Monthly Report for October 2008

FY 2009

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Executive Summary

Task 09.5.1: Infrastructure support related to operational running of the RUC and NAM operational modeling systems.

- **RUC upgrade implementation at NCEP planned for morning, Monday 17 Nov 2008.**
  - RUC upgrade package code includes (radar reflectivity assimilation, TAMDAR, longwave radiation, Grell/Devenyi upgrade).
  - http://ruc.noaa.gov/ruc13_docs/RUC-upgrade.impl-prebrief.4nov08.pdf - RUC upgrade pre-implementation briefing includes new case studies and comparisons between old and new RUC versions.

Task 09.5.4 Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

- Two real-time parallel RR cycles running at GSD, currently being used to evaluate impact of radar DDFI-based radar assimilation

Task 09.5.5: Develop, test, and implement 3DVARs for RR and NAM

- Ongoing work to add inclusion of height difference (actual vs. model terrain) in GSI surface observation assimilation

Task 09.5.15: Develop, test, and implement 3DVARs for RR and NAM

- Evaluation of RR cloud analysis and comparison against RUC cloud analysis ongoing

Task 08.5.24/19: Begin 3km High-Resolution Rapid Refresh testing / Improve radar assimilation

- Extensive verification and evaluation of summer 2008 HRRR forecasts completed and presented

Task 09.5.1 Infrastructure Support Related to Operational running of the non-WRF Rapid Update Cycle System in NCEP Operations

GSD

Final evaluations of RUC upgrade package and presentations to various RUC users

- Pre-implementation briefing to NCEP Director (Louis Uccellini) by Stan Benjamin and Geoff Manikin (NCEP/EMC) on Wed 5 November. Upgrade granted approval.
- Presentation developed and made available from http://ruc.noaa.gov at http://ruc.noaa.gov/ruc13_docs/RUC-upgrade.impl-prebrief.4nov08.pdf including a number of new case studies.
- Tele-training sessions on RUC upgrade to NWS Southern Regions.
- Some final improvements added to RUC post-processing for RTMA downscaling code as part of the RUC upgrade package, adding 5km output for potential temperature and local lapse rate.

NCEP

Dennis Keyser reports that NCEP/NCO's new recombination code, which ingests Build-10 WSR-88D Level II reflectivity (and radial wind) data and converts them back to a Build-8 look-alike format, was implemented on 7 October. Level II reflectivity data from all radar sites except San Juan are now once again available for the 88D mosaics used in the parallel RUC. On 1 October, the NWS began a 90-day outage of NOAA Profiler Network wind and RASS data for hardware upgrades to improve security. The RUC analysis uses both types of data. On 27 October, these data became available via the GTS through a temporary patch implemented by ERSL/GSD. NESDIS has been contacted on two problems with the "new science" GOES 1x1 field-of-view cloud data where random files (2-4 daily) where NESDIS encodes 1-2 beginning reports with missing lat/lon and a bogus satellite ID; and the later arrival of the GOES-East data which reduces the number of obs in the RUC dump files for some cycles. NCEP/NCO implemented an update to their upper-air dictionary on 7 October to correct obsolete default instrument types for many radiosonde sites. Parallel testing of TAMDAR aircraft temperature and wind data is underway. At the request of ERSL/GSD, efforts are being made to get TAMDAR airframe type and company code (not available in either ESRL MADIS or AirDAT feeds) for improved bias corrections. NCEP/NCO submitted an RFC to process Multi-Agency Profiler (formerly known as Cooperative Agency Profiler) wind and RASS data from an ESRL MADIS feed. These data have not been available since April 2006 when the NWS cut their support.

Geoff Manikin reports that the final stages of testing for a major RUC upgrade took place in October. This version ingests hourly reflectivity mosaic files, and the assimilation of the mosaic data is linked to the digital filter initialization to specify the 3-D profile of latent heating. Other changes include the assimilation of mesonet wind data from a list of approved providers and TAMDAR data, a change in the longwave radiative scheme from Dudhia to RRTM, a modification to the snow component of the land-surface model to decrease excessively cold 2-meter temperatures over fresh snow at night, another change to the snow model to allow for warmer temperatures during warm advection events over snow cover, and a modification to the convective scheme to decrease widespread coverage of light precipitation. After evaluating the new version of the model and finding subjective and statistical improvement, the code was turned over to NCEP Central Operations in July. The extremely active tropical weather of late August and early September, however, delayed the start of the outside RUC evaluation. This evaluation by the various NCEP service centers was completed in late October, and EMC received favorable feedback from forecasters at both the Storm Prediction and Aviation Weather

Centers. NCEP Director was briefed on 28 December and the implementation is scheduled for 12 November. Last minute update: a power failure at the backup facility in Fairmont, WV on Wednesday morning 12th and the subsequent Critical Weather Days for the space shuttle launch on 13th has caused the RUC implementation to be re-scheduled for 17 November.

