MDE Product Development Team - Monthly Report for May 2009

FY 2009

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(Compiled and edited by S. Benjamin and B. Johnson)

Executive Summary

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

- Continued evaluation of RUC and NAM, monitoring small May09 change to cloud analysis in GSD development RUC cycle.

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

- Continued real-time feed of RR files to other AWRP RTs and Alaska Region NWS and getting feedback from them
- Improvements in WRF-RR: testing of WRFV3.1 and options in 1-h cycle, terrain detail, cycling of land-surface variables, bug-fixes to land-surface physics modifications for snow and ice cover,
- Serious file-system problems on ESRL supercomputer caused major disruption in testing of RR 1-h cycle
- Two papers on RR presented at AMS NWP/WAF conference

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

- RR GSI – continued development of new forward model for surface obs to match RUC techniques, sensitivity tests for surface obs, profiler, satellite.
- 4 papers related to GSI and its application to Rapid Refresh at AMS NWP/WAF conference

Task 09.5.6: Improve WRF model

- Version 3.1 released 9 April 2009 (NCAR). Version 3.1.1 will be released in late June.

Task 09.5.15: Develop methods for improved cloud/hydrometeor analysis in RR

- Discussions on GOES cloud data for full RR domain including Alaska, not yet in test RR.

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

- Reconstruction of GSD RUC cycle (used for HRRR initial conditions) using grids from NCEP operational RUC after file-system problems.
- Continued evaluation of larger-domain HRRR over eastern 2/3 CONUS – some very good cases, including 13 May case with strong convection across central US.
- Additional GSD progress on a time-lagged HRRR-based convective probability forecast
- Evaluation of new HRRR post-processing for additional storm parameters
- Two papers presented on HRRR at AMS NWP/WAF conference

Test 08.5.20 Probabilistic forecasts

- Initial VSREF framework developed by NCEP/EMC, additional discussions in May

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

GSD

Code modification for RUC analysis developed to avoid intermittent over-moistening in a certain combination of conditions. This situation occurs satellite data shows cloud in lower troposphere in warm season and can result in an unstable vertical profile. It does not cause a crash in the RUC or subsequent HRRR due to use of the DFI. The changes have been implemented at GSD devRUC13, will go into backup RUC13 at GSD (improving HRRR also) in June. The changes are also ready to go for NCEP RUC but after discussion with NCEP (Geoff Manikin) were deemed non-critical for now. GSI interacted with WSI who initially pointed out this problem on 4 May (WSI uses RUC grids to initialize their high-resolution WRF run).

GSD has also monitored the situation on NOAA-AirDAT negotiations on TAMDAR data. *Currently, TAMDAR reports are NOT getting into the operational RUC at NCEP until this situation is resolved.* (GSD has no role in the negotiations.)

NCEP

Dennis Keyser reports that NCEP/NCO is investigating radiosonde sites that report an invalid instrument type. Still waiting for NESDIS to respond to two problems, the GOES 1x1 field-of-view cloud data (where a few random files have data problems) and the late arrival of GOES-East data. All sources of TAMDAR data were shut off on 7 April pending renewal of AiRDAT's contract with the NWS. Once these return, work will continue on getting TAMDAR airframe type and airline code into the PrepBUFR file for ESRL's bias correction work.

Geoff Manikin reports that the hourly RUC runs on the new CCS computer (known as cirrus) are being monitored. NCEP Central Operations has the code running reliably, and the output is being checked for any significant divergence from the operational runs on the old machine (dew).

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. (30 Sept 09)

09.5.1.4 Maintain access to model verification data. (30 Sept 09)

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)

CURRENT EFFORTS:

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: Lack of TAMDAR agreement between

NOAA and AirDAT, no TAMDAR data getting into operational RUC.

INTERFACE WITH OTHER ORGANIZATIONS: NCO.

UPDATES TO SCHEDULE: None.

09.5.1E2 (30 September 2009) (Manikin)
Perform configuration management for RUC, including thorough documentation, and respond promptly to any code malfunctions or performance issues.

CURRENT EFFORTS:

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: Lack of disk space on the new computer.

INTERFACE WITH OTHER ORGANIZATIONS: NCO.

UPDATES TO SCHEDULE: None.

09.5.1E3 (30 September 2009) (Manikin, Keyser)
Monitor RUC performance, respond to any problems detected by ESRL, NCEP, or any RUC users, diagnose cause, develop solution to RUC software, test changes and coordinate with NCO on implementation.

CURRENT EFFORTS:

PLANNED EFFORTS: Continue monitoring efforts.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS: NCO.

UPDATES TO SCHEDULE: None.

ESRL/GSD papers on RUC, Rapid Refresh, HRRR presented at 23rd WAF / 19th NWP Conference in Omaha:

Dezso Devenyi - **Experiments with anisotropic background error correlations in the Rapid Refresh system**
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154308.htm

Monitoring observation-model differences in the real time Rapid Refrash System
Dezso Devenyi, W. R. Moninger, S. R. Sahm, M. Hu, S. G. Benjamin, and S. S. Weygandt
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154298.htm

Adaptation and implementation of the Gridpoint Statistical Interpolation (GSI) for Rapid Refresh
Ming Hu, Devenyi, Weygandt, Benjamin -
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154318.htm

Status report on Rapid Refresh development
Steve Weygandt, T. G. Smirnova, M. Hu, J. M. Brown, D. Dévényi, S. G. Benjamin, W. R. Moninger, S. E. Peckham, G. A. Grell, K. J. Brundage, B. D. Jamison, C. W. Harrop, and J. B. Olson
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154330.htm

Implementation and testing of WRF Digital Filter Initialization (DFI) at NOAA/ESRL

Tatiana G. Smirnova, S. E. Peckham, S. G. Benjamin, and J. M. Brown
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154325.htm

The High Resolution Rapid Refresh (HRRR): an hourly updated convection resolving model utilizing radar reflectivity assimilation from the RUC / RR
Steve Weygandt, T. G. Smirnova, S. G. Benjamin, K. J. Brundage, S. R. Sahm, C. R. Alexander, and B. E. Schwartz
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154317.htm

