MDE Product Development Team
December 2009 – FY 2010 1st Quarter Report
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(Compiled and edited by S. Benjamin and B. Johnson)

Executive Summary

Rapid Refresh / RUC Technical Review at ESRL – Tues 3 Nov 2009 – 160-slide presentation – **http://ruc.noaa.gov/pdf/RR-RUC-TR_11_3_2009.pdf** . This PowerPoint contains information on RR and HRRR progress. Also now available is the RR/RUC (Benjamin/Weygandt) and Mesoscale (DiMego) presentations from the NCEP Production Suite Review, presented 8 Dec 2009 – **http://www.emc.ncep.noaa.gov/annualreviews/2009Review/index.html**

Task 10.5.1: Infrastructure support related to operational running of the RUC and NAM operational modeling systems.

- Testing continues at NCEP for 18h RUC/Canadian data, implementation now scheduled for Feb.
- TAMDAR thinning from limited NOAA funding has reduced RUC accuracy starting in late October.

Task 10.5.4 Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

- Partial cycling for Rapid Refresh running in primary 1-h cycle at GSD, giving much improved results
- Ceiling forecasts (MVFR, IFR) from RR now exceeding those from RUC (in addition to wind and temperature, as reported last month).
- Overall performance of the RR is now generally suitable for implementation of the RR. Transfer to NCEP has started, and discussions between ESRL and NCEP are now becoming much more frequent.
- RR real-time cycle at ESRL/GSD running on fully dedicated processors providing much greater reliability.

Task 10.5.5: Develop, test, and implement 3DVARs for RR and NAM

- RR GSI – further testing

Task 10.5.17: Infrastructure support for NAM, future RR, future HRRR, support for community WRF model

- WRFv3.2 nearing readiness. Contributions from NCAR to WRF model, especially on WRF physics.

Task 10.5.15: Develop methods for improved cloud/hydrometeor analysis in RR

- Ceiling forecasts from RR now matching or exceeding those from RUC, due to improvements to RR cloud/hydrometeor analysis
- Issue with RR radar assimilation leading to clearing of snow hydrometeors resulting in warm surface temperature bias identified and being resolved

Task 10.5.24/19: Development/testing of HRRR

- CONUS HRRR now running on fully dedicated processors providing much greater reliability
- Summer 2009 retrospective experiments underway to evaluate radar assimilation impacts within RUC and HRRR on HRRR forecasts.
- HRRR continues to run over full CONUS domain, examination of winter season fields underway.

Task 10.5.1 Infrastructure Support Related to Operational running of the non-WRF Rapid Update Cycle System in NCEP Operations

GSD

Preparation for upcoming RUC change package at NCEP, including extension to 18h, assisting EMC (Geoff Manikin) where current parallel version is being run **(http://www.emc.ncep.noaa.gov/mmb/ruc2/para/)**

Changes included:

- Extension from 12h/9h duration to 18h at all forecast times.
- Correction to cloud analysis code for warm clouds.
- Corrections to snow cover treatment (see next item)
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Snow cover investigation and changes to operational code:

- Background: An important change was made to the RUC on 31 March 2009 to begin using NESDIS snow cover data to trim areal coverage from the RUC 1h forecast under certain conditions (2m temps > 2 deg C, no current precipitation in RUC1h forecast).
- Two discoveries were made, both resulting in deficiencies in evolution of snow cover in RUC and both necessitating code changes to be implemented as part of the upcoming change package:
    - Change snow cover update time to 23z (after new NESDIS IMSsnow data becomes available) instead of the previous setting for 19z (meaning, that snow cover clearing was 20h later than it needed to be).
    - Snow clearing code needed to be matched from land-points in IMSsnow data to nearest land-points in RUC.

Other efforts:

- General monitoring of operational RUC at NCEP, inter-comparisons with backup RUC, dev RUC run at ESRL.
- Monitoring TAMDAR availability for RUC. Comparisons of RUC forecast skill and TAMDAR counts between different RUC versions (oper-NCEP, backup-ESRL, dev-ESRL)
    - Noted beginning of TAMDAR thinning starting 10/28 by about 90%.
        - About 60-90% of the TAMDAR temperature forecast improvement is lost from the thinning (compared to the devRUC, where all TAMDAR data is used), and about 90-95% of the TAMDAR moisture forecast is also lost from the thinning.

Subtasks

10.5.1.1 Maintain hourly RUC runs and provide aviation guidance grids. (30 Sept 10)

NCO was notified in November by EMC & GSD that radar reflectivity analyses were not getting into the RUC. NCO determined this was due to a “prod vs. para script switch” that occurred inadvertently when the new P6 computer became production in August. This “broke” the generation of the Level-II reflectivity mosaic used by the RUC in its diabatic digital filter initialization. NCO’s Chris Magee filed corrective RFCs, and the problems were fixed in early December. It seems that the absence of radar data for several weeks didn’t hurt RUC performance as much as feared, as the biggest gains from assimilating radar data are realized in convective events, and convection is at its yearly minimum during the fall months. Work is underway to extend all RUC cycles and their output to 18 hours, and code was tested and delivered to NCO. The change package also includes code to assimilate Canadian aircraft observations and a correction to a problem with virtual potential temperatures not being adjusted in response to changes in mixing ratio associated with cloud building There will also be a modification to the timing of the model snow clearing. It is currently performed each day at 1900 GMT, but the

snow data file becomes available around 2300 UTC, so snow will be cleared during the 23z cycle. A second clearing will be performed at 18z the next day to catch eastern points which might have temperatures too cold at 23z for the model to allow the removal. This package is scheduled for implementation on 23 February 2010. (Manikin)

10.5.1.2 Provide vendors with gridded model data via Family of Services (FOS), and the FAA Bulk Weather Data Telecommunications Gateway (FBWDTG). (30 Sept 10)

NCEP maintained real-time availability of SAV and AIV guidance to all vendors from the operational hourly RUC on pressure surfaces on the 80-km AWIPS grid #211 via the NWS Family of Services (FOS) data feed and the FAA Bulk Weather Data Telecommunications Gateway (FBWDTG). (DiMego)

10.5.1.3 Provide full grids from RUC runs on NCEP and NWS/OPS servers. (30 Sept 10)

NCEP maintained real-time availability of full resolution gridded data from the operational RUC runs via anonymous ftp access via the NCEP server site at **ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/ruc/prod/** and at the NWS/OPS site at **ftp://tgftp.nws.noaa.gov/SL.us008001/ST.opnl/** in hourly directories named MT.ruc_CY.00 through MT.ruc_CY.23. This includes hourly BUFR soundings and output grids which undergo no interpolation. Both sites now contain only grids packed into GRIB2 format, see **http://www.nco.ncep.noaa.gov/pmb/docs/GRIB1_to_GRIB2.shtml**. A limited set of fields from the RUC runs (and other NCEP models) can also be viewed at **http://www.nco.ncep.noaa.gov/pmb/nwprod/analysis/**. (DiMego)

10.5.1.4 Maintain access to model verification data. (30 Sept 10)

NCEP maintained its capability and provided access to routine verifications of the operational RUC analyses and forecasts. These include grid-to-station verifications versus rawinsonde, surface, aircraft, Profiler, and VAD data computed periodically at NCEP and accessible via NCEP's Mesoscale Modeling Branch (MMB) website: http://www.emc.ncep.noaa.gov/mmb/research/meso.verf.html (DiMego)

Deliverables

10.5.1E1 (30 September 2010) (Keyser, Liu)
Perform ingest, quality control and preparation of both existing and new observations in support of the operational RUC runs.

