The HWRF Development Process

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In collaboration with the HWRF Developers Committee
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Acknowledgments to DTC staff (M. Biswas, L. Carson, H. Shao, D. Stark, M. Hu, K. Fossell), EMC HWRF team, and HWRF users and developers
## Calendar: Operational Implementation

<table>
<thead>
<tr>
<th>Activities</th>
<th>Approximate dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of upgrades</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Final development of proposed upgrades</td>
<td>September - December</td>
</tr>
<tr>
<td>Test of individual proposed upgrades</td>
<td>December - March</td>
</tr>
<tr>
<td>Final test of combined proposed upgrades</td>
<td>March</td>
</tr>
<tr>
<td>Pre-implementation test at NCO</td>
<td>April</td>
</tr>
<tr>
<td>HWRF operational implementation (AL &amp; EP)</td>
<td>May</td>
</tr>
<tr>
<td>HWRF public release</td>
<td>August</td>
</tr>
</tbody>
</table>

WRF public release

GSI public release
HWRF distributed development

- **Examples** of HWRF activities currently going on
  - DTC: changes to compilation/configuration to support public
  - EMC: ensemble capability in python scripts
  - ESRL/OU/EMC: regional HWRF ensemble (EnKF) in DA
  - URI: alternate ocean initialization based on NCODA
  - UCLA: new eddy-mixing formulation in PBL scheme
  - DTC: updates to WRF from community (sync with v3.6.1)
  - EMC: improvements to vortex initialization
  - CIMMS: upgrades to UPP synthetic satellite images
  - etc.

Q: How do we move forward together with distributed developments?!?
A: With effective communication and a robust HWRF code management!
Communications

- HWRF Developers Committee
  - Membership: 2 from DTC, 2 from EMC
  - All developers welcome to meetings (Monday noon ET)
  - Forum for discussion, plans, and updates for development
  - Including testing, evaluation, and technical aspects
- Mailing list for exchanging information about development
  - hwrf_developers@rap.ucar.edu
  - All those with HWRF repository access are members
- Additional meetings scheduled as needed
  - Example: developers of HWRF regional ensemble with EnKF are meeting weekly now because of fast development phase
HWRF Developers Website

Extensive resources for developers: http://www.dtcenter.org/HurrWRF/developers
The centralized HWRF repository

- With one command the HWRF repo can be obtained
  
  ```
  svn co https://svn-dtc-hwrf.cgd.ucar.edu/trunk HWRF
  ```

- One more command for GSI and another command for HYCOM

- What is included
  - End-to-end python scripts
  - Tools for automation using the Rocoto Workflow Manager
  - Source for components
    1. WRF: atmospheric model
    2. WPS: global model pre-processor
    3. HWRF-utilities: libraries, utilities, and vortex initialization
    4. GSI: data assimilation
    5. MPIPOM-TC: ocean model
    6. HYCOM (optional)
    7. Coupler
    8. UPP: postprocessor
    9. GFDL Vortex Tracker
## Origin of components

<table>
<thead>
<tr>
<th>Component</th>
<th>SVN code repository</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRF</td>
<td><a href="https://svn-wrf-model.cgd.ucar.edu">https://svn-wrf-model.cgd.ucar.edu</a></td>
</tr>
<tr>
<td>WPS</td>
<td><a href="https://svn-wrf-wps.cgd.ucar.edu/">https://svn-wrf-wps.cgd.ucar.edu/</a></td>
</tr>
<tr>
<td>HWRF-utils</td>
<td><a href="https://svn-dtc-hwrf-utilities.cgd.ucar.edu">https://svn-dtc-hwrf-utilities.cgd.ucar.edu</a></td>
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<tr>
<td>Coupler</td>
<td><a href="https://svn-dtc-ncep-coupler.cgd.ucar.edu">https://svn-dtc-ncep-coupler.cgd.ucar.edu</a></td>
</tr>
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<td>MPIPOM-TC</td>
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<td>HYCOM</td>
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<tr>
<td>UPP</td>
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</tr>
<tr>
<td>Tracker</td>
<td><a href="https://svn-dtc-gfdl-vortextracker.cgd.ucar.edu">https://svn-dtc-gfdl-vortextracker.cgd.ucar.edu</a></td>
</tr>
<tr>
<td>GSI</td>
<td><a href="https://svnemc.ncep.noaa.gov/projects/gsi">https://svnemc.ncep.noaa.gov/projects/gsi</a></td>
</tr>
<tr>
<td></td>
<td><a href="https://gsi.fsl.noaa.gov/svn/comgsi">https://gsi.fsl.noaa.gov/svn/comgsi</a></td>
</tr>
</tbody>
</table>

