MDE Product Development Team
July Monthly Report – FY 2011
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(Compiled and edited by S. Benjamin and B. Johnson)

Executive Summary

Task 11.5.1: Infrastructure support related to operational running of the RUC and NAM operational modeling systems.

- No problems with operational RUC this month. Final testing toward NAM upgrade now planned for late Sept 2011. Note: Rapid Refresh implementation will be about ~2+ months after the NAM upgrade, so NAM implementation delays result in RR delays, as well.

Task 11.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

- *The RR run at ESRL/GSD and the real-time parallel RR at EMC continue to show improvement for the July period over RUC for precipitation, reflectivity, wind, temperature, and height, RH about even.*
- *ftp access continues for these grids from RR running at NCEP-EMC, evaluation of RR-NCEP-EMC continues.*
- *Planned date for RR implementation at NCEP – **mid Nov 2011**, due to additional delays now anticipated with the NAM implementation now scheduled for late September.*

Task 11.5.5: Develop, test, and implement 3DVARs for RR and NAM

- Successful presentation on the upcoming RR changes to NCEP/EMC Change Control Board on July 25, 2011.
- Boundary layer profiler data already used in GSD primary and development RR now includes profilers into the upper Midwest and Texas relocated as part of a NOAA/Dept. of Energy wind energy project.
- Tests of GSI with a reduced vertical correlation length-scale show small improvement in the forecast skill for the RR dev cycle.
- Code written to compute Jacobians by channel for satellite radiance data being assimilated into the RR through the GSI. Results indicate issues related to low model top affecting some channels.

Task 11.5.15: Develop methods for improved cloud/hydrometeor analysis in RR

- Intercomparisons of GOES-related cloud building between RUC-NCEP, RUC-backup-ESRL, and RUC-dev-ESRL continue toward improved initial cloud field in Rapid Refresh in RR2 in 2012. The ESRL RUC-dev includes a new version of GOES-based cloud building designed to avoid moist bias problems found in the previous method in RUC and RR tests.
- **Code developed with RUC to specify the radar-DFI latent heating as a function of stability, now running in development RUC.**

Task 11.5.24: Development/testing of HRRR

- Real-time HRRR runs continue to support summer CoSPA experiment with good overall reliability in real-time HRRR forecast production.
- HRRR time-step adjustment made (eliminates occasional instances where HRRR run does not complete on time, no forecast skill impact).
- HRRR-dev switched to run every other hour instead of every third hour. Continuing use of single-case runs and HRRR-dev (running every other hour) to evaluate impacts from changes to RR and HRRR system.
- Six presentations given by group members at the AMS ARAM conference and briefings on RR and HRRR given for Western, Central, and Eastern NWS regions (Southern Region scheduled for next week).

Task 11.5.1 Infrastructure Support Related to Operational running of the non-WRF Rapid Update Cycle System in NCEP Operations

ESRL/GSD
Operational RUC at NCEP has continued to run at 100% reliability since coordinate fix on 17 Nov 2010.

The ESRL development RUC was modified in early August with a change to modulate latent heating from observed radar reflectivity as a function of local thermodynamic stability. The development RUC continues to test re-introducing GOES cloud data over the lowest 1km AGL to improve cloud forecasts without causing an increase in RH error, as found in December 2010 with full troposphere use of GOES-based cloud building. (More under 5.15.)

ESRL continues to monitor operational RUC (and two ESRL versions of RUC with differences cloud assimilation). This evaluation is now especially important since it allows a benchmark for the parallel Rapid Refresh comparisons. Performance of the operational RUC is monitored at both ESRL and NCEP verification websites (see **http://ruc.noaa.gov/stats**). Inter-comparison of verification between the NCEP and ESRL versions of the RUC continue to be monitored by ESRL, also at **http://ruc.noaa.gov/stats**.

NCEP
The NRL-based aircraft quality control (QC) code package is expected to implement in late FY11. The new aircraft QC code includes quality controlled high-vertical-resolution aircraft profile data near airports, with the nearest METAR report providing the surface level. Earlier memory issues in the code have been corrected and the code has also been revised to run five times faster than previously. The final step is to update it to properly handle TAMDAR reports. Several erroneous AIREP aircraft waypoint locations were found and corrected, and this change was implemented on 5 July. The Florida and Georgia mesonet providers remained down. The Kansas DOT mesonet provider has been down since late June. (Dennis Keyser)

No infrastructure support was needed by the operational RUC in July. (Geoff Manikin)

Task 11.5.17 Infrastructure support for operational running of Rapid Refresh, North American Mesoscale, and HiResWindow (and future HRRR) at NCEP, including support for community WRF model

ESRL/GSD
Progress in Rapid Refresh development toward operational implementation at NCEP, now planned for Nov 2011, can be found under the Task 5.4 report.

