MDE Product Development Team
August 2011 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 still 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.
- Correction made to height assignment for RASS observations (used in operational RUC) after ESRL discovery of problem.

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 August 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 to mid Dec 2011,** due to additional delays now anticipated with the NAM implementation now scheduled for late September as of this report (9/15).*

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

- Identified issue with height assignment for boundary-layer profiler and RASS observations and worked with NCEP personnel to make specification in prepBUFR observation consistent with GSI observation processing code (into NCEP RR immediately).
- Completed coding within GSI to add soil temperature and moisture nudging based on lowest model level temperature and moisture analysis increments (into Rapid Refresh v2).
- Continued evaluation of impact on GSI fits to radiosondes profiles as a function of variations in i) vertical correlation length scale, ii) observation error, and iii) increased vertical resolution in the raob data.
- 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

- Identified and corrected RR cloud analysis issue, in which dust observations were being interpreted as clouds, leading to spurious cloud building and moistening.
- 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).
- To further evaluate impact of radar data assimilation, a 2011 retrospective case study period has been identified (11-22 Aug. 2011) and retrospective runs with no radar data assimilation in parent model completed and subsequent HRRR retrospective runs started.

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.

A problem with RASS observation height assignment was discovered at ESRL in late August. This was traced to a fix needed in NCEP processing, which was accomplished on 13 Sept by NCEP/NCO.

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 be implemented early in FY12. The new aircraft QC code includes quality controlled high vertical-resolution aircraft ascent & descent profiles 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 ten times faster than previously. The final step is to update it to properly handle TAMDAR reports. AirDAT provided the full TAMDAR feed to NCEP from 0000 UTC 26 August through 2300 UTC 29 August to support NWP during Hurricane Irene, and approximately 9 times the usual amount of TAMDAR data was assimilated. The Florida and Georgia mesonet providers remained down. The Kansas DOT mesonet provider has been down since late June. ESRL discovered that the CAP/MAP profiler and RASS data have the wrong height assignment in the NCEP BUFR files. The NCO decoder is adding the station elevation to heights, which, are already above ground level, meaning the station elevation is counted twice and the observations are being placed at too high a level. This error, which has been present since late 2008 but does not affect NPN wind/RASS data, will be corrected in NCEP production in early September. (Dennis Keyser)

No infrastructure support was needed by the operational RUC in August (except for the RASS issue mentioned above). (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. 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 movable 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. (Eric Rogers)

During August, the NAM parallel snow analysis update code (nam_snow2mdl) was found to be aborting because of a code compile error. This meant that in the NCO parallel NDAS snow was continuously cycling on itself without an analysis update since the last time that NCO restarted the production NDAS parallel from the EMC

NDAS parallel (which was mid June). This was fixed on 9 August, and NCO restarted the official 30-day evaluation the next day. The scheduled implementation date for the NAM package is now 20 September 2011. (Eric Rogers)

During August a new NMMB parallel was started with convection changes to address the low QPF bias in the NMMB run that will be implemented in September. Changes include the modified "BMJ_DEV" scheme with reduced resolution factor for the saturation pressure difference (DSP) profiles in the convective parameterization. (Eric Rogers)

The WFIP-relocatable boundary layer profilers and SODARs started being processed at NCEP in mid-July. The NCEP production RUC/RR (and NAM) PrepBUFR files reject these data so they will not be assimilated in any NCEP-based runs. The NCEP-generated experimental Rapid Refresh (RR) PrepBUFR files (in a private ESRL directory on the NCEP ftpprd server) continue to run like production, so they won't be rejected and the ESRL RR can assimilate these data. 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. Due to fall eclipse season, which began in mid-August, there are potential gaps in GOES data around 0600 UTC. NOAA-18 has on-going gyro issues that could lead to unusable products. An implementation on 9 August expanded the duplicate checking of ATOVS 1b reports to include "near" duplicates in location (within 0.01 deg lat/lon) which are found in orbital file overlaps and are due to differences in POES ground system processing. On 9 August, the Level 2.5 88D radar decoder was modified to correct an error, which output radar station height in feet instead of (the assumed) meters. A 7-hour outage of NOAA-18 ATOVS 1b data on 2 August was due to ground equipment problems. Hurricane Irene caused an outage of Langley cloud data from 26-29 August. Blind orbit problems interrupted all METOP products for 7 hours on 22 August. A hardware error interrupted WindSat data 28 July through 2 August. 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 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. (Dennis Keyser)

