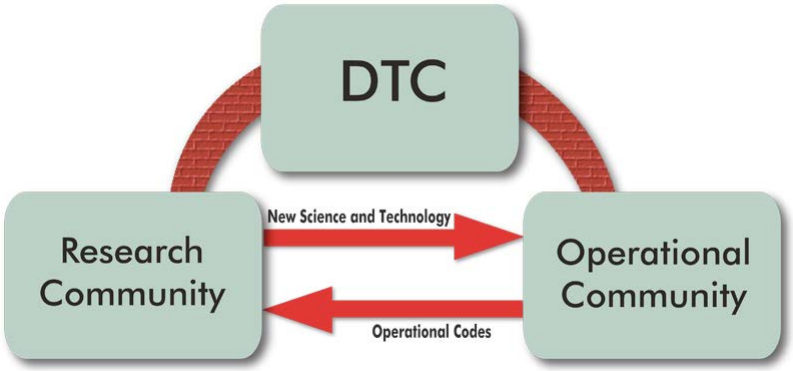
Developmental Testbed Center: Core Activities for HFIP

Kathryn Newman, Bill Kuo, Louisa Nance
DTC

HFIP Annual Meeting
2016 January 11

DTC strategies to promote HWRF O2R2O

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



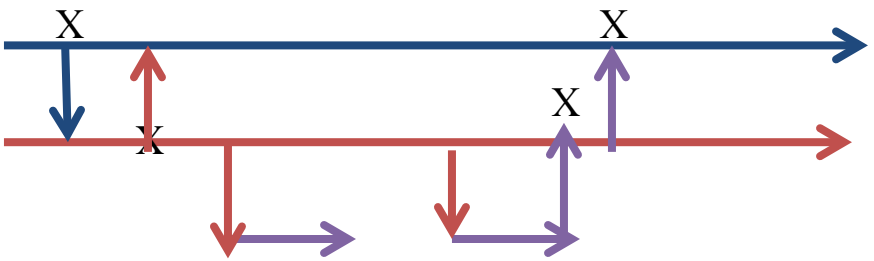
1. **Code management**
   - *Create and sustain a framework for NCEP and the research community to collaborate and keep HWRF code unified*
2. **User and developer support**
   - *Support the community in using and providing improvements for HWRF*
3. **Visitor program**
   - *Funds the research community to partner with DTC in R2O*
4. **Independent testing & evaluation**
   - *Test and evaluate innovations for potential operational implementation*

DTC activities funded by NOAA (including HFIP), Air Force, NSF, and NCAR

Code Management

- **Centralized HWRF repository**
  - SVN & Git repositories house all the components of HWRF
    - WRF and WPS transitioned to GitHub in August, 2016
  - 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

Code repository for each HWRF component (WRF, WPS, GSI etc.)