Probabilistic thunderstorm guidance from a time-lagged ensemble of High Resolution Rapid Refresh (HRRR) forecasts
Curtis R. Alexander, D. A. Koch, S. S. Weygandt, T. G. Smirnova, S. G. Benjamin, and H. Yuan
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154254.htm

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

NCEP
Since many of his activities listed under Task 09.5.1 also pertain to NAM, they are not duplicated here. For the NAM specifically, Dennis Keyser reports that AIRS radiance data counts, which had been lower for the last 12 months because of NESDIS hardware issues, should be much more reliable now that NESDIS has moved their processing to a new Linux machine on 17 May. There was an initial outage through 22 May due to file format issues after the hardware change. There was also an outage prior to the hardware change from 3-4 May and again from 9-11 May (these also affected MODIS winds). The mesonet wind uselist was found to contain errors in some provider listings which results in the loss of over 600 sites for the NAM-GSI. Some Alaskan radiosonde sites still need to move up their launch time so the NAM-GSI can use their data. A Request for Change form to add NOAA-19 1B HIRS-4, AMSU-A and MHS radiances to the 1B ingest and dumps (before NOAA-19 becomes operational on 2 June) was submitted to NCO on 26 May. Methods to speed up dump processing of NEXRAD Level II data are being explored. The following data types are monitored by the NAM-GSI: RASS virtual temperature profiles (NPN and MAP), QuikSCAT 0.5 deg. scatterometer wind superobs, Mesonet mass data, and MDCRS moisture data. Work continues with NCO/PMB to transition observation ingest, dump and quality control and processing codes and scripts to the new computer. Cron runs are generating NAM/NDAS PrepBUFR files with 50 km ASCAT and WindSat scatterometer wind data (both non-superobed) and NAM/NDAS dumps of METOP IASI radiances, GPS-RO data and SBUV-2 data. These changes to obs monitoring plus several NMM bug-fixes are being tested in Eric Rogers' real-time P6 parallel NDAS/NAM.

Dennis Keyser continues efforts to remove a legacy restriction that surface data must have a pressure report to be processed into the PrepBUFR files. This will allow many new surface observations (land, marine and Mesonet) to be assimilated in the RTMA.

NCEP NAM & NEMS papers/posters presented at 23rd WAF / 19th NWP Conference in Omaha:
Eric Rogers – past and future NAM changes
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154114.htm
Tom Black – paper describing progress in constructing NEMS (NCEP Environmental Modeling System) to be used in NAM in 2010 and in North American Rapid Refresh Ensemble in 2012
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154223.htm
Zavisa Janjic – paper describing development of NMMB
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_153264.htm
Ed Colon – paper describing progress of putting digital filter into NEMS
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_152738.htm

Subtasks

09.5.17.1 Maintain four-per-day North American Mesoscale runs and provide aviation guidance grids. (30 Sept 09)

09.5.17.2 Maintain four-per-day HiRes Window runs and provide aviation guidance grids. (30 Sept 09)

09.5.17.3 Provide vendors with gridded NAM model data via Family of Services and the FAA Bulk Weather Data Telecommunications Gateway. (30 Sept 09)

09.5.17.4 Provide full grids from NAM, and the HiRes Window on NCEP and NWS/OPS servers. Maintain access to model verification data. (30 Sept 09)

09.5.17.5 Working with NCO, complete the design, compilation, debugging, test runs and parallel testing of NAM and HRW (and SREF) codes on new CCS computer. (30 Sept 09)

Deliverables

09.5.17.E1 30 September 2009 **EMC** (Rogers, Pyle, Keyser, Liu)
Perform ingest, quality control and preparation of both existing and new observations in support of the operational WRF runs.

CURRENT EFFORTS:

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: GSD & NCO.

UPDATES TO SCHEDULE:

09.5.17.E2 30 September 2009 **EMC** (Rogers, Pyle, Keyser)
As requested by other RT's, incorporate new AHP calculations into Operational WRF Model post-processor and product generator.

CURRENT EFFORTS: No requests from other RT's were received during the second quarter.

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: NCO

UPDATES TO SCHEDULE: None

Task 09.5.4 Develop, test, and implement the Rapid Refresh.
NCEP
Dennis Keyser reports that his experimental Rapid Refresh (RR) PrepBUFR files containing 50 km ASCAT, WindSat data (non-superob) and expanded (time-window) QuikSCAT data (0.5 deg lat/lon superobs) are being copied to a private ESRL directory on the NCEP ftpprd server. RR dumps of expanded (time-window) Level 2.5/3 NEXRAD radial wind data are also being copied to a public ftp directory. These and hourly lightning data are being tested in ESRL's experimental RR runs. ESRL plans to test other new data types present in the production RR PrepBUFR and dump files, to include Multi-Agency Profiler winds, Canadian AMDAR data, QuikSCAT data (up to 2 hours old) and METOP-2 radiances.

GSD
We are in the process of converting the Rapid Refresh to run Version 3.1 of WRF, which was released 9 April 2009, merging with the recent ESRL-developed changed to the RR-WRF. This includes the WRF Preprocessing System (WPS), the WRF ARW model and the WRFpost, although our focus at present is on WPS and the model.