NCEP
The parallel test of the NEMS/NMMB model in the EMC NAM parallel system continues on the CCS. The run consists of a 12-km parent domain (same as current NAM) with all model and analysis changes that will be implemented into operations. NCO is running a pre-implementation parallel. Inside the 12 km parent domain in the NCO parallel are four high-resolution nested domains (4 km CONUS, 6 km Alaska, 3 km Hawaii, 3 km Puerto Rico) that run from 0-60 h, and a placeable fire weather nest within either the CONUS or Alaska nest at 1.33 km or 1.5 km resolution that runs from 0-36 hrs. The most recent science change to the NAM parallel was to modify the GSI analysis to exclude any mesonet surface pressure observations where surface pressure was set to or computed based on standard atmosphere. This change significantly improved the first guess fit of mesonet surface pressure. (Eric Rogers)

During July the NCO halted the 30-day evaluation of the NAM parallel to incorporate final changes to use the new NAM nests to create Downscaled Numerical Guidance products. After these changes were in place and verified to be sound by EMC programmers, the 30 day evaluation will be restarted on or about 1 August. The anticipated implementation date for this package is around mid-September 2011. (Eric Rogers)

On 27 July, the NCEP-generated experimental Rapid Refresh (RR) PrepBUFR files, copied to a private ESRL directory on the NCEP ftpprd server, were modified to run like production except the WFIP-relocatable boundary layer profilers, processed at NCEP since mid-July, won't be rejected so the ESRL RR can assimilate these data. The NCEP production RUC/RR (and NAM) PrepBUFR files reject these data and they will not be assimilated in any NCEP-based runs. RR dumps of Level 2 and expanded (time-window) Level 2.5/3 88D radial wind data, and GOES single-pixel cloud data from NASA/Langley (covering Alaska) are also copied to a public ftp directory. These, and early parallel dumps for 0000 and 1200 UTC, are being tested in ESRL's experimental RR runs and the EMC RR parallel. New VAD winds, RARS radiances (RARS parallel dumps) and "tcvitals" records for tropical cyclones will be tested next in NCEP parallel. Adding a 5th hourly ingest run for Level 2 88D radar data is under discussion with NCO. (Dennis Keyser)

Most of the issues in Task 11.5.1 also affect the NAM. GOES-13 radiances are monitored but will not be used until the next NAM update. NOAA-18 has on-going gyro issues that could lead to unusable products. There were several outages of Langley cloud data in July: 2 hours on the 7th, 8 hours on the 8th, 6 hours on the 11th, 7 hours on the 13th and 6 hours on the 19th, all due to disk space issues. A 22-hour ASCAT outage occurred on 5-6 July, and a 3-hour outage occurred on 23-24 July, reason unknown. The following data types are monitored by the NAM-GSI: RASS virtual temperature profiles (NPN and MAP), MAP wind profiles below 400 mb, Mesonet mass data, AIRS AMSU-A radiances, NOAA-19 HIRS-4/AMSU-A/MHS radiances, METOP IASI radiances, ASCAT and WindSAT winds, and MDCRS moisture data. All but RASS of these are being tested in Eric Rogers' NAM parallel. Ten meter wind speed from JASON-1 and -2 altimetry data will soon be monitored. NAM/NDAS PrepBUFR parallel files use the new NRL-based aircraft QC code. RTMA PrepBUFR files are being generated in parallel with 50 km ASCAT and WindSat scatterometer wind data (both non-superob) and these now include surface land, marine and Mesonet reports with missing pressure. These missing pressure surface reports are now being tested in the RTMA and will eventually be tested in the NAM/NDAS. Production NAM/NDAS dumps of METOP IASI radiances, GPS-RO data and SBUV-2 data are being created and dumps of RARS 1c radiances are being created in parallel. Use of the GFS tropical cyclone relocation procedure (for medium to strong tropical cyclones) to update the global first guess fields input to NDAS is also being tested in parallel. (Dennis Keyser)

The WAFS code for calculating mountain-blocking/gravity-wave stress from GFS master file was finished and ready for tuning or rescaling versus the UKMet. In the future, CIP will be extended to the globe. (Yali Mao)

NCAR/MMM

CURRENT EFFORTS:

NCAR hosted the WRF tutorial, July 11–22. MMM personnel conducted the tutorial on the basic WRF system during the first week. 80 people attended. The second week covered WRFDA and WRF-Chem. NOAA/ESRL/GSD scientists led the WRF-chem part of the tutorial

Jimy Dudhia (NCAR/MMM) is hosting visitor Hailey Shin (Yonsei Univ., Korea) to work on a new version of the YSU PBL scheme. This is a hybrid TKE scheme that employs the approach of the YSU scheme for unstable regimes and the approach of the QNSE PBL scheme for stable regimes. The development is in its early stages.

