Developmental Testbed Center: Core Activities for HFIP

Kathryn Newman

Evan Kalina, Louisa Nance, Bill Kuo

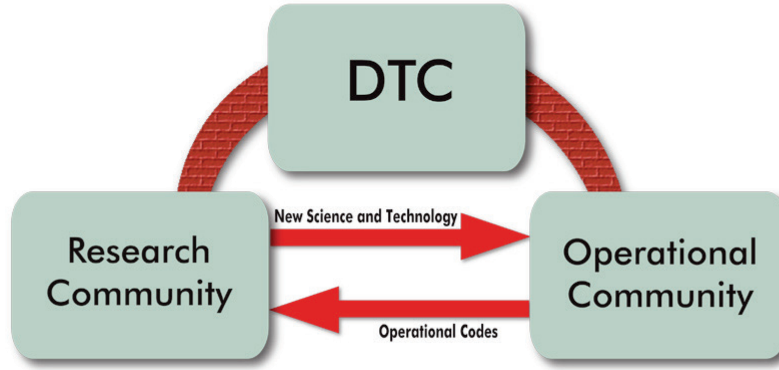
DTC

HFIP Annual Meeting

2017 November 8

DTC strategies to promote HWRF O2R2O

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



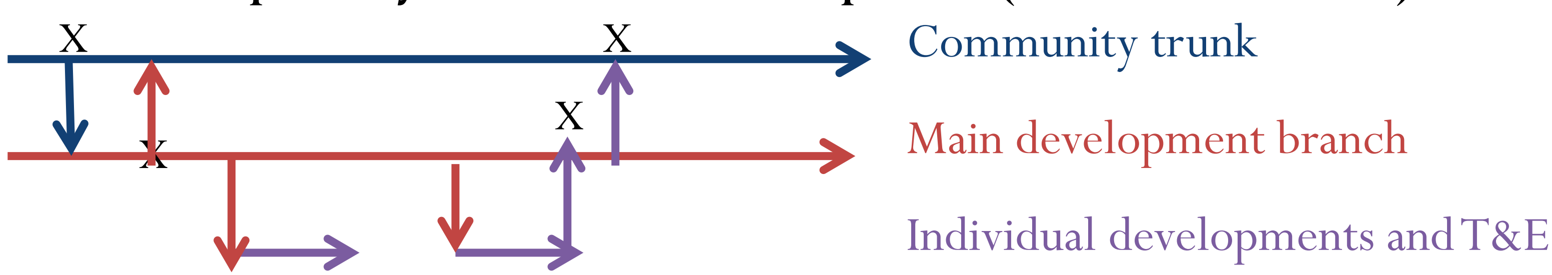
1. **Code management**
   - *Create and sustain a framework for NCEP and the research community to collaborate and keep HWRF code unified*
2. **User and developer support**
   - *Support the community in using and providing improvements for HWRF*
3. **Visitor program**
   - *Funds the research community 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
    - Community GSI repository transitioned to VLab svn February, 2017.
    - Unified GSI repository transition to VLab Git underway.
  - 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.)

