MODEL DEVELOPMENT AND ENHANCEMENT RESEARCH TEAM

Monthly Report for April 2008
Submitted 15 May 2008

With contributions from Geoff DiMego and Mary Hart (NCEP/EMC);
Stan Benjamin, John Brown, Steve Weygandt (NOAA/ESRL/GSD);
Jordan Powers, Roy Rasmussen (NCAR);
Ming Xue (OU/CAPS)
(Compiled and edited by S. Benjamin and B. Johnson)

Executive Summary

Task 08.5.1: Infrastructure support related to operational running of the RUC and North American Mesoscale (NAM) operational modeling systems.

- Testing continues at NCEP for RUC upgrade package code (radar reflectivity assimilation, TAMDAR, radiation, Grell/Devenyi upgrade). Implementation now planned for Sept 2008. See real-time comparisons in http://wwwt.emc.ncep.noaa.gov/mmb/ruc2/para . Summary from AMS Conference (late Jan) available here: Implementation of the radar-enhanced RUC.

Task 08.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

- Latest Rapid Refresh summary at http://rapid.refresh.noaa.gov .
- Web-page comparing cold start and hourly cycled RR at http://rapidrefresh.noaa.gov .
- Experimental RR 1-h cycle running fairly reliably
- One-hour cycle will soon be using WRF version 3.0 and latest regional GSI version (March 2008).

Task 08.5.6: Develop, test, and evaluate the performance of the nonhydrostatic WRF modeling system.

- WRF version 3.0 released early April. Incorporates improvements in preprocessor to initialize with RUC native grid initial conditions, including hydrometeors

Task 08.5.8: Improve model physics for aviation forecasts.

- Change to snowmelt in RUC LSM improves temperature forecast with melting snow

Task 08.5.15: Develop improved methods of cloud and moisture analysis for use in the WRF modeling system.

- Cloud analysis for GSI incorporating METAR cloud and GOES cloud-top data (similar to the RUC cloud analysis) has been tested in a 1-h cycle with the Rapid Refresh.

Task 08.5.24: Begin 3km High-Resolution Rapid Refresh testing

- Work underway with approval of previous Option B

Detailed report – MDE – February 2008

Task 08.5.1: Infrastructure Support Related to Operational Running of the RUC and North American Mesoscale (NAM) Systems

GSD

Two change packages:
Immediate (late May) change package and larger upgrade (September) change packages to RUC

GSD and EMC are working toward an immediate change (in late May) to the RUC to shift land-surface fields and begin to use higher-resolution GOES data in response to NESDIS needs. A slight horizontal (~5km) shift in its land-surface fixed fields (vegetation type, soil type) will correct these fields, and make them more accurate near coastlines. RUC users from The Weather Channel brought the need for this shift to GSD's attention, and subsequently, new fixed fields were derived, tested, and implemented in the GSD RUC and the NCEP/EMC parallel RUC. In the second component of this immediate change package, NESDIS is awaiting for a RUC change to cease production of 3x3 field-of-view (FOV) precipitable water data, which the operational RUC currently assimilates. Thus, the immediate change will also include some modifications to the RUC analysis to allow use of the much denser 1x1 FOV PW data.

RUC upgrade for model, assimilation, and post-processing
The RUC upgrade continues in parallel testing at NCEP. Real-time comparisons continue to be available at http://wwwt.emc.ncep.noaa.gov/mmb/ruc2/para. Both GSD and NCEP/EMC have used this web site on a daily basis to compare forecasts between the operational RUC and parallel RUC (with upgrade). One new comparison that arose in late April and early May was for moisture profiles in the southern Midwest, after being alerted by NCEP's Storm Prediction Center. It was found that operational RUC soundings sometimes had excessively deep moist layers, but in almost all cases, the parallel RUC did not have this problem and showed much more realistic soundings (also discussed below under NCEP for task 5.1)

GSD also tested (at GSD first) and then introduced two additional changes to the upgrade package. The first was to revert to the fall 2007 GSD version of the Grell-Devenyi scheme. It was found that upper-level wind forecasts appeared to have been degraded downstream from convectively active regions using the new version of the Grell-Devenyi scheme. The second was to introduce a modification to improve 2m temperature forecasts under conditions of warm advection over snow cover. This change was to limit melting in the snow component of the RUC land-surface model.