Dudhia continue to host visitors Pedro Jimenez (CIEMAT, Spain) and Jorge Navarro (CIEMAT, Spain) to test WRF LES capabilities in complex terrain. This is focussing on hill-top flow modification and boundary-layer rolls for better simulation of these small-scale conditions.

Dudhia obtained the Simple SiB (SSiB) land-surface model code from Yongkang Xue (UCLA). The code has been compiled and will be modified over the next few months. This scheme is being considered for possible inclusion in next WRF release (Spring 2012).

PLANNED EFFORTS: The development and implementation of new physics for WRF will continue through FY11Q4.

UPDATES TO SCHEDULE: NONE

GSD

CURRENT EFFORTS:

GSD continues its work on improved versions of the MYNN boundary layer scheme (Joe Olson) and the RUC land-surface model (Tanya Smirnova) . Changes will be submitted to be part of the next WRF update (to benefit non-RR WRF users), and will also be candidates for the Rapid Refresh 2. More under Task 5.8

Task 11.5.4 Develop, test, implement, and improve the Rapid Refresh

ESRL/GSD
NCEP/EMC's Configuration Control Board met Monday 25 July and approved moving forward on the RR implementation with the small caveat of needing to see more quantitative precipitation forecast verification from the RR parallel cycle at NCEP (provided on 15 Aug). The RR operational implementation is now scheduled for mid November, having been pushed back by additional delays in the NAM implementation. The RR parallel at EMC and the RR primary cycle at GSD continue to run stably, without crashes due to code or scripting problems.

With the code set for the initial RR implementation, attention in July was toward test and evaluation of analysis and model changes being considered for the 2012 RR upgrade ("RR2"). Because July and August are months that are typically dominated by convection and experience only weak synoptic weather systems to constrain the locations of this convection, these months are very challenging for any model. We determined, therefore, to concentrate our testing during July and August on enhancements to the RR that have promise toward improvement of convection, both for the parameterized convection in the RR and the explicit convection in the HRRR initialized from the RR. Motivated in part by slight high dew point and precipitation bias in the RR over the eastern CONUS and by some over forecasting of convection by the HRRR in the same area, we completed, continued or started testing in the RRdev the following.

- Addition of PBL-based pseudo residuals as described in the FY11Q3 report under Task 4. This testing was concluded early in July and the impacts of addition of the pseudo residuals were found to be positive overall particularly for convection forecasts from the HRRR. The FAA Aviation Weather Office team approved moving this change over to the RRprimary (from which the hourly HRRR is initialized) on 6 July, and the change was made effective 00z 7 July.
- Testing of reduction of the vertical correlation scale of background error in the GSI (see Task 5 for more details). This testing has continued from 15 July through the current time and has shown improvements in wind and humidity forecasts at most vertical levels.
- Reduction of soil moisture in the RR through "soil surgery" performed by Tanya Smirnova to replace the soil moisture and temperature in the RRdev cycle by the equivalent fields in the backup RUC cycle at GSD. (This replacement, of course, can only be done over that portion of the RR domain covered by the RUC domain.) This has resulted in reduction of the high dew point bias, but is only a temporary fix. This further motivates another RUC enhancement that remains to be implemented in the RR (next bullet).
- Nudging of soil temperature and moisture based on the sign of the observation innovations of 2-m temperature and moisture under certain conditions. The motivation here is the well-known tendency for daytime 2-m temperature and dew point under clear-sky conditions to be predicted too cool and moist (warm and dry) for too moist (dry) soil conditions. This soil temperature and moisture nudging has been done in the RUC since about 2003 (with subsequent modifications) to the benefit to the RUC 2-m temperature and dew point, particularly in summer. Ming Hu has started work toward introducing this enhancement into the RR and its version of GSI.

Physics testing underway for RR2 is covered under Task 8.