Subtasks

October 2008 through September 2009

09.5.1.1 Maintain hourly RUC runs and provide grids of SAV and AHP guidance products.

09.5.1.2 Provide vendors with gridded model data via Family of Services and the FAA Bulk Weather Data Telecommunications Gateway.

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

09.5.1.4 Maintain access to model verification data.

09.5.1.5 Working with NCEP/NCO and NCEP/EMC, complete the design, compilation, debugging, test runs and parallel testing of RUC codes on new CCS computer.

Deliverables

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

09.5.1.E2 Perform configuration management for RUC, including thorough documentation, and respond promptly to any code malfunctions or performance issues. (GSD, NCEP)

09.5.1.E3 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. (GSD, NCEP)

Task 09.5.17 Infrastructure support for operational running of WRF-based modeling system in North American Mesoscale and HiResWindow at NCEP.

NCEP

Dennis Keyser reports that NCEP/NCO's new recombination code, which ingests Build-10 WSR-88D Level II reflectivity (and radial wind) data and converts them back to a Build-8 look-alike format, was implemented on 7 October. Level II reflectivity data from all radar sites except San Juan are now once again available to the NAM-GSI. On 1 October, the NWS began a 90-day outage of NOAA Profiler Network wind and RASS data for hardware upgrades to improve security. The NAM-GSI uses profiler winds and monitors RASS temperatures. On 27 October, these data once again became available via the GTS through a temporary patch implemented by ERSL/GSD. Since early May, AIRS radiance data counts have been lower than average due to late posting of files caused by hardware issues with NESDIS' AIRS processing. This should improve later this year when NESDIS switches to new Linux machines. In mid-April the NAM-GSI stopped using AIRS AMSU-A radiances because AMSU-A channel 4 went bad. The NAM-

GSI is being modified to allow the remaining AMSU-A channel data to be used (as was implemented in the GFS-GSI in September). AIRS radiance and MODIS wind data were not available 6–9 October due to NESDIS hardware issues. Alaskan radiosonde data receipt has improved after NCEP contacted Alaska region, as sites like Shemya are now usually available before the NAM data cutoff. But there is still a need for some sites to move up their launch time so their data are received in time for the NAM-GSI. NCEP/NCO implemented an update to their upper-air dictionary on 7 October in order to correct obsolete default instrument types for many radiosonde sites. 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. The last two will be turned on in the NAM-GSI when the current NAM change package is implemented. Efforts to speed up the dump processing of NEXRAD Level II data are being explored. NCEP/NCO submitted an RFC to process Multi-Agency Profiler (formerly known as Cooperative Agency Profiler) wind and RASS data from an ESRL MADIS feed. These data have not been available since April 2006 when the NWS cut their support.

Eric Rogers reports that NCEP's Central Operations began the 30-day real-time parallel test of the fall 2008 NAM change package on 14 October. After two weeks of testing, the 30-day test period was restarted due to a problem with parallel NDAS soil states. The problem was caused by the NDAS cold start code, which was re-computing the total soil moisture instead of passing it through from the previous NDAS run. This error was fixed by running another code in the preprocessing step after the cold start code which ensured that the actual cycled NDAS soil states are used.

Matt Pyle corrected a bug in the post-processing of the WRF-ARW that created sporadic failures in the Alaskan HiResWindow starting on 25 October. Changes were made to ingest the proper field for net solar radiation and to eliminate the ingest of negative albedo values. These two changes prevent the pathological situation caused by a range of forecast values that couldn't be packed into GRIB at the specified packing precision (the code attempted to pack the data with more than the maximum allowable 16 bits). These changes were provided to NCO on 30 October and the changes were implemented into operations on 4 November.
Shun Liu reports that a set of (00Z) WRF-launcher runs were performed using the operational NAM domain and 12 km grid-spacing to examine the impact of improved radial wind analysis on forecasts. Preliminary results indicate positive impacts were produced. 12Z test cases will be performed next to further examine the effect of improved radar wind analysis on the forecast.

Subtasks

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

09.5.17.2 Maintain four-per-day HiResWindow runs and provide SAV and AHP guidance. (NCEP)

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

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

09.5.17.4 Maintain access to model verification data. (NCEP)

09.5.17.5 Working with NCO, complete the design, compilation, debugging, test runs and parallel testing of RR, NAM and HiResWindow (and SREF) codes on new CCS computer.

