MDE Product Development Team
November FY11 Monthly Report – FY 2011
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Executive Summary

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

- NCEP-RUC - Restoration to larger sigma-layer depths on 17 November (15z) after coordination between ESRL, NCEP/EMC, and NCEP/NCO. This was a response to intermittent crashes in the RUC from April-early November before the change. ESRL made same change to backupRUC (initializing HRRR) and development-RUC on 25 October. 100% reliability of backupRUC (already with change) in November. Note: RR ran without problem in all RUC crash cases in 2010 related to this issue.

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

- *RR now producing strongest improvement yet over RUC for wind, temperature, RH, height, surface.*
- *Final problems with Rapid Refresh (background error, WRF mass variable consistency, height diagnostic, others) solved in October and November.*
- *Updated versions of Thompson microphysics and MYJ boundary layer scheme implemented.*
- *Evaluation of RR-NCEP-EMC is underway.*
- *Anticipated RR implementation date at NCEP has now been moved back to July 2011.*

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

- Frozen version of GSI for RR including use of modified GFS background error covariance specification.
- Experiments continue to evaluate impact of including re-interpolation in the vertical and vertical re-integration following the GSI analysis (either at the end of the GSI program or in the beginning of the ARW model).
- Initial work 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

- RR using frozen version of GSI cloud analysis yielding significant improvement in short-range ceiling and visibility forecasts.
- Further revisions made to METAR-cloud-based RH pseudo-observations in variational humidity analysis in development RUC in November.

Task 11.5.24: Development/testing of HRRR

- June 2010 RUC / HRRR retro experiments ongoing to evaluate impact of variations in strength of radar DFI on HRRR forecast skill.
- July 2010 HRRR retrospective case study period identified and detailed plan in place for expanded RUC- and RR- based HRRR experiments including variations in radar DFI latent heating and possible inclusion of 3-km radar assimilation.
- Work complete on RUC / RR / HRRR radar reflectivity verification system including two new helpful web-sites (one for individual case verification graphics and one for aggregate and analysis of verification statistics).

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

ESRL/GSD

NCEP-RUC – Change:
Restoration to larger sigma-layer depths on 17 November (15z) after coordination between ESRL, NCEP/EMC, and NCEP/NCO. This was a response to intermittent crashes in the RUC from April-early November before the change. ESRL made same change to backupRUC (initializing HRRR) on 25 October. 100% reliability of backupRUC (already with change) in November. Note: RR ran without problem in all RUC crash cases in 2010 related to this issue.

> Background information on RUC change/crashes extracted from October 2010 report:
> ESRL conducted several tests on stability of the RUC forecast model (hybcst) for downslope wind forecast situations in October that resulted in crashes at NCEP and at ESRL. As a result, the maximum sigma layer thickness was changed from 10 hPa to 15 hPa in the backup RUC, resulting in successful runs without crashes and without any perceptible changes in output for non-crash cases. A similar change was made to the ESRL development RUC in August.
>
> Similar tests were made at NCEP with improved stability. This has resulted in a recommendation from NCEP/EMC and ESRL/GSD to NCEP/NCO to make this modification to the operational RUC at NCEP. NCO agreed to this change, and this change was made on 17 November.

ESRL continues to monitor operational RUC (and two ESRL versions of RUC with some differences in radar and cloud assimilation). 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 at http://ruc.noaa.gov/stats -- no unexpected differences occurred during July. Reminder: the backup RUC at ESRL is used to initialize the HRRR (http://rapidrefresh.noaa.gov/hrrr), and the dev RUC is used to initialize the HRRR-dev.