The persistent problem of WRF-RR-model crashes along the lateral boundaries once every few days continues to be under active investigation. More info below:

- RR retro run has now reproduced RR boundary crash, experiments underway for likely remedy(ies), including application of WRFv3.1
- We are satisfied that the GSI is properly handling the sigma coordinate of the background WRF-ARW 1-h forecasts.
- Heavy usage of the ESRL supercomputer and a major file-system crash (discussed further below) have been causing many dropped cycles on the GSD primary version of the RR and forced us to turn off the dev RR entirely for more than a month. The dropped cycles have complicated efforts to diagnose and solve this periodic model-crashing problem.
- A mechanism for reserving cores for regularly scheduled jobs such as the RR is now available on the ESRL supercomputer and we are migrating the RR cycle to this system, which we hope will increase the reliability of the RR cycles.
- Despite these file-system and heavy load problems we have discovered some issues with the recently added capability to predict temperature in sea ice and to predict the accumulation and ablation of snow on top of sea ice, with its attendant impact on albedo of the ice (see Task 8). Tests are now underway to see if recent fixes have solved a problem involving too warm skin temperatures over the ice during daytime. A bug involving albedo was found to be causing excessive cooling and crashes in the LSM; this has been fixed. Most recently the restarted dev RR 1-h cycle is testing the impact of increased 6th order diffusion on buildup of strong vertical velocity in humid, mountainous tropical areas that is being carried over into successive runs.

The revision of the cycling of land-surface variables during April seems to be working well. This allows for snow-cover trimming in the RR cycles as is done in the RUC (3/31/09 change package to operational NCEP RUC, see 15 April Q2 MDE report) when the daily NESDIS snow-cover and sea-ice product detects no snow cover, but snow cover is present in the RUC 1h forecast, and certain other criteria are met. Daily updating of sea ice is also now accomplished through use of this product, which is available through NCEP and also used by the NAM. (Formerly, sea ice in the RR was only updated upon cold starts from the GFS.) The cycling of land-surface variables was also redesigned to be more robust in order to better ensure continuity of cycling of soil properties and snow variables in the event of missed RR cycles.

GSD also introduced several additional severe-storm indices into the NCEP version of WRFpost during April and early May. This was done at the request of the Storm Prediction Center, primarily for HRRR output. These include vertical shear of the horizontal wind, echo top, total column rainwater and snow, as well as a number of variables for which the output is the maximum value during the previous hour (updraft-helicity, updraft, downdraft, 10m wind gust speed, total column graupel, and composite reflectivity).

The largest and most advanced file system (Lustre File System, /lfs0) on the wJET/hJET computer became subject to significant slowdowns and hangs, the latter necessitating occasional manual restarts, during late April and early May, contributing to too many missed RR cycles. An upgrade to the Luster server software that was touted by the vendor as the cure to these problems was installed on 18 May. This, however, only exacerbated the problems. Subsequent attempts to reinstall the upgrade resulted in the loss of many files on /lfs0 and it was shut down entirely for over a week while attempts were made to recover these files (lfs0 is not routinely backed up). Fortunately, GSD/AMB has been careful about making sure that critical source code, scripts, etc., are on a file system that is backed up, and we have become more aggressive about moving large data files to the Mass Store, so losses were less than for most other users. However, the data and boundary-condition files needed to run the new RR 1-h retro period noted in the April 2009 MDE report were lost and are currently being reconstructed. We estimate

that since 1 May we have lost close to 3 weeks of development time due to the /lfs0 problems and the efforts that have been put in to try to work around them. There has been close communication and collaboration with the Raytheon systems people during all of this and we acknowledge their strenuous efforts to deal with these problems.

In addition to this, there are a number of multi-hour outages and one multi-day outage planned over the next several weeks necessary to move hardware in preparation for the arrival of major upgrades to hJET, including additional processors for the HRRR (See Task 24).

ESRL/GSD papers on Rapid Refresh presented at 23rd WAF / 19th NWP Conference in Omaha:

Status report on Rapid Refresh development
Steve Weygandt, T. G. Smirnova, M. Hu, J. M. Brown, D. Dévényi, S. G. Benjamin, W. R. Moninger, S. E. Peckham, G. A. Grell, K. J. Brundage, B. D. Jamison, C. W. Harrop, and J. B. Olson
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154330.htm

Implementation and testing of WRF Digital Filter Initialization (DFI) at NOAA/ESRL
Tatiana G. Smirnova, S. E. Peckham, S. G. Benjamin, and J. M. Brown
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154325.htm

Subtasks

09.5.4.1 Ongoing evaluation of performance of real-time and retrospective runs of RR system.

GSD
Starting in late October 2008 (but subject to the recent serious interruptions discussed above) two parallel full hourly cycled versions of the Rapid Refresh have been running at GSD, with files from the primary RR going to many users (including AWR RTs), also with verification and web-based plots.

Verification of standard atmospheric variables (temp, RH, wind) through early March over the RUC verification domain continued to indicate the experimental Rapid Refresh is competitive with the RUC at most forecast lengths and output times. Upper level wind RMS errors were almost an exact match to the RUC, except near the tropopause where scores were a bit worse. Beginning in mid-late March, however, performance of the RR has been intermittently worse, particularly for winds and temperature near the tropopause. That aircraft reports were not being used in the GSI during part of this period contributed, but is not the full explanation. This is of considerable concern, and a full evaluation will be undertaken once the computing environment is more stable.

Verification over Alaska continues. We saw some very large errors in 925mb wind forecasts at Anchorage during a strong low-level easterly flow situation with a deep low pressure in the Gulf of Alaska. The next paragraph may provide a partial explanation.

Using less smooth terrain (implemented in Feb) improved the response to surface data, since the GSI observational error of METAR stations is related to the difference between the station elevation and the model elevation at the station location. However we found that there is an inconsistency in the terrain file we have been using for the mass points and that used for the velocity points in the WRF model. Experiments will soon be conducted to determine damage caused by this oversight.

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.

(ESRL/GSD)
GSD continues to make many different types of RR files available to users (AWR RTs, NWS). We are currently producing 4 flavors of RR files (native level, pressure level, surface field, and precip fields) for each of 3 grids (full RR, Alaska 249, CONUS) and in grib1 and grib2 formats. George Trojan at Alaska Region NWS has ported RR grids to the AWIPS workstation and forecasters at ANC and FAI and the AAWU have now had a few months to evaluate them. We reported on the major concerns expressed by the Alaska forecasters in the FY09Q2 report.