Deliverables

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

09.5.17.E2 As requested by other RTs, incorporate new AHP calculations into Operational WRF Model post-processor and product generator (NCEP).

Task 09.5.4 Develop, test, and implement the Rapid Refresh.

NCEP
No NCEP activity to report.

Subtasks

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

GSD
As of late October 2008, two parallel full hourly cycled versions of the Rapid Refresh are running at GSD, with files going to many users (including AWR RTs), verification and web-based plots.

Verification of standard atmospheric variables (temp, RH, wind) indicate the experimental Rapid Refresh is competitive with the RUC at most forecast lengths and output times. We are using these results to continue to refine the Rapid Refresh and improve the forecast skill. Wind forecast skill is very similar at lower levels and slightly worse at upper levels. Rapid Refresh moisture forecasts compared to the RUC show a slightly enhanced moist bias at low levels and a slightly enhanced dry bias at mid levels and slightly higher overall moisture RMS errors. We are still accumulating precipitation statistics and will report on them next month. Recently, we have been using the 2nd parallel cycle to evaluate the differences from the radar assimilation procedure (and also comparing against RUC forecasts with and without the radar assimilation. The real-time runs are complemented by a retrospective capability that has been used to evaluate different background error covariance specifications in the GSI and is now being used to evaluate 2 different boundary layer schemes in the WRF model.

09.5.4.2 1 Nov 2008 (GSD, NCEP)
Continue to solicit input from Inflight Icing, Turbulence, National Ceiling/Visibility, and Convective Weather RTs and NWS forecasters in Alaska and Puerto Rico, as well as AWRP RTs, on performance of pre-implementation Rapid Refresh. Arrange to have GSD RR grids available to examine and solicit feedback on RR performance.

(GSD)
GSD group has made many different types of RR files available to users (AWR RTs, NWS) and worked to assist them to access, process and display RR grids within various workstation

environments. We are currently producing 4 flavors of RR files (native level, pressure level, surface field, and precip fields) for each 3 grids (full RR, Alaska 249, CONUS) and grib1 and grib2. So far, most of the interaction with outside groups has been focused on answering technical details about the grids and fields, but RTs and Alaska NWS now have the grids processed and more detailed evaluation are commencing

09.5.4.3 30 May 2009 (GSD, NCEP, NCAR)
Updated report on status of tactical planning for making RR-WRF ARW model code for 2012 in compliance with Earth System Modeling Framework (ESMF) in agreement with the Sept 2007 Rapid Refresh MOU between NCEP and GSD .

09.5.4.4 30 Sept 2009 (GSD, NCEP)
Complete pre-JIF evaluation of Rapid Refresh in accordance with NCEP pre-implementation checklist for major implementations. Respond to evaluation questions, present information on Rapid Refresh pre-implementation testing and evaluation results in various forums, as required.

09.5.4.6 30 Sept 2009 (GSD and NCEP)
Pending EMC, and NCEP Center initial recommendations, Job Implementation Forms (JIFs) are filed to submit Rapid Refresh software to NCO.

Deliverables

09.5.4.E1 20 Dec 2008 (GSD)
Report on Rapid Refresh testing at annual NCEP Production Suite Review meeting.

Collection of real-time verification statistics and case study plots in preparation for NCEP suite review is underway.

09.5.4.E2 1 September 2009 (GSD, NCEP)
Complete documentation (in Technical Procedures Bulletin-like document) of Rapid Refresh system.

09.5.4.E3 30 September 2009 (GSD, NCEP)
Pending EMC, and NCEP Center initial recommendations, Job Implementation Forms (JIFs) are filed to submit Rapid Refresh software to NCO.

Task 09.5.5 Develop, test, and implement improvements to the operational 3DVARs for Rapid Refresh and North American Mesoscale runs.

NCEP
Wan-Shu Wu tuned the observational errors used in NAM after two bug fixes in GSI code ended up affecting the effective observational errors of rawinsonde, pibal and profiler data in the upper layers and the amount of observations used in the uppermost layer. A low resolution experiment was set up to test impact of the new observational errors, the bug fixes and the nonlinear quality control. Tests showed that the analysis code ran 20% slower with nonlinear quality control on. The analysis fit to the data was also worse with the nonlinear quality control on. The changes resulted in rejecting less data by gross check which was compensated by activating the variational quality control. The preliminary results showed small impact on the

forecasts. The tuning of the parameters of the quality control and gross check continue.