The first step of the plan to expand from CIP on the RUC regional model/domain to GCIP on the GFS global model/domain is to develop capability to ingest three datasets: a GFS master file, 3 channels of geostationary satellite imagery data (Visible, near-Infrared and Infrared), and METAR surface observation data (cloud and precip type from present weather). The RUC version of CIP ingests six datasets: RUC model data, satellite data, METAR, PIREPs, lightning, and the radar mosaic. To run the GCIP on CCS, the original CIP source code needs to be modified to ingest METAR data from the CCS BUFR dump file and ingest global satellite data in McIDAS format. The work to decode McIDAS satellite data is complete but amount of data currently available from NESDIS at NCEP is limited, either the global data from Visible and near-Infrared channels are missing, or data from all 3 channels are limited to the Northern Hemisphere. Fortunately, NESDIS can distribute more data on request, and we are waiting for a response from NESDIS to our request. (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** that 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. A developmental Very Short Range Ensemble Forecast VSREF) is run every hour using RUC and NAM time-lagged forecasts. It is being adapted to Rapid Refresh and will be renamed North American Rapid Refresh Ensemble – Time Lagged [NARRE-TL]. (Jun Du, BinBin Zhou)

NCAR/MMM - CURRENT EFFORTS:

NCAR/MMM personnel worked on preparing for the next minor release of WRF, V3.3.1. This is primarily a bug-fix release and will be issued in mid-September. Modifications that have been made have been on the SBU microphysics scheme, from Yanluan Lin (Stony Brook Univ.), and on the Thompson microphysics scheme, from Greg Thompson (NCAR/RAL). A fix has also been added for the surface 2-m temperature diagnostics in the case in which the RUC LSM is used with the YSU PBL scheme.

Jimy Dudhia of NCAR/MMM continued to work with visitor Marcela Ulate (Univ. of Miami) on investigating WRF physics and the simulation of the MJO. This has included diagnosing the mean heating and moistening profiles for a range of cumulus and PBL options on a 50-km WRF test grid.

Dudhia worked with Georg Grell (NOAA/ESRL) to add a fix for water conservation in the Grell 3D and Grell-Devenyi cumulus schemes. It had been found that the schemes were not strictly conservative.

Lastly, Dudhia worked with M. Biswas (DTC) on improving physics interoperability between the ARW and HWRF. This includes the NSAS convective scheme, where the detrainment process logic was improved in interactions with various microphysics schemes.

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 to mid-December, 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 August continued toward test and evaluation of analysis and model changes being considered for the next RR upgrade ("RR2") hoped for in 2012. We continued testing of RR enhancements 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 during August.

- 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 generally positive overall, and especially 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. Because the impacts of this change on RR forecasts (as opposed to HRRR) have not been uniformly positive, e.g., for 6-h wind

forecasts above the surface, we continue to use our capability to conduct retrospective experiments to test out possible refinements to the procedure.

- Testing of reduction of the vertical correlation scale of background error in the GSI (see Task 5 for more details).
- Nudging of soil temperature and moisture based on the sign of the observation innovations of 2-m temperature and moisture under certain conditions (see July 2011 monthly report). Testing began late in the month and was successfully completed in early September. This has now been introduced into the RRdev with slight reduction of the eastern CONUS high daytime dew-point bias. Further tuning of the strength of the nudging will continue.
- Special treatment of analysis increments for temperature and mixing ratio near shorelines following what is done in the operational RUC. This eliminates spurious pockets of high CAPE sometimes seen over coastal waters, most frequently offshore of southern California.

In addition to these RR2 matters, in preparation for giving the final code version to NCO for the initial RR implementation several small adjustments were made to ensure that WRF Preprocessing System had access to the initial surface pressure field and was initializing soil moisture from the RR correctly in the HRRR. Additional work was also needed to render the output files from UniPost as similar as possible between GSD and EMC. Unipost was also upgraded to output an estimated fractional cloud cover for low, middle and high clouds (three additional 2-d fields), based on the fraction of surrounding grid points containing cloud water or cloud ice in the near vicinity of each grid point.