PPT presentations (from the Alaskan Weather Symposium from 10-12 March in Fairbanks, AK). Summarizing the most recent Rapid Refresh verification can be viewed at:
http://ruc.noaa.gov/pdf/RR-AK-Wx-Symp-Mar09-pt1.pdf and
http://ruc.noaa.gov/pdf/RR-AK-Wx-Symp-Mar09-pt2.pdf

As a result of discussions with Alaska forecasters late last year, NASA Langley initiated an effort to produce GOES-based cloud products over most of the Rapid Refresh domain (more under 09.5.15). ESRL and NASA Langley are working to set up the real-time feed for this data, which is expected around mid-June (ESRL heavy job-load for IT services).

Various AWRP RTs at NCAR have also been accessing the RR grids and are evaluating the performance of their algorithms on this data. The Icing RT makes revealing displays comparing the hydrometeor fields from the RR vs. RUC.

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.

Tom Henderson of GSD has been working with Tom Black of NCEP on making necessary changes to the Flow-following, finite-volume Icosahedral Model (FIM, global model developed, and now under testing, at ESRL) to make it compatible with the NOAA Environmental Modeling System (NEMS) flavor of ESMF. Under this architecture, there will be 2 ESMF "components" for models such as the RR: a "dynamics" (i.e., dynamical core) and a "physics" component. Roughly how this will work at each model time step is as follows. An "output state" will be generated in the dynamics component after the dynamics for a given time step is completed. This will consist of variables (e.g., temperature, horizontal wind, vertical motion, hydrometeors) required as inputs for any physics routines that are to be called at that time step (since all physics routines are not called at every time step, provision will be made for this in the output state if computation efficiency dictates). The physics routines inside the physics component then generate time tendencies for their particular physical processes to be applied to the dependent variables. This output state is passed back as an input state to the dynamics where the tendencies are applied. Although this is simple in concept, there are many details that arise in implementation, for example, where to put (dynamics or physics) computation of certain online model diagnostics that need to appear in stdout model log files. Henderson and Black are wrestling with these matters in consultation with model developers and are keeping other applications (such as the ensemble RR) in view.

The object of this work is to preserve the generality that ESMF allows (e.g., the physics and dynamics components could in principle operate on a separate horizontal grid), without compromising model run time. Maintaining simplicity for easier code maintenance is also an important design consideration. In the application envisioned for FIM as an ensemble member within the Global Ensemble Modeling System (GEMS) at NCEP, both FIM and GFS will be operating under the NEMS, possibly with different physics suites. The situation is therefore analogous to that envisioned for the Rapid Refresh in 2012: both the ARW and the NMM dynamical cores and with possibly different physics suites (e.g., the RR and the NAM physics suites) will be run under NEMS. Though the details of how GEMS will work under NEMS are not yet fully fleshed out, the GEMS work is well along. It is anticipated that the RR design for running under NEMS will closely follow that for GEMS wherever possible. Serious work on the RR design will commence once the GEMS design is far enough along to allow prototype testing with FIM or the NMMB global model (under development at NCEP).

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 30 Sept 2009 **(previously extended to Q2 FY10 @ Jan09 AWRP meeting – DiMego and Benjamin)** (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.

A presentation summarizing the RR testing and refinement was given by Steve Weygandt at the NCEP Annual Product Review (see PPT slides for RUC/RR presentation under
http://www.emc.ncep.noaa.gov/annualreviews/2008Review/index.html

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 **(previously extended to Q2 FY10 @ Jan09 AWRP meeting – DiMego and Benjamin)** (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 reports that using QUIKSCAT data in her low resolution (30-day retrospective 32 km) NDAS test system produced a neutral impact on the forecasts. The observational error variances in the analysis system were re-evaluated with the DeRozier et al. adaptive tuning method. The results produced a slight negative impact on the low resolution NDAS test system. The tuning results of each observational type are now being evaluated individually.

Dave Parrish provided assistance to Eric Rogers in creating the new NMMB NDAS, and started updating the NMMB version of GSI in the new Subversion repository. He compared the operational NAM GSI to latest repository version with help from Wan-Shu Wu, and fixed a radar wind bug that was introduced into the repository version. This bug fix resolved a difference seen in the radar test results between the repository and operational GSI. Dave Parrish also fixed a bug in vertical obs error modification in the GFS and NAM GSI that was found originally by Wan-Shu Wu. This bug caused minor differences in the analysis near the top of model atmosphere, and will need to be corrected in the operational version once the model moratorium is over.

Shun Liu collected estimated mixing-layer height from radar reflectivity for April - May. He compared estimated mixing-layer height from radar with that estimated from ACARS and RAOBS. For daytime the mixing-layer height from radar is about 200 m lower than that from ACARS, while at night the mixing-layer height from radar is higher than that from ACARS. The estimation algorithm for mixing-layer height was modified to improve its performance at night. Shun Liu continued testing various options for initializing the 4 km Matt Pyle SPC run with 88D radial wind. He is also working on setting up 3 hour precipitation, reflectivity and echo top verification for those forecasts.

Manuel Pondeca built an experimental RTMA system for the Guam NDFD grid that uses a crude first guess that is bilinear interpolated from the GFS forecast. Real-time testing will begin once the downscaled (using smart nit) GFS forecast first guess is provided. Manuel Pondeca also wrote code that computes the EOFs of an ensemble for prescribing the background error covariances of the GSI – this is sometimes referred to as a "hybrid" data assimilation technique.