Dave Parrish reports that after many failed attempts to create a working multigrid scheme for use in an improved regional version of TLNMC, a global scheme based on a method outlined in Barros et al., 1990, has been shown to work quite well for this application. There now appears to be a clear path to successful completion of the improved regional TLNMC. Reference: Barros S., D. P. Dee, and F. Dickstein, 1990: A multigrid solver for semi-implicit global shallow-water models. *Atmos Ocean, v28, 24-47.*

Manuel Pondeca reports that he has submitted the fall 2008 upgrade packages for the CONUS RTMA and Alaska RTMA. In addition to the improvements that were made to the background error covariance models and observation quality control in both RTMA implementations, both systems now use the same unified code.

Shun Liu continued working with NCO to test the radar Build-10 data decoder and super-resolution data recombination algorithm (see Keyser reports under Tasks 1 and 17). A bug in Level-II data decoder was found where the spectrum width was incorrect. This bug has no impact on the reflectivity, but radial wind QC in the GSI was impacted by the bug. This bug was fixed by NCO.

GSD
Work by GSD continues on refining the GSI for Rapid Refresh. Development work is ongoing to account for differences between the elevation of surface observations and the associated model terrain and to allow for a selection of a best matched adjacent model point for coastal surface observations. We have also recently added the creation of a convective suppression mask field to the RR cloud analysis, which is used in the RR model to inhibit convection.

Subtasks

09.5.5.1 31 December 2008 (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.

09.5.5.2 31 December 2008 (NCEP)
Establish hourly cycled NAM assimilation system on NOAA R&D computer at NCEP (machine called “haze”) using GSI and WRF-NMM to be adapted to ARW-based RR by GSD.

09.5.5.3 31 January 2009 (CAPS and GSD)
Testing of and refinement to the radial velocity analysis component of GSI for Rapid Refresh configuration, together with the cloud analysis.

No CAPS activity to report.

09.5.5.4 28 February 2009 (GSD)
Report on preliminary statistical evaluation of Rapid Refresh forecasts initialized with the GSI, including examination of upper-level winds, surface fields, and precipitation.

09.5.5.5 31 July 2009 (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. strong constraint, improved satellite channel bias correction, improved use of WSR-88D radial wind and/or satellite radiances and/or retuned

co-variances to the GSI for FY2009 change package to the NAM.

Deliverables

09.5.5.E1 30 March 2009 (NCEP)
Subject to NCEP Director approval implement upgrades (e.g., partial cycling, TAMDAR) to GSI used in NAM/NDAS.

09.5.5.E2 30 September 2009 (GSD, NCEP)
Pending EMC, and NCEP Center initial recommendations, Job Implementation Forms (JIFs) are filed to submit GSI code as part of Rapid Refresh software to NCO.

09.5.5.E3 30 September 2009 (CAPS and GSD)
Finalize enhancement package for radial velocity data analysis to begin testing at GSD toward future implementation for Rapid Refresh.

09.5.5.E4 30 August 2009 (GSD, NCEP)
Complete report on Rapid Refresh performance, including that from the GSI component of the RR, in comparison with the operational RUC.

Task 09.5.8 Improve physics in the WRF model, especially that bearing on prediction of aircraft icing.

Subtasks

09.5.8.1 31 July 2009 (GSD)
Complete systematic GSD evaluation of physics performance in GSD 1-hour RR cycles for initial RR implementation.

A retrospective RR 3-h cycle run for 4-11 March 2008 has been initiated to test the Mellor-Yamada Nikinishi-Niino sub-grid-vertical-mixing scheme in the RR. This scheme had previously been implemented in WRFV3 by Mariusz Pagowski of GSD. For this retro period, performance of this scheme will be compared against the MYJ PBL option currently running in GSD's RR 1-hour cycles and in the cold-start RR.

Atmospheric and Environmental Research (AER), Inc. reported that the RRTM longwave radiation scheme (developed at AER) had an error in the WRF model implementation, with the ozone climatology vertical profile being inverted from what should have been. Jimy Dudhia has made a change to the WRF model. It turns out that the implementation of RRTM into the RUC (part of the RUC upgrade package) was done correctly. The modification will also be made for the Rapid Refresh version of the RUC.

09.5.8.3 30 July 2009 (NCAR)
Report on research and testing on addition of the new explicit aerosol variable(s) in initiating cloud water and ice. Computer storage and run time considerations will be considered as a constraint on the development.

09.5.8.5 1 December 2008 (DTC, GSD)
Report on FY07-funded GSD-DTC RR retrospective testing of the impact of different thickness of vertical model layers close to the surface and, as appropriate, other physics.