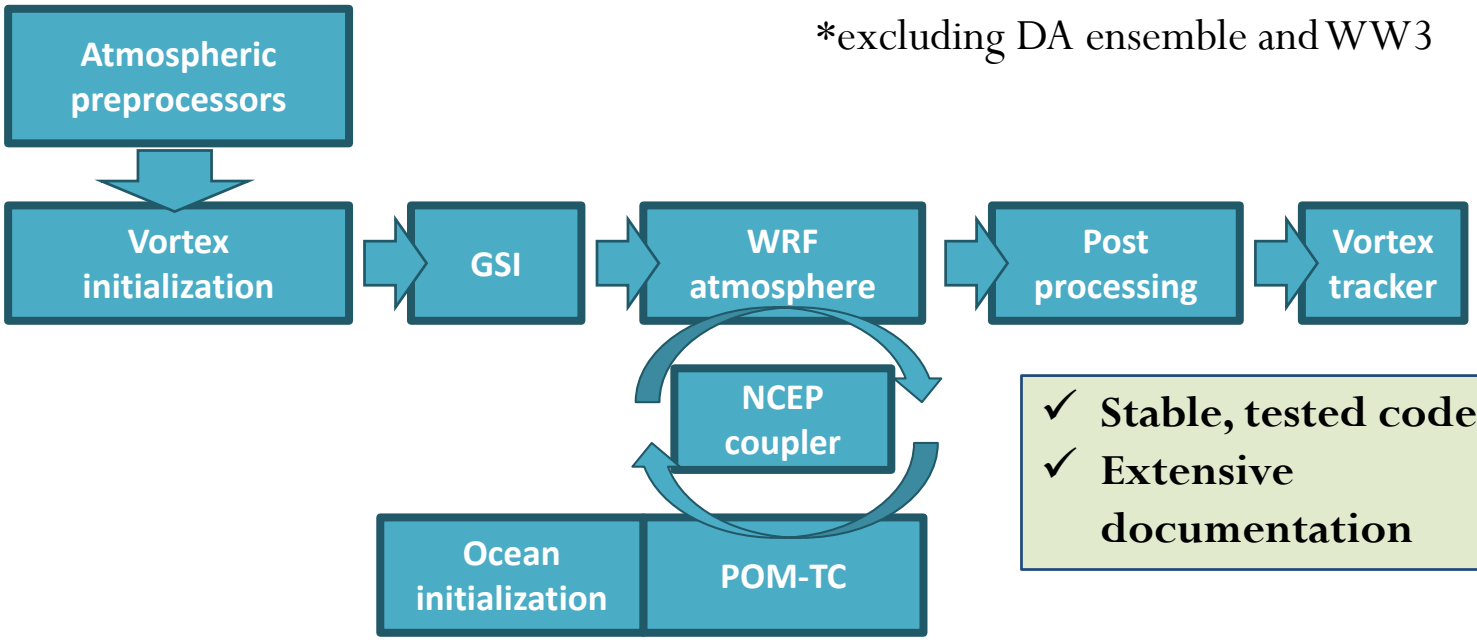


HWRF public release

- **HWRF v3.8a public release**
  - Released November, 2016
  - 2016 operational* + research capabilities
    - Idealized TC with landfall, alternate physics, 2015 d02/d03 grid sizes
    - Alternate configurations (i.e.: DA, ocean, input datasets)

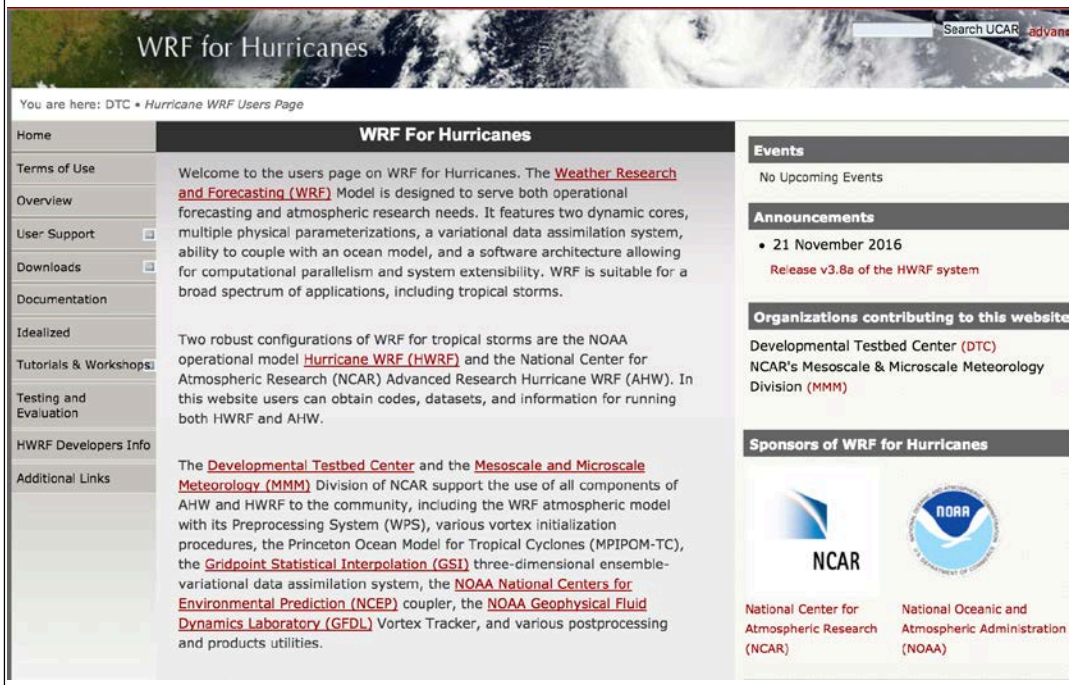
End-to-end atmosphere-ocean coupled HWRF system fully supported