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 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. The codes will be handed off to NCO in September and RR implementation is currently scheduled for November. (Geoff Manikin)

Various model and model physics configurations have been tested within the new SREF. Ensemble diversity (spread) issue has been investigated. 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 8 Sept 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.

From late July into August, ESRL held separate telcons with field forecasters from the Western, Central, Eastern and Southern Regions, respectively, 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. 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
Ming Hu completed coding of GSI modifications to apply soil temperature and moisture nudging within the RR hourly analysis. The nudging is based on the lowest atmospheric level temperature and moisture (relative humidity) increments. These changes were then included in the development version of the RR (RR-dev) at GSD. Evaluation of the analysis – background stats for the RRdev land the RMS surface temperature (T) and dew point (Td) errors for the RR-dev vs. RR-primary indicates that the soil nudging appears to be working and producing a slight improvement on surface T and Td forecasts. This analysis feature will not be part of the initial RR implementation, but is a likely candidate for the RR version 2 enhancements.

Another minor adjustment was made to the RR GSI to limit the low-level temperature and moisture analysis increment for near coastal oceanic regions. This change adds a feature form the RUC 3DVAR analysis that helps prevent the application of unrepresentative increments derived from coastal observations over near coastal oceanic areas.

Patrick Hofmann continued his testing and evaluation of the impact on GSI fits to radiosondes profiles as a function of variations in i) vertical correlation length scale, ii) observation error, and iii) increased vertical resolution in the raob data. A previous assessment within the real-time parallel RR-dev of just reducing the vertical correlation length scale indicated a modest forecast improvement. Patrick confirmed that our extended application of Wan-Shu Wu's code to provide the radiosonde observations at higher vertical resolution was functioning correctly, but yielding only modest impact of the analyzed sounding structure. As expected, the

biggest improvement in the analysis fit to raobs was obtained by reducing the observed error variance. Work is ongoing to evaluate the subsequent forecast impact for these changes.

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. An issue with the height assignment for the observations was identified and an interim fix to correct the problem was added to the GSI observation processing code. Once the correction to the height assignment was added prior to the prepbufr file generation, the interim fix within GSI was removed.

During the month, Ming Hu also worked with Geoff Manikin to resolve a 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.

CAPS

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

EnKF experiments of last month suggested that reduced vertical cutoff radius resulted in smaller 3-h forecast innovation, experiments tuning vertical cutoff radius continued. In the current EnKF, the vertical cutoff radius is of the same physical distance no matter what height of the observation is at. This fixed cutoff radius was found to be not comparable to GSI. The latter increases its effective cutoff radius with height in the horizontal but decreases it in the vertical. Therefore, we increased the horizontal cutoff radius with height based a nonlinear function in our earlier EnKF tests which proved to be positive. Here, we further applied a nonlinear function in the vertical by decreasing the vertical cutoff radius with height. This change greatly increased the spread in the upper level (grey dotted line in Fig.1), and more importantly, made the spread curve more parallel to the 3-h forecast innovation. Another issue is when we compared the observation error of deterministic ensemble mean forecast of EnKF with GSI; we found the adjusted observation errors in GSI are much smaller than EnKF especially in the lower level. Therefore, we reduced the observation error in EnKF by weighting 60% of adjusted observation error and 40% of original observation error. No improvement was found which suggested the observation errors were not the main cause of higher forecast innovation of EnKF.

To see if the use of multiple physics parameterization in the forecast ensemble would help improve the EnKF analysis, we performed a multiple-physics EnKF experiment. We divide the 40 members into five groups, with each group using different combinations of radiation, cumulus, and surface physics and PBL parameterization schemes. The results are encouraging. As expected, the spread was increased a lot and **for the first time EnKF 3-h forecast innovations of RH and U wind component are better than GSI innovations even at the upper level** (see dark green in Fig.1). However, the innovation for V wind component is still a little higher than that of GSI at the upper level. Further tuning of multiple physics configuration is still needed. The multi-physics configuration can potentially provide an optimal configuration for short-range ensemble forecasting that includes both initial condition and model physics diversity.