A draft report has been written by the DTC and GSD has provided comments on this draft.

09.5.8.6 1 August 2009 (GSD)
Begin to explore possibilities for enhancing treatment of sea ice and tundra (including spring-time pooling) in Rapid Refresh domain toward FY11 Rapid Refresh upgrade.

Preparations are being made to make available for evaluation for forecasters at Environment Canada's Arctic Weather Center at Edmonton the real-time RR1-h cycle running at GSD.

Deliverables

09.5.8.E2 30 Sept 2009 (GSD, NCEP)
Pending EMC, and NCEP Center initial recommendations, Job Implementation Forms (JIFs) are filed to submit upgraded WRF model physics code as part of Rapid Refresh software to NCO.

09.5.8.E3 30 Sept 2009 (NCAR)
Provide an improved microphysics scheme to GSD for evaluation toward FY11 Rapid Refresh upgrade.

Task 09.5.15 Develop improved methods of cloud and moisture analysis for use in the WRF Modeling System.

Subtasks

09.5.15.2 5 Jan 2009 (GSD and CAPS)
Continue 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.

GSD
Work by GSD continues on refining the GSI cloud analysis for Rapid Refresh. Comparison of RUC and RR analyzed ceiling statistics indicates slightly worse scores for the Rapid Refresh. We are investigating the cloud analysis to track down these issues. Improvements have also been made to the lightning assimilation module, including using a better relationship between lightning flash rate and maximum reflectivity.

Stan Benjamin, with help from Steve Weygandt, Bill Moninger, and others, has been developing and testing variations to the RUC analysis and model to improve retention of layers of cloud water, especially in the 1000-3000 ft layer (from IFR to MVFR). GSD verification against METAR ceiling observations and extensive has shown that cloud water in these layers will evaporate in the first hour of the model for both the RUC and WRF Rapid Refresh models. Bill Moninger has developed initial ceiling/visibility verification for the Rapid Refresh. Improvements for the RUC developed from this testing will be transferred to the Rapid Refresh code also (analysis and/or model, as is necessary). This work is also associated with separately funded NASA ASAP work for assimilating NASA Langley GOES cloud products into the RUC and Rapid Refresh.

09.5.15.3 30 Jan 2009 (GSD)
Develop and evaluate performance of diabatic digital filter initialization (DDFI) in the 13-km RR WRF model including assimilation of radar reflectivity data

GSD
We have the DDFI-based radar assimilation coded and running in one of our two real-time RR cycles. We have been evaluating difference between the RR cycles with and without the radar assimilation and comparing them with similar differences in the RUC. Based on a limited qualitative assessment, the signal from the DDFI radar assimilation in the RR looks similar to that from the RUC radar assimilation, but the difference between the with radar and without radar in the RR looks weaker than in the RUC. The main cause of this difference, however, appears to be more active convection in the non radar assimilating RR run compared to the non-radar assimilating RUC run. Our recent test cases have been for fairly strongly forced convection, and we are preparing a weakly forced summertime case to re-run to more fully evaluate this issue.

09.5.15.4 30 March 2009 (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.

09.5.15.6 30 Mar 2009 (GSD)
Include radar reflectivity-based latent heating within diabatic digital filter initialization (DDFI) in the RR WRF model

Deliverables

09.5.15.E2 30 Sept 2009 (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 09.5.6 Develop, test, and evaluate the performance of the nonhydrostatic WRF modeling system.

NCAR/MMM
Preparations of the next release of WRF are underway at NCAR. The release committee has begun meeting to oversee the release of WRF V3.1, scheduled for Spring 2009. Prospective features include new physics options and upgrades.

Jimy Dudhia of NCAR started preliminary work with Georg Grell (NOAA/GSD) on putting the convective mass flux into the dynamics of the new Grell 3 cumulus scheme. This is one of the early stages of this new version of this scheme.

Various bugs in different physics packages were identified and fixed. Minor fixes to the Morrison microphysics scheme were received and added to the repository. Similarly, a bug fix related to the ozone profile in the RRTM radiation scheme was added to the repository and posted as a known problem on the web page. Dudhia is currently testing the positive-definite advection (PDA) scheme on parallel platforms in idealized cases involving periodic boundary conditions. A problem in the PDA scheme in such cases was discovered, and a fix will be made later by software engineers at NCAR.

Dudhia is also working with QNSE PBL scheme developers in investigating issues in the behavior of the scheme in unstable regimes. This is close to resolution. The QNSE scheme will

eventually be added to the repository.