Several talks were prepared for the American Meteorological Society's 15th Conference on Aviation, Range and Aerospace Meteorology at Los Angeles, 1-4 August (Talks will be posted by the AMS at a later date):

5.4 Evaluation of the National Centers for Environmental Prediction (NCEP) implementation version of the Rapid Refresh and its skill in providing short-term guidance for aviation hazards.
Stephen S. Weygandt, M. Hu, T.G. Smirnova, C.R. Alexander, S. G. Benjamin, G. S. Manikin, J. M. Brown, H. Lin, J. B. Olson, P. Hofmann.

5.5 Improvement and testing of WRF physics options for application to Rapid Refresh and High Resolution Rapid Refresh.
John M. Brown, T. G. Smirnova, J. B. Olson, G. A. Grell, D. C. Dowell, S. Benjamin, C. R. Alexander, E. P. James, S. S. Weygandt, M. Hu, P. Hofmann, and H. Lin.

7.3 Radar-data assimilation into the Rapid Refresh (RR) and High Resolution Rapid Refresh (HRRR) models toward improved convective guidance for aviation.
David Dowell, C.R. Alexander, M. Hu, S. S. Weygandt, S. G. Benjamin, T. G. Smirnova, E. P. James, P. Hofmann, H. Lin, and J. M. Brown.

11.1 Beyond the 2011 Rapid Refresh: hourly updated numerical weather prediction guidance from NOAA for aviation from 2012-2020.
Stan Benjamin, S. S. Weygandt, J. M. Brown, and G. DiMego.

A change log on the ESRL primary and development RR 1h cycles is maintained at **http://ruc.noaa.gov/internal/RR_runs/RR_1h_info.txt**.

NCEP
The Rapid Refresh (RR) has been running stably in an EMC parallel environment since December and the code has been essentially frozen since April. Statistical evaluation shows that the Rapid Refresh is now comparable to the RUC for most parameters, with significant improvement shown for upper level wind and height fields. Once they have been made compatible with NCEP operations, the RR codes and scripts will be handed off to NCO in September and RR implementation is currently scheduled for November. (Geoff Manikin)

See extensive observation processing work by EMC's Dennis Keyser in support of RR under Tasks 11.5.1 and 11.5.17

Subtasks

11.5.4.1 Ongoing (GSD, NCEP)
Ongoing evaluation of performance of real-time and retrospective runs of RR system for SAVs, AHPs

11.5.4.2 1 Nov 2010 (GSD)

Solicit and respond to input from RR forecast users (e.g., FAA, AWC, SPC, NWS, other users), as well as AWRP RTs, on performance of Rapid Refresh.

ESRL continues to hold RR-status telecons for FAA and AWC colleagues every 4-5 weeks (last on 8/11/2011). All feedback from the other PDTs has been positive. This evaluation has been made possible by the availability of pgrb, sgrb and bgrb files for the RR in GRIB1 from the EMC test RR cycle output.

During July and early August, ESRL held telcons with field forecasters from the Western, Central and Eastern Regions of the National Weather Service. These had a dual purpose: briefing on both the RR and HRRR (a

limited collection of hourly surface grids from the latter are becoming generally available to field offices), and to obtain feedback on model performance from forecasters. A similar briefing will be given to NWS Southern Region forecasters on 16 August. Interaction with field forecasters is extremely valuable toward identifying and addressing performance weaknesses.

The Storm Prediction Center has begun to evaluate BUFR sounding output from the EMC RR test cycle (from both analyses and forecasts) as compared to the RUC. The SPC forecasters use both analysis and forecast soundings extensively as part of their decision process on whether developing weather conditions warrant issuing severe thunderstorm and tornado watches.

Task 11.5.5 Develop, test, and implement improvements to the operational data assimilation supporting Rapid Refresh and North American Mesoscale runs

ESRL/GSD
Stan Benjamin gave a successful presentation on the upcoming RR implementation to the NCEP/EMC Change Control Board on July 25, 2011. Bill Lapenta, NCEP/EMC Acting Director, requested some additional precipitation verification (of forecasts from the EMC RR compared to the operational RUC) to complement the verification of the GSD RR. This work was completed and successfully submitted to EMC on 8/15.

Testing of a change to the GSI to allow a reduced length scale for the background vertical correlation length-scale. The change was first tested in single case runs, and then implemented in the RR-dev on 16 July. Results have indicated some improvement for upper-level verification. We are also monitoring the impact on the HRRR-dev forecast from this change (no clear-cut signal). In addition, Patrick Hofmann has been examining the fit to the raobs in the RR GSI. By modifying the code from Wan-Shu Wu (that increases the vertical resolution of the raob data) to include all model levels, and decreasing the observation error and the length-scale of the background vertical correlation, Patrick was able to obtain a much better fit to the observed raobs. Impacts on the subsequent forecast are being examined.

