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Technical Implementation Notice 15-25  
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From:         Timothy McClung, Chief Operating Officer  
              NWS Office of Science and Technology Integration

Subject: Hurricane Weather and Research Forecast (HWRF) Model Changes:  
Effective June 9, 2015

Effective on or about Tuesday, June 9, 2015, beginning with the 1200 Coordinated Universal Time (UTC) run, the National Centers for Environmental Prediction (NCEP) will upgrade the HWRF-Princeton Ocean Model (POM) coupled system.

The scientific enhancements include the following:

- Increase the horizontal resolution of all three domains of the HWRF atmospheric model from 27km/9km/3km to 18km/6km/2km and upgrade the WRF Nonhydrostatic Mesoscale Model (NMM) core to community version V3.6.1.
- Upgrade and improve HWRF vortex initialization scheme and pre-processing system in response to increased resolution of both the Global Forecast System (GFS) and the HWRF models Improve HWRF Data Assimilation System through upgrade of one-way hybrid Ensemble Kalman Filter-Three Dimensional Variational (EnKF-3DVAR) Gridpoint Statistical Interpolation (GSI) to Environmental Modeling Center (EMC) GSI v5.0.0. Inner core data assimilation in the 6km and 3km domains will include all conventional data, NOAA P3 Tail Doppler Radar (TDR) data, and dropsonde data from NOAA P3, GIV, Air Force Hurricane Hunters and NOAA/National Aeronautics and Space Administration (NASA) Unmanned Aircraft Systems (Global Hawk) when available.
- Implement new GFS EnKF driven 40-member high-resolution (2km) HWRF ensembles for TDR data assimilation.
- Upgrade and tune HWRF physics to accommodate model resolution increase: replace Ferrier microphysics with Ferrier-Aligo scheme; replace Geophysical Fluid Dynamics Laboratory (GFDL) radiation with Rapid Radiative Transfer Model (RRTMG) and introduce sub-grid scale cloudiness parameterization in RRTMG; modify specification of drag coefficient for momentum (Cd) in the parameterization of surface physics and air-sea interactions; improve GFS Planetary Boundary Layer (PBL) with specification of wind-speed dependent vertical mixing; and replace GFDL

slab model to more advanced NOAA Land Surface Model.

- Add simulated brightness temperatures for new satellite sensors in all global basins as an additional operational forecast product.
- For the first time, expand operational HWRF capabilities by increasing the maximum number of model runs at any given time from five to seven and to run year-long, providing forecast guidance for all global tropical cyclones including in the Western North Pacific, Southern Pacific, North and South Indian Oceans. HWRF model will run uncoupled in all basins except North Atlantic and Eastern North Pacific.
- Implement operational HWRF workflow using complete Python based scripts for more efficient and unified system that runs in all basins.

The 2015 HWRF model configuration has been extensively tested individually and with a combination of all the upgrades listed above for a four-year period (2011-2014). The results showed further improvements in Atlantic Hurricane intensity forecasts by about 10 percent compared to the current operational HWRF.

#### Product Changes:

##### Filename Changes.

The file naming convention in the 2015 version of HWRF has changed to include domain and resolution information and to include a 3-digit forecast hour for all hours in the filename.

2014 HWRF		2015 HWRF
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*.hwrffprs_p.grb2f*	--->	*.hwrffprs.d1.0p20.fhhh.grb2
*.hwrffsat_p.grb2f*	--->	*.hwrffsat.d1.0p20.fhhh.grb2
*.hwrffprs_n.grb2f*	--->	*.hwrffprs.d3.0p02.fhhh.grb2
*.hwrffsat_n.grb2f*	--->	*.hwrffsat.d3.0p02.fhhh.grb2
*.hwrffprs_i.grb2f*	--->	*.hwrffprs.d2.0p06.fhhh.grb2
*.hwrffsat_i.grb2f*	--->	*.hwrffsat.d2.0p06.fhhh.grb2
*.hwrffprs_m.grb2f*	--->	*.hwrffprs.d23.0p02.fhhh.grb2
*.hwrffsat_m.grb2f*	--->	*.hwrffsat.d23.0p02.fhhh.grb2
*.hwrffprs_c.grb2f*	--->	*.hwrffprs.d123.0p20.fhhh.grb2
*.hwrffsat_c.grb2f*	--->	*.hwrffsat.d123.0p20.fhhh.grb2

##### New output files.

\*.hwrffprs.d123.0p25.fhhh.grb2: similar to \*.hwrffprs\_c.grb2f\* but in GFS global domain (NCEP GRID 193, 1440x721 lon/lat, 0.25 deg).

\*.hwrffsat.d123.0p25.fhhh.grb2: similar to \*.hwrffsat\_c.grb2f\* but in GFS global domain (NCEP GRID 193, 1440x721 lon/lat, 0.25 deg), where hwrffprs is pressure level output of atmospheric variables including surface variables, hwrffsat is synthetic satellite brightness temperatures, and hhh

is the 3-digit forecast hour (000, 003, 006, ... , 012, 015, 018, ... , 120, 123, 126).

All the output files will be in gridded binary version 2 (GRIB2) format; 0p02, 0p06, 0p20, and 0p25 indicate domain resolutions in lat/lon grid.

Additional products and their contents:

Additional simulated synthetic imagery from different satellite sensors will be included in \*hwrfsat\* output files in order to provide global coverage for all oceanic basins, including:

- GOES-13 for North Atlantic; GOES-15 for East, Central Pacific;
- SEVERI for South, East Atlantic, and Indian Ocean; MTSAT-2 for West, Central Pacific;
- DMSP/F17 SSMI/S for All basins; InSat-3D/Kalpana for Indian Ocean.

The content of non-satellite output files (\*hwrfrs\*) will remain the same as 2014 HWRP.

The HWRP GRIB2 products are disseminated via the NCEP File Transfer Protocol (FTP) server and are not available on NOAAPort or on the Advanced Weather Interactive Processing System (AWIPS).

More details about the HWRP-MPIPOM are available at:

[www.emc.ncep.noaa.gov/index.php?branch=HWRP](http://www.emc.ncep.noaa.gov/index.php?branch=HWRP)

NCEP encourages users to ensure their decoders are flexible and are able to adequately handle changes in content order, changes in the scaling factor component within the product definition section (PDS) of the GRIB files, and any volume changes which may be forthcoming. These elements may change with future NCEP model implementations. NCEP will make every attempt to alert users to these changes prior to any implementations.

For questions regarding these model changes, please contact:

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National Technical Implementation Notices are online at:

<https://www.weather.gov/notification/archive>

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