NCEP
Testing is complete for a major upgrade to the NCEP BUFR library that is critical to all observational ingests which impacts both the RUC and the NAM. A full 2-cycle production test on the development CCS machine was scheduled for 1 December and implementation was scheduled to occur on 14 December if the test is successful. Work continues on issues like three radiosonde sites that report an invalid instrument type (we are in contact with some of the sites); 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; and NRL-based aircraft QC code implementation preparation. The Florida and Georgia DOT and Aberdeen PG mesonet providers have been down for several months. GOES-13 cloud and precipitable water retrievals have not been used since the switch from GOES-12 to GOES-13 in April 2010. (Dennis Keyser)

The operational RUC experienced more CFL violation failures during the first two weeks of November. A time step reduction implemented in late October has not prevented more failures, so in mid-November it was decided to replace the code that defines the model vertical coordinate with the pre-March 2010 version. The March change was made in response to January crashes associated with an extreme trough over the Pacific Ocean; this change has made the model more susceptible to crashes associated with mountain wave events in the western U.S. Since the January event was a rare extreme event, it was decided to return to the old code and this code was implemented on November 17. This allows the model time step to again be set to 18 seconds and frees up extra resources that had to be devoted to the RUC in late October. No RUC crashes have occurred since 17 November. (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 during May toward operational implementation at NCEP can be found under Task 5.4 report.

NCEP

Parallel tests of the NEMS/NMMB model in the EMC NAM parallel system continue on the CCS. Two NMMB parallels are being run - one a 12 km control run and the other a 12 km experimental run with model and/or analysis changes for inclusion in the control run. The experimental parallel is running all four nested domains (CONUS, Alaska, Hawaii, Puerto Rico). During November, the MODIS-IGBP land use definitions were implemented in the control NMMB parallel. Enhanced diffusion for specific humidity and cloud water was tested in the experimental parallel and implemented in the control parallel in November. Also, the experimental parallel began a test of microphysics and radiation changes that will reduce NAM total cloud fractions by reducing unrealistically high amounts of cirrus clouds. (Eric Rogers, Brad Ferrier)

Several changes to the nested runs were made in November to eliminate problems. First, two changes suggested by Zavisa Janjic and Matt Pyle were made to eliminate CFL-like noise that was seen in the CONUS nest runs during early November: 1) the divergence damping constant for the nested runs was increased by 33%, and 2) slight off-centering was turned back on in the Crank-Nicholson vertical advection scheme. This was accidentally turned off in the parallels in June 2010. Second, at the recommendation of NEMS code developer Tom Black, the number of boundary blending rows in the Alaska nest was reduced from 5 to 3 to eliminate code hangs since with 5 blending rows, a 2:1 grid space ratio for the Alaska nest to the parent, and only 2 halo rows for the parent task, the blending region was too wide. When Alaska has its northern boundary extremely close to the northern boundary of a parent task then Alaska's blending region can completely cross from one parent tasks' integration region through that parent task's halo and into the next parent task's integration region, causing the code to hang. (Eric Rogers)

NCEP continues to generate experimental Rapid Refresh (RR) PrepBUFR files containing WindSat data (non-superob) and 50 km ASCAT, which are copied to a private ESRL directory on the NCEP ftpprd server. RR dumps of Level 2 and expanded (time-window) Level 2.5/3 88D radial wind data, hourly lightning data, and GOES single-pixel cloud data from NASA/Langley (covering Alaska) are also being copied to a public ftp directory. These, along with early (T+0:26 minute) parallel dumps for 0000 and 1200 UTC, are being tested in ESRL's experimental RR runs and now Geoff Manikin's RR parallel being run at NCEP. ESRL has been concerned about missing ASCAT data and the low number of WindSAT data. NCEP corrected its ASCAT processing on 9 November to handle a 14 September upstream processing change in wind solutions. The WindSAT and ASCAT data dump time windows have both been moved back 30 minutes to try to obtain more data for the RR. The AQUA AIRS and NOAA/METOP AMSU-A, AMSU-B, HIRS-3/4 and MHS, radiance dump time windows were moved from back 1 hour (to 3 hours prior to cycle time) to try to obtain more data for the RR. There are many unavoidable gaps in the WindSAT data due to problems upstream of NCEP. Future data tests will include Multi-Agency Profiler winds and METOP-2 and RARS radiances as well as "tcvitals" records for tropical cyclones. The NWS is increasing the resolution of the raw Level 3 ("NIDS") radial wind data in January so NCEP/NCO will need to modify the Level 3 decoder to maintain the processing of these data. EMC and GSD requested the Radar Operations Center (ROC) start their hourly processing of Level 2.5 88D data 25-30 minutes earlier so more data will arrive before the RR cutoff, as it's the only available radial wind data for the Alaska portion of the expanded RR domain. This process began in November but the changeover is gradual over time. Adding a 5th hourly ingest run to increase the

receipt of Level 2 88D radar data is being discussed with NCO. Level 2 data from 8 DOD CONUS sites are expected to become available soon. (Dennis Keyser)

