

NOUS41 KWBC 011549
PNSWSH

Technical Implementation Notice 14-32
National Weather Service Headquarters Washington DC
1140 AM EDT Fri Aug 1 2014

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From: Tim McClung
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Subject: Implementation the High-Resolution Rapid Refresh
(HRRR) Analysis and Forecast System: Effective
September 23, 2014

Effective Tuesday, September 23, 2014, beginning with the 1400 Coordinated Universal Time (UTC) run, the National Centers for Environmental Prediction (NCEP) will begin operationally running the High-Resolution Rapid Refresh (HRRR) forecast model.

Like the 13-km Rapid Refresh (RAP), the HRRR is an hourly analysis and forecast system, but with a much higher horizontal resolution of 3 km. Due to the significant computation resources needed for high resolution, the HRRR domain is only slightly bigger than CONUS.

General Framework:

Like the RAP, the HRRR will be run 24 times per day, once for each hour. Each run will be integrated to 15 forecast hours, and output will be available for each forecast hour. In addition, a small subset of parameters will be available with 15-minute output frequency throughout the entire 15-hour forecast.

The HRRR model is not cycled; there is no dependency on any previous HRRR runs. To initialize the HRRR, a 13-km RAP post-digital filter analysis valid for the previous hour is interpolated to the 3-km grid. Then radar reflectivity data at 15-minute intervals are assimilated during a 1-hour spin up, introducing temperature tendencies that help initialize ongoing precipitation. At the completion of the spin-up forecast, a 3-km Gridpoint Statistical Interpolation (GSI) variational and cloud/precipitation hydrometeor analysis is performed to provide the initial state prior to the 15-hour model integration. The previous hour's RAP provides lateral boundary conditions for the HRRR.

The 3-km horizontal resolution of the HRRR permits realistic simulation of deep convection. The HRRR therefore does not use any convective parameterization. The use of explicit convection permits more precise forecasts of convective-scale structure.

Like the RAP, the HRRR has 50 vertical computational layers. A sigma vertical coordinate is used, and the native grid is Lambert Conformal. The model is version 3.4.2 of the WRF-ARW and is similar to the WRF core used by the operational RAP, except that the HRRR does not use a convective parameterization, relying on explicit representation of convection, and has modifications to help reduce a nighttime cold bias that is most pronounced over snow cover.

Output:

All HRRR output will be in GRIB2 format. The HRRR will generate 3 km hourly output in three different files; each file covers the entire HRRR domain. Files with data on pressure levels (and a few extra parameters) will be named `hrrr.tXXz.wrfprsfHH.grib2`, where XX is the run initial time (00-23), and HH is the forecast hour duration (00-15).

Files with data on native levels (and a few extra parameters) will be named `hrrr.tXXz.wrfnatfHH.grib2`

Smaller files with a set of generally surface parameters (and others computed over various depths of the atmosphere) will be in files named `hrrr.tXXz.wrfsfcfHH.grib2`.

The HRRR will also generate 15-minute, sub-hourly data in files named `hrrr.tXXz.wrfsubhfHH.tm00.grib2` and will contain surface or column-integrated parameters. Each file will contain data for the forecast hour HH as well as 15, 30, and 45 minutes before the hour. For example, `hrrr.tXXz.wrfsubhf04.grib2` contains data valid at forecast hours 0315, 0330, 0345, and 0400. The file `hrrr.tXXz.wrfsubh00.tm00.grib2` contains only analysis data.

Station time-series BUFR data will also be available. The HRRR will use the same station list as used by the NAM and RAP, but only 1134 of the stations in that list fall within the HRRR domain. The BUFR files will contain only hourly data.

Note that the parameter labeled as "cloud base height" in the RAP is actually a cloud ceiling product. In the HRRR, the corresponding product is correctly labeled as "ceiling".

These data will be available on NOAAPORT, NOMADS and the NCEP FTP server.

NOAAPORT Data:

This output was first described in previously issued TIN 14-28.

The grid that will be provided over the SBN and NOAAPORT is the 2.5 km NDFD grid #184. This is not the expanded 2.5 km grid #187. The data will be provided for the analysis and each forecast hour out to the end of the model integration at hour 15. The sub-hourly (15 minute) HRRR output will not be available over the SBN or NOAAPORT with this initial release. The per cycle data volume will be approximately 1.9 GB.

The WMO Heading for these products will be as follows:

T1: DATA FORMAT OF GRIB2 /Y/
T2: PARAMETER CODE /ONE OF ADEFHKMNOPQRSTUVWXYZ/
A1: GRID CODE /C/
A2: FORECAST TIME /ONE OF ABCDEFGHIJKLMZ/
II: LAYER OR LEVEL /ONE OF 00 01 50 70 73 74 85 86 89 92 98
99/
CCCC: KWBY

A complete explanation of the WMO headers for all of the products is available at:

http://www.nco.ncep.noaa.gov/pmb/changes/hrrr_wmo_headers.shtml

Information on WMO Headers and NECP GRIB messages is online at:

<http://www.nco.ncep.noaa.gov/pmb/docs/on388/appendixa.html>

NOMADS Data:

Datasets will be available on the NOAA Operational Model Archive and Distribution System (NOMADS) via the OpenDAP and GRIB filter interfaces.

Product Delivery Times:

Each run commences at 24 minutes past the hour. After the pre-forecast steps, the forecast hour 00 files are available at approximately 47 minutes past the hour. The remaining files will arrive sequentially with the final 15-hour files available approximately 82 minutes past the synoptic time of the start of the run.

Canceled Runs:

The HRRR is allocated a finite amount of NCEP computing resources. The model integration requires too many resources to allow the forecast from the previous run to overlap either the 1-hour spin-up or 15-hour free forecast of the current hour. In the rare event that the previous hour's run overlaps with the 1-hr spin-up forecast of the current hour, the current hour's HRRR run will be canceled.

Data Location:

A consistent parallel feed of data is available on the NCEP server via the following URLs:

<http://www.ftp.ncep.noaa.gov/data/nccf/nonoperational/com/hrrr/pa>
ra

<ftp://ftp.ncep.noaa.gov/pub/data/nccf/nonoperational/com/hrrr/pa>
a

The BUFR files with data for a single station can be found in the bufr.tXXz subdirectory.

For more general information about the HRRR, please see:

<http://rapidrefresh.noaa.gov/hrrr>

For questions regarding this implementation, please contact:

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NWS National Technical Implementation Notices are online at:

<http://www.nws.noaa.gov/os/notif.htm>

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