

January 11, 2011

MEMORANDUM FOR: NCEP Model Implementation Scientific Review Team

FROM: Chris Caruso Magee, Team Lead, Production Control
Production Management Branch, NCEP Central Operations

SUBJECT: Proposed Implementation of Rapid Refresh V1.0.0

The Environmental Modeling Center (EMC) has proposed implementation of the Rapid Refresh model (RAP) V1.0.0. This model runs hourly and will replace the Rapid Update Cycle model (RUC) in the NCEP Production Model Suite.

The RAP model includes :

- Change from RUC 3dvar analysis to GSI analysis
 - Uses regional GSI analysis, similar in configuration to that used for NAM
 - Uses prepBUFR files similar to those already produced for the RUC but now with additional observations and over the larger North American domain.
 - Option added for elevation correction to surface observations to match background terrain elevation
 - Option added for cloud/hydrometeor assimilation to modify background 3-d hydrometeor variables (cloud water, ice, rain (2-moment), snow, graupel, ice number concentration) using GOES cloud-top data, METAR ceiling/visibility/current weather data, and radar reflectivity. This technique closely follows the technique previously used in RUC analysis. All observation types are already included in the RUC-RAP prepBUFR files.
- Change from RUC model to WRF-ARW model
 - Uses WRF-ARW with GSD-modifications already included in WRF or will be included in WRFv3.2.1.
 - Uses similar parameterizations to those used for RUC for cloud microphysics (Thompson mixed-phase bulk microphysics) and convection (Grell-3D) to meet aviation requirements (improved icing forecasts) and severe weather requirements (relatively small modification to convective environment, from Storm Prediction Center).
 - Use digital filter initialization for quiet 1-h forecasts and radar reflectivity assimilation, as used within RUC forecast model.
 - Uses RUC land-surface model including 6 levels and 2 snow layers, as used within RUC forecast model.
 - All options used in the RAP version of the WRF model have been made to the WRF repository.
- Change from RUC post-processing to NCEP unified post processing
 - Options added for use of ARW C-grid input, and for 5-species hydrometeor fields for ceiling, visibility, precipitation type, and reflectivity.
 - A bug fix for precipitation-type resulting in excessive mixed snow-rain in the RUC – fixed in the RAP.
- Domain changed from RUC domain covering from ~55 deg N (southern Northwest Territory, only southern tip of southeast Alaska to 15 deg N (southern Mexico) to a North American domain including all of Alaska including all of the Aleutian Islands (requirement from NWS), Puerto Rico, and Caribbean Sea (requirement from AWC).
- The Rapid Refresh domain uses a rotated-latitude-longitude grid, similar to that used for the NAM.
- Horizontal resolution will continue to be about 13km for the Rapid Refresh, same as for the RUC.

- A partial cycling design, similar to that implemented for the NAM in December 2008, is being used for the Rapid Refresh. Twice daily (planned for 03Z and 09Z), a 6-h spin-up cycle is started with GFS initial conditions and a 1-h forecast followed by a RAP analysis and 1-h forecast made at each of the next 5 hours. The new initial condition from this partial cycle is introduced to the full RAP cycle at 09Z and 21Z.

Output file changes include:

- All fields produced by the RUC will also be produced by the RAP.
- The output grids from the RAP include the following:
 - 13 km grids covering current RUC domain w/ data on native levels (awp130bgrb)*
 - 20 km grids covering current RUC domain w/ data on native levels (awp252bgrb)*
 - 13 km grids covering current RUC domain w/ data on pressure levels (awp130pgrb)*
 - 20 km grids covering current RUC domain w/ data on pressure levels (awp252pgrb)
 - 40 km grids covering current RUC domain w/ data on pressure levels (awp236pgrb)
 - 11 km grids covering Alaska (awp242)
 - 32 km grids covering the full domain (awip32)
 - 16 km grids covering Puerto Rico (awp200)
- While the entire RAP domain will be written out internally to the AWIPS grid #83, these grids will not be distributed externally, following the treatment of the NAM for which the full domain grids are also not distributed.
- Hourly BUFR sounding output will be continued, as for the current RUC. Many more stations are available due to the larger Rapid Refresh domain.
- Hourly output will be made from 0-18h, just as for the RUC (including the March 2010 upgrade for extension to 18h duration).
- The RUC model identifier will be retained in PDS section of Rapid Refresh GRIB files (per discussion on Thursday 10 Dec 2009 by EMC, NCO, and GSD representatives).