Current planned implementation date – September 2008

BACKGROUND on RUC upgrade:
Please see the October report for more details on RUC upgrade. Key components:

- Assimilation of new observations: radar reflectivity, TAMDAR aircraft, mesonet winds
- Model physics changes – RRTM longwave radiation (new), Grell-Devenyi convection with

improved (reduced) spatial coverage for light precip, snow density and limited melting in land-surface model to improve 2m temp forecasts over snow cover

Effect of changes:

- Much improved precipitation, new reflectivity products.
- Elimination of 2m temp warm bias in summer and cold bias in winter.
- Improved lower tropospheric temps, winds, RH, clouds (TAMDAR, radiation physics)

NCEP

Dennis Keyser reports that from 1800 UTC 9 April through 2000 UTC 11, April NPN wind profiler data were not available because they were reporting longitude in degrees east instead of in degrees west. Tests of both "new science" GOES 1x1 f-o-v cloud data and GOES 1x1 f-o-v PW data (replacing current 5x5 f-o-v products) are underway. Parallel testing of TAMDAR aircraft temperature and wind data is also currently underway. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ESRL MADIS feed.

Geoff Manikin reports that EMC began running a parallel version of the RUC model last fall, with the primary feature of this code being the use of radar reflectivity data. Geoff Manikin has been working with Shun Liu to generate hourly reflectivity mosaic files to be ingested by the RUC to specify the 3-d profile of latent heating for use in the digital filter initialization. Other changes include the assimilation of mesonet wind data from a list of approved providers and of TAMDAR data, a change in the longwave radiative scheme from Dudhia to RRTM, a modification of the snow component in the land-surface model to decrease excessively cold 2-meter temperatures over fresh snow at night, and a modification to the convective scheme to decrease widespread coverage of light precipitation. Daily comparison of operational and parallel forecasts continues, and statistical evaluation of the new version of the model is underway. Implementation of this package is scheduled for late summer or early fall 2008.

In addition, an upgrade to the operational RUC is being prepared to switch from reading 1x1 GOES precipitable water radiances instead of the current 5x5 values, as NESDIS is looking to shut off the 5x5 data feed. The analysis code must be updated to handle a larger volume of GOES precipitable water data. A May implementation is likely.

Finally, SPC forecasters alerted EMC to a problem with the RUC generating near-saturated layers near the top of the PBL over the Southern Plains in southerly flow, leading to extremely erroneous values of elevated cape (see GSD section under task 5.1, above). The problem appears to be caused by overfitting the GPS precipitable water observations, and a fix is being sought for a possible crisis or expedited implementation in May. Other users have noticed a problem with a slight shift of the model coastline along the Great Lakes relative to the truth, and it was determined that the model topography and land-use files are indeed shifted slightly from truth. Replacement files will likely be implemented in late May.

Subtasks

08.5.1.1 Maintain hourly RUC runs and provide grids of SAV and AIV guidance products.

08.5.1.2 Provide vendors with gridded model data via Family of Services (FOS), and the FAA Bulk Weather Data Telecommunications Gateway (FBWDTG).

08.5.1.3 Provide full grids from RUC runs on NCEP and NWS/OPS servers.

08.5.1.4 Maintain access to model verification data.

Deliverables

08.5.1.E1 1 October 2007 - 30 September 2008 EMC (NCEP, GSD)
Perform observation ingest, quality control, and preparation of both existing and new observations in support of the operational RUC runs.
CURRENT EFFORTS: Ongoing for both NCEP and ESRL/GSD.

08.5.1.E2 1 October 2007 - 30 September 2008 (GSD)
Perform configuration management for RUC, including thorough documentation, and respond promptly to any code malfunctions or performance issues.
CURRENT EFFORTS: Ongoing for both NCEP and ESRL/GSD.

08.5.1.E3 1 October 2007 - 30 September 2008 (GSD, NCEP)
Monitor RUC performance, respond to any problems detected by GSD, NCEP, or any RUC users, diagnose cause, develop solution to RUC software, test changes and coordinate with NCO on implementation.
CURRENT EFFORTS: Ongoing for both NCEP and ESRL/GSD.

Task 08.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

ESRL/GSD

A significant work effort is nearly complete to upgrade the two major components of the RR 1-h cycled system (the WRF model and the GSI analysis) to the most recent versions. Soon after version 3 of the WRF model was released at the end of March, Tanya Smirnova began working toward getting these new versions of the WRF model and the WRF Preprocessing System compiled and running on wJET. This proved to be less of a chore than in some past releases. The new WPS release incorporates GSD enhancements to allow initializing the WRF model with RUC native vertical grid data, including 5 types of hydrometeors. With the release of WRFv3.0, WRF users can now obtain initial cloud/hydrometeor fields from operational RUC grids (only available via RUC). The new WPS also now correctly initializes areas of sea ice coverage from the GFS, another important improvement that benefits the RR. Tanya has resumed the RR full domain cold start runs with DFI using version 3.