For the NAM specifically, we are contacting Alaska Region to discuss the radiosonde at Shemya, AK (70414) that still launches too late for the NAM-GSI. AQUA AIRS data were either very low or unavailable for 40 hours on 2-3 November due to late posting of files on the NESDIS server. 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 the demise of the gyros and unusable products within 6 months. NESDIS engineers still need to conduct the last of three 24-hour tests where the corrupted navigation data will not be sent to NCEP. JMA continues to produce cloud-derived winds with MTSAT-1R due to a failure in the MTSAT-2 ground data processing system. The switch back to MTSAT-2 is not expected until late December. The following data types are monitored by the NAM-GSI: RASS virtual temperature profiles (NPN and MAP), Mesonet mass data, AIRS AMSU-A radiances, NOAA-19 HIRS-4/AMSU-A/MHS radiances, ASCAT winds, and MDCRS moisture data. All but RASS of these are being tested in Eric Rogers' parallel. Ten meter wind speed from JASON-1 and -2 altimetry data will soon be monitored. NAM/NDAS and RTMA PrepBUFR files are being generated in parallel with 50 km ASCAT and WindSat scatterometer wind data (both non-superob) and production NAM/NDAS dumps of METOP IASI radiances, GPS-RO data and SBUV-2 data are being created. 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 Eric's parallel as an alternative to the current use of synthetic wind data bogus but this can only be done at the t-12 hour start time of the NDAS. A legacy restriction (that only surface data with a reported pressure is processed) will be removed to allow many new surface observations (land, marine and Mesonet) to be assimilated in the RTMA and possibly NAM/NDAS. This testing has just started in the RTMA. (Dennis Keyser)

A single case retrospective test was made using the NEMS/NMMB with a 12 h NDAS, both with and without digital filter initialization (DFI). Running the DFI in the NDAS required a code modification to avoid doing precipitation adjustments while the model was in a filtering state. There were some indications of better fits of first guess surface pressure within the analysis and improved geopotential height errors and wind errors at longer-range forecasts, but generally the differences were quite small (expected with the three hourly analysis updates) and not always positive. This code has been provided to Eric Rogers for extended parallel testing. (Pyle)

The code to ingest GINI satellite imager data into NCEP's Fortran version of CIP algorithm has been completed. Coding work has started to ingest lightning data from US National lightning network. Coding work for the last dataset of CIP, the radar data ingest, will begin as soon as the work on lightning data is complete. (Mao)

NCAR

CURRENT EFFORTS:
NCAR has set the dates of the next WRF tutorial as Jan. 31-Feb. 8, 2011. The tutorial will cover WRF structure and operation, as well as related model components, such the Metgrid verification tool.

NCAR continued preparations for WRF major release V3.3. New code continued to be received, and the target release timing is Spring 2011. Information on the release and a list of candidate features may be found at http://www.mmm.ucar.edu/wrf/users/release_3.3.html.

Jimy Dudhia of NCAR/MMM worked on various areas of WRF physics. He obtained the Lin-Colle (Stonybrook University) microphysics scheme from Yanluan Lin. The code has gone through basic testing and is ready to add to the WRF repository for the V3.3 release.

Dudhia obtained the SSiB land-surface model from UCLA. He evaluated the code's standards for WRF and sent comments on changes to the scheme's authors (Prof. Xue and F. de Sales). Dudhia also obtained an updated

version of CLM3.5 land scheme in WRF V3.2.1. This scheme will be made available in a tar file supported by the developer (Jimimg Jin, Utah State) that will be separate from the V3.3 release.

Dudhia continued working with Pedro Jimenez (NCAR/MMM visitor) to evaluate surface wind biases in his large, multi-year northern Spain dataset and 2-km ARW output. They are finding ways to improve surface wind output in complex terrain based on topographic properties.

