MDE Product Development Team
May Monthly Report – FY 2011
Submitted 16 June 2011

With contributions from **Geoff DiMego** and **Mary Hart** (NCEP/EMC);
Stan Benjamin, **John Brown**, and **Steve Weygandt** (NOAA/ESRL/GSD);
Jordan Powers and **Roy Rasmussen** (NCAR); and **Ming Xue** and **Xuguang Wang** (OU/CAPS)

(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 in May, final testing toward upgrade to NAM planned for July 2011.

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 May 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. Some difficulties with system issues for RR-NCEP in May and early June causing intermittent interruptions.*
- ***Planned date for RR implementation at NCEP – update – early Oct 2011, due to additional delays now anticipated with the NAM implementation in July.***

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

- GSI modifications were developed to PBL-based pseudo-residuals – these were added to the RR-development version on 13 June. This follows an important innovation used in the RUC 3dVAR and is significant for the pre-convective environment for both the RR and the HRRR.
- Further testing of radial winds (with level-II data) in a parallel RR cycle at ESRL (RR-dev) showed very little degradation, encouraging for continued testing.
- Work continues to evaluate value added from radiance assimilation in RR (via GSI) including assessment of bias correction by channel for AMSU data.

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 toward improved initial cloud field in Rapid Refresh in RR2 in 2012.
- RR using GSI cloud analysis yielding significant improvement in short-range ceiling and visibility forecasts over those from the RUC.
- Testing continued with the RR with variations on specification of hydrometeors; one result was a correction to the reflectivity-snow algorithm used in GSI radar processing.

Task 11.5.24: Development/testing of HRRR

- Summer experiment for 2011 started on 1 June after extensive testing and switch to RR as HRRR parent assimilation system in April. Extensive testing of HRRR continuing with different variations to initial conditions. A parallel HRRR is running since 13 June every 3h using RR-dev initial conditions with PBL-based pseudo-residuals added, showing some improvement in HRRR performance.

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 to test re-introducing GOES cloud data over the lowest 2km 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 some differences in radar and 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**.

ESRL and NCEP/EMC also both tested use of a combined RUC/Rapid Refresh observational (prepBUFR) files, both successfully running the RUC pre-analysis program. These tests are preparing for eliminating one of the NCEP prepBUFR "dumps".

NCEP
The NRL-based aircraft quality control (QC) code package is expected to implement late in FY11. It replaces a fairly ancient legacy code whose author is now deceased. 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. A solution for memory issues found in testing is being worked. The code is also being streamlined to run faster for profile processing and will be updated to properly handle TAMDAR reports. Several erroneous AIREP aircraft waypoint locations were found, corrected and are being tested for a June implementation. Work continues on late arrival of GOES 1x1 field-of-view cloud data; bringing in new SSM/IS data from DMSP F-16, F-17 and F-18 satellites to replace discontinued SSM/I products; use of TAMDAR data from AirDAT as a MADIS alternative. The Florida and Georgia mesonet providers remained down. The Aberdeen PG mesonet provider, down since 24 April, returned in early May. GOES-13 cloud and precipitable water retrievals have not been used since the switch to GOES-13 in April 2010. (Dennis Keyser)

No infrastructure support was needed by the operational RUC in May. (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 planned for Oct 2011 can be found under 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. Inside the 12 km parent domain 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 official pre-implementation 30-day test began 13 June. (Eric Rogers)

During May, some additions to output fields from the parallel NAM were made for downstream applications and NCEP service centers. These changes were tested in the development parallel and handed over to NCO for eventual implementation. (Eric Rogers)

NCEP generates experimental Rapid Refresh (RR) PrepBUFR files containing WindSat data (non-superob) and 50 km ASCAT that are copied to a private ESRL directory on the NCEP ftpprd server. These PrepBUFR files no longer flag MDCRS and TAMDAR moisture because of the new NRL-based aircraft QC code. 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 plus early (T+0:26 minute) parallel dumps for 0000 and 1200 UTC are being tested in ESRL's experimental RR runs and the NCEP RR parallel. EMC and GSD requested the Radar Operations Center (ROC) start their hourly processing of Level 2.5 88D data 25-30 minutes earlier for the RR, for the Alaska portion of the expanded RR domain. NAM data impact tests have been performed on Multi-Agency Profiler winds and METOP-2, and on filling out RAOB profiles between the significant levels. New VAD winds, RARS radiances (RARS parallel dumps are being generated) and "tcvitals" records for tropical cyclones will be tested next. A request for a 5th hourly ingest of Level 2 88D radar data was made to NCO. The ROC has been contacted a decrease in the amount of Level 2 and Level 2.5 (locally-generated superobs) data arriving since December 2010. A new site software build has limited Level 2.5 data collection to only 26 sites. The Level 2 data are only being collected at 140 sites. ROC confirmed that this number is correct. (Dennis Keyser)