For the analysis, Ming Hu has been working toward getting the new regional version (March 2008) of the GSI compiled and running on wJET with inclusion of the RR-specific features. The new GSI version has extensive changes to the satellite radiance assimilation package, which has

required a significant effort to get it running on wJET. This effort is mostly working now, but a few details are still being resolved. Once this is complete, the ongoing real-time 1-h cycle will be switched to these new code versions (expected in next couple of weeks).

NCEP

PLANNED EFFORTS: Complete upgrade of RR 1-h cycle to latest WRF model (version 3) and latest regional GSI (March 31 version).

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: See discussion under subtask 4.1 below.

INTERFACE WITH OTHER ORGANIZATIONS: DTC, NCEP, NCAR

UPDATES TO SCHEDULE: None.

Subtasks

08.5.4.1 30 December 2007 (GSD, NCEP) COMPLETE
Begin real-time hourly cycling of RR model with GSI over RR domain with availability at GSD of hourly prepBUFR files from NCEP having begun on 12 October 07.

CURRENT WORK:
See discussion above for description of recent enhancements to the Rapid Refresh real-time 1-h cycle.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: NCEP, NCAR

UPDATES TO SCHEDULE: None

08.5.4.2 1 March 2008 (GSD) [COMPLETE]
Begin collaborative evaluation with planned NOAA Rapid Refresh users, including AWC, SPC, NWS in Alaska and Puerto Rico. Arrange to have GSD RR grids available to examine and solicit feedback on RR performance.

We anticipate that interactions with Alaska forecasters will increase once they begin receiving grids from the GSD 1-h cycle. Graphical products from various parallel cycles of the Rapid Refresh continue to be available via the Rapid Refresh web-page. Sample RR grids have been downloaded by Turbulence and Icing RT scientists and offered to NWS Alaska. Following will be beginning of real-time ftp transfer of RR files to the ESRL/GSD ITS branch for dissemination to other FAA AWRP Research Teams and NWS.

08.5.4.3 1 March 2008 (GSD)
Begin collaborative evaluation of Rapid Refresh with Inflight Icing, Turbulence, National Ceiling/Visibility, and Convective Weather RTs. Arrange to have GSD RR grids available to examine and solicit feedback on RR performance.

Test grids from the RR 1-h cycle have been made available via the GSD ftp site and initial feedback from RTs on data format issues have been received. Work to establish real-time file transfer has progressed well (automated procedure to rename the files and transfer them to GSD ITS branch functioning).

08.5.4.4 30 May 2008 (GSD, NCAR, NCEP)
Report on status of tactical planning for making RR-WRF code for 2012 in compliance with Earth System Modeling Framework (ESMF) as specified in the Sept 2007 Rapid Refresh MOU between NCEP and GSD.

Tom Henderson (formerly NCAR, now with ESRL/GSD) is progressing nicely toward putting the ESRL FIM (Flow-following Icosahedral Model, under development, test and evaluation within GSD) into the ESMF framework, a necessary step if it is to contribute members to NCEP's Global Ensemble. In the process of doing this, Tom is working closely with Tom Black of EMC. Tom Henderson now has FIM running within a very rudimentary ESMF version at GSD, and will convert this to run under NCEP's version of ESMF version 3.1 as soon as it becomes available from NCEP. Experience so gained will facilitate the process of putting the RR under ESMF.

08.5.4.5 Ongoing (GSD)
Further enhancement to WRFpost version for Rapid Refresh application, including modifications for generation of RUC-specific fields.

Output from the RR 1-h cycle at GSD, as well as that from the full-domain cold-start and run continue to be available. The Alaska window real-time products continues to be available from the cold-start run. Refinement of the presentation style (e.g., color tables) of these plots has been made to facilitate comparison with output from the various RUC hourly cycles running at GSD and NCEP. As noted under subtask 2 above, a separate display (based on AWIPS grid #249) is available to facilitate evaluation of RR over Alaska. Visibility, ceiling, and cloud-top height plots have proven helpful in evaluating the cloud-analysis performance (see tasks 08.5.5 and 08.5.15).