*excluding DA ensemble and WW3



- ✓ **Stable, tested code**
- ✓ **Extensive documentation**

User support



www.dtcenter.org/HurrWRF/users

- Users work with stable yearly release with known capabilities
  - 1300+ registered users
  - Code downloads, datasets, extensive documentation (updated for v3.8a – Technical memo pending), online tutorial
- Helpdesk:
  - hwrf-help@ucar.edu

2015 HWRF NCAR Technical Note

Tallapragada et al., 2016: Hurricane Weather Research and Forecasting (HWRF) Model: 2015 Scientific Documentation. NCAR Technical Note NCAR/522+STR, 116 pp.

HWRF tutorials: home and abroad

HWRF tutorial: NUIST

HWRF tutorial: NCWCP
(remote participants not pictured)

Recent HWRF Public Tutorials	
Nanjing, China	December 2015
College Park, MD	January 2016

Lectures from HWRF developers on all aspects of the end-to-end system

Past tutorial materials available on DTC webpage, including online practical exercises

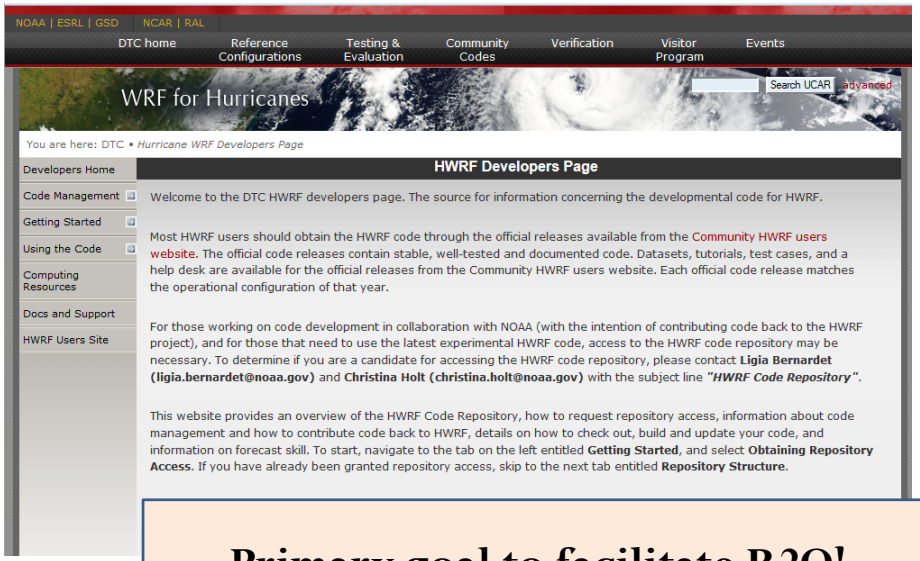
Tutorials jointly hosted by DTC and EMC

- **Next US tutorial anticipated during 2017**

http://www.dtcenter.org/HurrWRF/developers

Support to HWRF developers

Motivation: access to code repository & timely support for developers to work in fast-paced, multi-institutional collaborative mode expedites code readiness



Primary goal to facilitate R2O!