Haidao Lin is continuing his satellite radiance data assimilation work. Based on suggestions he received from the JCSDA Workshop in May, he has coded up routines to compute Jacobians for the assimilated radiance channels (both for standard atmosphere and for Rapid Refresh background model fields). His results help to quantify the possible negative impacts from assimilating into the Rapid Refresh model (which has a model pressure top of 10 hPa) specific channels with weight functions that peak high in the atmosphere. Haidao is also conducting experiments to assimilate AIRS SFOV temperature and moisture retrievals.

Both GSD Rapid Refresh versions (primary and developmental) began ingesting WFIP boundary layer profiler data in late July (no code change involved). After some initial work by Ming Hu to directly ingest files created locally, Dennis Keyser created special files containing the observations and began sending them out. During the month, Ming Hu also worked with Geoff Manikin to resolve s number of minor script issues with the EMC parallel RR. Ming Hu and Joe Olson also completed work (converting to prepbufr etc.) to get nacelle (wind farm turbine) data into the GSD RR cycles for monitoring only. Ming Hu is also coding up modifications to perform soil temperature and moisture nudging in upper soil layers in the Rapid Refresh/GSI. This will be tested at GSD as a likely RR version 2 enhancement.

CAPS
Report on initial test results of implementing the EnSRF package for RR application.

After further tuning the inflation and the covariance localization for the EnKF, verification of the 3h forecast against the radiosonde observation shows that the EnKF started to show better result than the GSI except at upper levels around 200 hPa (Fig 1, blue line for GSI and magenta line for the EnKF). The following describes series of tuning conducted.

While experiments of last month were focused on tuning horizontal correlation length scale, experiments of this month were made to adjust the vertical influence radius of the vertical covariance localization. In these

experiments, the DFL procedure from the last quarter's experiments was adopted. In earlier experiment (red line in Fig 1), vertical cutoff radius of 2.0 for the surface pressure observation and 1.2 for other observations were used. In the new experiment (Magenta line in Fig. 1), the vertical influence radius of the vertical covariance localization was reduced. As expected, the decrease of vertical influence radius increased the spread (grey lines in Fig.1). Encouragingly, the corresponding 3-hour forecast errors of the EnKF were reduced.

Several additional attempts to tune the EnKF were also made during this period, including reducing the vertical cutoff radius of the fix inflation, and the magnitude and scale of the initial perturbation at the beginning of the data assimilation cycles as well as those of the boundary perturbation through the WRF "randomcv" step. No further improvements were found by far for these trials.

To further improve the inflation factor in the EnKF, several attempts are ongoing. We are working on adding a new option of the inflation factor based on the maximum-likelihood inflation method of Wang and Bishop (2003). We are also working on using different values of the fixed inflation over the ocean and over the land where the former has much less observations than the later. The results will be reported in the next report.