CURRENT EFFORTS: NCEP/NCO is investigating radiosonde sites that report an invalid instrument type. NESDIS hasn't yet responded to problems with the GOES 1x1 field-of-view cloud data. A problem with MADIS NetCDF TAMDAR file changes was corrected on 14 October. The amount of TAMDAR data available to NCEP (AirDAT / MADIS) was reduced by 90% after 29 October when the AirDAT contract with the NWS changed. NCEP plans to obtain all TAMDAR data from AirDAT as a MADIS alternative to add airframe type and company code for the development of improved bias corrections. The backup AFWA feed for MDCRS data ended on 30 October when their contract with ARINC expired. These data are used by NCEP only once or twice a year when the primary ARINC MDCRS feed goes down. NCEP continues work on implementing the superior NRL-based aircraft QC code. Changes are being made to speed up the dump processing by this new (slower) QC code. The station pressure problem of some drifting buoys was corrected on 27 October. No tide gauge data was available October 5-6. An updated version of the NCEP BUFR library is being tested for FY2010 implementation. The last recorder on the DMSP F-13 satellite failed on 19 November, and now SSM/I data are no longer available

(including SSM/I oceanic precipitable water assimilated by the RUC). Efforts continue to bring in F-16 and F-17 SSM/IS. The Colorado and Minnesota DOT mesonet providers were down for most of November. Florida and Georgia DOT, Aberdeen PG providers and Colorado DOT mesonet were down for all of December. The number of CWOP/APRSWXNET and AWS mesonet obs increased by more than 50% after 4 November when their temporal frequency increased from 15 to 5 minutes. *(Keyser)* The codes for dumping BUFR format VAD wind were integrated into the radar QC package. Scripts were modified to generate a VAD wind BUFR tank. 2009 version of Level-II radar data QC package from NSSL was parallel tested. The LAPACK library used at NSSL is not available at NCEP, so similar subroutines in NCEP's ESSL were used to replace those in LAPACK. Test results showed that the impact from this change is very small. The 2009 QC version also rejects too many radar observations and is being investigated. It also runs slower than the operational QC package. EMC and NSSL removed some unnecessary codes and simplified some other codes in the new QC package. The 2009 radar bundle update is being prepared. The update includes improving the radar QC package, dumping VAD wind from QC package and converting 3D mosaic products to GRIB format. *(Liu)*

PLANNED EFFORTS: See also PLANNED EFFORTS listed under Task 10.5.17.E1 below for aircraft quality control issues. Obtain all TAMDAR data from AirDAT as alternate to MADIS feed and add airframe type and company code to allow improved bias corrections to be developed. *(Keyser)* Find the reasons more data is rejected in 2009 QC package will by investigating a Dec 2009 precipitation case. *(Liu)*

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: A shortage of disk space on the new P6 computers.

INTERFACE WITH OTHER ORGANIZATIONS: NCO, NSSL.

UPDATES TO SCHEDULE: None.

10.5.1E2 (30 September 2010) (Manikin, ESRL)
Perform configuration management for RUC, including thorough documentation, and respond promptly to any code malfunctions or performance issues.

CURRENT EFFORTS: Work is underway to extend the RUC to 18 hours for all cycles, at the request of AWC and SPC. The new configuration (along with a few bug-fixes) is now running in parallel at EMC. (Manikin and ESRL)

PLANNED EFFORTS: The RUC 18 hr package will be implemented in 2nd quarter (Feb-March). (Manikin)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: Lack of disk space on the new computer will make adding the extra hourly output to 18 hours a challenge.

INTERFACE WITH OTHER ORGANIZATIONS: NCO & ESRL.

UPDATES TO SCHEDULE: None.

10.5.1E3 (30 September 2010) (Manikin, ESRL)
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: No problems or failures detected in NCEP operational running of the RUC this quarter. (Manikin and NCO/PMB)

PLANNED EFFORTS: Continue monitoring.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS: NCO.

UPDATES TO SCHEDULE: None.

Task 10.5.17 Infrastructure support for operational running of Rapid Refresh, North American Mesoscale, and HiResWindow (and future HRRR) at NCEP, including support for community WRF model

GSD
Progress in Rapid Refresh development toward upcoming implementation at NCEP over next few months as experimental RR cycle for testing before final submission to NCO for operational implementation next May-June.

Subtasks

10.5.17.1 Maintain hourly RR and four/day North American Mesoscale runs and provide aviation guidance grids. (30 Sept 10)

The NDAS/NAM/DGEX bug-fix bundle was implemented into operations on 3 November 2009. The NEMS-based NDAS/NAM NMMB real-time parallel system continues to run on the CCS. An important fix installed in November turned on gravity wave drag/mountain blocking in the NMMB, which was inadvertently turned off due to a logic error in the code. New observation types (NOAA-19, METOP-IASI, and MODIS AMSUA_AQUA radiances, ACARS humidity, and oceanic wind scatterometer (WDSATR)) were turned on in the GSI analysis. In December an additional NEMS-based parallel was initiated, testing passive tracer advection. In December a prototype hourly assimilation system using the NEMS-NMMB and the NMMN GSI analysis was developed and successfully tested. The scripts were written to mimic the expected operational configuration of NARRE, so these scripts can be easily adapted for use in the WRF-ARW-based Rapid Refresh system when it is posted to the CCS by GSD/Manikin. (Rogers)

10.5.17.2 Maintain four/day HRW runs and provide aviation guidance grids. (30 Sept 10)

A change was made to the operational HiResWindow on 08 December 2009 to raise the model interface pressure between the terrain-following and isobaric portions of the WRF-NMM hybrid vertical coordinate from 420 hPa to 300 hPa. The Alaskan WRF-NMM run failed in the model integration for several cycles beginning with 20091112/18Z. The root cause was found to be a deep low pressure system coincident with some very high (> 4500 m) model terrain. This combination generated very thin model levels near the surface, which generates instability when combined with a strong flow. Raising the interface pressure provides a larger portion of the atmosphere to the terrain-following portion of the vertical coordinate, generating somewhat thicker near-surface layers and preventing the instability from being generated for this case. A minor set of script changes were implemented for the operational HiResWindow on 10 November 2009 to reorganize the jobs slightly and prevent sporadic operational failures. Conflicts developed on the new P6 systems (cirrus/stratus) caused by various HiResWindow system components (e.g., model, post processor, product generator) interfering with one another

and leading to non-reproducible failures. The change is for each component to run in its own separate run directory, eliminating the possibility of job conflict. (Pyle)

NCEP maintains 4/day runs of WRF-NMM at 4 km and WRF-ARW at 5 km when there are no hurricane runs. Five domains are run with three large domains – East-Central CONUS (00z & 12z), West-Central CONUS (06z) and Alaska (18z), and two small domains - Hawaii (00z & 12z) and Puerto Rico (06z &18z). For most of this quarter, the HiResWindow runs were made since there were few tropical systems to cause preemption. (Pyle and NCO) NCEP also maintains twice-per-day runs of six WRF-based members (3 running NMM and 3 running ARW) within the Short Range Ensemble Forecast (SREF) system. Aviation guidance prepared from the SREF is available from **http://wwwt.emc.ncep.noaa.gov/mmb/SREF/SREF.html** which now includes specific output for Alaska and Hawaii (eastern Pacific). (Du, Zhou)