For HWRF developers (HFIP PIs), DTC/EMC provides:

- Access to the unified HWRF code repository hosted by DTC
- Access to the latest experimental codes
- Contrib repository: peer-to-peer sharing of codes
- Support for inter-developers collaboration
- Training in code management, development, automation
- Specialized in-person training
- Developer website
- Bi-weekly developers committee telecons
- Mailing lists
- Helpdesk

Developer Support: training offered

- Specialized Python for HWRF training offered to expedite developments using redeveloped HWRF scripts in Python
  - Held in conjunction with HFIP annual meeting, HWRF public tutorial
  - 8 hours of material (including audio) available on developers webpage

Python Training Slides -- College Park, MD, Jan. 22, 2016:

Audio/visual recording: MP4

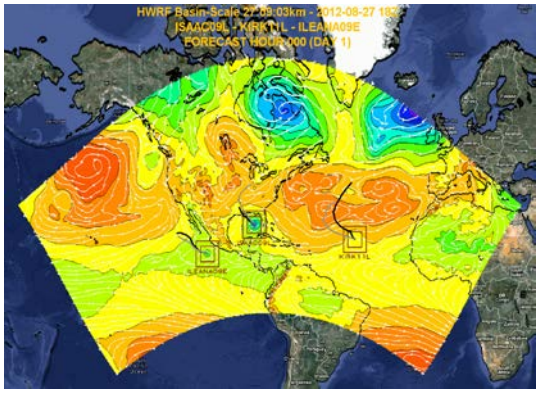
- Overview PDF
- Internals Overview PDF
- Object-oriented Scripting PDF
- Produtils Overview PDF
- Logs PDF
- Troubleshooting PDF
- Configuring PDF
- Rocoto PDF
- Database PDF
- Debugging PDF
- Adding a Component Activity PDF

Python Training Slides -- Miami, Nov. 20, 2015:

- Overview PDF
- Object-oriented Coding PDF
- Rocoto PDF
- Configuring PDF
- Logs PDF
- Scripts I PDF
- Scripts II PDF
- Database PDF
- Debugging PDF

Support for multistorm capability

- Requirements document for ocean coupling in multistorm
  - Assessment of current state of multistorm framework
  - Recommendations for scripting enhancements
- Provided updates to run 18/6/2 km (*committed to trunk*)
- Merged automation entities between multistorm and operational configurations (*development in branch*)
- Addition of a multistorm DA ensemble (*development in branch*)



DTC Visitor Program

http://www.dtcenter.org/visitors

DTC Visitor Program – Recent hurricane-related work		
Michael Iacono & John Henderson	AER	Testing Revisions to RRTMG Cloud Radiative Transfer and Performance in HWRF (2016)
Robert Fovell	SUNY-Albany	Impact of Planetary Boundary Layer Assumptions on HWRF Forecast Skill (2016)
Subashini Subramanian & Dev Niyogi	Purdue University	Developing and Supporting Global HWRF Ocean Coupling with Advanced Ocean Physics and Initialization Options and New Diagnostic Tools for Comprehensive Model Evaluation (2016)
Shaowu Bao	Coastal Carolina University	Evaluation of the Microphysics Scheme in HWRF 2016 version with remote-sensing data (2016)

- **Iacono/Henderson (AER):** Implemented alternate cloud overlap methodology in HWRF – ***testing underway by DTC***
- **Subramanian (Purdue):** Development of landfall capability for Idealized TC – ***included in HWRFv3.8a public release***

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

DTC Testing and Evaluation

- Testing & evaluation activities with focus on impact of physics parameterization innovations

2015 HWRF implementation

2014
- RRTMG and implementation of partial cloudiness
- Improvements to planetary boundary layer (PBL) physics that complement use of RRTMG radiation from DTC visitor (Fovell)