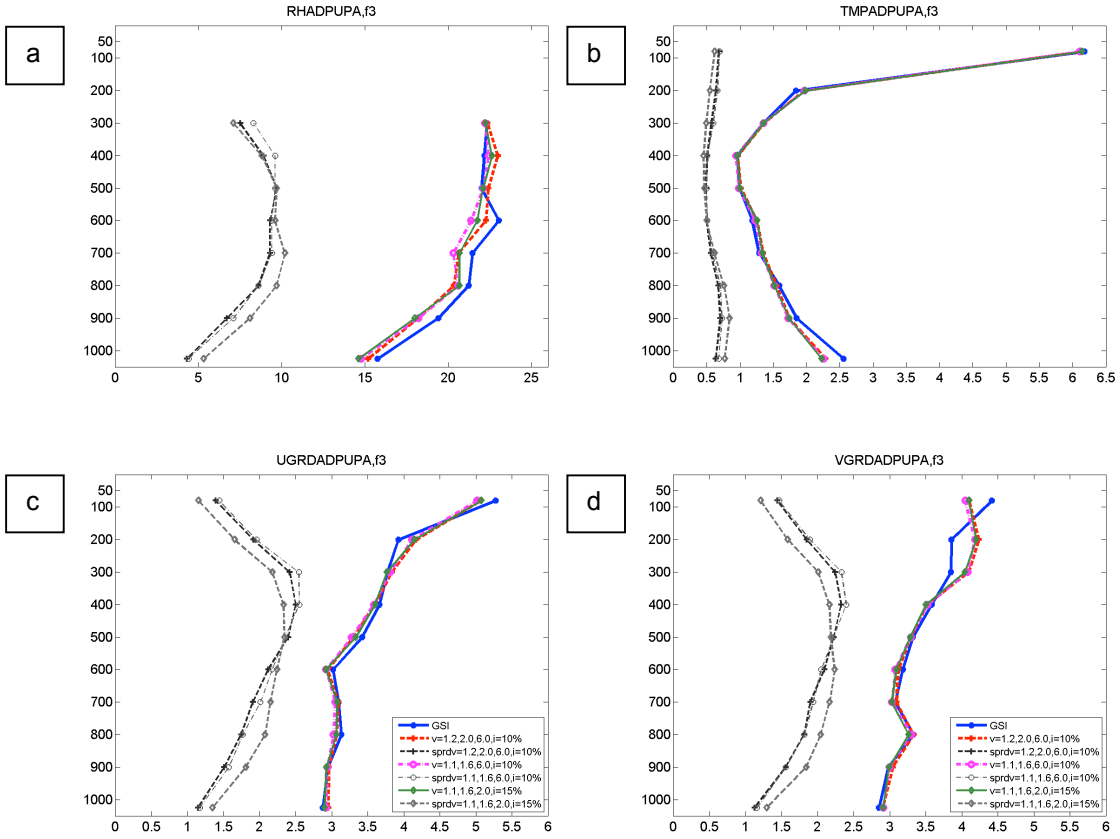

Fig.1. Vertical spread (grey and black) and RMSE (colored) profiles of 3 hr deterministic forecasts for (a) relative humidity; (b) temperature; (c) x-component wind and (d) y-component wind. All are verified against upper air reports (ADPUPA). The numbers in the legend are the vertical cutoff of radius for observations except surface pressure, vertical cutoff of radius for surface pressure observations, the vertical cutoff radius for the fixed inflation, respectively.

NCEP
To create a tag in the SubVersion (SVN) system for the upcoming NDAS implementation in NCEP, GSI codes, fix files and related libraries were prepared and tested. The files were then stored in a GSI project branch in the SVN system. The branch will be tagged when the regional implementation becomes operational so all the last minute updates are included. Work on the regional 3dvar-ensemble hybrid continues. The bug fixes have been incorporated into a recent GSI version that included all the bundle structures. The work to incorporate vertically inhomogeneous background errors for blending coefficients of variational and ensemble solutions was implemented with a flag, as was the code to use a vertically integrated alpha on surface pressure instead of using the first level above the ground. A switch was also added to use an ensemble member, which was perturbed with respect to the regional first guess instead of the global ensemble mean. The impact of each of these features will be tested with the off-line parallel system. Jim Jung's proposed solution for the spurious sensitivities in the upper layers when using the satellite data in NDAS was tested in the off line parallel but the impact was negative. Artificially dividing the upper layers fed into the CRTM into sub layers (NLAYERS) was also tested. Since the impact was neutral, the NLAYERS method did not solve the problem. Work was also done to prepare to move NDAS on to a newer version of the GSI code. (Wan-Shu Wu)

HiRes initialization scripts were updated and tested, following Matt Pyle's update for HiRes NMMB forecast. Strong constraints were tested again in the HiRes domain, along with Digital filtering (DFI), surface option and hourly cycling. The results from these tests were examined either by plotting surface pressure tendency or by checking RMS and forecast bias. Using an hourly cycle with strong constraints and DFI shows slightly better performance in wind, temperature and moisture verification. But hourly cycling made the surface pressure noisier. Reflectivity assimilation at the end of hourly cycle was tested, and the performance was slightly worse than that without using the reflectivity. The reason for this is under investigation. (Shun Liu)
The hybrid ensemble part of GSI has been successfully converted to use the general control variable format. While this work was being finished, a bug was found and corrected in an omp directive in subroutine smoothrf.f90, which caused irreproducible results when the number of processors was varied (as is done in the GSI regression tests). (Dave Parrish)

Task 11.5.8 Improve physical processes in the WRF (RR and HRRR) and NAM models, especially including those that affect aircraft icing.

GSD
Modifications to the RR version of the RUC LSM reported in the FY11Q2 and FY11Q3 reports, most of which concern cold-weather / high latitude conditions, continue to be working well. These upgrades are being prepared for submission to the NCAR WRF repository after the upcoming WRFv3.3.1 bug fix release. Meanwhile, Tanya Smirnova has made additional modifications to improve the cold-season performance of the RUC LSM through her participation in the Snow Models Inter-comparison Project (SnowMIP) after a new series of SnowMIP tests with the otherwise most recent version of the RUC LSM.