Subtasks

09.5.6.3 1 September 2009 (NCEP)
Maintain and further develop WRF Post-processing system including necessary RR capabilities and updates to all documentation, in response to community requirements.

09.5.6.4 30 June 2009 (NCAR/MMM)
Deliver a WRF Users' Workshop and a WRF tutorial for the user community.

09.5.6.5 30 Sept 2009 (NCAR/MMM)
Incorporate physics improvements from the WRF user community, GSD, and NCEP into the WRF software infrastructure for use in the Rapid Refresh model. Perform code testing to permit implementation into WRF repository. In collaboration with GSD, assist in the evaluation of those physics schemes for the RR that may be tested using the ARW.

Deliverables

09.5.6.E1 30 June 2009 (NCAR/MMM)
Deliver a WRF Users' Workshop and a WRF tutorial for the user community

09.5.6.E2 30 September 2009 (NCAR/MMM)
Incorporate physics improvements from the user community, GSD, and NCEP into the WRF software infrastructure for use in the Rapid Refresh model. Perform code testing to permit implementation into WRF repository. In collaboration with GSD, assist in the evaluation of those physics schemes for the RR that may be tested using the ARW.

Task 09.5.24 Test WRF Rapid Refresh model at 3-km resolution toward High-Resolution Rapid Refresh

GSD
The GSD group has performed extensive verification and evaluation of the summer 2008 HRRR forecasts and worked with NCAR and MIT/LL to evaluate the combined CoSPA product. GSD HRRR reflectivity verification (at 3-h intervals) indicates 6-h HRRR forecasts with radar assimilation are better than 3-h HRRR forecast without radar assimilation at all times of the day. GSD has further evaluated the relative strengths of the HRRR and RCPF as a function of the diurnal cycle of convection. The RCPF does quite well at identifying mesoscale areas of convective initiation. The HRRR appears to have similar skill for convective initiation (based on verification of HRRR forecasts that have been up-scaled to a 13-km grid). As expected, HRRR improvements from the RUC radar assimilation increase as the initial time convective coverage increases.

Subtasks
09.5.24.1 15 Feb 2009 (GSD, NCAR/RAL, NCAR/MMM, CAPS, MIT/LL)
Design the assimilation/modeling configuration for the HRRR during the 2009 summer convection forecasting (CoSPA) exercise.

GSD

Tanya Smirnova has recently run test of an expanded HRRR domain that would provide additional coverage the west and south. The new domain, which extends west to the Rocky Mountains and south to the Gulf Coast, is rotated clockwise to minimize grid points over the Atlantic Ocean. There would be several advantages to this expanded HRRR domain: 1) expanded coverage for key hubs including Atlanta, Minneapolis, Dallas and Denver, 2) by placing the western domain edge well west of the mean dry-line, the western boundary contamination (from large MCSs that are poorly represented in the parent model, entering the HRRR domain) would be greatly reduced. 3) Greater utility to all users, including NOAA operation forecast units. Initial tests indicated about 66 minutes for a 12-h forecast on 400 processors. We are looking into small changes to get the run time under an hour.

09.5.24.2 15 Aug 2009 (NCAR/MMM)

Evaluate techniques for convection-permitting (e.g.,3-km) forecasting by the ARW core in the HRRR configuration. In collaboration with GSD, perform and evaluate convection-permitting forecasts on test cases using radar-enhanced RUC or Rapid Refresh (13-km) grids from GSD for initial condition fields to identify strengths and weaknesses of HRRR-ARW forecasts. This will include a 2009 analysis on evolution of convective storm mode during first 1-3 hours of model transition from effective resolution 13-km to actual 3-km resolution. Perform fully-explicit tests and evaluate short-term forecast results. Submit summary of results and collaborate with other groups on consolidated summary of results from 2009 HRRR exercise and research results.

09.5.24.3 15 Sept 2009 (NCAR/MMM, GSD)

Collaborate on analysis of convection-permitting tests using HRRR cases. Draft and deliver summary of results.

09.5.24.4 30 Sept 2009 (GSD, NCAR/RAL)

Complete 2009 HRRR summer exercise using modeling and assimilation modifications determined in 2008 exercise. Collaborate on analysis of HRRR tests and deliver summary of results.

Deliverables

09.5.24.E1 15 August 2009 (NCAR/MMM)

Submit report on evaluation of HRRR-ARW forecasts.

09.5.24.E2 30 August 2009 (NOAA/ESRL/GSD)

Complete FY09 test with Northeast Corridor U.S. domain with 3-km High-Resolution Rapid Refresh running every 1 h.