08.5.4.6 Ongoing (GSD, DTC later)
Ongoing evaluation of performance of real-time and retrospective runs of RR system for SAVs, AHPs.

Now that the 1-h cycle is running more consistently on wJET, quantitative statistical validation is beginning. These statistics will become more meaningful once conversion of the 1-h cycle to run using WRF version 3 is complete (see subtask 4.1). The web displays noted above continue to permit qualitative evaluation.

Deliverables

08.5.4.E1 30 Aug 2008 (GSD)
Have available for delivery to NCEP initial 'experimental level' WRF Rapid Refresh code for start of EMC testing toward 2009 Rapid Refresh implementation.

Task 08.5.5: Develop, test, and implement improvements to the operational WRF 3DVARs for Rapid Refresh and North American Mesoscale runs.

NCEP
Wan-Shu Wu looked into a complaint about widespread and apparently spurious precipitation in the first 6 hours of the 12z NAM cycle forecasts off the West Coast. Through data denial tests, she identified the main source for the humidity bias as AMSUA and MHS satellite radiances. She also worked to incorporate the adaptive tuning of observational error using the DesRoziers et al. method as an option within the official GSI code. This method is now available with each update of both the global and regional systems.

Shun Liu worked with NCO to test the new radar data processing package. This package includes new job scripts, a new data decoder, updated radar radial wind quality control (QC), reflectivity QC and interpolation of reflectivity from polar to Cartesian coordinates. He has run the new package and compared it with his parallel, and also examined the data dumps from the new package and parallel. The results from the two runs are identical so the new package will be implemented at NCO soon. He continued working with NSSL to improve current radial wind QC to handle new scan modes. These improvements have been included in the radial wind QC package and are under parallel testing and use in the parallel RUC.

GSD

Subtasks

08.5.5.1 31 December 2007 (GSD and CAPS) COMPLETE
Progress report on testing and evaluation of the generalized cloud/hydrometeor assimilation (including GOES cloud-top data and METAR cloud/visibility/weather data) within a cycled GSI on the full Rapid-Refresh domain.

Ming Hu has ongoing work to merge cloud analysis capability into latest regional GSI version. Also, discussions are underway to establish an SVN (Subversion, a software change management tool) repository to systematically track the evolution of GSI versions and aid collaboration between GSI developers.

08.5.5.2 31 December 2007 (NCEP and GSD)
Report on testing of 2DVAR GSI assimilation of high spatial and temporal mesonet surface data using analysis grids with 5-km or finer resolution.

08.5.5.3 31 January 2008 (NCEP and CAPS)
Further refine the radial velocity analysis component of GSI in response to model resolution changes. Examine data impact at higher assimilation frequencies and higher spatial resolutions. Consider issues on data quality, super-obbing, and optimal decorrelation scales.

08.5.5.4 28 February 2008 (GSD)
Report on statistical evaluation of Rapid Refresh forecasts initialized with the GSI, including examination of upper-level winds, surface fields, and precipitation.

The most recent statistical comparison of the RR 1-h cycle vs. the operational RUC upper-level winds (over the matched CONUS radiosondes stations) for a 6 week period from early March through late April indicates that for levels below ~400 mb, the wind RMS errors for the RR 1-h cycle are smaller than the current operational RUC for the +3h and +6h forecasts (very good news) and those for +9h and +12h forecast wind RMS errrors were similar.

08.5.5.5 31 July 2008 (NCEP)
Based on case-study testing and refinement of the research quality code, deliver result in an 'experimental' code for an upgrade package (e.g. improved use of WSR-88D data and satellite radiances and covariances) to the WRF-GSI for FY2009 change package to the NAM-WRF.

Deliverables

08.5.5.E1 30 March 2008 (NCEP)
Subject to NCEP Director approval implement upgrades to WRF-GSI used in NAM/NDAS.

CURRENT EFFORTS:

PLANNED EFFORTS:

08.5.5.E2 30 August 2008 (GSD)
Rapid Refresh code delivery date to NCEP/EMC for initial testing of RR version of GSI.

08.5.5.E3 30 September 2008 (NCEP and CAPS)
Deliver enhancement package for radial velocity data analysis for further implementation testing.