NCEP GSI papers/posters presented at 23rd WAF / 19th NWP Conference in Omaha:
Geoff Manikin - paper on 2DVAR/RTMA challenges
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_152991.htm
Jim Purser - paper on anisotropic covariance treatments in GSI
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154187.htm
Manuel Pondeca and Geoff Manikin – paper on RTMA upgrades
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_152992.htm
Yanqiu Zhu – paper on experimental wind gust analysis using 2DVAR/RTMA
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_152738.htm

GSD
Dezso Devenyi completed his work on a set of modifications to map the surface observations from the actual terrain to the model terrain (using a local lapse rate from the background field). By providing for a more accurate innovation, an improved fit to the surface observation should be obtained. Without this change, surface observations for which there is a significant height difference between the actual and the model would just be down-weighted, resulting in a less close analysis fit to these observations. A few minor coding issues were resolved during the month and the improvement now yields reduced O-B and O-A statistics. Transfer of the code modifications to the GSI version used for the GSD real-time cycle were delayed by the GSD computer disk issues, but will be completed shortly. Dezso has also worked with Bill Moninger on creating a web-based utility for tracking O-B and O-A statistics. The prototype is up and running and will be extremely helpful for diagnosing observation using including QC issues etc. Dezso gave presentations on both the surface assimilation and observations monitoring work at the recent NWP and WAF conferences, respectively.

Ming Hu has completed work to evaluate the 1QFY09 version of GSI and add the cloud analysis package into it. He has also upgraded the GSD real-time RR cycle to use WRF ARW version 3.1 and is working on adding in the modifications needed for the DFI-based radar assimilation. Curtis Alexander continues to work on tracking down the build-up of errors along the boundaries and resultant crash of the RR every few days, using the RR retrospective capability (including retrieving from the mass store the files lost during the disk outage).

09.5.5 30 May 2009 (CAPS and GSD)
Testing and refinement to the radial velocity analysis component of the GSI for Rapid Refresh configuration together with the cloud analysis.
CAPS has completed a series of radial velocity assimilation experiments using GSI focusing on high-resolution predictions of tropical storm Erin and begun experiments at 13-km. These experiments have been complemented by GSI radial velocity assimilation tests conducted at GSD, using the level 2.5 radial velocity feed from NCEP. These latter experiments have uncovered data feed latency issues with the NCEP feed that are now being addressed as discussed below.
Stan Benjamin and Steve Weygandt have continued to work with Dennis Keyser at NCEP (with help from Geoff DiMego and others) to access suitable level 2.5 radial velocity files from NCEP and begin evaluation of them within the GSI for Rapid Refresh. Level 2.5 radial velocity files are now being transferred from NCEP to GSD; however, due to upstream issues with the data cutoff time, these files contain radial velocity data that is from the previous hour. This is because the initial processing (super-obbing, done at the radar sites) to create the level 2.5 data and feed it to NCEP does not complete until +:35 to +:55 minutes after each hour, which is well after the RUC/RR data cutoff time (+:26 min after the hour). We are pursuing options for resolving this issue, including getting the initial radar data processing time moved up and obtaining an interim feed from NSSL. The current files (with 1-hour old radial velocity

data), while not useful for real-time testing and evaluation, are suitable for retrospective testing. Thus, in conjunction with the Rapid Refresh retrospective testing capability that has been created to evaluate sporadic crashes (see task 09.5.4) radial velocity data files are being archived to evaluate impacts from level 2.5 radial velocity data and assess different strategies for using these data.

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.

The cycled assimilation system with the digital filter is functional. (Wu)

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.

Extensive evaluation of the RR in late February (in advance of our trip to Alaska to discuss RR with Alaska NWS folks) indicated satisfactory results in most verification statistics.

Details are included in the following PPTs, presented at the Alaska Weather Symposium: PPT presentations (from the Alaskan Weather Symposium from 10-12 March in Fairbanks, AK), summarizing the most recent Rapid Refresh verification can be viewed at:
http://ruc.noaa.gov/pdf/RR-AK-Wx-Symp-Mar09-pt1.pdf and
http://ruc.noaa.gov/pdf/RR-AK-Wx-Symp-Mar09-pt2.pdf

The computer disk outage in late May has greatly complicated efforts to evaluate and refine the Rapid Refresh cycle since that time. A change was made to the ARW damping coefficients in early May (just before the disk issues), that made the verification scores worse. This change was removed late in the month. Preliminary precipitation verification indicates improved CSI scores compared to the RUC, but slightly higher biases.

09.5.5.5 Based on case-study testing and refinement of the research quality code, deliver 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. (31 Jul 09)
(Pondeca, Yanqiu Zhu, Parrish)

Deliverables

09.5.5.E1 31 March 2009 **EMC** (Rogers, Wu, Parrish, Pondeca, Liu)
Subject to NCEP Director approval, implement upgrades (e.g., partial cycling, TAMDAR) to GSI used in NAM/NDAS.

CURRENT EFFORTS:

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: Significant computer down time do to major issues with the main GSD supercomputer disk system completely compromised the Rapid refresh (and HRRR) real-time cycle during much of the month of May. GSD personal quickly transferred operations to

other disks, but I/O was slower resulting in many missed runs. In addition, work to transfer GSI enhancements (such as the surface observations terrain matching code) to the real-time cycle was greatly hampered. The disk became available again in early June and more reliable real-time runs have resumed.

INTERFACE WITH OTHER ORGANIZATIONS: NCO

UPDATES TO SCHEDULE: Completed December 2008.

09.5.5.E2 30 September 2009 **(previously extended to Q2 FY10 @ Jan09 AWRP meeting – DiMego and Benjamin)** (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.

Several times during January and February our Alaska verification revealed onshore flow in northwest Alaska as being too warm. We found this to be an issue common among models, not allowing sufficient surface radiative cooling when there is snow on ice. During February and March, Tanya Smirnova looked into what would be required to modify the RUC LSM to treat ice as a land surface, including the accumulation and ablation of snow on the ice and vertical heat diffusion within the ice, as well as cycling of snow and ice temperature, and also with temperature and snow-cover dependence for albedo (smaller albedo for temperatures approaching and above freezing when ponding on the ice may be present). We hypothesized that this enhancement would permit more realistic buildup and maintenance of cold air over the ice surface in winter through greater negative surface heat flux to the atmosphere. Tanya modified the RUC LSM accordingly and subsequent tests with this new version of the RUC LSM in the cold start RR indicated that, indeed, 2-m temperature forecasts along the northwest coast of Alaska were improved. Tanya has also made a number of other improvements to the RUC LSM. These include removal of a singularity that occasionally manifested itself as anomalously cold surface temperatures with very thin snow cover, loosening of the constraints on melting rate when air temperature is above freezing, and general code cleanup. These changes were introduced into the RR1h cycles in late April. Recent evaluation has revealed situations where temperature within the ice was erroneously rising above the melting point, leading to too warm skin temperatures. Tests of a fix are underway.

