSA has the largest storm structure (too large)

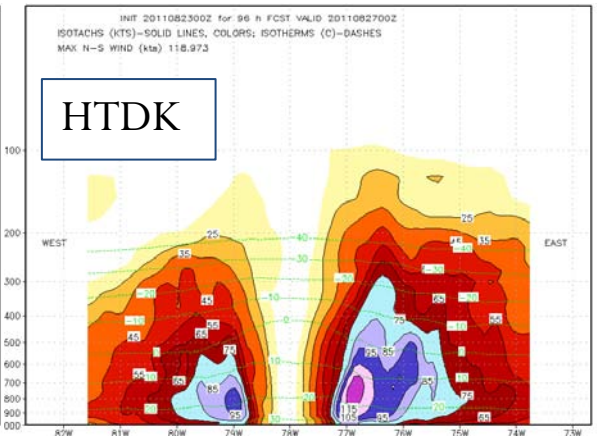
Irene init Aug 23, 00 UTC: 96-h isotachs (kt), isotherms (C)

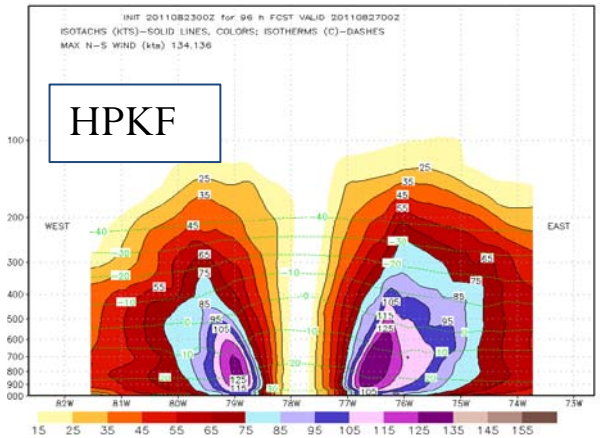




Configurations with higher intensity are vertically stacked







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
  - Techincal 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

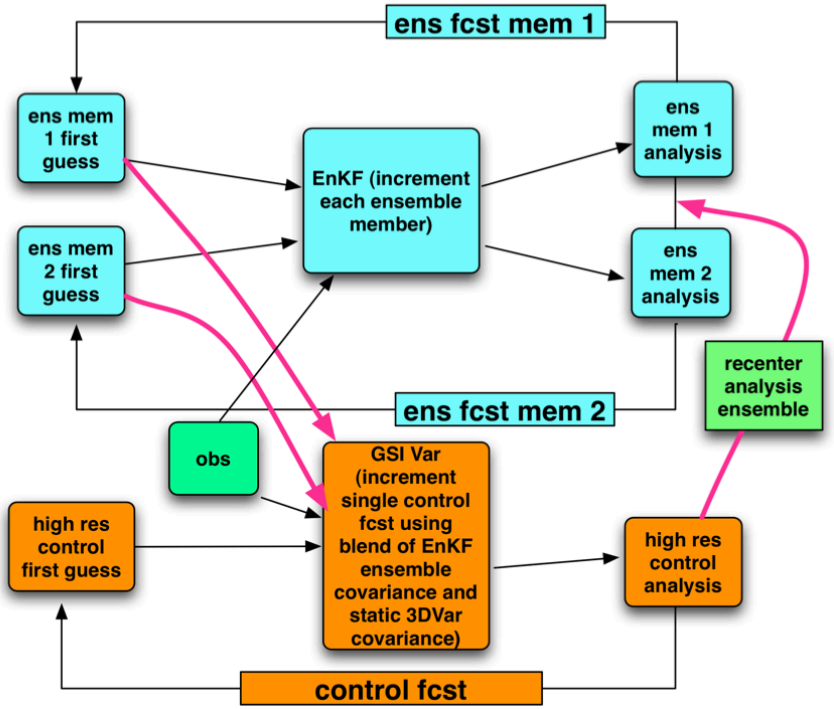


Figure courtesy of Jeff Whitaker, NOAA/ESRL/PSD

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