CURRENT EFFORTS:

PLANNED EFFORTS:

Task 08.5.6 Develop, test, and evaluate the performance of the nonhydrostatic Weather Research and Forecasting (WRF) modeling system.
NCAR/MMM
NCAR released WRF Version 3.0 in April. This major release offers a number of new features and improvements, including a global ARW capability, a variable time step, an implicit upper

boundary gravity-wave absorbing layer, digital filter initialization (with contribution from GSD), a modified WRF-NMM storage order, merged WRF and WRF-Var, and WRF-Chem. There are a number of new physics packages available, including Morrison microphysics, Goddard microphysics, a new Grell cumulus scheme, the Unified Noah LSM, the Asymmetric Convection Model 2 PBL scheme, and the Pleim-Xiu LSM.

NCAR personnel put on a WRF tutorial at the 2nd East Asia WRF Workshop and Tutorial, held April 7-12 at Seoul National University in Seoul, Korea. Approximately 50 people attended the tutorial.

NCAR performed testing of the global ARW capability to help isolate problems in the new Held-Suarez test case. These were resolved and corrections will be included in future releases.

Ensemble runs done by the Air Force Weather Agency using WRF have produced some extremely moist values in the diagnostic 2-m moisture field in certain conditions when the 5-layer slab thermal land model is used. Jimy Dudhia of NCAR has started investigating this and has proposed using the lowest-level moisture in the interim.

ESRL/GSD

As reported previously, ESRL/GSD has also worked with MMM toward WRF v3.0 to introduce the digital filter initialization, improved versions of the Grell-Devenyi scheme and the RUC/Smirnova land-surface scheme, and improvements to the WRF Real program to allow community use of RUC native-grid initial conditions including hydrometeors.

Task 08.5.8: Improve physics in the WRF model, especially that bearing on prediction of aircraft icing.

GSD

The planned 2008 RUC change bundle continues in parallel testing at NCEP (see discussion under Task 08.5.1).

GSD and DTC

Planning for a test of the impact of changing the vertical distribution of vertical levels in the WRF-ARW is underway in a collaborative effort between GSD and DTC. The particular impacts to be examined are on forecasts of 2-m temperature and dew point and 10-m wind, as well as low ceiling and visibility. Of particular concern are situations having low-level warm advection over snow-covered ground, a condition that has caused systematic daytime cold biases in 2-m temperature forecasts (subtask 1, below). The hypothesis is that higher resolution in the lowest ~500m above ground will improve these forecasts beyond what has already been achieved by alterations to the RUC LSM (subtask 1).

Subtasks

08.5.8.1 31 Dec 2007 (GSD)

Begin systematic GSD evaluation of physics performance in GSD 1-hour RR cycle and address issues that arise in preparation for 2009 RR implementation. Particular attention will be given to microphysics and interactions between microphysics and the other parameterized physical processes.

Initial qualitative and quantitative evaluation of the RR cycled runs has begun, revealing specific issues that are being addressed. Too cold temperature forecasts under conditions of strong advection over snow cover of air with much above freezing temperatures have been addressed by restricting the rate of snowmelt based on empirical snowmelt studies. This allows more of the downward turbulent heat flux toward the surface from aloft to increase the temperature at the lowest model level, reducing the cold temperature bias. This change, introduced both into the RUC and the RUC LSM version used in the RR, is part of the RUC change package scheduled for implementation later this year (see Task 1).

08.5.8.2 15 May 2008 (NCEP)
Development efforts produce a 'research quality' code of physics upgrades for consideration in the 2009 NAM-WRF change package.

08.5.8.3 May 2008 (NCAR)
Expand the current one moment microphysical scheme to two moments and add a variable for aerosol particles in order to improve forecasts of freezing drizzle and icing. Computer storage and run time considerations will be considered as a constraint on the development. (NCAR)

Focus of the work during the past month has been on adding a two moment scheme for rain in order to properly account for drizzle formation versus rain formation. We plan to participate in the WMO Cloud Modeling Workshop this July in order to compare our results with other schemes.

Deliverables
08.5.8E3 May '08: Improved microphysics scheme to ESRL for evaluation in WRF Rapid Refresh. (NCAR)

08.5.8.4 15 July 2008 (NCEP)
Based on case-study testing and refinement of the research quality code, deliver an "experimental" code of physics upgrades for the 2009 NAM-WRF change package.

08.5.8.5 31 Mar 2008 (DTC, GSD)
Report on GSD-DTC RR retrospective testing of land-surface model formulations for snow, and, as appropriate, other physics.