10.5.17.3 Provide vendors with gridded model data via Family of Services and the FAA Bulk Weather Data Telecommunications Gateway. (30 Sept 10)

NCEP maintained real-time availability of SAV and AIV guidance to all vendors from the operational 4/day NAM on pressure surfaces on the 80-km AWIPS grid #211 via the NWS Family of Services (FOS) data feed and the FAA Bulk Weather Data Telecommunications Gateway (FBWDTG). Higher resolution grids (40-km grid #212 and 12-km grid #218) are also made available to FOS (and NOAAPORT) users. (DiMego)

10.5.17.4 Provide full grids from RR, NAM, and the HRW on NCEP and NWS/OPS servers. Maintain access to model verification data. (30 Sept 10)

NCEP maintained real-time availability of full resolution gridded data from the operational 4/day NAM and HiResWindow (HRW) suite of WRF-NMM and WRF-ARW runs via anonymous ftp access via the NCEP server site at **ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nam/prod/** (on numerous **grids**) and at the NWS/OPS site at **ftp://tgftp.nws.noaa.gov/SL.us008001/ST.opnl/**. At the NWS/OPS site, the NAM data are in 4/day directories named MT.nam_CY.*hh* where *hh*=00, 06, 12 or 18; while the HRW data are in 4/day directories named MT.hires_MR.*mmm*_CY.*hh* where *mmm*=arw or nmm and *hh*=00, 06, 12 or 18. This includes hourly BUFR soundings (NAM only) and output grids which undergo little or no interpolation. Both sites now contain only grids packed into GRIB2 format, see **http://www.nco.ncep.noaa.gov/pmb/docs/GRIB1_to_GRIB2.shtml**. HRW outputs were added to NOAAPORT feed this quarter and will become available to NWS forecast offices with AWIPS OP9. A limited set of fields from the NAM and HiResWindow (HRW) runs (and other NCEP models) can also be viewed at **http://www.nco.ncep.noaa.gov/pmb/nwprod/analysis/** (DiMego)

10.5.17.5 Maintain access to model verification data. (30 Sept 10)

NCEP maintained its capability and provided access to routine verifications of the operational RUC analyses and forecasts. These include grid-to-station verifications versus rawinsonde, surface, aircraft, Profiler, and VAD data computed periodically at NCEP and accessible via NCEP's Mesoscale Modeling Branch (MMB) website: **http://www.emc.ncep.noaa.gov/mmb/research/meso.verf.html** (DiMego)

Deliverables

10.5.17.E1 30 September 2010 (Keyser, Liu)
Perform ingest, quality control and preparation of both existing and new observations in support of the operational RR, NAM & HRW WRF runs.

CURRENT EFFORTS: In addition to the items reported in 10.5.1E1, some Alaskan radiosonde sites still need to move up their launch time so the NAM-GSI can use their data. Mobile synoptic data were not available from 26-30 October and again from 12-18 November due to provider site issues. The SSM/I oceanic wind speed product is no longer available to the NAM-GSI after the 19 November demise of DMSP F-13. A processing change at JMA resulted in no MTSAT-1R satellite derived winds from 15–27 November (used on the edge of the NAM analysis). NOAA-17 AMSU-B radiances were changed from "use" to "monitor" on 22 December due to an anomaly in these data degraded their quality. METOP-2 radiances were unavailable 19 December due to communication problems. The GOES-12 sounder noise increased over the past few months and an additional problem with the filter wheel developed on 16 December. These problems may reduce the quantity and quality of the GOES-12 radiances (and retrievals in the RUC). The following data types are monitored by the NAM-GSI: RASS virtual temperature profiles (NPN and MAP), Mesonet mass data, and MDCRS moisture data. NOAA-19 1b radiances will soon also be monitored. QuikSCAT data (0.5 deg lat/lon superobs) were monitored until satellite died on 23 November. The QuikSCAT data was dropped from the global and NAM GSI and RTMA analysis in October due to its poor quality and subsequent demise. Lower P6 Level II 88D radar data dump counts (vs. their P5 counterparts) are being investigated. NAM/NDAS and RTMA PrepBUFR files are being generated in parallel with 50 km ASCAT and WindSat scatterometer wind data (both non-superobed) and production NAM/NDAS dumps of METOP IASI radiances, GPS-RO data and SBUV-2 data are being created (as of 1 December). These changes to obs monitoring are being tested in the real-time parallel NDAS/NAM. Using the GFS tropical cyclone relocation procedure (for medium to strong tropical cyclones) to update the global first guess fields input to the t-12 hour NDAS is being tested as a possible replacement for the current synthetic wind data bogus. A legacy restriction (that only surface data with a reported pressure is processed) will be removed to allow many new surface observations (land, marine and Mesonet) to be assimilated in the RTMA and possibly NAM/NDAS. The parallel RTMA is now testing observational data dumps generated from a geographical domain which includes Guam in addition to the existing expanded NAM domain. (Keyser)

PLANNED EFFORTS: Use AIRS AMSU-A radiances in the next NAM-GSI update (assimilation stopped in April 2008 when channel 4 went bad). Add a new aircraft quality control module from NRL once NCO evaluation is finished and run times are improved. Change PrepBUFR processing to add report sub-type information for development of bias corrections based on data sub-types. Complete NAM impact tests for several new data types: TAMDAR (from AirDAT feed); mesonet mass and roadway data, and new mesonet data feeds (including "hydro", "snow", modernized COOP, UrbaNet and late-arriving mesonet data); MDCRS aircraft moisture; NPN and MAP RASS virtual temperature profiles; JMA, European and MAP profiler winds; GOES 3.9 micron and visible satellite winds; WindSat and ASCAT scatterometer wind data; METOP IASI radiances; ozone from NOAA-series SBUV-2 and METOP GOME-2; GPS radio occultation data; SSM/IS wind speed and total precipitable water products; SSM/IS and TRMM/TMI rain rate; METEOSAT-9 IR and visible satellite winds; NOAA-19 AMSU-A, MHS and HIRS-4 radiances; RARS 1c radiances (to fill in gaps in NESDIS 1b ATOVS radiances); VAD winds from QC'd NEXRAD Level II data; GOES-13 and -14 radiances and winds. Coordinate with the field to speed up more Alaskan RAOB processing. Maximize Alaska data retrievals (especially mesonet, aircraft and coastal surface). Add GSI events to the NAM PrepBUFR files. Let GSI use the actual or estimated anemometer, barometer and thermometer heights on ships. Generate and QC high vertical-resolution aircraft profile data near airports. Work with NCO to bring in new radar data sources (TDWR, Tail Doppler Radar from hurricane hunter P3 aircraft, Canadian, CASA). Examine possible use of mixed-satellite (Aqua and Terra) MODIS winds which have better coverage and timeliness than the current single-satellite (Aqua-only or Terra-only) MODIS winds. (Keyser)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: A shortage of P6 disk space.

INTERFACE WITH OTHER ORGANIZATIONS: GSD & NCO.
UPDATES TO SCHEDULE:

10.5.17.E2 30 September 2010 (Manikin, ESRL/GSD)
Perform configuration management for RR, including thorough documentation, and respond promptly to any code malfunctions or performance issues.

10.5.17.E3 30 September 2010 (Manikin, ESRL/GSD)
Monitor RR, NAM & HRW performance, respond to any problems detected by ESRL/GSD, NCEP, or any users, diagnose source/cause of the problem, develop solution, test changes and coordinate with NCO on implementation.