09.5.8.3 30 July 2009 (NCAR)
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. (NCAR task)

In addition to including emission and settling (gravitational) of dust, Trude has now included a routine to account for dry deposition of dust due to turbulent transfer to the surface. This routine is also based on WRFchem GOCART module (as the emission and gravitational settling routines are), but an assumed size distribution is used instead of using size binning. Based on a literature review is seems that the shape of dust size distributions do not change much during transport, while the number concentration does, and an assumed constant size distribution shape can be justified.

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.

See subtask 8.1 for modifications already made for sea ice. Ftp arrangements were made to make RR grids 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.

09.5.8.3 Jul '09: 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. (NCAR task)

09.5.8.5 Dec '08: Report on FY07-funded ESRL-NCAR RR retrospective testing of the impact of different thickness of vertical model layers close to the surface and, as appropriate, other physics. (Joint NCAR and ESRL task)

09.5.8E2 Sep '09: Provide an improved microphysics scheme to ESRL for evaluation toward FY11 Rapid Refresh upgrade. (NCAR)

09.5.8E3 Aug '09: Complete FY09 physics improvement for icing, C&V, turbulence and convective forecasts. (NCAR)

Task 09.5.15 Develop improved methods of cloud and moisture analysis for use in the Rapid Refresh.

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. Extensive information on this task in the last quarterly report. Main task this month *by Ming Hu) has been completion of porting the cloud analysis modifications to the new GSI version (1QFY09).

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

09.5.15.4 30 May 2009 (GSD and CAPS)
Request in February from Stan Benjamin and Ming Xue: DEFER due date from 30 March to 30 May. Assumed approved.

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

We have the DDFI-based radar assimilation coded and running our real-time RR cycle. 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 recent qualitative assessment, the signal from the DDFI radar assimilation in the RR looks similar to that from the RUC radar assimilation, with the exception that the RR produces larger areas of heavy convective precipitation (though this may be linked more to the model than the implementation of the radar assimilation procedure

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
NCAR is organizing the 10th WRF Users' Workshop. This will be held at NCAR's Center Green facility in Boulder June 23rd-26th, 2009. It will feature both plenary and parallel sessions, with a developers' forum and a poster session. The final day will have instructional presentations on model-related utilities. Full information may be found at http://www.mmm.ucar.edu/events/2009_wrfusers/index.php.

Jimy Dudhia of NCAR completed working on changes to the Lin microphysics scheme, received from Peter Blossey (Univ. of Washington); they were added to the repository. These improvements relate to more accurate evaporation calculations.

Dudhia worked with Penn State to distinguish grid-nudging for the stable mixing regime (regime 2), which is planned as a future addition. He also added a fix to the V3.1 repository to enable spectral nudging.

Dudhia diagnosed and resolved problems related to slope radiation effects, where these had been exaggerated due to a bug in the code. He is working with David Gochis and Ethan Gutmann (RAL) to develop additional slope effect improvements in surface fluxes. These would address enhanced surface fluxes from an increased surface area (compared to a horizontal surface).

CURRENT EFFORTS:

PLANNED EFFORTS

PROBLEMS/ISSUES/SCHEDULE CHANGES:

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.

GSD – Some improvements in WRF-Post described under 09.5.4, yet to be submitted to NCEP (Huiya Chuang). SVN repository set up for all ESRL changes to WRF-post.

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

CURRENT EFFORTS:

PLANNED EFFORTS:

UPDATES TO SCHEDULE: NONE

09.5.6.5 30 Sept 2009 (NCAR/MMM)
NCAR released WRF Version 3.1 in April 2009. Preliminary work involved completing testing and certification of the code for release.

CURRENT EFFORTS:

PLANNED EFFORTS:

UPDATES TO SCHEDULE: NONE

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.

<u>Task 09.5.24</u> Test WRF Rapid Refresh model at 3-km resolution toward High-Resolution Rapid Refresh

GSD

GSD has worked to optimize creation and dissemination of the grids for the 2009 larger-domain HRRR. Latency has been reduced to ~2-h for the 120h HRRR forecast. This has included placing the HRRR runs within a computer job core reservation system and tuning the number of cores such that the HRRR run for a given hour finished in slightly less than 1 hour, allowing the same computer cores to be used for the next HRRR run. In addition, as part of the CoSPA collaboration, code supplied by NCAR/RAP to create 15-min output of VIL (calculated two ways) and forecast echo-top has been incorporated into the

WRF-ARW version used for the HRRR. Finally file transfer procedures have been adjusted to maximize reliability and minimize delay.

This work has been supplemented by real-time case study evaluation of the new larger-domain HRRR in May. Some excellent case studies have occurred, including the central US squall line case on 13 May with unusual (but well-forecast by HRRR) convective mode. This can be seen in the Fig. showing an 11-h HRRR forecast of maximum reflectivity and the accompanying NSSL verifying reflectivity mosaic. Barry Schwartz has completed coding and scripting to verify HRRR reflectivity forecast against the NSSSL reflectivity mosaic and is working on procedures to verify HRRR precipitation forecasts. Without question, however, simple qualitative assessments clearly indicate much better HRRR forecasts (compared to 2008) are now regularly available from Iowa-Illinois into the Chicago area and from Missouri toward St. Louis with the larger HRRR domain.