Near real time parallel data:

Beginning Thursday, January 12, 2012 and starting with the 1200Z cycle, a consistent parallel feed of data will be available at:

HTTP:

<http://www.ftp.ncep.noaa.gov/data/nccf/com/rap/para/rap.YYYYMMDD>

FTP:

<ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/rap/para/rap.YYYYMMDD>

where YYYYMMDD is the year, month, day.

Sample output files comparing the RAP to the operational RUC are available at:

<http://www.emc.ncep.noaa.gov/mmb/gmanikin/rap/para/>

Details about the RAP model are online at:

<http://rapidrefresh.noaa.gov>

The TIN for the RAP model may be viewed at:

<http://www.nws.noaa.gov/os/notification/tin11-53ructorap.htm>

Request for Evaluation

Please complete the attached “Intent to Participate” form and return to Chris.Caruso.Magee@noaa.gov no later than January 17, 2012. NCO requires an intent form be filed by all NCEP Service Centers. AWC and SPC were listed in the RAP project charter as being the Service Centers primarily responsible for this evaluation. The NWS Regions and the FAA are also recommended participants. HPC, OPC, and NHC are optional, as are any other WFOs, government agencies, or private companies not listed above. For the NCEP Service Centers, if, in your estimation the nature of the proposed change would have little or no impact on the forecast process at your Service Center, simply indicate that you do not intend to participate in the subjective evaluation and return the form.

The 30-day evaluation period will start at 12Z on Thursday, January 12, 2012 and run through February 11, 2012. Participants need to complete the attached “Model Implementation Subjective Evaluation Report” form and return to Chris.Caruso.Magee@noaa.gov no later than February 15, 2012. Please indicate the overall performance of the product, with any additional comments on specific cases with noteworthy positive or negative performance. Please note that NCO requires evaluators to specifically address the benefits stated in the attached form as to whether those benefits were observed or not. Any feedback you wish to provide during the evaluation period should be emailed to Chris.Caruso.Magee@noaa.gov .

A final coordination teleconference will be scheduled to review the objective evaluation and address any outstanding issues. Based on the outcome of that teleconference EMC and NCO will prepare a recommendation for Dr. Uccellini (NCEP Director). This teleconference has not yet been scheduled.

Points of Contact

Chris.Caruso.Magee@noaa.gov (NCO)

Geoffrey.Manikin@noaa.gov (EMC)

Stan.Benjamin@noaa.gov (GSD)

**Intent To Participate
Model Implementation Subjective Evaluation**

Scientific Review Team Member: _____

Team Member E-mail: _____

Region, Service Center Company Representing: _____

**(Govt Only) Authorizing Official or
Service Center Director:** _____

Intent to Participate:

____ Will Participate in the Evaluation

____ Will Not Participate in the Evaluation

Model Implementation Subjective Evaluation Report

Scientific Review Team Member: _____

Region, Service Center or Company Representing: _____

Proposed Change: Rapid Refresh Model

Model Developer: Geoffrey Manikin (EMC) and Stan Benjamin (GSD)

Real-Time Parallel Runs:

General comments: _____

Direct comparison of operational and proposed change:

Evaluation of expected benefits:

Do you observe the following and are they beneficial to you?

1. Are wind and temperature forecasts at all levels improved when compared to the RUC?

2. Are ceiling and precipitation forecasts improved when compared to the RUC?

Recommendation:

Implement as proposed ____

Reevaluate after changes ____

Do not implement ____