Dudhia continued working with NCAR/MMM visitors Thara Prabhakaran and Dipu Sudhakar (Indian Institute of Tropical Meteorology). This work includes investigating shallow convection, aerosols, and dust transport in the Indian region.

Dudhia obtained Wayne Angevine's TEMF (Total Energy Mass Flux) PBL/shallow convection scheme from NOAA/ESRL. Testing is uncovering some items to be fixed regarding its surface diagnostic fields at 2 meters.

Lastly, Dudhia began working with Steven Cavallo (NCAR/MMM) to add an ozone capability to the ARW. This would allow the ARW to ingest or initialize ozone analyses (instead of climatological ozone) that the model would advect and allow to interact with radiation.

PLANNED EFFORTS: The development and implementation of new physics for WRF will continue through FY11Q1.

UPDATES TO SCHEDULE: None

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

ESRL/GSD

Intensive effort continued in November toward freezing the Rapid Refresh code in preparation for several weeks of testing by EMC (started in December) prior to submission of the Request For Change to NCO for the RR to replace the RUC. The main emphasis was on making sure that the RR at ESRL and the RR test cycle at EMC performed at least as well as the operational RUC. This is a necessary condition for operational implementation of the RR. We continue to have nearly daily coordination telecons with Geoff Manikin of EMC. At this writing, we have a configuration of the RR running at GSD that is systematically superior to the backup RUC at GSD and slightly superior overall to the operational RR-NCEP. This final configuration was been moved to EMC in November.

No code changes for GSI or WRF have been made to the EMC Rapid Refresh since 1 Dec, although some smaller mods have been made regarding post-processing and access to higher-resolution sea-surface temperature data.. The excellent reliability of both the primary and developmental RR cycles, plus the capability of making short retrospective runs and the quick verification tools available to the RR development team have been crucial to overcoming the numerous issues that have arisen in the past few months. A change log on the ESRL primary RR 1h cycle is maintained at http://ruc.noaa.gov/internal/RR_runs/RR_1h_info.txt. Major issues dealt with during November include

- Discovering and fixing a major bug in the "curvature term" in the WRF model code when the Rotated Lat-Lon (RLL) option is used;
- Change in background error covariance to that from GFS (instead of NAM) and change to GSI scale parameters after experiments to optimize these values for the Rapid Refresh.
- Modification to WRF model regarding post-DFI resetting of water vapor and hydrometeor fields. Testing of workarounds for a serious problem that arises in WRF from use of the RUC treatment of moisture and hydrometeors after application of the digital filter initialization (DFI);
- Addressing various post processing issues at NCEP.

More details are included below on specific changes.

GSI Testing

GSI-RR now set for GFS background error with optimized scale parameters.

Background: GSI testing continued in October/November and in parallel with progress on other model and DFI issues. The result has been greatly improved understanding of GSI limitations in the context of the RR's hourly updating, as well as the effect of various combinations of GSD analysis settings (e.g., background error). Both NAM and GFS background error configurations (both available) have been extensively tested, and each has its unique set of strengths and weaknesses. The final configuration is very likely to be the GFS configuration. We have also adapted GSI to make fuller use of surface data, particularly over the western CONUS, Alaska and the Appalachians by sharply reducing the inflated observation error assigned to stations that report station pressures that are not within a few hPa of the model surface pressure at the gridpoint location.

WRF modifications for Rapid Refresh

After testing in November, the WRF-RR now includes bug fixes to the Thompson microphysics scheme, and a recent update to the MYJ PBL scheme.

Modifications to DFI

No new changes were made in November; see October report for changes made in that month.

Rotated lat-lon bug fix in WRF

This major issue was identified in late October (see October MDE report), and NCAR fixes have been running in both RR primary and RRdev since 4 November, and at NCEP since soon after.

RR post processing

Changes were made to correctly calculate heights from the Rapid Refresh.