Most of the issues in Task 11.5.1 also affect the NAM. A software problem caused the loss of MODIS POES wind data for 14 hours on 6 May. 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. NCEP will stop pulling NOAA-15 AMSU-B data from NESDIS DDS in June because the data are now always flagged as bad after a scan motor failure on 28 March. There have been several outages of WindSat data: 14 hours on 6 May due to ground system problems, 8 hours on 13 May and 66 hours on 22-25 May. There have also been several outages of ASCAT data: 3 hours on 2 May for a system reboot, 60 hours on 14-16 May due to an instrument anomaly, and 6 hours on 6 May and 4 hours on 29 May. An implementation on 3 May added 50 km ASCAT and WindSat scatterometer wind data (both non-superobed) into the operational NAM/NDAS dumps and PrepBUFR files, in preparation for the NAM upgrade in July. 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 likely be tested soon 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 FIP package was modified to take more model inputs, like the RUC, RR and NAM. Work resumed on the WAFS mountain wave package. Since the GFS has only gravity wave drag from u/v acceleration, more work needs to be done to calculate the gravity wave stress from acceleration. (Yali Mao)

NCEP also maintains four times-per-day runs of ten WRF-based members (5 running NMM and 5 running ARW) within the Short Range Ensemble Forecast (SREF) system. Aviation guidance prepared from the SREF is available from **http://www.emc.ncep.noaa.gov/mmb/SREF/SREF.html**, which now includes specific output for Alaska and Hawaii (eastern Pacific). The SREF ensemble product generator includes the following forecasts: minimum, maximum, mode, 10/25/50/75/90 percentiles of many aviation related variable. (Jun Du, BinBin Zhou)

NCAR/MMM
CURRENT EFFORTS:
NCAR worked on the organization and preparation of the next WRF Users' Workshop, which will be held June 20-24 at NCAR. As seen last year, the first day's program will have lectures on the fundamentals of WRF physics. The topics this year will be PBL and land-surface model (LSM) physics. The usual modeling topic areas will be covered during the week, and there will be instructional talks on the final day.

[ESRL/GSD note: 4 talks at the WRF Workshop will be given by GSD scientists:

- Rapid Refresh application of WRF (John Brown)
- HRRR application of WRF (Curtis Alexander)
- RUC land-surface model development in WRF for RR and HRRR (Tanya Smirnova)
- Development of WRF-chem (and testing in RR-chem and HRRR-chem (Georg Grell)]

NCAR/MMM personnel presented a WRF tutorial in Cyprus in the first week in May. This was part of the conference "The Weather Research and Forecasting Model in the Middle East".

MMM personnel have begun work on the next basic WRF tutorial at NCAR, to be held July 11-15, 2011. Following this there will be a WRF-Chem tutorial from July 18-19 and a WRFDA tutorial from July 20-22.

Jimy Dudhia of NCAR/MMM collaborated with Yongkang Xue (UCLA) on adding the SSiB (Simplified Simple Biosphere) land surface model to WRF. He has been updating the code to work with WRF V3.3. Testing continues.

Dudhia is investigating a problem with the MYNN PBL scheme in collaboration with Ming Chen (NCAR/MMM) and Joe Olson (NOAA). It has been found that instabilities may arise in using the scheme in WRF, with the problem being related to TKE advection. Corrections are currently being explored.

Dudhia started work on adding regional climate diagnostics, such as outputting maximum daily surface temperature fields. Collaborator Ruby Leung of PNNL has provided the code. This may potentially be released with the next minor release of WRF, V3.1.1 (approx. August 2011).

PLANNED EFFORTS: The development and implementation of new physics for WRF will continue through FY11Q3.