See above discussion of planned tests of vertical resolution in WRF. These tests will be done with a restriction to the rate of snow melt recently introduced into the RUC LSM. Tests with this modification in RUC have shown improved (though still with some cold bias) spring-season daytime temperature forecasts over snow cover.

08.5.8.6 1 August 2009 (GSD)
Begin to explore possibilities for enhancing treatment of sea ice and tundra (including spring-time pooling) in Rapid Refresh domain.

08.5.8.7 1 September 2008 (NCAR) Option B
NCAR (from January)
Test and evaluate current microphysics parameterizations for the prediction of icing and freezing drizzle in stratocumulus clouds. This will involve comparison to observations of well observed cases such as January 31 case from Cleveland, Ohio as part of the NASA/Glenn in-flight icing field studies and the use of LES modeling with WRF to simulate the processes forming super-cooled liquid water and drizzle. This task will be linked to the aerosol task due to the finding that CCN concentration often plays a dominant role in the formation of drizzle in these types of clouds.

NCAR
In collaboration with NCAR/RAL, investigate potential for RR application of existing physics schemes that combine PBL processes with prediction of PBL-driven stratocumulus or shallow cumulus.

Deliverables

08.5.8.E1 30 March 2008 (NCEP)
Subject to NCEP Director approval, the physics upgrades become Operational at NCEP as part of the 2008 change package for WRF-NMM. (Will supplement physics progress toward Rapid Refresh.)

08.5.8.E2 30 Aug 2008 (GSD, NCEP)
Have available for delivery to NCEP initial 'experimental level' WRF Rapid Refresh code, including physics routines, for start of EMC testing toward 2009 Rapid Refresh implementation.

08.5.8.E3 May 2008 (NCAR)
Status of improved microphysics scheme to ESRL for evaluation in WRF Rapid Refresh.

Task 08.5.15: Develop improved methods of cloud and moisture analysis for use in the WRF Modeling System.

Subtasks

08.5.15.1 31 October 2007 (NCEP)
Based on parallel testing and refinement of the experimental code, deliver the 'pre-implementation' code to NCO including improved diabatic initialization (e.g. nudging to analyzed precipitation and GOES cloud-top) for the March 2008 NAM change package.

08.5.15.2 30 Jan 2008 (GSD) COMPLETE
Develop and evaluate performance of diabatic digital filter initialization (DDFI) in the RR WRF model without use of radar data

08.5.15.3 30 March 2008 (GSD and CAPS)
Further refine the generalized cloud analysis for the target RR resolution, model physics scheme and use of additional data. Perform forecast test evaluations to document the impact of the cloud analysis refinements.

With help from GSD, CAPS ported new versions of GSI to OU's Linux supercomputer. Together with GSD, CAPS tested the generalized cloud analysis package using the March 2006 squall line case, and the August 2007 case for Tropical Storm Erin, which re-intensified over Oklahoma and produced significant flooding. The cloud analysis package was enhanced to determine stratiform versus convection precipitation locally and perform the appropriate treatment. Reflectivity formulations consistent with the WRF microphysics options, in particular, the new Thompson scheme, are now used in the cloud analysis. For both cases, positive impacts are found for short term forecasts. They are now being tested together with additional radial velocity data, and with frequent analysis cycles. Continued refinement with the cloud analysis package, and testing over extended periods are still needed for reliable evaluation statistics. Ming Hu (now at GSD and at CAPS before fall 2007) has rerun 13 March 2006 severe squall-line case to further evaluate cloud and hydrometeors increments to the background cloud and hydrometeor fields. A poster summarizing the results was presented at the CIRES Science Symposium in early April.

08.5.15.4 30 May 2008 (NCEP)
Based on development efforts, deliver 'research quality' diabatic initialization upgrades (e.g. initial use of Level II reflectivity) for consideration in the March 2009 change package for NAM.

08.5.15.5 30 Mar 2008 (GSD)
Include radar reflectivity-based latent heating within diabatic digital filter initialization (DDFI) in the RR WRF model.

The components for RR reflectivity assimilation are in place with the release of WRF version 3 including diabatic digital filter initialization and cloud analysis capability within GSI (currently being upgraded to latest GSI version). Testing and refinement of DDFI within 1-h cycle and of various cloud analysis options (including reflectivtiy assimilation) continue.

08.5.15.6 30 July 2008 (NCEP)
Based on case-study testing and refinement of the research quality code, an 'experimental' WRF code is delivered with diabatic initialization upgrades (e.g. initial use of Level II reflectivity) for the March 2008 change package for NAM.