Background: Work to ensure that UniPost was producing RUC look-alike grids on CONUS grid #130 for the *sgrb* and *pgrb* files was mostly completed in October. A few lingering concerns were addressed this month, including a low height bias in heights the lower troposphere coming out of UniPost. To remove the bias, we found it necessary to reintegrate the hydrostatic equation for the heights directly in UniPost rather than using the heights directly from the wrfout files. The *bgrb* files on grid #130, with the concurrence of the Inflight Icing and Turbulence PDTs, will not (at least initially) contain certain fields (e.g., drip from canopy) output in the current operational RUC *bgrb* files. Unfortunately, the rotated lat-lon grid option continues to be unrecognized by *wgrib2*, so that RLL grib2 output is not currently usable by the other PDTs. Fortunately, the other PDTs are using #130 grids from the RR. We expect this situation to be resolved during FY10Q3.

Subtasks

11.5.4.1 Ongoing (GSD, NCEP)

Ongoing evaluation of performance of real-time and retrospective runs of RR system for SAVs, AHPs

The RR 1-h cycles at GSD on the Rotated Lat-Lon domain now verify better for RMSVE winds and RMS temperatures aloft than the backup RUC at GSD. Mid-level (near 500mb) RH still verifies a little worse.
No egregious problems exist in surface verification. The 2-m temperature biases at GSD discussed in last month's MDE report were improved at initial time (0h) by applying the analysis increment at the lowest model level to both 2-m temperature and skin temperature. This improves the diurnal cycle of temperature overall, but we do still find that for certain land-use categories (e.g., deciduous forest) that the diurnal cycle is too suppressed. Verification of IFR ceilings (< 1,000ft) is a bit better than the backup RUC at GSD.

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.

As noted above, the RR has been undergoing rapid changes the past few months, so coherent evaluation by users has not been possible. However, along with the improvements to RR performance has come the capability to make pgrb, sgrb and bgrb files available based on the EMC test RR cycle output, and we expect that with this

cycle very close to being frozen, systematic evaluation of RR output by the other PDTs will occur during the next several weeks.

Deliverables

11.5.4.E1 20 Dec 2010 (GSD)

Report on Rapid Refresh status and plans to NCEP Operational Model Production Suite Review meeting.

Complete. Presentation available at http://www.emc.ncep.noaa.gov/annualreviews/2010Review/

NCEP

Work continues on the development of the Rapid Refresh for implementation at NCEP. A major bug in the post processor computation of geopotential heights was discovered at the end of November, and it will be corrected in the NCEP parallel in early December. The NCEP parallel has been stable and statistical verification has been steadily improving. It is anticipated that test grids will be available at some point during December. (Geoff Manikin).

See extensive observation processing work by EMC's Dennis Keyser in support of RR under Task 11.5.17.

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

ESRL/GSD

Based on group work spearheaded by Ming Hu, a frozen version of the GSI for the Rapid refresh implementation was obtained in November. The biggest change was to switch from use of a NAM-based background error covariance (BEC) file to a GFS-based BEC file. Based on detailed comparisons of single-observation analysis increments from GSI using the NAM and GFS BEC files, Ming made changes to the GFS BEC specification (changes to the amplitude and vertical correlation length scale) that resulted in equal or slightly superior RR forecasts from the GFS BEC compared to the NAM BEC. Rapid testing and evaluation of these changes was greatly facilitated by Haidao Lin's retrospective runs from a May 2010 5-day test case and application of Bill Moninger's radiosonde verification package. Additional testing and evaluation was completed using the two parallel real-time RR cycles at NCEP. Updated code was then passed to Geoff Manikin's real-time RR cycle running at NCEP.

Additional GSI-related work has focused on testing of a vertical interpolation and vertical re-integration following the 3DVAR analysis step to better preserve hydrostatic balance. Ming Hu implemented these adjustments in GSI and Haidao tested them in his retrospective experiments, but only found very slight impact. Haidao has also used his RR retrospective test period to evaluate the impact of satellite radiance (AMSU-A/B, HIRS, MHS) data on the RR forecast. Results from the first test showed near neutral impact. Analysis of the channel biases indicate sub-optimal performance of the bias correction scheme, which will be addressed in future experiments.

GSD personnel (Stan Benjamin, Ming Hu, Haidao Lin, Steve Weygandt) visited NCEP in early December for the Product Suite Review (presentation on RUC/RR/HRRR and discussions with NWS users). The presentation can be found at: http://www.emc.ncep.noaa.gov/annualreviews/2010Review/
GSD personnel also discussed various aspects of GSI for regional application with NCEP GSI researchers.