2015
- Thompson microphysics & partial cloudiness modifications

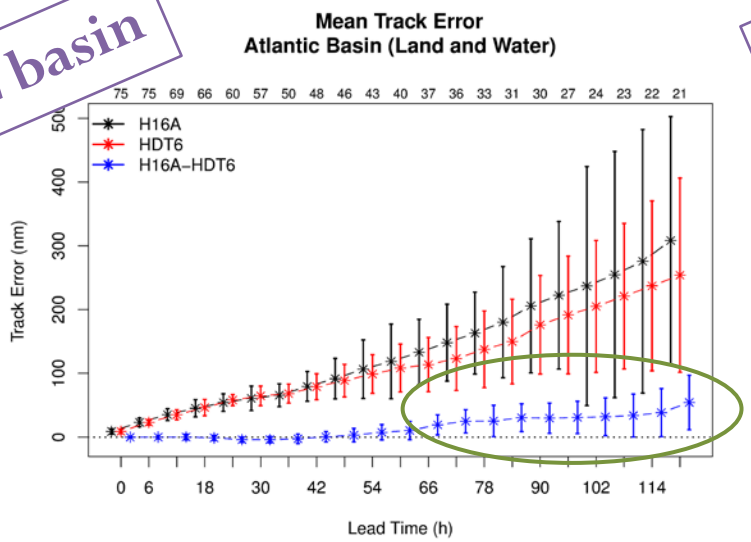
2016
- Grell-Freitas convection
- RRTMG cloud overlap and partial cloudiness modifications

Primarily OAR funding - HFIP funds & deliverables help make possible!