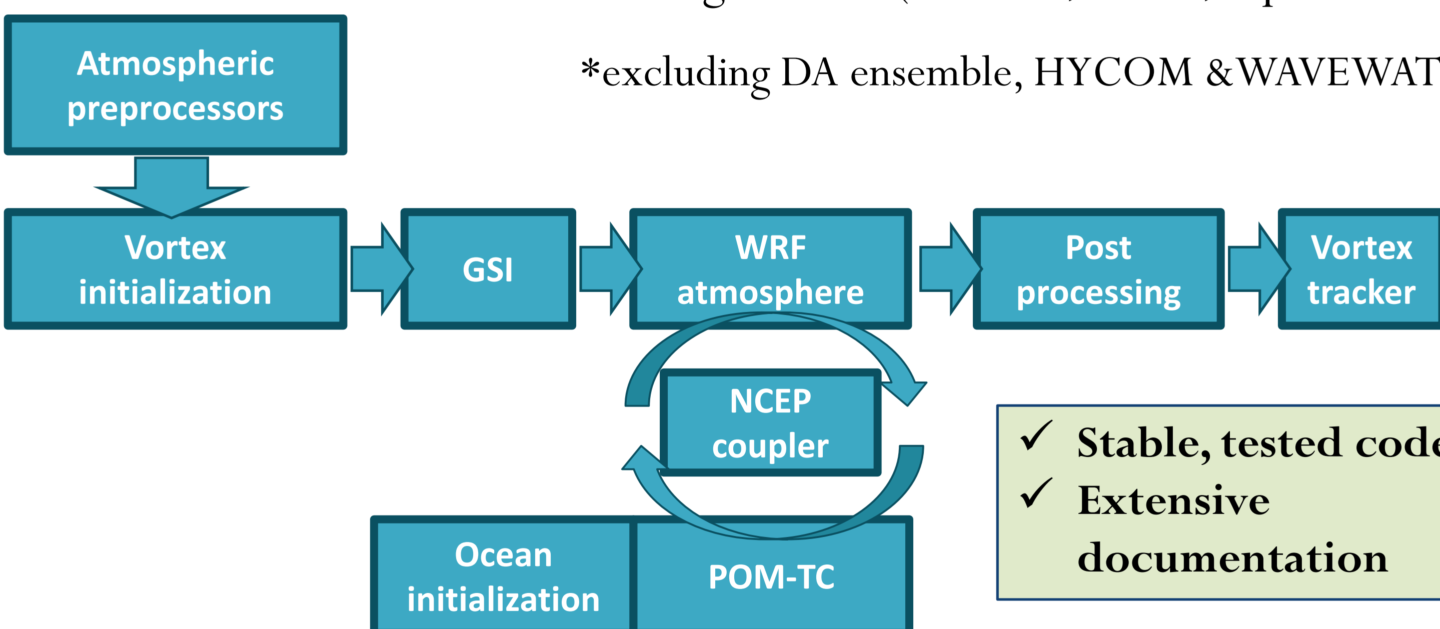


HWRF public release

- **HWRF v3.9a public release**
  - Released October, 2017
  - 2017 operational* + research capabilities
    - Idealized TC with landfall, alternate physics, previous operational d02/d03 grid sizes, vertical levels/model top & horizontal resolution
    - Alternate & research configurations (i.e.: DA, ocean, input datasets)

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

*excluding DA ensemble, HYCOM & WAVEWATCH III



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

User support

www.dtcenter.org/HurrWRF/users

- Users work with stable yearly release with known capabilities
  - 1500+ registered users
  - Code downloads, datasets, extensive documentation (updated for v3.9a – published technical notes in progress), online tutorial
- Helpdesk:
  - hwrf-help@ucar.edu

2016 GSD Technical Memo

Biswas, M. K., L. Carson, K. Newman, L. Bernardet, C. Holt, 2016: Community HWRF Users' Guide V3.8a, NOAA Technical Memorandum OAR GSD-47, 149 pp., http://doi.org/10.7289/V5/TM-OAR-GSD-47.

HWRF public tutorial

Upcoming HWRF tutorial
January 23-25, 2018
College Park, MD – NCWCP

2014 HWRF tutorial

2016 HWRF tutorial

Lectures from HWRF developers on all aspects of the end-to-end system & hands-on practical sessions

Agenda includes 13 hours of lecture material and 7 hours of practical experience

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

Tutorial jointly hosted by DTC and EMC

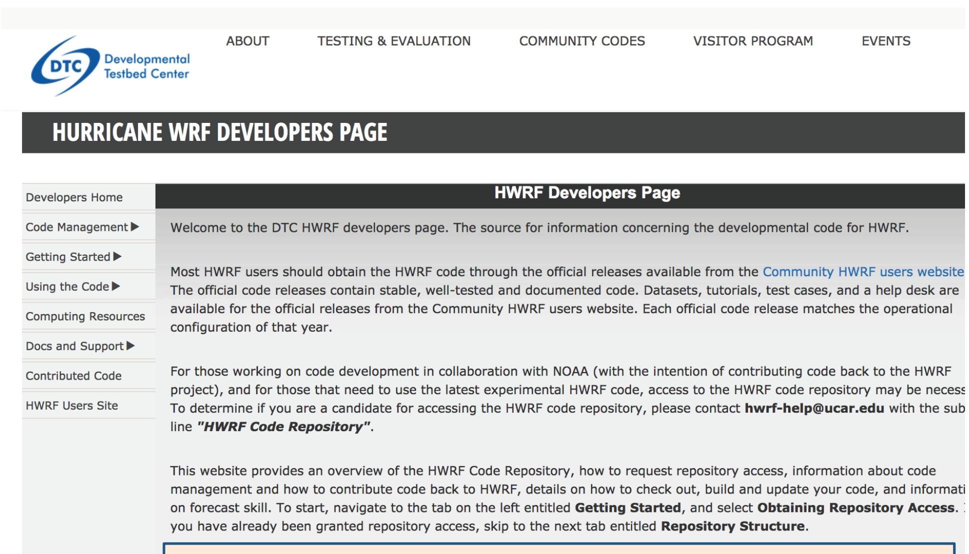
- **Registration now open!**

https://dtcenter.org/HurrWRF/users/tutorial/2018/

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!