Two changes were made to improve the use of surface observations in GSI. First a linear ramp of the weighting (based on the observation vs. model pressure level difference) was added for surface observations below the model surface. Second, a bug, which only allowed the terrain matching pre-processing to be applied during the first outer loop (as oppose to all outer loops) was found and fixed.

CAPS

In November, CAPS continued to test the EnKF configuration in a slightly smaller domain (that avoids issues near southeastern boundary). In the previous month, it was reported that the three-hour forecast innovations with the EnKF assimilation were larger than those of parallel GSI experiments. It has been found to be caused by parameter 'sprd_tol' associated with extra EnKF observation QC procedure. Observation data are excluded if the deviation from the background exceeds certain threshold. In the previous tests, too strict constraint was applied and too many data were excluded from the observation system, leading to larger forecast innovations than GSI.

Figure 1 shows the corrected results of potential temperature and east-west wind component. In this experiment, the unlimited adaptive inflation approach together with a fixed covariance inflation of 1.2 was adopted. The horizontal localization radius was set to 600 km. This time the calculated three-hour forecast innovations of EnKF were close to the GSI though still slightly higher. To see if an increase in inflation can improve the results, experiments with unlimited adaptive inflation but fixed covariance inflation of 1.3 and 1.5 have been tested. However, both led to unstable WRF integration after first few days of cycled analysis. Further tuning of the EnKF system is needed for it to perform better than the GSI.

In addition, experiments with the same grid spacing resolution as RR initialized from the EnKF ensemble mean have been constructed. The comparison with forecast results from the standard RR procedure using GSI running at 13 km grid spacing is underway. The above experiments were all run at 40 km grid spacing so that the EnKF procedure would use a similar amount of computing as the 13 km GSI cycles.

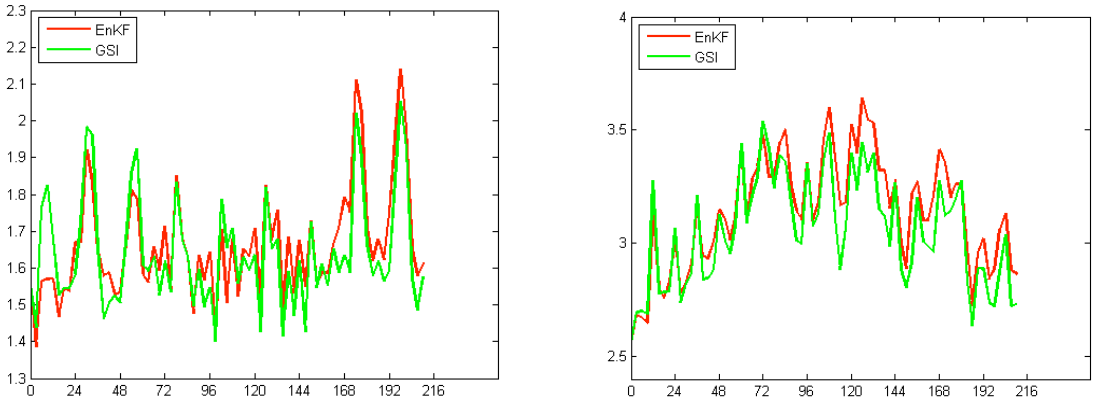

Fig.1 Three-hour forecast innovations of EnKF and GSI analyses for (a) potential temperature and (b) x-component of velocity.

NCEP

Work continues on use of hybens GEFS NMMB GSI (hybrid ensemble GSI for NMMB using GEFS ensembles directly for the ensemble part of the background error). After much effort and help from Edward Colon and Brad Ferrier, successful runs were obtained with the NMMB-GSI launcher including the hybens GEFS NMMB GSI.