UPDATES TO SCHEDULE: NONE

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

ESRL/GSD

Progress toward implementation of the RR at ESRL had been steady toward a Sept 2011 implementation. However, there is a dependency on the earlier NAM implementation in July, and now, with some delays in the NAM implementation, the RR implementation now will likely be delayed until October. NCEP/NCO personnel must complete the NAM implementation (planned for July, now slipping into August) before being to work full-time on the RR implementation

Efforts this month were mainly toward continued evaluation of RR performance, both at GSD and at NCEP. No changes have been made to the RR at NCEP, and development and testing is now toward the next version of the Rapid Refresh (RR2) in late 2012.

Motivated in part by the appearance of a positive bias in RR precipitation amounts during this spring's active severe storm season, the RUC procedure to more effectively spread the surface temperature and dew point observation innovations vertically into the mixed layer, if one exists in the 1-h forecast background, was recently introduced into the GSI by Ming Hu and Stan Benjamin and is now undergoing testing. This addition of PBL-based pseudo-residuals derived from surface observation residuals is now running in the RR-development real-time cycle, and is being used to initialize the HRRR-dev run every 3h. Some improvement is apparent in reducing too widespread convection in comparing both the RR-dev with RR, and the HRRR-dev with the HRRR. This modification is a strong candidate for inclusion with RR2.

We anticipate implementation of the RR2 upgrade will be a much less arduous process than we are getting close to concluding. Nevertheless, we anticipate at least minor changes in all aspects of the RR, including various aspects of GSI (including moving the cloud analysis a bit closer to a variational framework), the Diabatic Digital

Filter Initialization and the model (upgrades to the present physics suite, perhaps changing the boundary-layer scheme from MYJ to the GSD version of the MYNN).

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**.

A recent evaluation comparing the RR to the RUC shows that precipitation forecasts in May were clearly superior from the RR (Fig. 1). The upper-level wind forecasts from the RR also continue to show improvement over the RUC in May (Fig. 2). RH forecasts from the RR do not show in the warm season the same improvement evident in the cold season (Fig. 3), but a continued improvement from the RR is still evident in temperature forecasts (Fig. 4).

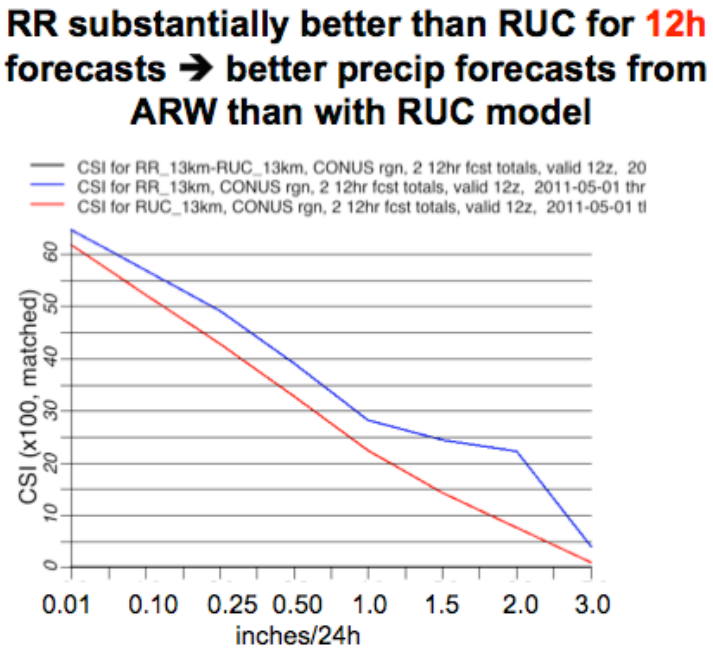

Figure 1. Precipitation forecast skill for 2 12h periods summed to 24h period from the RUC (red) vs. the Rapid Refresh (blue). Critical Success Index (CSI) measures skill at different accumulation thresholds from 0.01" to 3.0".

