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Technical Implementation Notice 14-32 Amended
National Weather Service Headquarters Washington DC
750 AM EDT Mon Sep 8 2014

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From: Tim McClung
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 Office of Science and Technology

Subject: Amended: Implementation of the High-Resolution Rapid Refresh
(HRRR) Analysis and Forecast System: Effective September 30, 2014

Amended to change effective date to September 30, 2014; to clarify certain
parameter descriptions; and to mention the gradual turn on of data to
NOAAPort.

Effective Tuesday, September 30, 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 three km.
Due to the significant computation resources needed for high resolution,
the HRRR domain is only slightly bigger than the contiguous U.S. (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 three 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 three
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 three 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 Weather Research and Forecasting (WRF)-Advanced Research WRF (ARW) and is similar to the WRF core used by the operational Rapid Refresh (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 gridded binary version two (GRIB2) format. The HRRR will generate three 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 Binary Universal Form for the Representation of meteorological data (BUFR) data will also be available. The HRRR will use the same station list as used by the NAM and RAP, but only 1,159 of the stations in that list fall within the HRRR domain. The BUFR files will contain only hourly data.

Please note the following information related to some of the available parameters:

- 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". The units are correctly labeled as geopotential height in meters, as the values represent the ceiling height above sea level.

- The parameter labeled as lightning is labeled as being a non-dimensional yes/no lightning indicator. The field actually represents an hourly maximum predicted flash rate with units of flashes per square km per 5-minute period.

- The wind shear u and v components, computed over 0-1 km and 0-6 km depths, are incorrectly labeled as 1/seconds. The correct units are meters/second.

These data will be available on NOAAPort, NOAA Operational Model Archive and Distribution System (NOMADS) and the NCEP FTP server.

NOAAPort Data:

This output was first described in previously issued [Technical Implementation Notice \(TIN\) 14-28](#).

The grid that will be provided over the Satellite Broadcast Network (SBN) and NOAAPort is the 2.5 km National Digital Forecast Database (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 World Meteorological Organization (WMO) Headings for these products will be as follows:

T1: Data Format of GRIB2 /Y/
T2: Parameters 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

Note: NOAAPort data dissemination will begin October 1, 2014 and parameters will be turned on gradually until all parameters are available by the end of October 2, 2014.

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 NCEP GRIB messages is online at:

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

NOAA Operational Model Archive and Distribution System (NOMADS) Data: Datasets will be available on 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/para>
<ftp://ftp.ncep.noaa.gov/pub/data/nccf/nonoperational/com/hrrr/para>

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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National Technical Implementation Notices are online at:

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

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