As noted under Task 4, our real-time RR cycles are showing a positive daytime dew-point bias at low levels that is likely contributing to a high precipitation bias over the eastern CONUS. We think this is not due to the RUC LSM itself, but is in part to a high bias in the RR 0-1h precipitation that is used as the precipitation input to the continuously cycled soil moisture, so that the soil is too moist. As noted under Task 4, we will soon be testing out the same soil temperature and moisture procedure that has helped ameliorate analogous problems in the RUC.

Modification and testing the MYNN planetary-boundary-layer (PBL) scheme continued in July, with encouraging results in test cases. Joe Olson has been collaborating with Mikio Nakanishi, one of the original authors of the scheme, in this effort. Next will be a retrospective run using our May 2010 retro period. Pending favorable outcome of this, and after the conclusion of CoSPA on 30 September 2011, the MYNN will likely be implemented in the RRdev real-time cycle at GSD for further scrutiny and evaluation, with an eye toward using it as the

surface-layer and planetary-boundary-layer option for the RR2. It is also being considered for eventual application in the HRRR.

NCAR/RAL

No report this month.

Task 11.5.15 Develop improved methods of cloud and moisture analysis for use in the Rapid Refresh and NAM Modeling Systems.

GSD

Stan Benjamin introduced new code changes into the RUC-dev code to re-introduce cloud building from GOES cloud retrieval data, but only for within 1500m of the surface. The goal is to improve low-level cloud cover while avoiding the RH bias discovered in December 2010, leading to removal of cloud building in the RR at that point. If this new treatment is successful, this change will also be a candidate for the RR2 upgrade in spring 2012.

Using the RUC cloud analysis as an initial testing ground, Stan has also coded a change in the calculation of the radar latent heating-based temperature tendency. The change provides an inverse linear ramping of the temperate tendency based on the degree of convective instability in the model background field. The idea behind this is that for more unstable environments, less latent heating is needed to create a realistic convection evolution. Based on evaluation of this configuration in the RUC-dev (including possible subsequent HRRR-dev runs), we may proceed to code and test this in the RR-dev for possible inclusion in the RR2 and use for HRRR initialization in 2012.

Task 11.5.24 Develop, test, and improve the 3-km WRF-based High-Resolution Rapid Refresh

GSD

Production of real-time hourly HRRR forecasts for the summer CoSPA exercise continued. Overall reliability was good and day-to-day monitoring has identified some case with excellent HRRR forecast skill. One example (for which we did a comparison re-run initialized off of the RUC to document the improvement from 2010 to 2011) is shown in Fig. 2. The very difficult case was for a mesoscale convective system (MCS) with very strong straight-line winds. The HRRR with RR initial conditions did an excellent job for this case and somewhat better than the HRRR-dev initialized with the RUC (also shown in Fig. 2).