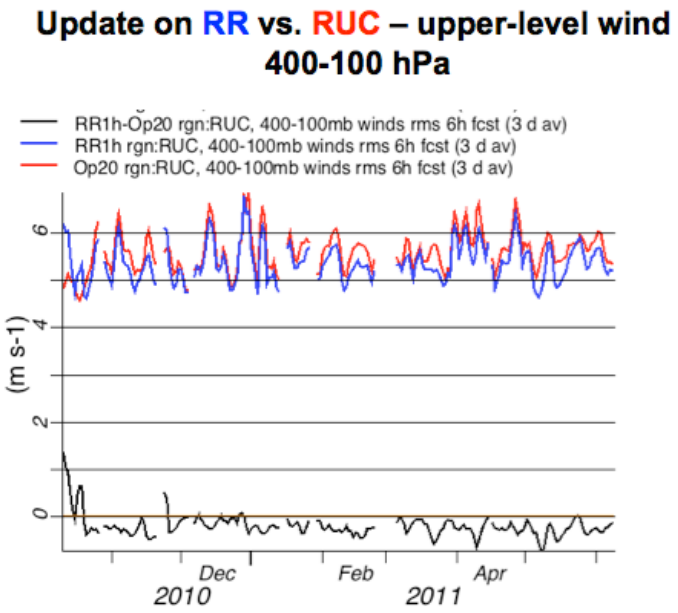

Figure 2. 6h forecast error (vs. raobs) for 400-100 hPa winds from RUC (red) vs. Rapid Refresh (blue) for the period from October 2010 until early June 2011.

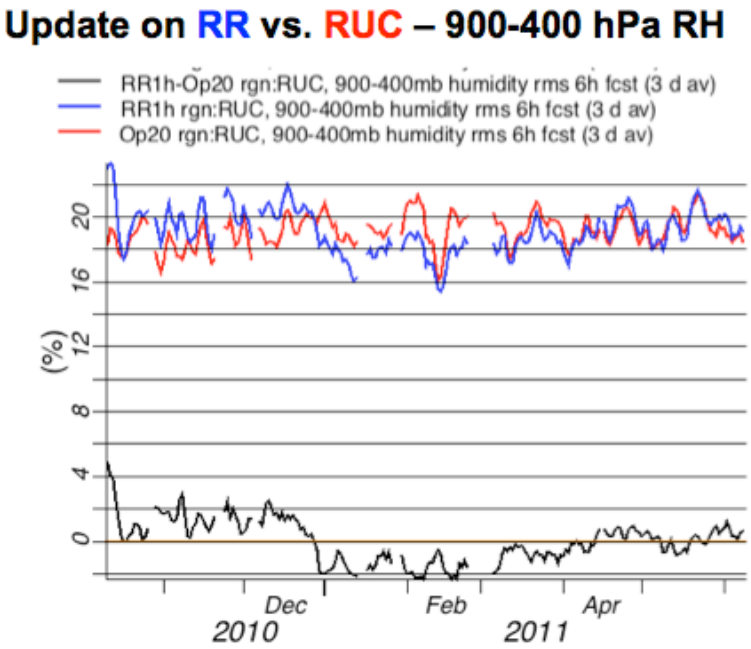

Figure 3. Same as Fig. 2, but for relative humidity forecasts averaged between 900-400 hPa.

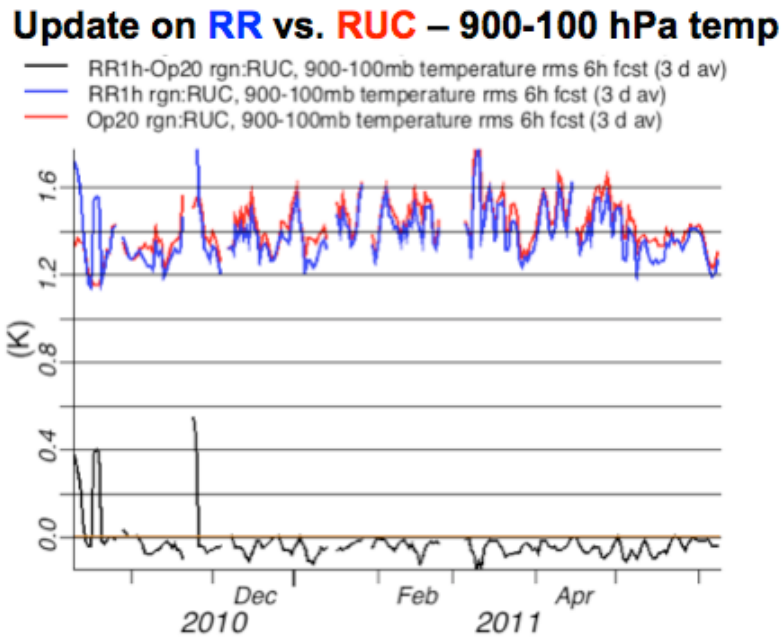

Figure 4. Same as Fig. 2, but for temperature forecasts averaged between 900-100 hPa (through most of the troposphere into the lower stratosphere).