- Conduct real-time summer 2009 HRRR forecasts using 3-km WRF initialized with radar-enhanced Rapid Refresh over Northeast US Corridor domain
- Coordinate with other AWRP users and other collaborators
- Provide project management
- Lead writing of report on summer 2009 HRRR experiments

09.5.24.E2 30 September 2009 (NCAR/RAP and NCAR/MMM)

Collaborate with GSD on analysis of 2009 results. Draft and deliver summary of results.

Evaluate techniques for convection-resolving (e.g., 3-km) forecasting by the Rapid Refresh (ARW core). Perform and evaluate HRRR convection-resolving forecasts on test cases using

Rapid Refresh grids from GSD to identify strengths and weakness of model at high resolution. Perform 2009 experiments to re-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.

Task 09.5.19 Develop ability to assimilate WSR-88D radial velocity and reflectivity data through GSI and Rapid Refresh toward High-Resolution Rapid Refresh.

Subtasks

09.5.19.1 30 October 2008 (GSD, NCAR/RAL, CAPS)
Select initial case studies from summer 2008 for 3-km HRRR data assimilation case studies.

GSD
A set of 8 summer 2008 cases has been selected for coordinated GSD, NCAR, MIT/LL evaluation. These include 20, 27 July; 2, 8, 13, 15 Aug; 6 Sep. We are also looking at some other cases for specific HRRR analysis including 31 July and 13 Sept.

09.5.19.2 31 August 2009 (GSD, NCAR-RAL)
Run case studies from early 2009 using 3-km HRRR on GSD jet computer using different RR-based initial conditions

- Radar-DFI enhanced RR
- Radar-DFI RR using unsmoothed latent heating
- Test of 3-km radar-enhanced diabatic digital filter initialization (DDFI)

09.5.19.3 30 Sept 2009 (CAPS)
Complete new 3-km GSI data assimilation experiments toward improved assimilation of radial wind.

At CAPS, Kefeng Zhu continued the work of Aimei Shao who used NAM as the analysis background and boundary conditions for tropical storm Erin. Assimilation cycles of 10 minute intervals from 00 UTC to 02 UTC were performed, using both reflectivity and radial velocity data (Figure 1). Aimei compared the results of 10 and 30 minute assimilation cycles earlier and showed that 10 minute cycles predicted better vortex position and structure but the vortex moved too slow and too much towards the northeast. Also the predicted intensity was too strong. It is suspected that the too much energy is introduced through the frequent cloud analysis cycles; additional experiments will be performed to tune the temperature and moisture adjustments in the cloud analysis. Further efforts will also be made to verify the vortex center position against that determined using the much more frequent mesonet and radar data, since the best track data are available only every 6 hours.