10.5.17.E4 30 September 2010 (DiMego, Manikin, Chuang)
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 last quarter. New hire Yali Mao finished studying all the background material on the transition of AWRP modules to NCEP and contacted the previous employee who had started the work on this effort for additional information. Yali Mao now has access to the EMC server at AWC and has gotten copies of the newest FIP and CIP code. (Ma)

PLANNED EFFORTS: Respond to requests as received.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: NCAR, AWC.

UPDATES TO SCHEDULE: None

NCAR/MMM

CURRENT EFFORTS: NCAR/MMM began working on the next major WRF release. This will be WRF V3.2 and is targeted for spring 2010. Activities involved working with contributors to get code into the repository, code testing, and code modification. This work will continue into the next quarter.

NCAR will host and lead the next WRF tutorial, to be held January 25-February 4, 2010. The tutorial will cover model structure, preprocessing, and operation, and practical sessions will provide opportunities to run model components and perform test simulations. WRFDA and MET (Model Evaluation Tools) tutorials will also be given.

NCAR/MMM worked on WRF physics improvements and implemented new WRF code. In PBL physics, the YSU scheme was improved for conservation of water and generalized for future extension to mixing more variables. Jimy Dudhia (MMM) also added a QNSE surface layer fix to the repository and modified the gravity-wave drag option to correct issues associated with thin model layers. He and Wei Wang (NCAR/MMM) added corrections for problems seen with nest feedback and surface vertical velocity. In other surface schemes, Dudhia worked on the addition of a new thermal roughness formulation from Fei Chen (NCAR/RAL) for the "sfclay" and "myjsfc" packages. Improvements to the Pleim-Xiu LSM and ACM2 PBL were obtained from Jon Pleim (EPA) and added to the repository. Dudhia also worked with Kevin Manning (MMM), Mukul Tewari (RAP), and Fei Chen to also implement improvements in the Urban Canopy Model (UCM).

Dudhia updated the WSM (WRF single moment) and WDM (WRF double moment) microphysics schemes. He also obtained a new microphysics scheme for WRF, the Milbrandt 2-moment scheme, from Environment Canada. He worked with Ming Chen on making the scheme work in parallel applications. The Milbrandt scheme is being

added for the V3.2 release. An improved version of the Morrison microphysics scheme was obtained from Hugh Morrison (MMM) and also implemented.

In radiation physics, the RRTMG longwave and shortwave schemes were modified to improve the simulation of outgoing and incoming radiation. Second, Dudhia and Steven Cavallo (NCAR/MMM) worked to improve the treatment of radiation near the model top in order to address unrealistic cooling in that region. Third, Dudhia generalized solar radiation slope effects to work with all radiation options. The modifications were added to the repository for the V3.2 release. Fourth, Dudhia worked with Ming Chen (MMM) on evaluating effects of physics changes in KF cumulus on outgoing longwave radiation. Lastly, Dudhia began to clean up the use of pressure information by radiation and cumulus physics options. The purpose is to improve efficiency by avoiding repeated computations of a hydrostatic pressure that these schemes need.

NCAR/MMM implemented a new sub-grid turbulent stress parameterization from Jeff Mirocha (Lawrence Livermore NL), the Nonlinear Backscatter and Anisotropy (NBA) scheme. This will be an LES option targeted for V3.2.

Dudhia and Wei Wang (NCAR/MMM) tested code for improving the handling of shallow convection over the ocean. This is to mitigate WRF's over prediction of PBL moisture and low clouds over marine areas.

PLANNED EFFORTS: The support of the WRF physics infrastructure and the implementation of modifications will continue. NCAR will continue preparation of the next major WRF release.

Task 10.5.4 Develop, test, implement, and improve the Rapid Refresh.

GSD

Major progress toward the Rapid Refresh operational implementation occurred during the quarter. This was made possible by a much more favorable computing environment than during either of the preceding 2 quarters. Although there have been some incomplete cycles (model forecast failing to complete to 12h) and short outages, the number of missed cycles is far less than last summer. On 3 November our progress to that point was summarized as part of an ESRL/GSD Technical Review presented in Boulder. This presentation is available at **http://ruc.noaa.gov/pdf/RR-RUC-TR_11_3_2009.pdf .**

On 5 October the primary RR cycle began using “partial cycling” wherein the atmospheric fields are rederived in a catch-up hourly update cycle twice daily, starting from GFS or NAM grids. (Because the NAM grids available at GSD are not available to sufficiently high altitude, we are using the GFS in our testing at GSD.) This partial cycling design takes advantage of the improved data assimilation for longer waves in the global GSI than for the regional GSI used in the NAM and RR. The procedure starts from GFS atmospheric fields excepting the land-surface fields (soil temperature/moisture at 6 levels, snow water equivalent/density/temperature in 2 layers), which are fully cycled by the RR. Two times per day (03z and 15z), the RR takes the GFS atmospheric fields and performs an hourly updated pre-forecast cycle for 6h (through 9z and 21z respectively). Then a regular full, hourly, cycled RR proceeds until the results of the next 6-h pre-forecast cycle become available. Results from the partial cycling are very encouraging, showing improvement for most fields over those obtained earlier without the partial cycling. In late November, partial cycling was also introduced into the RR development cycle.

With the termination of the 2/3 CONUS HRRR runs in early November (the full CONUS HRRR runs on nJet), the path was opened to put the RR cycles into reservations on w/hJet. We now have 300 processors reserved for the RR primary cycle on wJet. Further, we are looking into the possibility of moving the primary RR cycle to dedicated nodes on nJet once the HRRR is nested within the RR instead of the RUC. We are also considering

running the primary RR to 15 or 18h at certain times of the day, since when the RR becomes operational at NCEP, it will be run hourly to 18h if NCEP computing resources allow (see Task 1 for discussion of progress toward the 18-h RUC.)

The previously reported boundary problem in the RR is not a critical issue now that partial cycling is being used. Nevertheless, we continued to investigate it since it is probably causing some degradation in the verification scores. We are now certain that this lateral boundary problem comes about because the time tendencies from the external model (in our case, the GFS) are not updated in the WRF model using the latest analysis fields. We have discussed this matter with NCAR. At their suggestion, we are modifying and testing a WRFVAR routine, update_bc, to recalculate these boundary and blending-zone tendencies inside the WRF model to be consistent with GSI analysis increments and DFI-produced changes, taking into account also that our cycling is more frequent than the 3h-frequency at which the external model forecast fields are available.
[This new code was developed and successfully tested by Tanya Smirnova on 15 Jan 2010 and will be implemented next week.]

Tanya Smirnova continues to add RUC options to the NCEP WRFpost-processor (WPP). The recently implemented RUC algorithms for precipitation type applied to the RR are giving similar results to the RUC in areas of mixed, freezing and frozen precipitation. Discussions were begun at NCEP in early December in conjunction with the NCEP Program Suite Review toward merging the GSD additions and enhancements into the new NCEP Unified post program, which has replaced the WPP for the global model and will become the standard post-processor for the regional models in 2010. Since then Ming Hu has successfully compiled and run a recent version of the Uni Post on wJet (using Linux) and results from a test case are nearly identical to those from WPP. The present plan is to merge the ESRL changes to WPP into the latest NCEP version of the Uni Post in the near future, and then for ESRL to do further Uni Post development for the RR on a Subversion branch off the NCEP trunk. The ESRL branch would then be tested and merged back into the NCEP trunk at frequent intervals.