Deliverables

08.5.15.E1 30 March 2008 (NCEP)
Subject to NCEP Director approval, the WRF-NMM code with upgraded diabatic initialization capability (e.g. nudging to analyzed precipitation and GOES cloud-top) becomes Operational at NCEP as part of the March 2008 change package to NAM.

08.5.15.E2 30 Aug 2008 (GSD)
Complete testing of GSI generalized cloud analysis for Rapid Refresh and deliver code to NCEP as part of Rapid Refresh package delivered to EMC, pending availability of NCEP testing capability.

Task 08.5.17: Infrastructure Support for operational running of WRF-based modeling system in North American Mesoscale and HiRes Window at NCEP.

NCEP
Dennis Keyser reports that from 1800 UTC 9 April through 2000 UTC 11, April NPN wind profiler data were not available because they were reporting longitude in degrees east instead of in degrees west. Since the beginning of April, Level II radial wind data from four WSR-88D radar sites have been unavailable to the NAM-GSI due to their switch from Build 8 to Build 10 software. NCEP/NCO (Krishna Kumar) is working on a recombination code in order to ingest these data and convert them back to a Build-8 look-alike format. Much of the Alaskan radiosonde data are still not available in time for the NAM data-cutoff. NCEP has contacted Alaska in hope of resolving this issue. The following data types are now monitored by the NAM-GSI: RASS virtual temperature profiles, QuikSCAT 0.5 deg. scatterometer wind superobs, TAMDAR (via ESRL MADIS feed) and Canadian AMDAR aircraft temperature and wind. Efforts to speed up the dump processing of NEXRAD Level II data are being explored. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ERSL MADIS feed.

Eric Rogers reports that the assimilation of AIRS satellite radiance data in the NDAS/NAM GSI analysis, which was supposed to be implemented with the 31 March 2008 NAM change package, was not done on that date due to an error in the scripts provided to NCO. This error was fixed on 22 April 2008.

Subtasks

08.5.17.1 (NCEP)
Maintain four-per-day North American Mesoscale runs and provide SAV and AIV guidance.

08.5.17.2 (NCEP)
Maintain four-per-day HiResWindow runs and provide SAV and AIV guidance.

08.5.17.3 (NCEP)
Provide vendors with gridded model data via Family of Services and the FAA Bulk Weather Data Telecommunications Gateway.

08.5.17.4 (NCEP)
Provide full grids from NAM, and HiResWindow on NCEP and NWS/OPS servers.

08.5.17.4 (NCEP)
Maintain access to model verification data.

08.5.17.6 Provide assistance to Inflight Icing, Turbulence, Convective Weather, Ceiling and Visibility and Oceanic Weather PDTs when their algorithms and product generation systems are ready to transition into NCEP's operational Production suite.

Deliverables

08.5.17.E1 (NCEP)
Perform ingest, quality control and preparation of both existing and new observations in support of the operational WRF runs.

08.5.17.E2 (NCEP).
As requested by other PDTs, incorporate new AIV calculations into Operational WRF Model post-processor and product generator

Task 08.5.19: Develop ability to assimilate WSR-88D radial velocity and reflectivity data through GSI and Rapid Refresh toward High-Resolution Rapid Refresh.

Subtasks

08.5.19.1 30 May 2008 (GSD, NCAR/RAL, CAPS)
Select initial case studies from 2007 and 2008 for 3-km HRRR data assimilation case studies.

Primary case study examined so far is 10 July 2007. More to be reported next month.

08.5.19.2 31 August 2008 NCAR-RAL
Run case studies using 3km HRRR using different RUC-based initial conditions

- Run case studies from spring/summer 2008 using 3-km HRRR on GSD jet computer using different RUC-based initial conditions
    - Operational RUC (without radar reflectivity assimilation)
    - Radar-DFI enhanced RUC (probably from GSD)
    - Radar-DFI RUC using unsmoothed latent heating
    - Test of 3-km radar-DFI when code ready from GSD
- Use Northeast US Corridor domain for HRRR runs as used at GSD.
- Provide detailed report on case studies by 15 Sept 08

08.5.19.3 30 Sept 2008 (CAPS)
Complete 3-km GSI data assimilation experiments for potential application within the HRRR assimilating radial wind.

