Developmental Testbed Center: Core Activities for HFIP

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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.)**

  - Community trunk
  - Main development branch
  - Individual developments and T&E
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)

*excluding DA ensemble, HYCOM & WAVEWATCH III

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

Diagram:
- Atmospheric preprocessors
- Vortex initialization
- GSI
- WRF atmosphere
- Post processing
- Vortex tracker
- NCEP coupler
- Ocean initialization
- POM-TC

- Stable, tested code
- Extensive documentation
User support

- 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

www.dtcenter.org/HurrWRF/users

2016 GSD Technical Memo
HWRF public tutorial

Upcoming HWRF tutorial

January 23-25, 2018
College Park, MD – NCWCP

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/
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

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

Primary goal to facilitate R2O!

http://www.dtcenter.org/HurrWRF/developers
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
## DTC Visitor Program – Recent hurricane-related work

<table>
<thead>
<tr>
<th>Researcher(s)</th>
<th>Institution</th>
<th>Project Title</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev Niyogi &amp; Subashini Subramanian</td>
<td>Purdue Univ</td>
<td>Developing Landfall Capability in Idealized HWRF for Assessing the Impact of Land Surface on Tropical Cyclone Evolution</td>
<td>2016</td>
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<tr>
<td>Robert Fovell</td>
<td>SUNY-Albany</td>
<td>Impact of Planetary Boundary Layer Assumptions on HWRF Forecast Skill</td>
<td>2016</td>
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<tr>
<td>Shaowu Bao</td>
<td>Coastal Carolina Univ</td>
<td>Evaluation of the microphysics scheme in HWRF 2016 version with remote-sensing data</td>
<td>2016</td>
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<tr>
<td>Ting-Chi Wu</td>
<td>Colorado State Univ</td>
<td>Evaluation of the Newly Developed Observation Operators for Assimilating Satellite Cloud Precipitation Observations in GSI within HWRF system</td>
<td>2017</td>
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<tr>
<td>Michael Iacono &amp; John Henderson</td>
<td>AER</td>
<td>Testing Variations of Exponential-Random Cloud Overlap with RRTMG in HWRF</td>
<td>2017</td>
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<tr>
<td>Jun Zhang</td>
<td>U. Miami and HRD</td>
<td>Evaluating the Impact of Model Physics on HWRF Forecasts of Tropical Cyclone Rapid Intensification</td>
<td>2017</td>
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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!
GF: Track and intensity errors

Neutral to positive track forecasts improvements for GF scheme

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

Storms included:
- Gonzalo (2014)
- Edouard (2014)
- Matthew (2016)
GF: Rapid Intensification (RI)

“RI” is defined as 20 kt intensity increase in 24 hr

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Control
- POD = 0.35
- FAR = 0.317
- CSI = 0.301

GF
- POD = 0.475
- FAR = 0.406
- CSI = 0.358

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

*Funded by NOAA OAR
GF: precipitation

Time series of area-averaged accumulated precipitation

- Parent domain average
- Total precipitation
  - Explicit precipitation
  - Convective precipitation

GF produces higher total precipitation than control

Explicit precipitation higher than convective precipitation in GF

HWRF-GF: Majority of precipitation from explicit precipitation.

*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
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