Version 3.2 of the WRF model will be released in early 2010. Tanya Smirnova and Ming Hu have been testing pre-release versions of this code and report no significant problems. As part of the porting of RR code to the NCEP development machine, Vapor, Ming Hu reports that this pre-release V3.2 runs on Vapor, providing the DFI is turned off. Work continues toward getting V3.2 running with the DFI.

Subtasks:

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

GSD
The partial cycling primary RR cycle continues to show performance that is equivalent to or better than the backup RUC running at GSD for wind and temperature when measured against rawinsondes. For November and early December, RMS vector wind errors at all levels at 3 and 12h are consistently better by up to 0.5m/s or so than the RUC backup, and RMS temperature errors are similar. There is a small high bias on wind speeds at most levels for the RR1h, and a small warm bias in temperature.

With the advent of cold weather in Alaska, we have noticed continued issues with 2-m temperature forecasts in the interior valleys where there is typically a very stable, cold air mass near the surface due to persistent darkness. These issues relate in part to the poor fit by the GSI of METAR 2-m temperature reports, in part to the difficulty with current boundary-layer schemes in reproducing the extremely stable conditions in the first 100m or so above the surface (see task 8), and part due to the inability of the model terrain at 13km horizontal grid spacing

to resolve the smaller valleys. Separately, a nighttime warm bias over the western CONUS has been tracked to deficient snow cover due to a combination of a few untimely missed cycles during snowstorms and inadvertent removal of snow aloft as part of the GSI hydrometeor assimilation. This latter problem, which is causing deficient snowfall in many areas of the CONUS, is being worked at this writing. [Accurate cycling of surface variables in the RR (soil moisture and temperature and snow cover) is dependent on an accurate 0-1h RR forecast of precipitation.]

NCEP
Nothing to report. (Manikin)

10.5.4.2 1 Nov 2009 (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.

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. Per a NWS Aviation Testbed meeting in November in Kansas City, the RR will produce two primary output files:

1. native level 3-d files plus all 2-d fields (land-surface, precip, others), including 2-d diagnostic fields
2. pressure level 3-d files plus all of the same 2-d fields

It was agreed (NWS, NCEP, AWRP PDTs) that these RR files will meet all known requirements.

Discussions are ongoing with Bob Sharman of the Turbulence PDT regarding a few additional 2-d fields desired to streamline the generation of their G2G forecasts and clarification of procedures used for calculation of certain quantities by the WRF Postprocessor (WPP). Coordination between GSD and AWC to facilitate transfer of experimental RR grids to AWC is nearly complete and AWC has begun examining RR grids.

10.5.4.3 30 July 2010 (GSD, NCEP, NCAR)
Updated report on status of tactical planning for making RR-WRF ARW model code for 2013 in compliance with Earth System Modeling Framework (ESMF) in agreement with the Sept 2007 Rapid Refresh MOU between NCEP and GSD. Work in this area will commence in FY11.

Stan Benjamin, Steve Weygandt and Ming Hu visited NCEP in early Dec. and discussed (with Geoff DiMego, Dennis Rogers, Matt Pyle, Geoff Manikin) scripting, post-processing and other issues related to future NEMS-based RR-ensemble. There was agreement to build from a common set of scripts (initial work by Eric Rogers) and the common NCEP unified post-processor program. As noted above, work with the NCEP Uni Post has begun. On Thurs 14 Jan 2010, ESRL/GSD gained access to the NCEP unipost code repository (thanks to Huiya Chuang and others at NCEP for this).

10.5.4.4 31 Mar 2010 (GSD, NCEP)
Complete pre-RFC 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.

An NCEP Charter document for the Rapid Refresh implementation was completed on 10 Dec 2009 and submitted to NCO via Geoff DiMego. Preparation is underway for RR presentations at the 14th Conference on Aviation, Range and Aerospace Meteorology in Atlanta in January 2010.

Nothing to report. (Manikin)

Deliverables:

10.5.4.E1 20 Dec 2009 (GSD)
Report on Rapid Refresh testing at annual NCEP Production Suite Review meeting.

Stan Benjamin, Steve Weygandt and Ming Hu attended the NCEP Production Suite Review 8-10 December and gave an update on RR progress. This presentation can be found at
http://www.emc.ncep.noaa.gov/annualreviews/2009Review/presentations/Benjamin-Weygandt-RUC_C.ppt

10.5.4.E2 1 Aug 2010 (GSD, NCEP)
Complete documentation (in Technical Procedures Bulletin-like document) of Rapid Refresh system.

10.5.4.E3 1 May 2010 (GSD, NCEP)
Pending EMC, and NCEP Center initial recommendations, Requests for Change (RFCs) are filed to submit Rapid Refresh software to NCO.

NCEP
CURRENT EFFORTS: No activity to report.

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: ESRL.

UPDATES TO SCHEDULE: None.

Task 10.5.5 Develop, test, and implement improvements to the operational data assimilation supporting Rapid Refresh and North American Mesoscale runs.

GSD
With the much improved Rapid Refresh run reliability due to the now fully dedicated processors, we are more closely monitoring and evaluating the GSI performance and short-range error scores within RR upper level wind, temperature and relative humidity. RMS wind errors for the RR with the partial cycling continue to be less than those from the RUC at virtually all levels and forecast lead times, including the 0-h analysis fit. For RMS temperature and moisture error comparisons between the RR and RUC, similar results or slightly better performance for the RR are seen. Ming Hu has continued his comparison of RR and RUC cloud analysis and forecast differences and continues to make minor changes to the RR cloud analysis code within GSI. With these changes included, RR cloud analyses and forecasts outperform those from matched RUC runs. Surface verification scores continue to indicate a warm, moist bias in the 3-h RR forecast, but this is likely due to the issue with the RR radar assimilation clearing the snow hydrometeors. Work within the GSI to implement the RUC-based pseudo-observation assimilation throughout the boundary layer continues to be on hold as we begin efforts to recruit an experienced data assimilation scientist to replace Dezso Devenyi, who died suddenly on 26 Nov. 2009.

Subtasks:

10.5.5.1 30 Nov 2009 (CAPS, NCEP)

Refine the radial velocity analysis component of GSI and determine the optimal decorrelation scales for different analysis passes.

NCEP

The forecast of 7 December, 2009 precipitation case was rerun with and without assimilating radar radial wind. After examining the two results, it appears that short-term forecast in storm scale was improved with radial wind assimilation. However, the improvement on forecast score is slight. Hourly updates for initialization of the HiResWindow runs are being developed. The radar radial wind will be assimilated three times with hourly intervals. (Liu)

CAPS

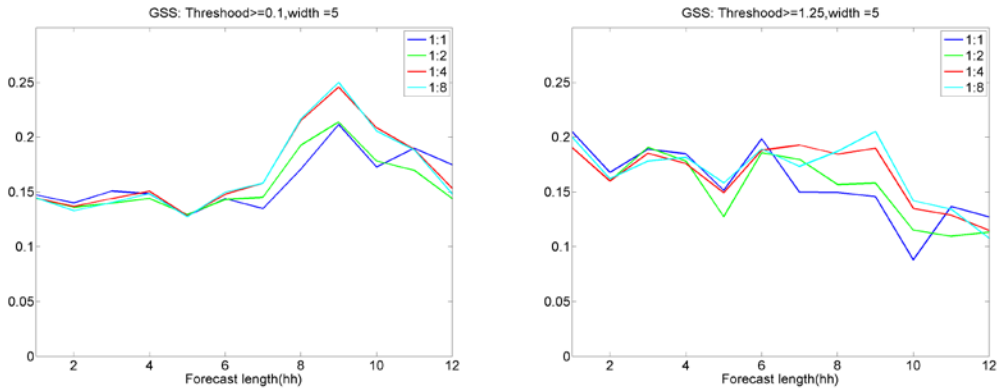
Over the past quarter, further experiments were performed CAPS with the June 16, 2009 test case. These experiments were formed to test the effectiveness and impact of the radar assimilation capabilities within GSI, and some variations in assimilation and initialization methodologies and associated computational costs. Quantitative evaluations were performed using the precipitation scores. The RR-grid and forecast configurations were used.