HWRF developers (HFIP PIs) receive:

- Access to the unified HWRF code repository with experimental codes
- Contrib repository: peer-to-peer sharing
- Support for inter-developer collaboration
- Training in code management, development, automation
- Specialized in-person training
- Assistance with developments
- Oversight of code integration
- Developer website
- Bi-weekly developers committee telecons
- Mailing lists
- Specialized helpdesk

Developer support

Sample of recent active developers

- **M. Leidner (AER)**
  - Repository/code assistance for work underway to assimilate CYGNSS wind speed data into HWRF
- **W. Lewis (U. Wisconsin)**
  - Repository support for development work to assimilate GOES-16 RAPIDSCAN AMVs into HWRF
- **R. Torn (U. Albany)**
  - Support for running GEFS-based HWRF ensemble using public release wrappers on NCAR's HPC Yellowstone.
- **G. & E. Grell (NOAA ESRL)**
  - Support for debugging reproducibility issues and integration of updated features of Grell-Freitas cumulus scheme into HWRF trunk
- **AOML HRD**
  - WRF debugging assistance for multistorm capability
  - Code review and assistance with integration of latest multistorm code into HWRF trunk

http://www.dtcenter.org/visitors

DTC Visitor Program

DTC Visitor Program – Recent hurricane-related work		
Michael Iacono & John Henderson	AER	Testing Revisions to RRTMG Cloud Radiative Transfer and Performance in HWRF (2016)
Dev Niyogi & Subashini Subramanian	Purdue Univ	Developing Landfall Capability in Idealized HWRF for Assessing the Impact of Land Surface on Tropical Cyclone Evolution (2016)
Robert Fovell	SUNY-Albany	Impact of Planetary Boundary Layer Assumptions on HWRF Forecast Skill (2016)
Shaowu Bao	Coastal Carolina Univ	Evaluation of the microphysics scheme in HWRF 2016 version with remote-sensing data (2016)
Ting-Chi Wu	Colorado State Univ	Evaluation of the Newly Developed Observation Operators for Assimilating Satellite Cloud Precipitation Observations in GSI within HWRF system (2017)
Michael Iacono & John Henderson	AER	Testing Variations of Exponential-Random Cloud Overlap with RRTMG in HWRF (2017)
Jun Zhang	U. Miami and HRD	Evaluating the Impact of Model Physics on HWRF Forecasts of Tropical Cyclone Rapid Intensification (2017)

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

2016

Grell-Freitas cumulus parameterization
- Promising results – retest for 2018 HWRF

RRTMG updated cloud overlap methodology
- Neutral results – follow on DTC visitor project aimed at methodology improvements

RRTMG partial cloudiness enhancements
- Positive forecast impacts - implemented in 2017 HWRF

2017

Grell-Freitas cumulus parameterization
- Test during 2018 pre-implementation. Updated scheme version from developers

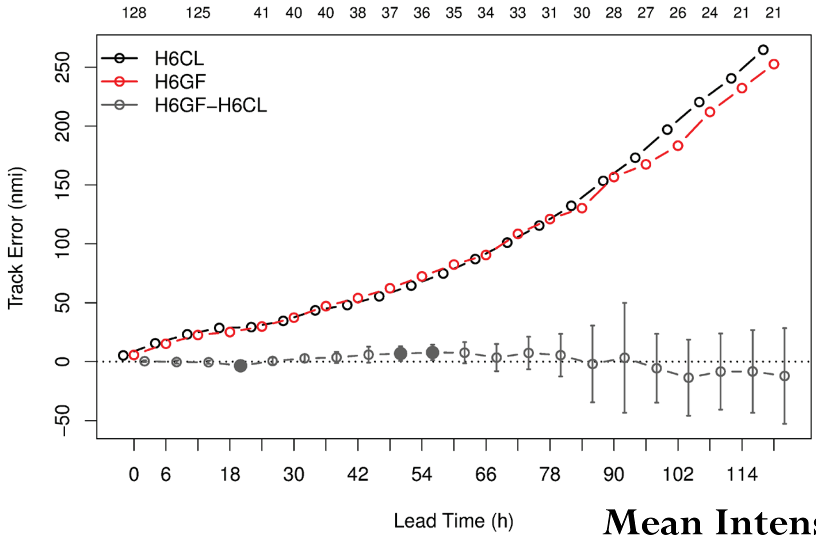
NOAA OAR funding - HFIP funds & deliverables help make possible!