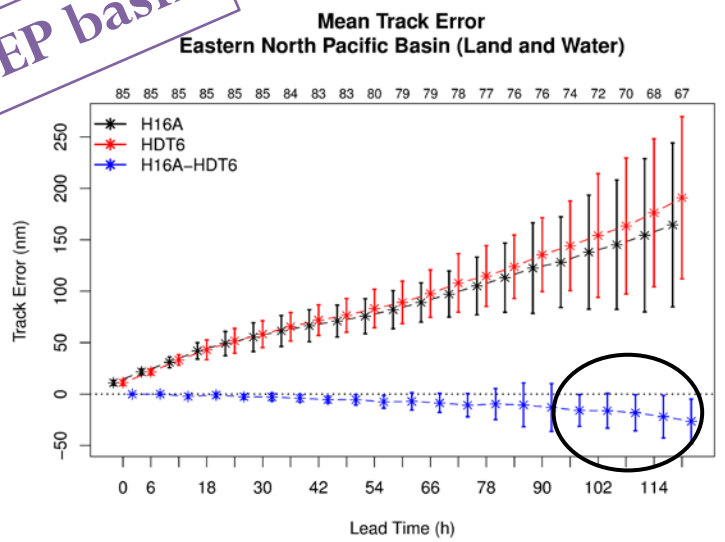
*Funded by NOAA OAR

Thompson microphysics

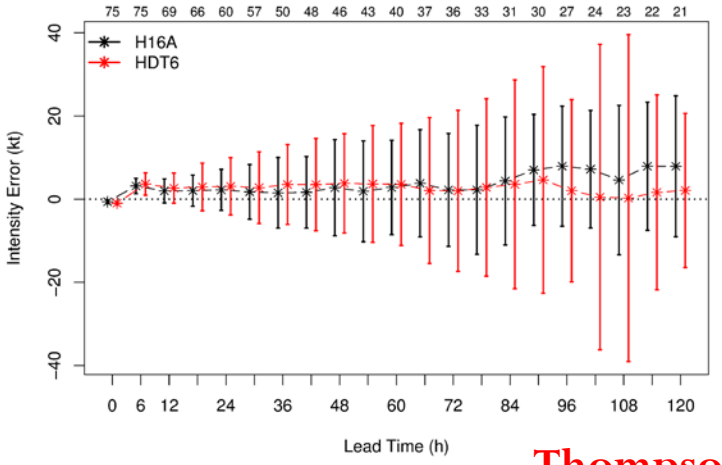
AL basin



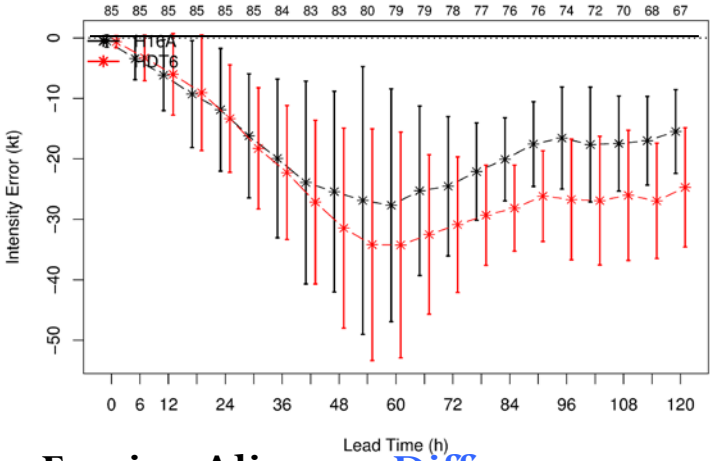
EP basin



Intensity error



Intensity error



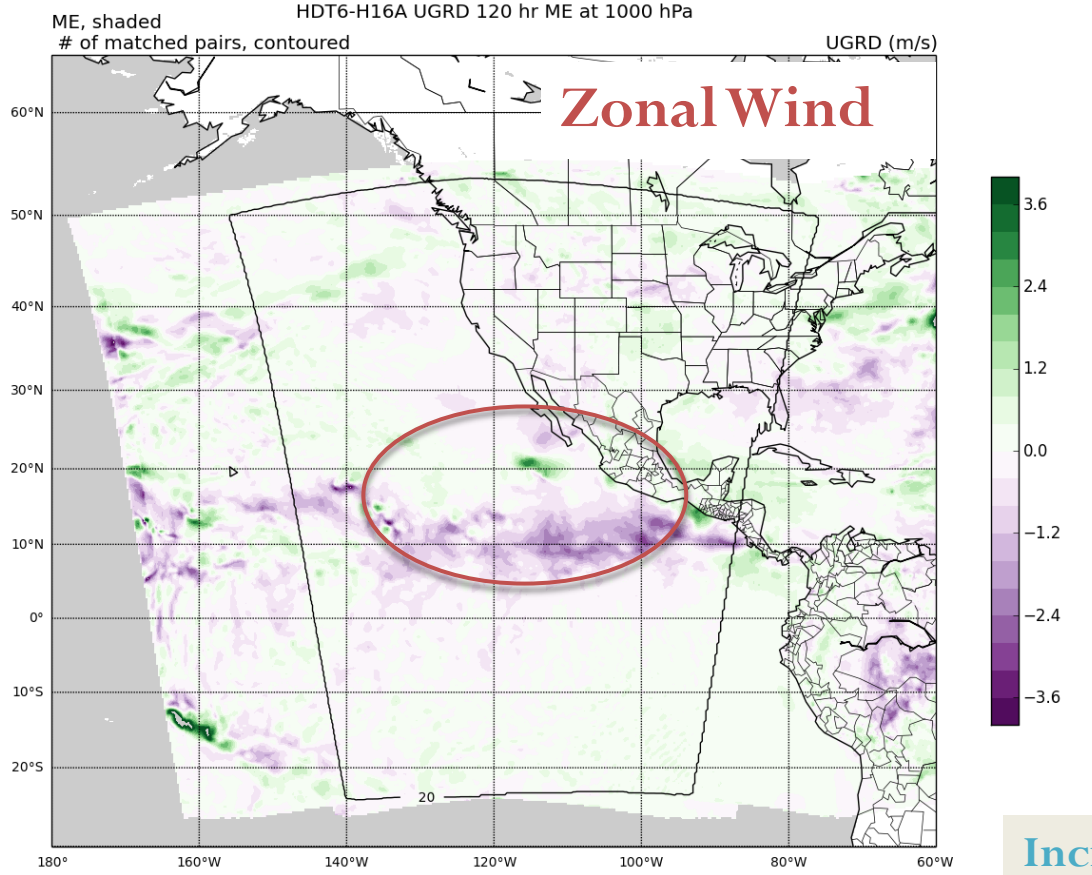
Thompson Ferrier-Aligo Difference

*Funded by NOAA OAR

Thompson MP: Large-scale Verification

HDT6 – H16A ME

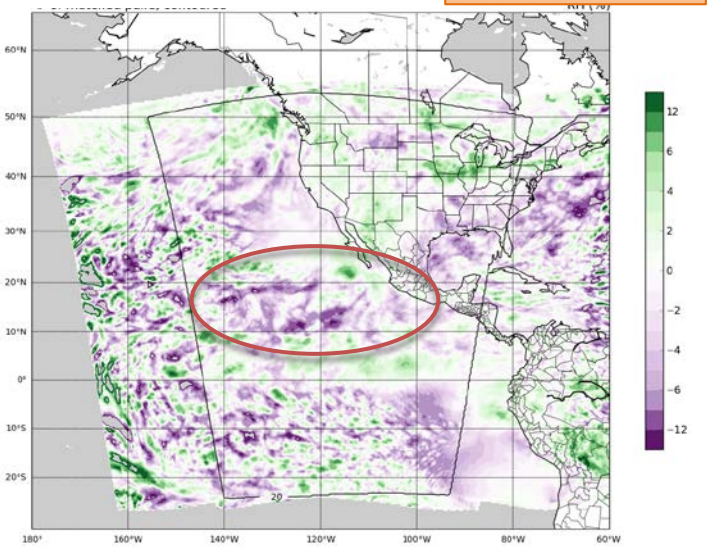
1000 hPa



Green is more westerly
Purple is less westerly

Relative Humidity

850 hPa

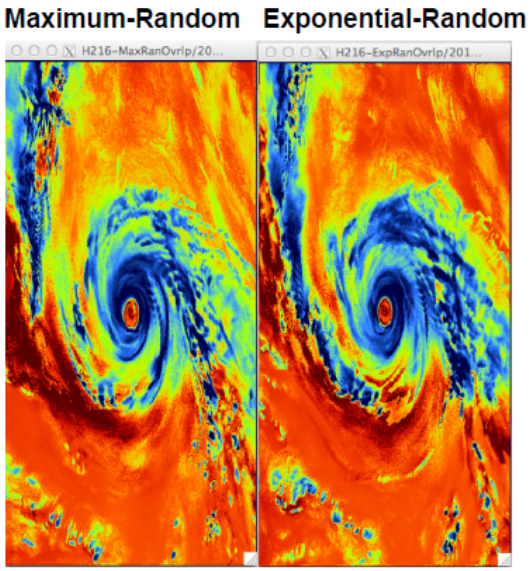


Green is more humid
Purple is drier

Increased large-scale shear, combined with **cooler, drier mid-levels** could be a source of EP intensity degradation.

Ongoing DTC Testing and Evaluation

- Alternate **cloud overlap** methodology (Exponential-Random) and **partial cloudiness** with **RRTMG** in HWRF
  - Cloud overlap advancements brought into HWRF through a DTC visitor program project by M. Iacono and J. Henderson (AER)
  - Partial cloud (icloud=3) modifications provided by G. Thompson (NCAR)
- DTC testing underway