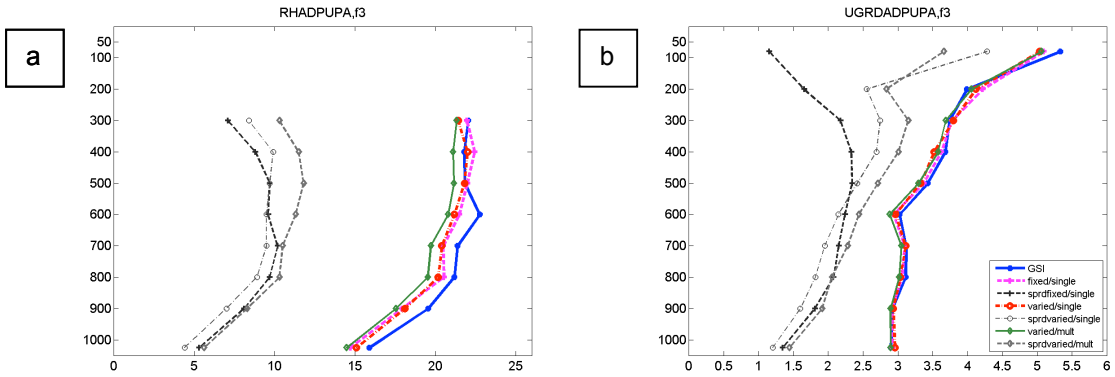
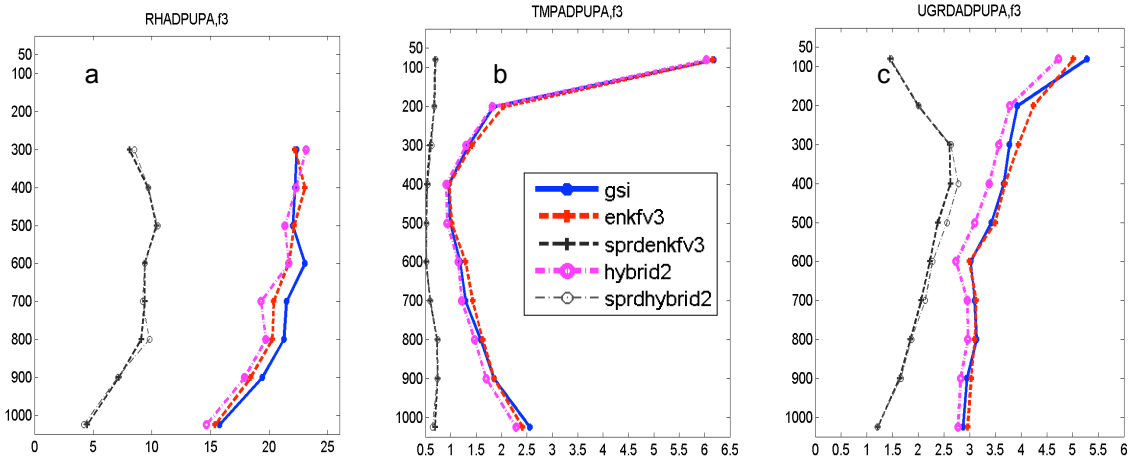


Fig.1. Vertical profiles of spread (gray and black) and RMSE (colored) of 3-h deterministic forecasts for (a) relative humidity; (b) x-component of wind. All are verified against upper air reports (ADPUPA). The pink line is of the vertical cutoff radius and single physics scheme; the red line is using a nonlinear function which decreased the vertical cutoff radius with height and the dark green is the same as red except using multiple physics schemes.