NCEP

The Rapid Refresh (RR) has been running stably in an EMC parallel environment since December. The code has been frozen since changes made in April to improve model handling of snow cover. Statistical evaluation has shown that the Rapid Refresh is now at least comparable to the RUC for most parameters, with significant improvement shown for upper level wind and height fields. Grib1, Grib2, and station time-series BUFR data files have been made available to the FAA, the NCEP service centers, and other RUC users on an FTP site, and informal evaluation of the model analyses and forecasts is underway. Special test files were provided to several FAA groups to ensure a seamless transition when the RR replaces the RUC. RR implementation is currently scheduled for September. (Geoff Manikin)

For the upcoming SREF implementation, various alternative physics packages/schemes such as GFS physics were tested (by Weiguo Wang and Brad Ferrier) using the WRF version 3.3 release (ARW core) to increase forecast diversity within an ensemble. Work was also done (by Dusan Jovic, Jamie Wolff of DTC and Brad Ferrier) concerning the Rapid Refresh physics options to be used in SREF. The findings from these tests can also be applied to the future NARRE and HRRRE. (Jun Du)

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 6/9/2011). 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.

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

In May and early June, as reported under 5.4, a change was made to GSI to allow extra pseudo-observations to be created from surface observations based on background (1h forecast) planetary boundary-layer (PBL) height. This change is running in the RR-dev at ESRL. It appears to be producing more accurate dew point predictions from forecast runs initialized in the daytime (when the PBL is much deeper). This change was enabled by work done in April (reported last month) to diagnose PBL height within GSI. Again, these changes will be part of the code change for the RR2 upgrade in late 2012. Haidao Lin continues his satellite data assimilation work, and has obtained some modest improvement in a test with AIRS radiance data added to just conventional observations. Haidao presented a summary of this work at the JCSDA Satellite Data Assimilation workshop in College Park, MD in May.

GSD also conducted an additional observation impact test of several days for radial wind data with the height processing correction suggested by NCEP (see NCEP's section below). For this new period, radial wind continued to produce a small negative impact, especially on lower troposphere forecasts of 3h-6h duration. Subsequently, GSD also conducted yet another radial wind experiment period using level-II data instead of the previous level-2.5 data. For this test, the result was closer to neutral, with only a very small negative impact. GSD has decided to still withhold radial wind assimilation from the RR until the 2012 RR upgrade and when additional improvements are developed in radial wind processing and possibly with QC.

CAPS

As reported in our April report, we modified the way soil model state variables are initialized when the forward only "Digital Filter Launch" (DFL) option is used, which eliminated the forecast instability we experienced previously that prevented successful cycled assimilation with the DFL option either with GSI or EnKF. Subsequent comparisons between DFL and the Twice Digital Filter (TDF) that involves a backward adiabatic integration showed slight though clearly noticeable better results with short-range forecasts, as well as the analyses of relative humidity and wind, especially at the higher levels against soundings, where the EnKF analyses errors have been relatively large. For subsequent experiments, we plan to stick to the DFL option, with a proper choice of filter half width.

From previous experiments, we found the EnKF analysis errors are smaller with 6-hourly cycles than 3-hourly cycles while the GSI analyses show the opposite, as should be expected. To see if the 3-hourly cycles were producing too noisy covariance that led to analysis deterioration, two single-observation tests were conducted based on the ensembles after 6 days of cycling, from the 3 hourly and 6 hourly experiments, respectively. We calculated spatial and cross-variable correlation coefficients among a hypothetical temperature observation at 700 hPa over Norman Oklahoma, and other state variables. The correlation coefficients from the 3-hourly case were indeed noisier than those in the 6-hourly case, with geostrophic signals more clearly identifiable in the 6-hourly case. However, in a 6-hourly experiment with 80 ensemble members, the analysis results are not noticeably improved over the 40 member case, suggesting noisy covariance is not the only or main cause of the worse analyses for some of the variables compared to GSI.

Besides, we noticed the analysis errors of wind were larger at higher levels, especially in the 3 hourly case and when verified against sounding. Therefore, we examined the ensemble spread through all cycles, and found that the sounding-relative spread in the 3-hourly case kept growing through the analysis cycles while the 6-hourly case

is stable. At the same time, an experiment with increased adaptive inflation enlarged the analysis error. This is likely due to the fact that soundings are only available and assimilated very 12 hours while inflation is applied at each assimilation step. Therefore, there is twice the static inflation in the 3-hourly case than in the 6-hourly case, when the same static inflation coefficient is used. These results seem to point to too much non-adaptive inflation for short-cycles for certain variables, with wind in particular. Our net set of experiments will focus on turning the inflation as well as covariance localization.