The experiments can be divided into four groups: one using different horizontal correlation scales for the radial winds assimilation (for determining the optimal error de-correlation scale); one differing in the observational data sets assimilated (for determining the data impact); one using different cloud analysis options (for improving the cloud analysis package) - the stratiform cloud option originating from RUC cloud analysis system and one originating from the ARPS cloud analysis package targeting convective clouds); and one differing in the way analysis increments are used (e.g., used via DDFI or used directly) (for evaluating the effectiveness of the initialization procedures and their cost-effectiveness).

Figure 1 shows the GSS scores (also known as ETS) for the first group of forecasts. Notice the impact of different correlation scale shows no big difference in the first few hours of forecasts but after 5 to 6 hours reduced correlation scales (1:4, 1:8) perform better than the larger ones (1:1, 1:2). At 03 UTC, Jun 16, 2009, a scale that is 1/4 of the default value based-on the NMC method gives the highest score.

Similar is found at EMC by Shun Liu, for the NAM domain. With NDAS for 20 cases in NAM domain, with reduced filter scale (1/4 of default), positive impact of radar data was found on 36 h to 48 h forecasts. For tests with HiRes domain at 4 km resolution, a month-long test showed positive impact in 24 to 30 h forecasts.

One quarter of the default value is therefore recommended as the de-correlation scale for radial velocity data assimilation in GSI for RR and NAM grids.



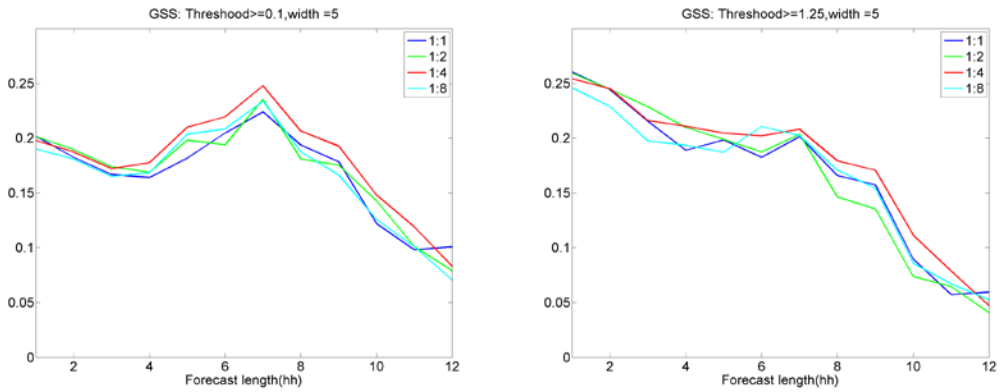


Fig. 1 Prediction GSS scores for forecasts starting at 0100 UTC, June 16, 2009 (upper panels) and at 0300 UTC June 16, 2009 (lower panels), using different horizontal de-correlation scales for radial velocity data assimilation: (a) Threshold > 0.1 mm (b) Threshold > 1.25 mm.

In the second group of tests with different observations, however, the positive impact of radar data is mainly found in the first 4 to 6 hours of forecast. For the cloud analysis formulations, the stratiform-cloud-based method is slightly better when the initial time was at the development stage of the MCS, while the convective option performs clearly better when initializing the forecast at the mature stage of the MCS. The difference becomes smaller when initializing the MCS at its dissipation stage. The forth group of experiments with different ways of using analysis increments showed that the current DDFI procedure used by RR produces somewhat better forecasts, at the RR resolution, even though it carries additional cost for re-running the forecast model backward. With this procedure, the cloud analysis fields are not subject to the digital filtering, to avoid the smearing of cloud scale structures. The direct use of cloud-scale analysis increments gives slightly inferior results. If computational cost is an issue, the latter can be a viable option, as has been shown in CAPS spring forecast experiments as part of the of NOAA Hazardous Weather Testbed, where a single time analysis was produced using a 3DVAR/cloud analysis procedure without an initialization step (e.g., digital filter).

10.5.5.2 28 Feb 2010 (GSD)

Report on statistical evaluation of pre-implementation Rapid Refresh forecasts initialized with the GSI, including examination of upper-level winds, surface fields, and precipitation.

Detailed evaluation of RR forecasts, including upper-level fields, surface fields, and precipitation fields was completed as part of a GSD internal review of the AMB branch. Results (see slides 82-86 in the RR-RUC Technical Review PowerPoint from (**http://ruc.noaa.gov/pdf/RR-RUC-TR_11_3_2009.pdf**), were very encouraging, with RR upper-level wind and temperature skill equal or better than RUC at virtually all levels. RR upper-level moisture was similar to RUC, but a bit worse at some levels. Surface verification was also encouraging for the RR, with scores similar to the RUC for temperature, dew point and winds.

A further report on the Rapid Refresh and RUC development ant testing was presented to a much wider audience the NCEP Production Suite Review meeting on Tuesday 8 Dec 2009.
Available at **http://www.emc.ncep.noaa.gov/annualreviews/2009Review/presentations/Benjamin-Weygandt-RUC_C.ppt**

Barry Schwartz has recently completed work to generalize the GSD precipitation verification package allowing for comparisons at various resolutions, forecast lead-times, accumulation periods of RUC, RR, and HRRR

precipitation forecasts, and begun accumulating statistics. Preliminary results are consistent with previous assessments that the scores between the RUC and Rapid Refresh are similar.

10.5.5.3 31 May 2010 (NCEP, GSD)
Report on testing of 2DVAR GSI assimilation of high spatial and temporal mesonet surface data using analysis grids with 2.5-km or finer resolution.

NCEP
An experimental version of the 2.5-km CONUS RTMA system has been built and its long-term evaluation using near-real time hourly runs has begun. NWS' Eastern and Western regions are pulling this parallel in to distribute to their WFOs. In addition, the capability to assess the analysis quality using cross-validation and a Cressman analysis as the benchmark has been added
to that system. (Pondeca)

10.5.5.4 30 June 2010 (NCEP)
Establish hourly cycled NDAS-like assimilation system on NOAA R&D computer at NCEP (machine called "vapor") using GSI and NMMB within NEMS to be adapted to a NEMS- and ARW-based RR by GSD.

The hourly cycled assimilation system has been built and is functional. The digital filter option still requires some work and the lack of a strong constraint in the GSI remain as big stumbling blocks for a routine running of this NAM Rapid Refresh. (Rogers, Wu)

10.5.5.5 31 July 2010 (NCEP)
If authorized by NCEP Director, implement initialization of HiResWindow runs using CAPS/Shun Liu improved techniques for radial velocity analysis in GSI together with Diabatic Digital Filter use of 88D reflectivity Mosaic.