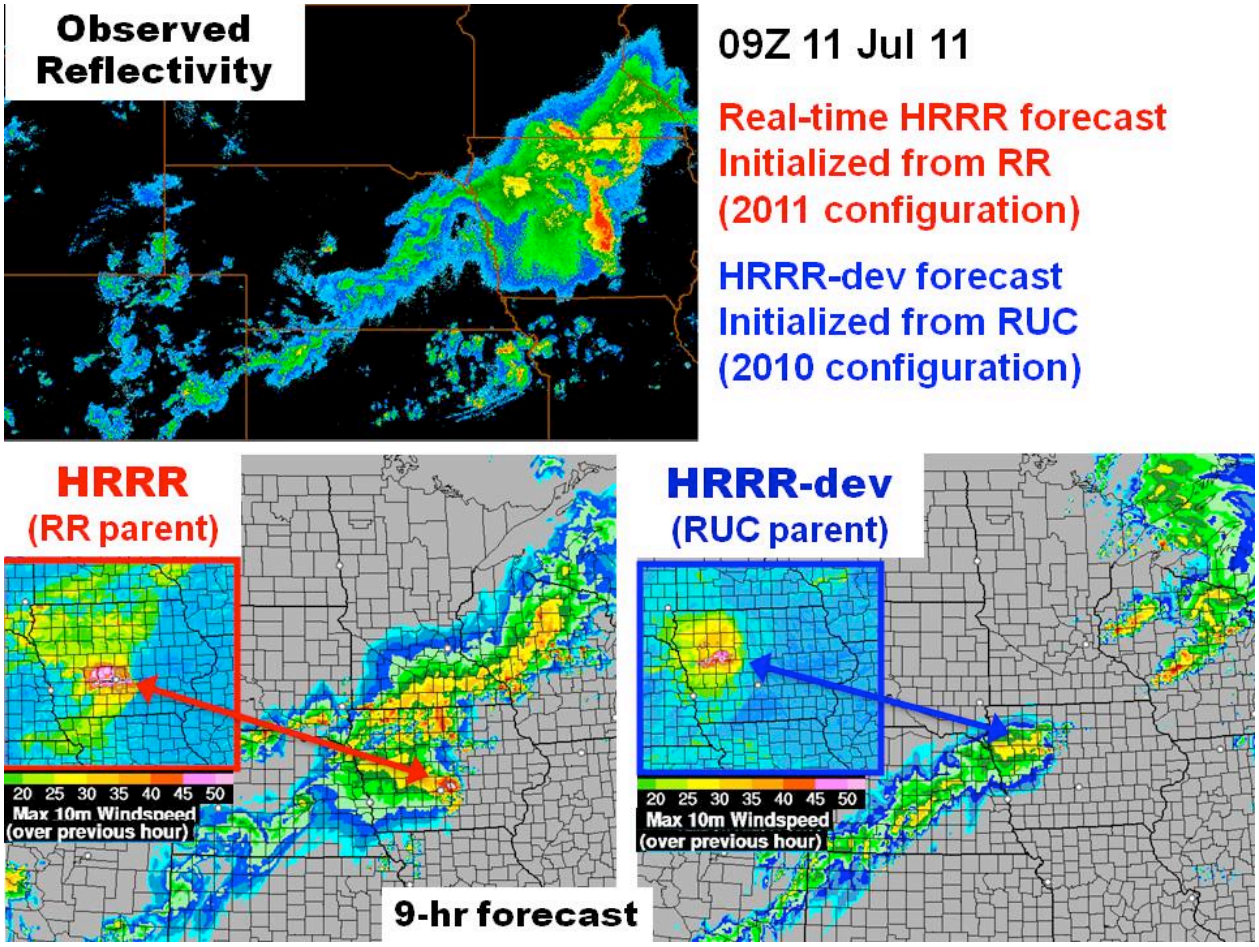

Figure 2. HRRR and HRRR-dev 9-h forecast maximum reflectivity and 10 m wind max in the past hour (inset) valid 09z 11 July 2011. The HRRR is the real-time HRRR forecast (initialized from the GSD primary RR) produced in support of CoSPA. The HRRR-dev is an additional run initialized from the GSD back-up RUC. Also shown (in the upper-left) is the verifying maximum reflectivity from the NSSL site. This storm system began as clusters of storms in Western High Plains around the model initial time (00z 11 July 2011) and produced considerable wind damage along an arc from Southwestern NE to Northern IL.

An increase to the maximum allowable time-step in the HRRR was made. This change, that had not impact on HRRR forecast skill, reduced overall run time by 5-8%. This change has been very helpful in further reducing the small fraction of HRRR runs that have not quite been completing in the allowed wall clock time. Also, using this time-step change and some other configuration optimization steps, the real-time HRRR-dev was switched from running everything third hour to running every other hour. This has allowed more opportunity to evaluate changes in the HRRR-dev cycle. These changes have included the use of the PBL pseudo-obs in the RR (approved as change for the HRRR last month), the minor time-step adjustment, and changes to the vertical length scale of the background error covariance.

Stan Benjamin, Curtis Alexander, and Eric James gave HRRR-related presentations at the ARAM conference in Los Angeles and Stan Benjamin and Steve Weygandt have given hour-long briefings on the RR and HRRR to several NWS regions. Finally, David Dowell has continued his work on testing cycled sub-hourly assimilation, obtaining generally encouraging results.

NCAR/MMM

CURRENT EFFORTS:

During July, MMM continued to review HRRR forecasts as the candidates for in-depth study. Jim Bresch (NCAR/MMM) met with NOAA GSD personnel, and a mesoscale convective system case from 11 July 2011 was selected for detailed analysis. The HRRR forecasts of the event showed very different behavior depending on whether the model was initialized with RUC or RR output. The reasons for this behavior will be examined.

PLANNED EFFORTS:

NCAR will continue to review the real-time forecast output and will proceed with the case investigations and analyses.

UPDATES TO SCHEDULE: NONE