Preliminary results from one case, 20100501 (Tennessee floods), show some sensitivity of forecasts to the inclusion of GEFS information. However, this is only one case and it isn't clear if the impact is positive. The hybens GEFS NMMB GSI has been run in a parallel by Wan-Shu, and shows a small but very consistent positive impact (compared to Eric Roger's NMMB NDAS parallel) for the NDAS for fits of 3 hour forecast winds to observations, especially at upper levels. There is also some improvement in the fit to moisture observations, while temperature is neutral and surface pressure has a consistently negative impact. No parameter tuning has been attempted yet. (Dave Parrish)

Studies continue on the impact of the analysis grid size and results show grid size can be doubled without degradation to the forecasts, which will help to reduce the computational requirements when we move to a hybrid-ensemble technique. MAP wind usage is being limited to levels below 400 mb and the latest NEMSIO library has been tested with the GSI code. A failed GSI job was traced to the use of GPS data. Although ASCAT winds were turned on in GSI analysis, a QC flag in the prepbufr files prevented their use. The observational errors were provided to D. Keyser and the flag has been fixed and the code updated. D. Keyser also found an error in the observational error table that W. Wu fixed. The hybens GEFS NMMB GSI was incorporated into the off-line parallel and preliminary results were encouraging. (Wan-Shu Wu)

Work continues on the 20101027-precipitation case to examine the impact on the forecast from assimilating VAD wind and radial wind. A detailed analysis was also done to identify the improvement in PCP ETS score for low thresholds after assimilating radial winds. Work continues on full vector wind retrievals from radar radial wind to get a tangential wind. These retrieved winds are compared with VAD winds. Efforts continue to create an interface so that GSI can read in the retrieved wind. (Shun Liu)

Using cross-validation, the covariance models used with the Alaska RTMA parallel have been fine-tuned. Code that generates mesonet station use lists for the Alaska RTMA on a periodic basis was also developed. Bugs have been fixed that were introduced into the 2DVAR option of the GSI subversion code while adding the 'bundle coding format'. (Pondeca)

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

GSD

GSD tested fixes to bugs in the Thompson microphysics scheme within the Rapid Refresh application, and decided to implement this. Tests showed only small effects. GSD also tested a new version of the MYJ PBL (planetary boundary layer) scheme in the 5-day May 2010 retro period, where it showed small positive effects. It has also been implemented in the frozen RR code.

Verification of 2-m temperature and dew point based as a function of land-use category has shown surprisingly large systematic differences in forecast behavior as a function of land use. For example, deciduous forest areas demonstrate a markedly suppressed diurnal cycle in temperature over the observed. As noted under Task 4, this contributed to our decision to apply the lowest-layer temperature increment from the GSI analysis to the 2-m and skin temperatures also. We will continue to use this information about performance as function of land use as guidance for identifying problems in the land-surface and surface-layer/boundary-layer schemes.

NCAR

Trude Eidhammer prepared a poster for the American Geophysical Union meeting entitled: "Modeling of dust impact on precipitation via heterogeneous ice nucleation". This poster describes the impact of the new dust ice nucleation scheme on the April 2010 winter storm. This is a storm which dust was observed to be generated in the desert southwest and likely impacted the storm.

She has also been examining reasons for the production of unexpected precipitation in the model simulations in regions when dust ice nucleation was included. It seems that model induced gravity waves during the spin-up time is a likely source of the problem. This “model induced” precipitation difference then makes it difficult to determine the physical based differences in precipitation. A solution to this problem is being worked on.

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

The RR with the frozen GSI version (including the cloud analysis) is yielding good forecast skill for ceiling and visibility variables (see ceiling verification slide in the NCEP Product Suite Review presentation slides: http://www.emc.ncep.noaa.gov/annualreviews/2010Review/, even though we are not resetting the cloud and relative humidity fields to the pre-DFI values in observed cloudy regions following application of the DFI in the WRF ARW initialization. In the RUC system, these fields are reset, following the DFI to help retain (in the model forecast) the clouds information added during the cloud analysis. Within the Rapid Refresh system, this resetting was previously found to cause some imbalance within and degradation of the RR forecasts (winds and other fields). Given the high skill of the RR cloud forecasts even without this reset of the hydrometeor and relative humidity fields, this change was deemed not critical for the RR implementation. Determination of the cause of this imbalance remains a priority, however, as resetting the fields may yield additional cloud forecast improvement in the RR and may be important for the HRRR 3-km radar reflectivity assimilation. Tanya Smirnova is continuing efforts to find a rebalancing procedure that alleviated this problem.