The VAD wind from Level-II radar QC package is being compared with that in operations. The impact of assimilating VAD wind on HiRes forecast will be examined. The result of one radial wind analysis will be compared against two or three uses of radial wind analysis with hourly intervals. (Liu)

10.5.5.6 31 July 2010 (NCEP)
Based on case-study testing and refinement of the research quality code, deliver results in an 'experimental' code for an upgrade package (e.g. 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 FY2011 change package to the NAM.

The impact studies on new satellite data including HIRS4 and AMSUA from NOAA 19, IASI from METOP-A, and AMSUA from AQUA, and new conventional data and humidity from ACARS were completed. Although the new data resulted in neutral impact on the short term forecasts, they will be turned on in the next implementation. An extension of the adaptive tuning (Deroziers et al.) to adjust not only the observational error covariances but also the magnitudes of background error variances has been constructed as a GSI option. The method was also found to be suitable in identifying unreasonable structures of the background error covariances. Negative local penalties were observed when suboptimal structures were used. The time-reference and time-shift variables in the regional mode of the GSI code were fixed. This was necessary to exercise FGAT option and was in preparation for the future extension of GSI to 4D-Var. The code will be reviewed and checked into the GSI repository. (Wu)

Testing continues with the new dynamic constraint. Unfortunately, performance as measured by guess fit to observations after 12 hours of assimilation is still slightly worse compared to the current constraint and both are a bit worse compared to no constraint. (Parrish)

10.5.5.7 30 Sept 2010 (GSD)
Report on testing of FY11 version of GSI for FY11 Rapid Refresh upgrade.

Deliverables:

10.5.5.E3 31 Dec 2009 (GSD, CAPS)
Further refinement to the radial velocity analysis component of GSI for Rapid Refresh configuration.

With some assistance from GSD, Yi Yang at CAPS conducted a controlled retrospective test for a Kansas MCS case from 15-16 June 2009. Comparisons were made between Rapid Refreshes run with no radar assimilation (the control), reflectivity assimilation, single-pass radial velocity assimilation, a 2-pass radial velocity assimilation (using a shorter error correlation length scale) and both radial velocity assimilation option in conjunction with the reflectivity assimilation. 3-h, 6-h, and 12-h precipitation verification score comparison indicate that as expected the biggest improvement over the control comes from the addition of the reflectivity assimilation. Consistent with similar tests conducted at NCEP, addition of the radial velocity data (with either 1 or 2 passes) yielded little additional improvement.

Discussion with Shun Liu and Dennis Keyser on the radial velocity data access issue has yielded progress. The very large size of the existing level II files (that made real-time transfer to GSD and use within the RR difficult) is because the files contain 3-h of radial velocity data. Work is underway at NCEP to produce smaller level II files (containing data from a much narrower time window). Transfer and use of these files will alleviate the data latency issue with the level 2.5 files that precluded real-time use of them within the GSI for RR.

10.5.5.E2 28 Feb 2010 (GSD, NCEP)
Complete report on Rapid Refresh performance, including that from the GSI component of the RR, in comparison with the operational RUC.

A detailed comparison of RR and RUC was completed in preparation for a GSD internal review of the AMB group, including upper-level, surface and precipitation verification. Details are in slides 82-91 in **(http://ruc.noaa.gov/pdf/RR-RUC-TR_11_3_2009.pdf**) and summarized in 10.5.5.2.
Complete with 8 Dec 2009 presentation at NCEP Production Suite Review meeting:
http://www.emc.ncep.noaa.gov/annualreviews/2009Review/presentations/Benjamin-Weygandt-RUC_C.ppt

10.5.5.E3 1 May 2010 (GSD, NCEP)
Pending EMC, and NCEP Center initial recommendations, Requests for Change (RFCs) are filed to submit GSI code as part of Rapid Refresh software to NCO.

NCEP
CURRENT EFFORTS: No activity to report.

PLANNED EFFORTS: Once ESRL delivers code, work will begin on constructing a parallel.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS: NCO

UPDATES TO SCHEDULE: None.

10.5.5.E4 31 Aug 2010 (GSD, CAPS)
New version of GSI including revised radial wind assimilation for FY11 RR upgrade.

GSD
PROBLEMS/ISSUES ENCOUNTERED OR ANTICIPATED:

A key scientist in the Rapid Refresh/RUC group at GSD, Dezso Devenyi, died suddenly on 26 November 2009. We will seek another experienced data assimilation scientist to fill that gap. We do not believe that this will significantly delay the Rapid Refresh implementation in 2010, given what had already been accomplished by Dezso, Ming Hu, and Steve Weygandt. But finding a very effective scientist will be essential for subsequent progress with the RR and HRRR and will be a critical task for early 2010.

10.5.5.E5 30 Sept 2010 (NCEP)
Subject to NCEP Director approval, implement NEMS/NMMB version of GSI (e.g. strong constraint, revised bkgs+obs errors) in NAM/NDAS.

NCEP
CURRENT EFFORTS: Adapted the parallel scripts to run the NDAS with NMMB. An off-line parallel using these scripts is testing the revised observational and background error covariances and new data. (Wu) Testing continues with the new dynamic constraint. (Parrish)

PLANNED EFFORTS: Upgrade the GSI code to the latest SVN version. Test the impact of all the fixes in the latest version and then turn on GPS RO data to test its impact on the short term forecasts. (Wu) Look at alternative formulation for grid and tangent linear model. (Parrish)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: Analysis grid different from model, generic tangent linear model differs too much from WRF/NAM and NMMB. (Parrish)

INTERFACE WITH OTHER ORGANIZATIONS: GSD

UPDATES TO SCHEDULE: New strong constraint not ready to implement in Sept. 2010. We must request this milestone be moved into FY2011. (Parrish)

Task 10.5.8 Improve physical processes in the WRF (RR and HRRR) and NAM models, especially including those that affect aircraft icing.

Subtasks:

10.5.8.1 30 Nov 2009 (GSD)

Complete systematic GSD evaluation of physics performance in GSD 1-hour RR cycles for initial RR implementation.

The overall performance of the RR WRF physics configuration was completed as part of the November (GSD Tech Review) and December (NCEP model review) meetings. The behavior of the physics (a critical component) appears to be very good, with the RR model now producing at least equal results to the RUC in all key areas (upper-level wind/temp – better, surface wind/temp/Td – about equal overall, precipitation – better for CSI, perhaps too high for bias, ceiling – better for MVFR and IFR conditions). Additional evaluations will be conducted up to the transfer of RR code to NCEP/NCO, but these results including the physics now appear adequate.

The Rapid Refresh will be upgraded to WRFv3.2 when it is released by NCAR early in 2010. WRFv3.2 will include some improvements to the Thompson microphysics and RUC land-surface model. An RR retrospective test of the MYNN vertical mixing (boundary-layer) scheme with enhancements to the mixing-length formulation is still planned. We are looking particularly for evidence of beneficial impacts on prediction of low level wind and temperature, and amplitude of the diurnal cycle of temperature, as compared to the MYJ currently used in all the GSD RR cycles.

10.5.8.2 30 July 2010 (NCAR/RAL)
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.

10.5.8.3 1 April 2010 (GSD)
Test and evaluate upgrades of RUCLSM to handle sea ice and snow cover on sea ice under wintertime conditions for FY11 Rapid Refresh upgrade.
The new version of the RUCLSM with the explicit prediction of sea ice temperature and its effects on sea ice albedo, as well as accumulation and ablation of snow on the sea ice, continues to run in the RR at GSD. Impacts over Alaska are being monitored as we head into the winter season. So far, performance has been satisfactory. NCAR has submitted these enhancements to the WRF svn repository and they will be part of the WRF v3.2 release due early in 2010.