The work on Hybrid-EnKF continued. In last month, both 1-way and 2-way Hybrid EnKF capabilities have been implemented and tested. In the 1-way Hybrid, the ensemble perturbations of the EnKF system are used in the Hybrid scheme for flow-dependent background error covariance. In the 2-way Hybrid EnKF, the mean of the EnKF analyses is replaced by the Hybrid analysis, and recentralize each member. Both 1-way and 2-way experiments conducted far employed half static covariance and half flow-dependent covariance. The results of initial tests of the Hybrid-EnKF are very encouraging. **The 2-way Hybrid-EnKF (pink lines in Fig.2) completely outperforms the GSI (blue line in EnKF) for all verified variables (relatively humidity, temperature, wind of soundings and wind profilers) at all levels (including the jet levels where we had problem beating GSI for wind with pure EnKF – see red lines), something that we have not been able to achieve so far with EnKF.** However, the Hybrid 1-way is not working as well as 2-way. Further investigations and configuration tuning are still needed in future.

An important caveat: We note here that a scripting error was identified very recently that affects all EnKF and the 1-way hybrid experiments reported here; due to the error the deterministic forecasts used in the verification were initialized with 3-hour ensemble mean forecasts instead of the current ensemble mean analyses. Only the 2-way hybrid experiment had this error corrected. With the correction, we expect further improvement to the EnKF and 1-way hybrid results.



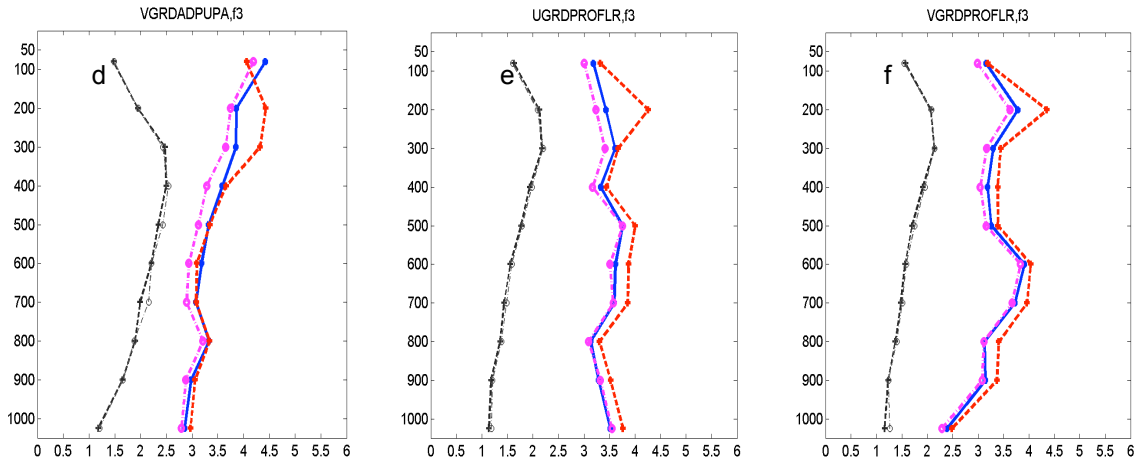


Fig.2. Vertical profiles of spread (black) and RMSE (colored) of 3 hr deterministic forecasts for (a) relative humidity; (b) temperature; (c) x-component of wind against soundings and (d) y-component of wind against soundings; (e) x-component of wind against wind profilers; and (f) y-component of wind against profilers.

NCEP

The work done on the regional GSI using hybrid ensemble had been incorporated (though not turned on) into a recent GSI version that included all the NAM upgrade package structures. Tests on the vertically integrated alpha for the surface pressure increments show that using the weighted linear-balance projection matrix produced the best impact. The effect on the regional first guess from adding a perturbed ensemble member instead of the global ensemble mean was shown to be positive in the resulting forecasts. Incorporating vertically inhomogeneous background errors for blending coefficients of variational and ensemble solutions has a small but positive impact. The version was then put into an off-line parallel. Work was done to reformulate the parallel scripts to submit jobs a few at a time to avoid time penalties in the machine queue. Work continues on identifying radiosonde layers where it is justifiable to generate intermediate levels; i.e. there are significant levels reported that bracket the layer. A potentially code-breaking bug in the use of radar data was found, and a fix was developed and added to the soon to be implemented GSI code for testing in the official parallel. The code for the vertically integrated alpha for the surface pressure increments was finished and tested before giving it to the global hybrid ensemble group. (Wan-Shu Wu)