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

GSD

Curtis Alexander has coded script change to improve the HRRR latency by ~ 30 minutes and is testing them in the “HRRR-dev” shadow system. We were already using the previous hour RUC for lateral boundary conditions (LBCs) to avoid needing to wait for the current hour RUC to complete an 18-h forecast before starting the WPS pre-processing to obtain the LBCs. Note, we use the current hour RUC post-DFI fields for the HRRR initial conditions (ICs) to get the latest radar data information into the HRRR). The improvement is accomplished by running the WPS pre-processing for the HRRR LBCs in a separate step, as soon as the previous hour RUC 18-h forecast is complete. Then a second WPS is run for the HRRR ICs as soon as the current hour RUC post-DFI file is available. While it requires running WPS twice, the IC specification version runs much faster than a version that also processes the lateral boundary conditions, thereby achieving the time savings. This will soon be moved over to the primary HRRR run.

Curtis has also scoped out the work needed to switch the HRRR "15-min VIL output files from the current netcdf format to grib2 format. Currently, the fields are computed and directly from the ARW model at 15-min intervals, stored internally and output every 3-h. Under the new system, complete model history files will be output every 15-min, and the two different UNIPOST utilities will be run. The first one will create the 15-min grib2 files (allowing for the inclusion of some additional fields and shifting some of the diagnostic calculation from the model to the post program). The model output files from the "non-hour" times will then be purged to keep disk space use within reasonable bounds. A second UNIPOST run will then create the usually hourly grib2 files. This work will be completed in January 2011, with sample files being distributed to downstream users prior to the switchover of the real-time HRRR system.

Eric James is completing a RUC retrospective test from a June 2010 period. In this controlled environment test, the strength of the radar-based latent heating temperature tendency in the Diabatic DFI is being varied. Subsequent HRRR tests can then evaluate the impact on the HRRR forecast. This work will be expanded using a longer retrospective period from July 2010 that includes examples of key HRRR-related issues observed during the summer 2010 operational evaluation (including MCS propagation/maintenance, SE coverage, etc.). A detailed experiment plan is in place for this expanded testing, which will include matched RUC and RR retrospective runs, with associated HRRR runs, allowing for controlled comparisons of the RR-based HRRR and the RUC-based HRRR. Grids from these experiments will fed into Patrick Hoffman's reflectivity verification package and be provided to the other CoSPA teams for evaluation prior to switching the HRRR from the RUC to the RR.

Patrick Hofmann has completed work on his real-time RUC / RR / HRRR scale-dependent radar reflectivity verification package and added to very helpful web page for accessing the verification information. The first web-page displays forecast and validation graphics (full fields and color coded categorical information). The second web-page is patterned after Bill Moninger's verification pages and displays customizable time-series of statistical verification data. To create this page, Patrick ported the verification data to a database. A third web-page will allow customizable display of aggregate verification statistics as a function of valid time of day.

Patrick is also working on a similar scale-dependent 24-h accumulated precipitation verification for the RUC, RR, and HRRR models. The verification engine and web-image display page are complete and based on about three weeks of data indicate improved precipitation forecast for RR and HRRR compared to the RUC.

NCAR

Evaluate convection-permitting forecasting by the ARW core for ultimate application in the HRRR

CURRENT EFFORTS: Jimy Dudhia of NCAR/MMM worked with Greg Thompson (NCAR//RAL) in the investigation of causes of reflectivity differences seen in the 3-km high-resolution ARW runs of the 2009 tests and the 2010 tests using different versions of the Thompson microphysics scheme. The report has been completed and will be sent to ESRL in this quarter.

PLANNED EFFORTS: New RR-initialized, high-resolutions will be planned and conducted in Spring 2011.

UPDATES TO SCHEDULE: None

Task 11.5.19 Develop and refine techniques to assimilate radar radial velocity and reflectivity data through GSI and Rapid Refresh toward the HRRR

Not funded in FY11, an unfortunate slow-down to HRRR development.

Task 11.5.20 Develop ensemble-based probabilistic products for aviation users

Not funded in FY11.