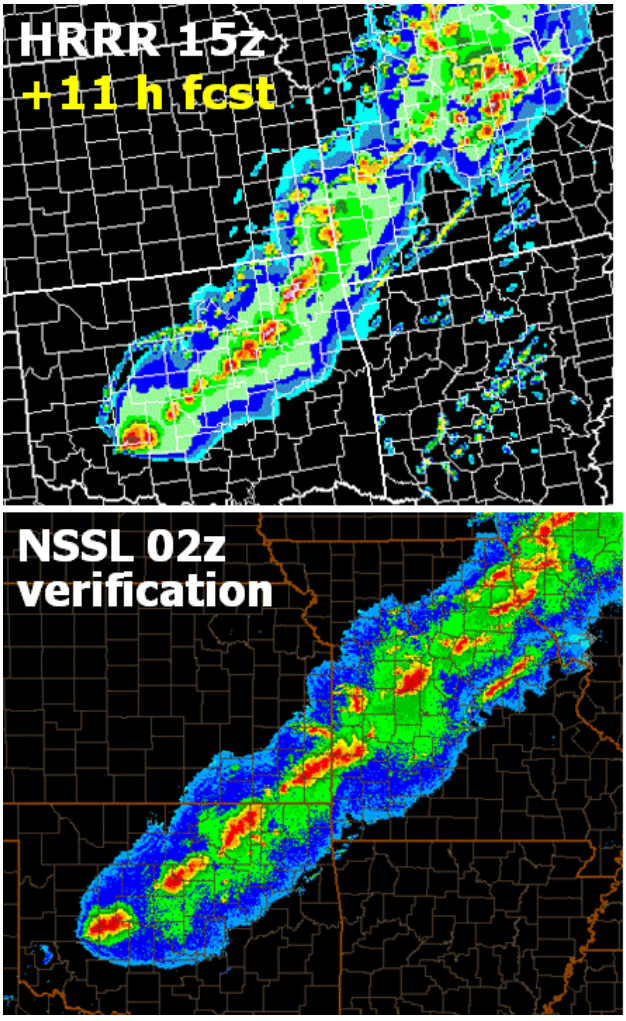

Fig. 1 (Top) HRRR 11-h forecast simulated maximum reflectivity valid 0200 UTC, 14 May 2009. (Bottom) NSSL maximum reflectivity mosaic used as validation.

Ongoing evaluation of real-time HRRR runs has continued through May and into early June and has re-enforced this favorable impression. The HRRR has produced quite realistic storm structure (often correctly forecasting regions of super cells, multi-cells, bow-echoes and multi-cell storms. In addition, the HRRR has been quite good at indicating locations of significant convection, often to within a couple of counties. This skill has been seen not only for HRRR runs initialized with ongoing storms (via the RUC

DFI-based radar assimilation), but also for longer lead time morning HRRR runs (initialized before convective initiation). In addition to the HRRR evaluation conducted by NSSL/SPC as part of their spring program, the HRRR guidance has been used extensively by the VORTEX-2 field project forecasters. At the recent NWP conference in Omaha, NE, Steve Weygandt gave a talk summarizing improvements to the HRRR for the 2009 season and results so far.

GSD has conducted a series of tests with different WRF namelist parameters for diffusion, advection, and forward differencing options, as suggested by Lou Wicker at NSSL after Stan Benjamin's visit to NSSL/SPC in April. One set of changes for diffusion was implemented immediately into the real-time HRRR runs in late April, and other changes are possible.

In addition to Stan's visit to Norman in April for only 1.5 days, Steve Weygandt and John Brown visited SPC/NSSL for a full week each during May to participate in the Spring Forecast Experiment for convective weather forecasting. The HRRR is now an important participant among the experimental NWP products being evaluated in this Experiment.

GSD has developed a prototype time-lagged ensemble-based convective probability forecast product from the HRRR and NCAR has preliminary results from a statistical assessment of HRRR time-lagged forecasts. As of early May, a HRRR Convective Probability Forecast (HCPF) product is being created and verified in real-time.

The HRRR products now available have been expanded after changes to WRFpost and HRRR ncl scripts for graphical products. This is now the list of products available hourly for the full HRRR domain, and each of 4 regional quadrants (NW, SW, NE, SE). See http://ruc.noaa.gov/rr/hrrrlargeq1/

1 km agl reflectivity
reflectivity
max reflectivity
surface CAPE
surface CIN
most unstable CAPE
LCL
0-1 km shear
0-6 km shear
max updraft helicity
storm motion
max vert int graupel
10m wind
max 10m wind
skin temp
2m temp
2m temp - skin temp
2m dew point
precipitable water
1h acc precip
total acc precip
snow water equiv
precip type
850mb temp
850mb wind
850mb rh
850-500mb mean rh

700mb temp
700mb vvel
mean vvel
max updraft
max downdraft
500mb temp
500mb vort
250mb wind
visibility
cloud top height
ceiling

ESRL/GSD papers on HRRR presented at 23rd WAF / 19th NWP Conference in Omaha:

Reports from AMS WAF/NWP Conference in Omaha, NE, 1-5 June 2009
The High Resolution Rapid Refresh (HRRR): an hourly updated convection resolving model utilizing radar reflectivity assimilation from the RUC / RR
Steve Weygandt, T. G. Smirnova, S. G. Benjamin, K. J. Brundage, S. R. Sahm, C. R. Alexander, and B. E. Schwartz
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154317.htm

Probabilistic thunderstorm guidance from a time-lagged ensemble of High Resolution Rapid Refresh (HRRR) forecasts
Curtis R. Alexander, D. A. Koch, S. S. Weygandt, T. G. Smirnova, S. G. Benjamin, and H. Yuan
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154254.htm

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.

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.

CURRENT EFFORTS:

During FY09Q2, NCAR/MMM and GSD scientists developed the plan for this work, the evaluation of convection-permitting forecasts. The strategy, **implemented in early May**, exploits the 3-km real-time NWP conducted this spring at NCAR in support of the SPC's Spring Forecast Experiment. NCAR will be running the ARW at 3 km twice-daily **using 13-km RUC DFI grids** (as used in the ESRL HRRR) for initial conditions. Two to three forecasts/cases will be chosen, based on GSD input, for close evaluation. GSD personnel will review the forecasts daily, and candidates for further study will be noted. The cases are being analyzed jointly by NCAR/MMM and GSD.