- Conduct 3-km GSI data assimilation experiments assimilating radial wind data. Evaluate and refine techniques for radial wind assimilation within GSI as needed.
- Use experimental RUC or RR 1-h forecast background fields from GSD on 3-km Northeast Corridor US HRRR initial domain.

Option B task originally unfunded. Worked started in anticipation of additional FY09 funding. Later completion date than August 2008 is expected.
At CAPS, an ARPS radar data processing package was adopted for use by GSI for the WRF grid; it produces radial velocity data re-mapped to the WRF model columns for use directly inside GSI. CAPS will need to acquire NCEP's radial velocity QC and super-obing package to be consistent with NCEP's processing of radial velocity data.

Initial tests were performed, with a single time analysis, a few hours before the time of maximum intensity of tropical cyclone Erin, on a large 3 kilometer grid. Experiments were performed to determine the effect of the spatial correlation scales for radial velocity data on wind analysis. The documentation on the parameter for adjusting the scale in GSI appears to be backwards. Experiments will continue with ~ 30 min analysis cycles for up to 6 hours to evaluate the impact of radial velocity data, in addition to reflectivity data via cloud analysis, on the prediction of Erin. The NAM grids are used for analysis background and boundary conditions. Later, we will switch to RUC grids to be more consistent with the target HRRR configurations.
Assistance from Shun Liu (NCEP) and Ming Hu (GSD/DTC) is greatly appreciated.
The CAPS received $70,000 FY2007 funds in August 2007. In March and April, about $10000 (loaded) was spent on salary, with $25,420.0 remaining.

08.5.19.4 30 Sept 2008 (GSD)
- Develop new stand-alone 3-km processor from raw 3-d reflectivity tiles to 3-km HRRR domain, similar to software developed for 13-km RUC
- Develop and test code at 3-km for assimilation of radar reflectivity using observation-based specification of latent heating within WRF-DFI.

HRRR initial testing now gaining extra attention with recent funding of MDE Option B.

Deliverable

08.5.19.E1 GSD, CAPS, NCAR-RAL 30 Sept 2008
Complete improved version of 13km/3km radar assimilation techniques for demonstration in FY09 exercises.

Task 08.5.20: Develop ensemble-based probabilistic products for aviation users.

UNFUNDED

Task 08.5.24

Task 5.24 specifically treats development and testing of the 3-km HRRR model itself. Development and testing work on assimilation of radar data at the 3-km scale is under Task 5.19.

Subtasks

08.5.24.1 30 September 2008 (GSD, NCAR/RAL, NCAR/MMM)
Conduct HRRR summer exercise. Collaborate on analysis on HRRR tests. Draft and deliver summary of results.

Real-time ftp transfer of HRRR grids to NCAR and MIT/LL since mid April. Plans underway to speed up HRRR processing time. VIL fields with 15-min output added to HRRR grids and also ftp'd to NCAR (accomplished in mid-May).

5.24.2 NCAR-MMM
Evaluate HRRR forecasts with different initializations using GSD HRRR runs

- Compare 3-km HRRR forecasts using initial conditions from 2 versions of the RUC: radar-enhanced RUC from GSD, no-radar RUC from NCEP.
- All HRRR runs performed at GSD, from spring/summer 2008
- Perform analysis of evolution of convective storm mode during first 1-3 hours of model transition from effective resolution 13-km to actual 3-km resolution.

Deliverables

08.5.24.E1 30 August 2008 (NOAA/ESRL/GSD)
Complete FY08 test with small NorthEast U.S. domain with 3-km High-Resolution Rapid Refresh running every 1 h.

- Conduct real-time summer 2008 HRRR forecasts using 3-km WRF initialized with radar-enhanced RUC over Northeast US Corridor domain
- Coordinate with other AWRP users and other collaborators
- Provide project management
- Lead writing of report on summer 2008 HRRR experiments

08.5.24.E2 30 September 2008 (NCAR/RAP and NCAR/MMM)
Collaborate with GSD on analysis of results. Draft and deliver summary of results.
Evaluate techniques for convection-resolving (e.g., 3-km) forecasting by the Rapid Refresh (ARW core) in preparation for development of high-resolution RR (HRRR). Perform and evaluate RR convection-resolving forecasts on test cases using radar-enhanced RUC or Rapid Refresh grids from GSD to identify strengths and weakness of model at high resolution. Evaluate effects of transition from 13-km parameterized convection to 3-km resolved convection in 0-3h forecasts and in lateral boundary conditions from the RUC or Rapid Refresh using the Grell-Devenyi parameterization.