In addition, 12 hour-long 13-km forecasts starting from the interpolated 00 and 12 UTC 40-km GSI and EnKF analyses, which consistently employed the new version of DFL, were produced for the weeklong period. GSS scores were calculated for precipitation forecasts against NCEP Stage IV precipitation data. For a threshold of 0.1 mm/hr, the GSS indicated the forecasts initialized from the EnKF analysis were better than the ones from GSI as before. This is consistent with our earlier more preliminary results.

On June 8, Ming Xue of CAPS gave a presentation on our EnKF and EnKF-Hybrid results obtained so far, on behalf of the group, to the EMC data assimilation scientists. The CAPS and GSD groups also attended it. Regular exchanges will occur through such means among the three collaborating groups.

NCEP

Work continued to test the impact of fixing the discrepancy between height specification of radar observations (above sea level) and height of the first-guess defined inside the GSI (above ground) – see more details below. The fix was tested in the off-line parallel for a week and its impact on the short-term forecasts was neutral which is an improvement over negative impact seen in Shun Liu's earlier testing before the fix. The fix was then communicated to Eric Rogers and to NCO for inclusion in the NAM package to be implemented in July. Work also continues on the regional hybrid ensemble using the operational global GEFS ensembles in the regional NDAS. It was observed in the parallel test that the impact of hybrid method is negative near the top and bottom model boundaries while positive in the middle. This motivates the work to have vertically inhomogeneous background error for alpha. In an attempt to improve the negative impact on the surface pressure, the code was changed to use vertically integrated alpha on surface pressure instead of using first level above ground. Work was also done to add an ensemble member in which is a perturbation of global ensemble mean by the regional first guess. (Wan-Shu Wu)

After finding the bug for Level 2 radar radial wind, the reported height of level-2.5 and level-3 data was also checked, and they all report a height above sea level. All codes related to height calculation in GSI code are being checked and the method of converting geopotential height to geometric height is examined in detail. The RMS and bias between the radial wind and guess have been checked, and both are improved after the bug fix and more observations have become available at low altitudes. (Shun Liu)

A significant error was found in the height assignment of radar radial wind observations in the GSI. In the GSI, 3D fields of pressure and geopotential height are computed before any observations are processed. Then a vertical interpolation of model fields to the observations is done for height or pressure depending on how the observation is reported. For radar radial winds, the height above sea level is computed for each observation. In the subroutine setuprw.f90, the 3D geopotential height was assumed to be height with respect to sea level, but it is actually height above the model surface. Therefore, all radar radial winds have been misplaced too high in the vertical by the amount of the local surface elevation, a major error. This bug fix (see testing above) is in final review for addition to the GSI Subversion trunk. (Liu, Wu, Parrish)

One reason for the disappointing performance of the regional strong constraint may be because it is applied on the analysis grid, which is different from (coarser) the model grid. This is not the case for the global application. A clean test of resolution dependence can be done with a global run, but the code is hardwired for one resolution only. The dual resolution capability introduced in the hybrid ensemble extension to GSI required the creation of more general software not hardwired to the analysis grid. Work started in 3rd quarter FY10 (but was discontinued) to extend this capability to the rest of the GSI code, in particular the strong constraint, which is the most complicated part. This work has been restarted and will add significant flexibility to GSI beyond just testing the strong constraint at different resolutions. (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 report appear to be working well.

As noted in earlier reports, we decided to use the v3.2 version of Thompson with known bugs removed, rather than switching to Thompson v3.3 at this time. However, we anticipate upgrading to a later version of Thompson for the RR2 upgrade in late FY12. No further testing on later versions was done in May.

Work on the MYNN planetary-boundary-layer (PBL) scheme continued in May, with further testing of modifications to keep the turbulence kinetic energy predicted by the scheme positive semi-definite. The formulation of the surface layer, both for the roughness length specification for temperature and moisture and the stability functions, continues to be tested on individual cases. Criteria for evaluation are the 2-m temperature and dew point and 10-m wind, and also prediction of low-cloud coverage.

The use of this modified version of the MYNN scheme is being considered for the RR2 in FY12. It is also being considered for eventual application in the HRRR.