*Funded by NOAA OAR

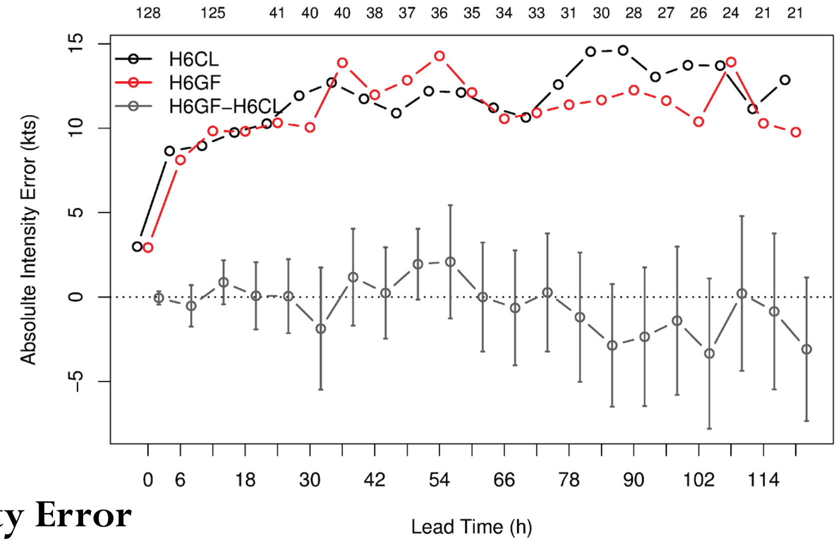
GF: Track and intensity errors

GF **SASAS** **Difference**

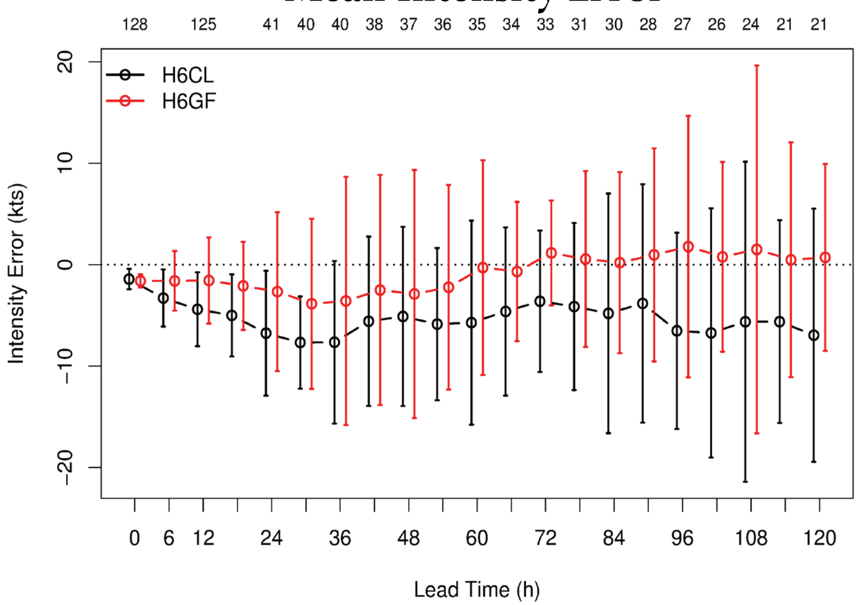
Mean Track Error



Mean Absolute Intensity Error



Mean Intensity Error



Storms included:
Gonzalo (2014)
Edouard (2014)
Matthew (2016)

Neutral to positive track forecasts improvements for GF scheme

Negative intensity bias was alleviated for the GF scheme especially at longer lead times

*Funded by NOAA OAR

GF: Rapid Intensification (RI)

Control

		Observation	
		RI	***No RI***
Model Forecast	***RI***	**28**	13
	No RI	52	472

GF

		Observation	
		RI	***No RI***
Model Forecast	***RI***	**38**	26
	No RI	42	459

"RI" is defined as 20 kt intensity increase in 24 hr

Control

POD = 0.35
FAR = 0.317
CSI = 0.301

GF configuration more accurately predicts RI occurrence, but increases number of false alarms