Testing of GSD's cloud analysis package for NMMB initialization has begun. An adjusted temperature tendency from the cloud analysis is converted back to temperature increment and an NMMB forecast was made with the modified temperature field. The forecast impact from the modified temperature is mixed. The temperature forecast is slightly improved, but the wind forecast becomes worse. Liu and Parrish worked on checking a bug in the radial wind assimilation code where the GSI does not handle level2.5 and level3 data properly when the observation is too close to a radar station. The GSI code was also modified to use the real station ID for level2.5 and level3 data. (Shun Liu)

While attempting to extend the global hybrid ensemble dual resolution option to regional application in GSI, several more bugs were uncovered. These fixes will be included in the first September GSI trunk update. Currently, GSD assimilates radar reflectivity by creating a fixed latent heat forcing based on the cloud analysis. This is used in a diabatic digital filter model run, with model latent heating replaced with the fixed latent heat field. An alternative approach is being formulated to assimilate latent heat “retrievals” directly in the GSI. By adding a latent heat control variable which forces the GSI tangent linear tendency model temperature tendency, it may be possible to use the GSI regional strong constraint to create appropriate convergence/divergence of the analysis wind increment. (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
Modification and testing the MYNN planetary-boundary-layer (PBL) scheme continued in August. Joe Olson has been collaborating with Mikio Nakanishi, one of the original authors of the scheme, in this effort. Retrospective runs using our May 2010 retro period showed overall good performance by MYNN relative to MYJ, but also showed what we regard as undesirable sensitivity of low-level wind shear to the procedure for calculating boundary-layer depth. Further investigation and additional retro runs are planned. Pending favorable outcomes, and after the conclusion of CoSPA on 31 October 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
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 is testing the new ice nucleation scheme for the Thompson microphysics by running a well-observed wave cloud case from the ICE-L field program. The results of the simulation are currently being analyzed and will be presented 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
On the night of 28 August 2011, SPC forecasters expressed concern about extremely high MUCAPE (most-unstable Convective Available Potential Energy) values over the lower deserts of California and Arizona in both the RUC and RR. This problem was traced to low ceilings reported at METAR stations as a result of a low lying layer of dust raised earlier by strong outflow from convection over southern AZ. A safeguard against this problem was added in early September to the backup RUC and RRdev cloud analysis to ignore ceiling height from METAR observations when dust or certain other restrictions to visibility are reported, or when the ceiling height is inconsistently low relative to the 2-m dew point depression. This code change has been added to the Rapid Refresh GSI code for the initial implementation of the RR at NCEP.

GSD continued to monitor changes introduced in late July by Stan Benjamin 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 (which it is so far), 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 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 (most unstable Lifted Index – LI) 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. Some HRRR tests were run in August using RUC-dev initial conditions to test this LI-dependent latent heating calibration, with mixed results so far.

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 with good overall reliability and skill. Following real-time use of the HRRR-dev parallel slot (new runs every other hour) to evaluate the impact of pseudo-observations within the RR and sensitivity to the model time-step, we began a set of retrospective HRRR runs. These HRRR retrospective runs will focus on an identified period of active weather (11-22 Aug. 2011). Research efforts devaluate HRRR improvements will focus on retrospective testing form this period. Initial work has focused on running an RR retrospective without radar reflectivity DFI assimilation and then running a series of HRRRs from this retrospective RR. This combined with our real-time HRRR runs will provide a bracketing set of results for additional retrospective testing during the cold season. A number of candidate changes to both the parent RR and the HRRR will be evaluated.

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: MMM acquired the HRRR source code, namelists, and initial conditions for the 11 July case study from GSD. This selected case is a noctural derecho-like event in which organized convection propagated across Nebraska, Iowa, and Illinois. It was seen that the RR simulated the event, but the RUC did not. Thus, part of the investigation is to understand this performance difference. The HRRR code was ported to an MMM computer and preliminary runs were started. Initial and boundary conditions from the RR and RUC will both be tested.

PLANNED EFFORTS: NCAR will complete the ARW test runs and analyze the output for the selected event. A report will be prepared.

UPDATES TO SCHEDULE: NONE