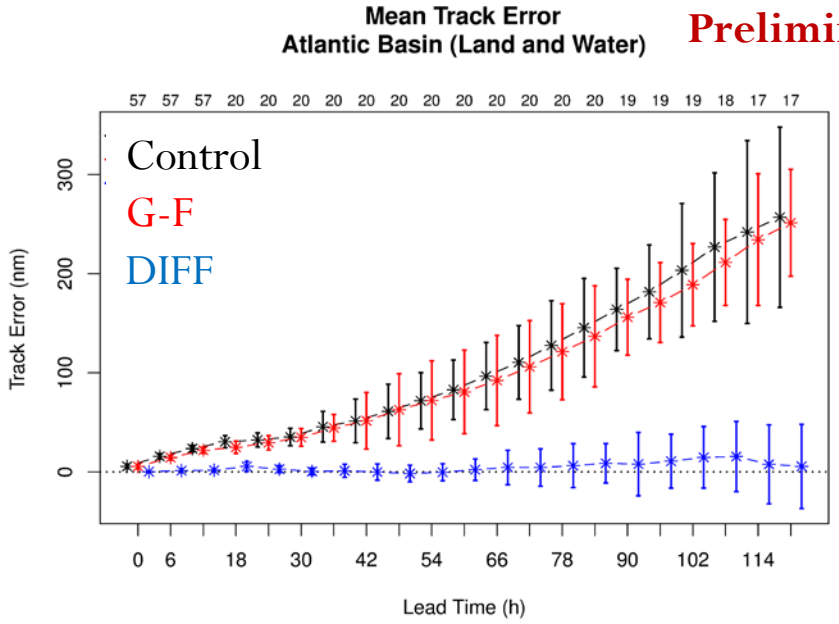


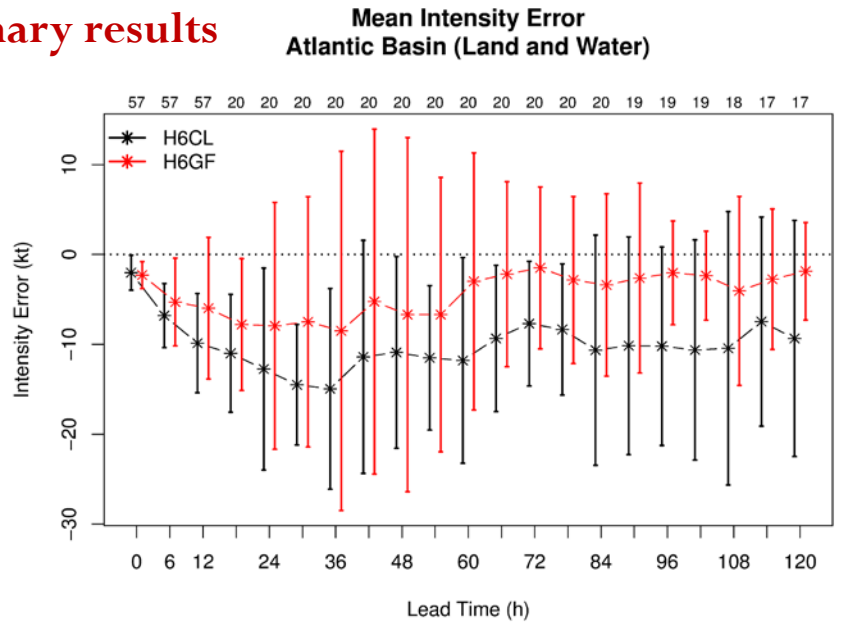
SW radiative heating rates for Joaquin (courtesy M. Iacono)

Ongoing DTC Testing and Evaluation

- **Grell-Freitas cumulus scheme** implemented in HWRF by G. Grell and J.-W. Bao (NGGPS PI)
  - Developer support to bring code and subsequent bug fixes into centralized HWRF repository
  - Ongoing testing to increase sample

Preliminary results





Future plans

- Continued code management and maintenance of unified code
- Continued user & developer support
  - Support for public release and active HWRF developers (HFIP PIs)
  - Maintain support for DTC Visitor Program PIs
- R2O potential through testing and evaluation
  - Physics advancement: Thompson and/or G-F schemes
  - Support migration of TC physics into future unified modeling system at NCEP