Source code for components comes from their own repositories

In HWRF repo, these are *externals*, that is, *links* to other repos

Important because code is not being duplicated, helps avoid divergence
Example for WRF development

- WRF repository is hosted at NCAR, gets contributions for non-HWRF groups
- Branches/HWRF is used for centralizing all HWRF development
  - DTC updates it periodically from trunk (black arrows)
- Branches/projects are used by members of a project for development
  - Developers update them periodically from branches/HWRF
- When development is ready/tested, it gets committed to trunk
Access for developers

- Account on SVN repositories (takes 2 weeks)
  - EMC arranges access to EMC GSI repository
  - DTC arranges access to all other repositories
- HFIP PIs can apply for accounts/projects on NOAA’s Jet
  - Follow instructions at https://rdhpcs-s.noaa.gov/acctmgmt
  - Let Robert Gall (robert.gall@noaa.gov) know you’re applying
  - Contact Nysheema Lett (Nysheema.Lett@noaa.gov) for a NOAA email address if you don’t have one
- Jet Questions go to Jet Help Queue (rdhpcs.jet.help@noaa.gov)
- For help determining needed resources, email Christina or Ligia

Helpful Jet documentation: https://sites.google.com/a/noaa.gov/oar-jetdocs/
Great resource for svn: http://svnbook.red-bean.com/
What else is needed to run HWRF?

- Fix files (topography, microphysics tables etc.)
  - Available from DTC

- Input datasets (GFS, GDAS, GFS ensemble, obs etc.)
  - Available in NOAA HPSS but a challenge in other platforms

- Two running options:
  - **Simple, step by step**: use wrappers to submit python scripts
    - Instructions are available in [HWRF Users’ Guide v3.6a](http://rdhpcs.noaa.gov/rocoto/)
  - **Automated**: use *Rocoto Workflow Manager*
    - Documentation available here: [http://rdhpcs.noaa.gov/rocoto/](http://rdhpcs.noaa.gov/rocoto/)
    - Details for using with HWRF: [HWRF/README.rocoto](http://rdhpcs.noaa.gov/rocoto/)
    - Training will be provided by DTC in a few weeks
New Object-Oriented Python scripts

- Recently developed by EMC and DTC
  - At least 3x less lines than previous ksh scripts
  - Modular, small blocks make it easier to reuse code
  - No hardcodes, all configuration is abstracted
- Partially implemented in 2014 operational HWRF
- End-to-end now available in HWRF repo and public release

It is not necessary to know Python to run HWRF.
For introducing changes to HWRF workflow, familiarity with Python and HWRF is required.

Documentation in public wiki:
https://wiki.ucar.edu/display/DTCHWRF/DTC+HWRF+Scripts+Home
HWRF Public Release

Welcome to the users page on WRF for Hurricanes. The Weather Research and Forecasting (WRF) Model is designed to serve both operational forecasting and atmospheric research needs. It features two dynamic cores, multiple physical parameterizations, a variational data assimilation system, ability to couple with an ocean model, and a software architecture allowing for computational parallelism and system extensibility. WRF is suitable for a broad spectrum of applications, including tropical storms.

Two robust configurations of WRF for tropical storms are the NOAA operational model Hurricane WRF (HWRF) and the National Center for Atmospheric Research (NCAR) Advanced Research Hurricane WRF (AHW). In this website users can obtain codes, datasets, and information for running both HWRF and AHW.

The Developmental Testbed Center and the Mesoscale and Microscale Meteorology (MMM) Division of NCAR support the use of all components of AHW and HWRF to the community, including the WRF atmospheric model with its Preprocessing System (WPS), various vortex initialization procedures, the Princeton Ocean Model for Tropical Cyclones (MPHOM-TC), the Gridpoint Statistical Interpolation (GSI) three-dimensional ensemble-variational data assimilation system, the NOAA National Centers for Environmental Prediction (NCEP) coupler, the NOAA Geophysical Fluid Dynamics Laboratory (GFDL) Vortex Tracker, and various postprocessing and products utilities.

The effort to develop AHW has been a collaborative partnership, principally among NCAR, the Rosenstiel School at the University of Miami, and the Air Force Weather Agency (AFWA).

Current release: HWRF v3.6a (2014 operational)

Yearly releases, code downloads, datasets, documentation, helpdesk
800 registered users
Stable, tested code
Operational and research capabilities (idealized simulation, alternate physics)
Ideal for users, not developers

2014 Tutorials: College Park, MD and May in Taiwan (36 participants from 10 countries)
Extensive release documentation

Summary

- DTC facilitates access to HWRF code for users and developers
- Lots of resources, websites, and documentation
- It is very important that developers follow code management so new code becomes available for operational testing
- We are here to help! Please contact us if you would like more information about the development process