PLANNED EFFORTS:

NCAR has produced 3-km ARW forecasts this Spring based on 13-km RUC DFI initialization. In collaboration with GSD, cases will be selected for review. The evaluations will take place over the next two quarters.

UPDATES TO SCHEDULE: None.

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.

Coordinated evaluation of specific case studies is ongoing with monthly meetings between GSD and NCAR. Sensitivities to grid resolution, model numerics, and microphysics have been examined. Other experiments have illustrated the benefit of using the RUC initial fields (with the DFI-based radar assimilation).

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.

A significant effort to make the HRRR production and file delivery system robust has been completed, including placing HRRR within the jet reservation system, adding new post-process variables, calibrating the number of cores to optimize the run time and working with user communities to achieve timely and reliable transfer of various output files. Additional work is ongoing to evaluate real-time HRRR runs, identify strengths and weaknesses, and resolve issues. One issue that we have identified is the presence of streamers in the vorticity field entering from the upstream boundary. This is likely due to inconsistencies in the WPS interpolation from the external native model grid. Tests using pressure level data from the external model have not shown this problem and we are actively investigating this problem.

Deliverables

09.5.24.E1 30 August 2009 (NCAR/MMM)
Submit report on evaluation of HRRR-ARW forecasts.

CURRENT EFFORTS:

The planning for the approach to the evaluation was completed.

PLANNED EFFORTS:

NCAR will draft the report in the third and fourth quarters as the evaluation is done.

UPDATES TO SCHEDULE: None

09.5.24.E2 30 August 2009 (NOAA/ESRL/GSD)
Complete FY09 test in 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.

GSD

We are continuing to examine how the convergence / divergence fields initialized in the HRRR (from the RUC radar reflectivity assimilation) evolve down-scale during the first 1-3 hours of the HRRR model run to yield 3-km-scale convective systems. Curtis Alexander has made plots of the HRRR initial (00-h from the 13-km RUC diabatic-DFI) and HRRR 1-h divergence fields, illustrating the scale-contraction and intensification of the low-level convergence. Analysis is ongoing for both cases were the convection has initiated within the first hour (DDFI reflectivity-based convergence is diagnosed for the first time within the RUC system) and for cases with ongoing convection (DDFI reflectivity-based convergence superimposed upon ongoing RUC convection from previous radar assimilation cycles).

CAPS

Complete new 3-km GSI data assimilation experiments toward improved assimilation of radial wind.

In June, Yi Yang started test runs for the 13 km RR grid, assimilating radial velocity data, on top of the existing procedure assimilating reflectivity data through DDFI. The runs are made on the GSD machine, using the Rapid Refresh workflow modified for running retrospective cases. The goal is to evaluate and maximize the positive impact of additional radial velocity data for the RR configuration. Results will be reported in the future.

Additional quantitative evaluations were performed in May by Yi Yang and Kefeng Zhu, on the tropical storm Erin case, using MET 2.0. Further, NCEP Stage IV precipitation data are now used instead of Stage II data; the formal is found to be more accurate compared to the Oklahoma Mesonet data. Efforts are being made to summarize the results in a manuscript.

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, and 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, 13 Sept. and 5 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)

GSD has been providing, to NCAR, RUC lateral boundary and radar-enhanced initial condition (history file dump directly after the RUC diabatic DFI-based radar assimilation) files for experimental re-runs of selected test cases from the 2007 convective season. Initial work has focused on 5 Sept.

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

09.5.19.4 30 Sept 2009 (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.

Task 09.5.20 Develop ensemble-based probabilistic products for aviation users.

GSD
Curtis Alexander and Doug Koch developed code to create and verify real-time HRRR Convective Probability Forecasts (HCPF). Steve Weygandt supplied RCPF code to Binbin Zhou, who is utilizing time-lagged RUC ensemble members and other model grids to create a prototype Very Short Range Ensemble Forecast (VSREF). Curtis Alexander gave a presentation on preliminary HCPF results at the recent NWP conference in Omaha, NE.

ESRL/GSD paper on HRRR-based probabilistic forecasting presented at 23rd WAF / 19th NWP Conference in Omaha:

Probabilistic thunderstorm guidance from a time-lagged ensemble of High Resolution Rapid Refresh (HRRR) forecasts
Curtis R. Alexander, D. A. Koch, S. S. Weygandt, T. G. Smirnova, S. G. Benjamin, and H. Yuan
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_154254.htm

NCEP
Jun Du reports that the radar echo top product was added to the post (by Hui-Ya Chuang) and turned on in output from the parallel SREF in response to a request from FAA Command Center. The verification of the parallel SREF was done based on its daily runs from February through May 2009 and the results were presented at 23rd WAF / 19th NWP Conference in Omaha:
http://ams.confex.com/ams/23WAF19NWP/techprogram/paper_153264.htm . NCO is planning to start its real-time parallel for pre-implementation testing 23 June with actual implementation as early as mid-August (depends on many things).

BinBin Zhou continued work on VSREF products based on the RUC and NAM forecasts (using the SREF ensemble product generator) and completed the general framework for the VSREF procedure. The preliminary products can be viewed at the following website, which is now open for comments
http://www.emc.ncep.noaa.gov/mmb/SREF_avia/FCST/VSREF/web_site/html/vsref.html

CAPS

Subtasks

09.5.20.1 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. (31 Jan 09)

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 Develop & deliver a new fog algorithm used in SREF product for aviation. (30 Apr 09)

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.

GSD has identified a new scientist to work on the VSREF project with NCEP – more on this topic by next month's report.

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

Deliverables

09.5.20.E1 31 August 2009 EMC (Du, Zhou)

Demonstrate products from experimental VSREF probabilistic forecasts updated hourly.

CURRENT EFFORTS:

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: AWS, GSD

UPDATES TO SCHEDULE: None.