GF

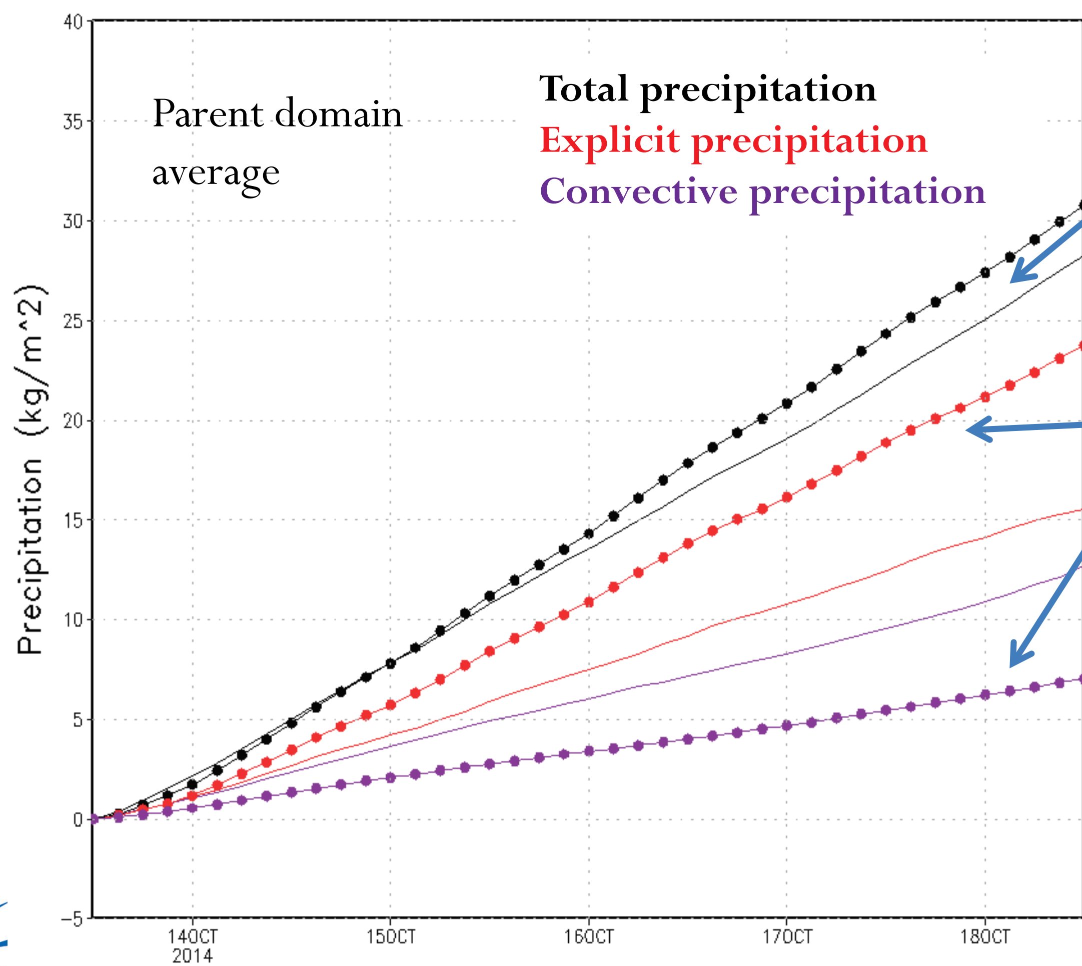
POD = 0.475
FAR = 0.406
CSI = 0.358

*Funded by NOAA OAR

Closed circle - GF
Solid line - SASAS

GF: precipitation

Time series of area-averaged accumulated precipitation



GF produces higher total precipitation than control

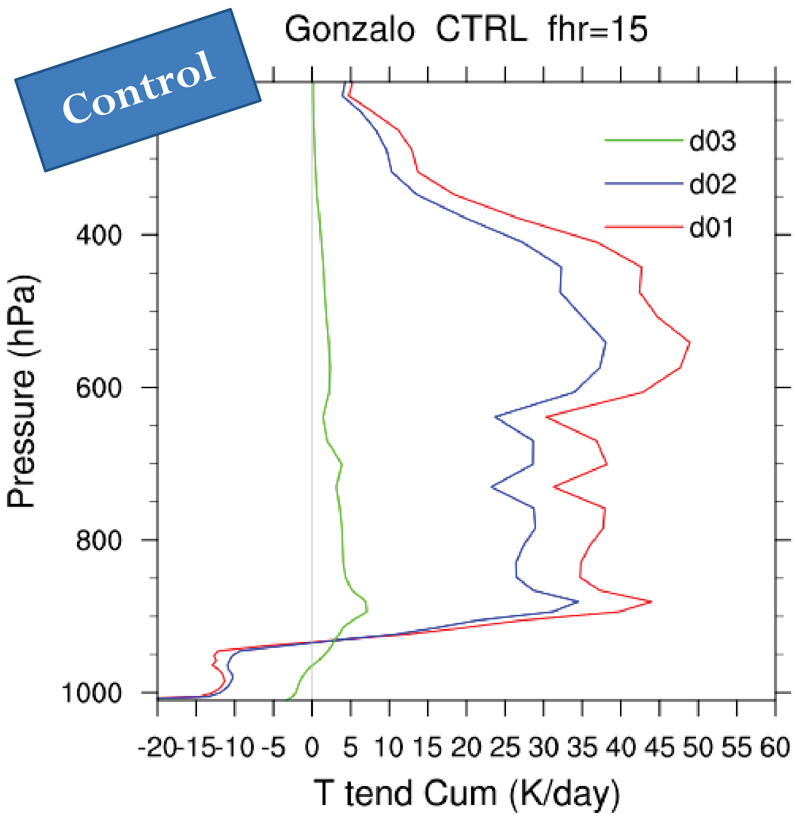
Explicit precipitation higher than convective precipitation in GF

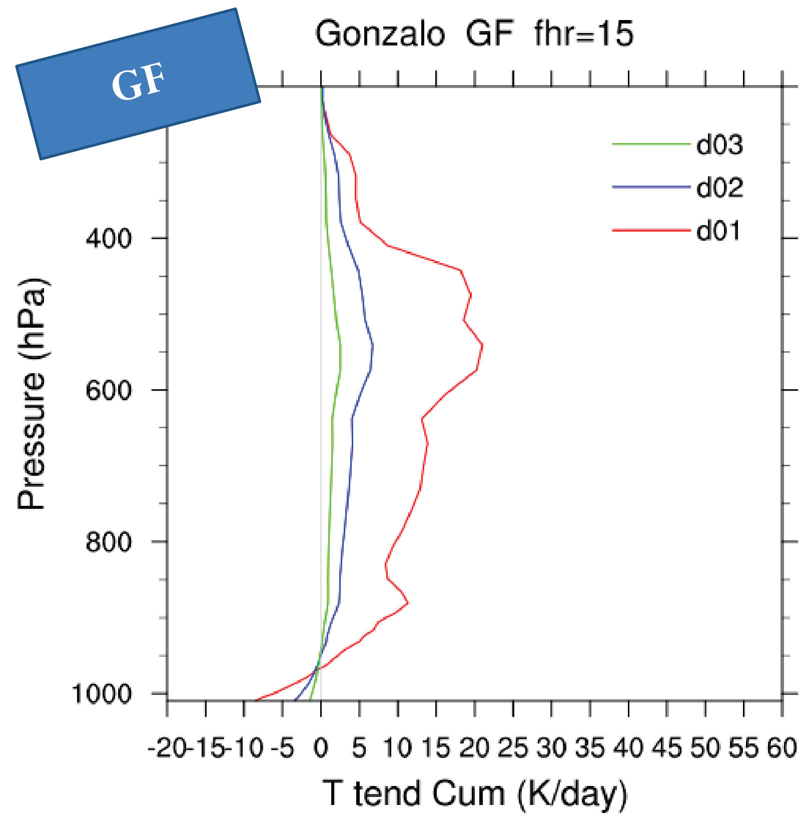
HWRF-GF: Majority of precipitation from explicit precipitation.

Developmental Testbed Center

*Funded by NOAA OAR

GF: scale awareness





Both configurations exhibit scale-awareness

- Convective temperature tendencies decrease from coarser to finer resolution
- GF scheme less active

Developmental Testbed Center

Future plans

- Ongoing code management and maintenance of unified code
- Continued user & developer support
  - Support for public release and active HWRF developers (HFIP PIs)
  - Continued partnerships with DTC Visitor Program PIs
- R2O potential through testing and evaluation
  - Physics advancement: G-F cumulus scheme during 2018 HWRF pre-implementation testing
- Looking ahead to unified forecast system
  - Support migration of TC physics into unified forecast system
  - Begin engaging with FV3 system for hurricane prediction