NCAR/RAL

Subtasks:

11.5.8.1 Oct '10

Start to evaluate the relatively performance of new microphysics and PBL schemes used in the physics-perturbation-only 4-km CONUS-scale forecasts from CAPS spring forecast experiment.

11.5.8.2a Apr '11

Continue testing newly implemented coupled aerosol-microphysics scheme in case studies and perform sensitivity analyses.

11.5.8.2b May '11

Determine the best method for including aerosols into HRRR's initial analysis and boundary conditions so they are available to the microphysics scheme.

Deliverable

11.5.8E3 Sep '11

Deliver an improved ice nuclei tracking scheme in the two-moment microphysics scheme to ESRL for real-time testing in the WRF Rapid Refresh.

CURRENT EFFORTS:
Trude combined the code for the CCN and IN into one code. The updated schemed is being testing on the IMPROVE II case that Greg Thompson has set up and worked extensively on. Part of this testing was to evaluated the freezing mechanisms in the code including heterogeneous freezing, parameterized by Demott et al (2010), droplet freezing (both immersion and homogeneous freezing) by Bigg, homogeneous freezing and by deliquescent aerosols (Koop et al 2000), and specific tests to make sure all droplets below a certain temperature

freeze. Results of the evaluation will be reported in the next monthly report.

PLANNED EFFORTS:
Continue developing and testing the new aerosol scheme.

PROBLEMS/ISSUES ENCOUNTERED OR ANTICIPATED:
None

INTERFACE WITH OTHER ORGANIZATIONS:
GSD

UPDATES TO SCHEDULE:
None

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 late 2012.

Preliminary work continues to code a capability to do nudging of skin temperature, based on the lowest model level air temperature increment.

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

GSD

A careful evaluation of the HRRR continued during May 2011. The HRRR did an excellent job in showing an outbreak of severe rotating thunderstorms for the Joplin Missouri tornado on 5/22/2011. Some cases have been found with too high areal coverage of convection in the HRRR, more so with the onset of summer in the month of June. Associated with this has been the development of an assimilation modification for testing, creation of PBL-based pseudo-observations, as discussed under Tasks 5.4 and 5.5. With the additional processors funded by the FAA and with the completion of 2010 retrospective experiments for now, GSD is now running a development version of the HRRR every 3h, and using these experimental new initial conditions from the RR-dev with the additional PBL-based pseudo-observations. Initial results are showing improvement in convection forecasting, and more will be reported next month.

As reported last month, a key milestone was achieved on April 14th, 2011, when the HRRR was switched to run nested within the Rapid Refresh. Prior to this time (and since the inception of the HRRR in 2007) it had always run as nest within the RUC. A very significant amount of work preceded this important switchover. First, work to bring the RR to an NCEP operationally ready level was completed, including numerous code updates and fixes (including introduction of partial cycling, resolving issues with the rotated lat lon coordinate, and resolving issues related to DFI balance and hydrometeor reset after the DFI. Next, an extensive set of RUC-HRRR and CW PDT colleagues at NCAR completed RR-HRRR tests on summer 2010 high impact weather periods with detailed analysis of results here at GSD and. Based on this modification were made to the RR radar-DFI assimilation and changes made to the HRRR, resulting in RR-HRRR results that are generally superior to the RUC-HRRR. This work and this accomplishment would have been extremely difficult without the HRRR shadow computer system on jet and the in-house verification package developed by Patrick Hofmann. The RR-based HRRR has been running in real-time with high reliability (and latency trimmed from ~3h last year to ~2h this year) through all the recent severe weather. Shown below is a comparison of HRRR and RUC 9-h forecasts for the April 27th

Southeast U.S severe weather outbreak day (this day was also one with very significant aviation impact). As can be seen the HRRR does very well in capturing the overall character of the convection (clusters of super cells ahead of a thin squall-line). It also reproduced certain storms down to a county scale, including the devastating Tuscaloosa tornado storm indicated by the white circles.

NCAR/MMM

CURRENT EFFORTS: NCAR reviewed real-time HRRR forecasts in order to help select cases for further study. Spring 2011 has been very active with many potential cases meriting further study. NCAR made a few sample tests of high-resolution (4-km) WRF runs in preparation for these HRRR cases. NCAR participated in the MDE planning telecon on 3 May.

PLANNED EFFORTS: NCAR will continue to review the real-time forecasts for possible cases and will collaborate with GSD on the selection as the season progresses.

UPDATES TO SCHEDULE: NONE