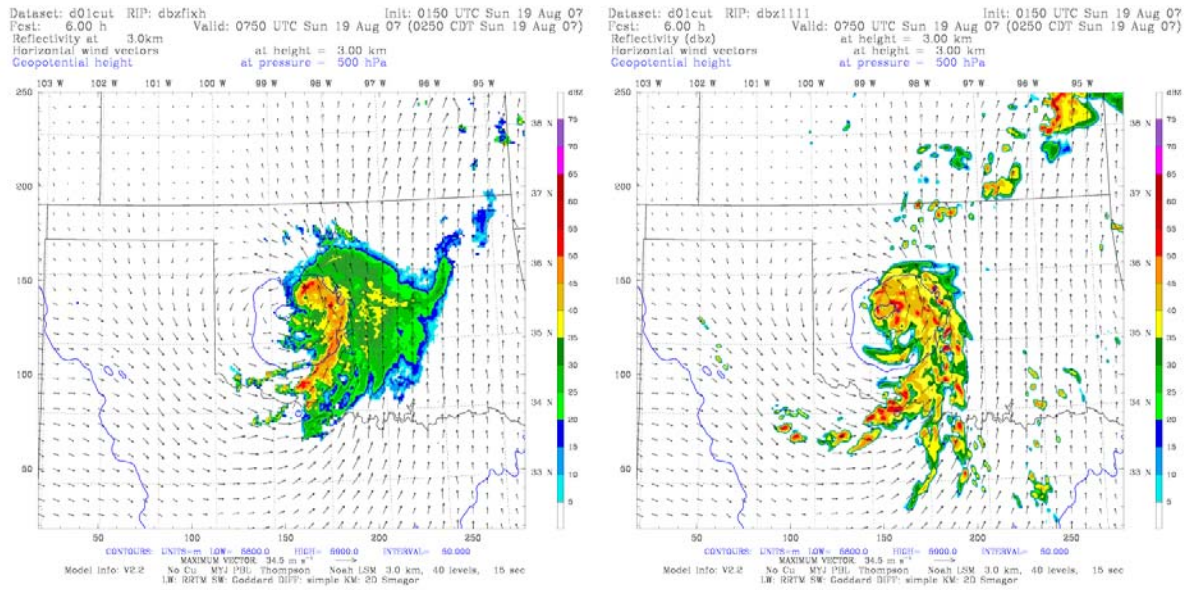

Fig.1: Observed (left) and model predicted (right) reflectivity fields 3 km height at 0800 UTC August 19, 2007, or the time of 6-hour forecast, overlaid on predicted wind and geo-potential height fields.

Further, earlier experiments also used radial velocity data up to 150 km radial only, due to some data quality issues. An interface has been added to CAPS radar preprocessing program for WRF, i.e., 88d2arps, to write out and read back data in the format used by interactive radar data editing program Solo II from NCAR, which would allow further manual editing to the data after automatic QC. Further experiments will use full range radial velocity data with additional manual QC.

Yi Yang continued parallel experiments using RUC analysis background and lateral boundary conditions. The latest experiments start from 00 UTC on August 19, but start assimilating radar data every 10 minutes from 04 UTC for two hours. With RUC data, the predicted vortex has a tendency to move too fast. As in the NAM case, the vortex is also too strong and the track is too far to the north. New experiments added conventional (rawinsonde, profiler and ASOS etc) and mesonet observations at hourly intervals, and these additional data are found to help improve the track and intensity forecasts. Details will be reported in the future.

09.5.19.4 30 Sept 2008 (GSD)
Develop and test improved DFI assimilation of radar reflectivity at 3-km using observation-based specification of latent heating within WRF-DFI developed by GSD and NCAR in FY08.

Deliverables
09.5.19.E1 30 Sept 2009 (GSD, CAPS, NCAR/RAL)
Complete improved version of 13km/3km radar assimilation techniques for demonstration in FY09 exercises.

<u>Task 09.5.20</u> Develop ensemble-based probabilistic products for aviation users.

NCEP
Jun Du reports that an upgrade of the SREF in December 2008 will include an increase in WRF

members from 6 to 10, an increase in model resolution from 45km to about 32km, and the addition of the Ferrier cloud scheme to 3 RSM members to increase physics diversity. As requested by AWC, the forecast output frequency from the SREF will increase to hourly (from 3-hourly) for the first 39 hours of the forecast to meet aviation forecast needs, and three new aviation products (icing, ceiling and flight restrictions) will be added to the SREF ensemble products (mean, spread and probability). A visit to AWC is being considered (if resources are available) to discuss new aviation product requirements and to train forecasters to use more ensemble products.

BinBin Zhou is evaluating the current versions of fog/visibility/ceiling algorithms used in the ensemble members in SREF. He is testing some new algorithms for diagnosing fog/visibility/ceiling in single members of the SREF, and is applying the ensemble product generator to generate aviation hourly-products for the RUC and display them on NCEP web site.

Shun Liu worked with Matt Pyle and BinBin Zhou on developing a set of new scripts and codes to convert binary format 3D reflectivity mosaic to GRIB format. The new package started running in parallel. This will be used as truth in the grid-to-grid component of the verification package to verify the simulated reflectivity products produced by NAM and HiResWindow runs.

Subtasks

09.5.20.1 15 January 2009 (NCEP)
Complete 'research quality' version of upgrade to SREF (e.g. higher resolution, more WRF members and more physics diversity) for consideration in November 2010 SREF upgrade package.

09.5.20.2 15 February 2009 (NCEP)
NCEP visits AWC to conduct continued training and education on SREF applications, receive feedback on existing guidance, and to acquire new requirements (fully depending on FAA funding).

09.5.20.3 15 April 2009 (NCEP)
NCEP develops and delivers a new fog algorithm used in the SREF product for aviation (fully depending on FAA funding, $60K requested).

09.5.20.4 31 August 2009 (NCEP)
Based on case-study testing and refinement of the research-quality code, deliver the upgrade SREF codes to NCO for November 2010 SREF upgrade package.

09.5.20.5 31 March 2009 (GSD and NCEP)
Develop a preliminary procedure appropriate for aviation users from Very Short-Range Ensemble Forecast (VSREF) system using high-resolution RR and NAM existing runs.

09.5.20.6 1 July 2009 (GSD and NCEP)
Further calibrate probabilities and potential echo-top (improve statistical reliability) ensemble cumulus information.