10.5.8.4 1 Aug 2010 (GSD)
Continue exploring possibilities for enhancing treatment of sea ice and tundra (including albedo changes and spring-time ponding) in Rapid Refresh domain toward a FY11 Rapid Refresh upgrade.

10.5.8.5 30 July 2010 (NCAR-RAL)
Evaluate the new aerosol based ice initiation scheme that was implemented into WRF during the previous year using available case studies, including ICE-L and IMPROVE II.

10.5.8.6 30 Aug 2010 (NCAR-RAL)
Develop a scheme to explicitly predict the number of cloud droplets based on an assumed aerosol/CCN spectrum. This includes testing various droplet activation schemes in the recent literature based on updraft, general turbulence characteristics, super saturation, and aerosol properties. These changes will enable improved prediction of the size distribution of water droplets, including when freezing drizzle will occur.

10.5.8.10 30 Sept 2010 (GSD, NCAR)
Begin testing at GSD of latest version of microphysics for Rapid Refresh upgrade in FY2011.

Deliverables:

10.5.8.E2 1 May 2010 (GSD)
Pending EMC, and NCEP Center initial recommendations, Requests for Change (RFCs) are filed to submit upgraded WRF model physics code as part of Rapid Refresh software to NCO.

10.5.8.E3 30 July 2010 (NCAR-RAL)
Provide an improved microphysics scheme to GSD for evaluation toward the FY11 Rapid Refresh upgrade.

CURRENT EFFORTS:
Trude prepared for and attended the International Aerosol Modeling Algorithms (IAMA) Conference in UC Davis. Presented a poster on the work done including dust sources in the Thompson microphysics scheme in WRF.

Work continued on integrating the dust/aerosol climatology into WRF for boundary and input conditions. The WRF boundary code was not written to include boundary conditions for scalars (dust and aerosol are defined as scalars), and thus the problem had to be identified and corrected. The new Dust/Aerosol climatology is also being used by Greg Thompson in the development of droplet activation by aerosols in the Thompson microphysics code. A poster on this work will be presented at the International Aerosol Modeling Algorithms (IAMA) conference in Davis in December.

PLANNED EFFORTS:

Continue testing the new aerosol scheme.

PROBLEMS/ISSUES ENCOUNTERED OR ANTICIPATED:
None

INTERFACE WITH OTHER ORGANIZATIONS:
GSD

UPDATES TO SCHEDULE:
None
Task 10.5.15 Develop improved methods of cloud and moisture analysis for use in the Rapid Refresh and NAM Modeling Systems.
GSD

Subtasks

10.5.15.2 5 Jan 2010 (GSD)
Complete improved version of 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.

A number of improvements have been made to the RR/GSI cloud analysis, including moving the cloud analysis after the variational solver, so that modifications made by the cloud analysis are retained within the final analysis fields. In addition, Ming Hu and Stan Benjamin have conducted a detailed evaluation and comparison of the RR/GSI cloud analysis with that from the RUC, and have identified and resolved a number of small differences between the RR and RUC cloud analyses that were degrading the RR cloud analysis skill scores. As a result, POD and TSS scores for both analyses and 1-h forecasts have improved recently for the RR and are now very

competitive with the RUC (see Fig.4 below). These improvements were first introduced in to the RRdev cycle, and then ported to the RRprim cycle. Additional work by Ming Hu in late November has further improved the RR cloud analysis so that it is outperforming the RUC for IFR and MVFR ceiling forecasts.

We continue to assimilate experimental NASA Langley satellite-derived cloud-top data into the RRdev cycle. These data provide much more extensive coverage over Canada and Alaska, and the tropical Pacific and Atlantic Ocean regions of the RR domain. Qualitative evaluation of results indicates that introduction of these data help to reduce a high bias in high-level cloudiness of the tropical ocean regions.

Further improvements to the RUC/RR cloud analysis have been developed including, for the first time, allowance of partial cloudiness from the background 1h forecast in the vicinity of METAR stations. Also for the first time, innovations (observation-background differences) for clouds using the background grid column nearest to each METAR station are being used. This new code will be moved into GSI by early 2010.

GSD scientists recently uncovered an issue with the Rapid Refresh cloud analysis inside GSI, in which snow hydrometeors are being erroneously removed, leading to less accumulated snowfall during the 1st hour of the model integration with the hourly RR cycling. This is the critical period for the cycled snow depth field in the Smirnova LSM used in the RR. This reduced snow depth, has in turn led to warm temperature biases over snowpack. With the task of diagnosing the cause of the problem complete, work is ongoing to resolve the erroneous snow removal.
[This problem has apparently been solved as of Friday 15 Jan 2010.]

10.5.15.3 30 Jan 2010 (GSD)
Complete improved diabatic digital filter initialization (DDFI) in the 13-km RR WRF model including assimilation of radar reflectivity data

Assessment of the RR DDFI reflectivity assimilation continues, including evaluation of retrospective case study results and summertime precipitation skill scores. Results look good overall, but some adjustment to the strength of the latent heating forcing may be made. Tests are now underway with the latent heating reduced by 50% in the development version of the RUC. HRRR tests will be performed using initial conditions from the devRUC compared to the usual configuration with the backup RUC. We hypothesize that this will result in less "shattering" of 2-3h HRRR reflectivity fields, an intermittent weakness in 2009 HRRR forecasts.
Deliverables:

10.5.15.E2 1 May 2010 (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.

10.5.15.E3 30 Aug 2010 (GSD)
Complete testing of revised cloud analysis for part of FY11 change package to Rapid Refresh

Task 10.5.24 Develop, test, and improve the 3-km WRF-based High-Resolution Rapid Refresh

Subtasks:

10.5.24.1 15 Jan 2010 (GSD, NCAR/RAL, NCAR/MMM)

Design the assimilation/modeling configuration for the HRRR during the 2010 summer convection forecasting (CoSPA) exercise.

In mid-December, agreement was reached to acquire an additional 826 dedicated nJET cores. Combined with the 408 dedicated nJET purchased previously, there are now 1224 nJET cores dedicated to completing the HRRR runs (including running of the parent RUC / RR in a dedicated mode) for the 2010 summer convection forecasting exercise. Following the acquisition, work has been completed to fully dedicate the HRRR on 820 cores. The additional cores will be available for use toward some of the following tasks: 1) running a dedicated version of the RR to feed the HRRR, 2) increasing the HRRR forecast length to 15-h, 3) decreasing the HRRR run-time to reduce forecast latency, 4) possible increase in size of HRRR domain.

Full dedication of the HRRR cores has increased run reliability for the hourly 12-h CONUS HRRR forecasts, which continue to run on the nJET supercomputer with files transfer to NCAR, MIT/LL and other users. Some minor adjustments of the scripting and run configuration (including possible use of quilted I/O and additional cores) to further improve run time are being explored. Initial tests with the new dedicated disk (/pan) have revealed some issue with I/O speed that is also being examined. The assimilation configuration for 2010 will very likely include a second pass of the diabatic DFI-filter-based radar reflectivity assimilation. This 2nd pass filter has been evaluated in case study mode this past summer and gives a big improvement in the first few hours of the forecast. The changes are easy to implement (uses existing code) and will only add a few minutes to the runs time. Additional testing will be completed with implementation into the real-time HRRR by late February.

10.5.24.2 15 Aug 2010 (NCAR/MMM, GSD)

In collaboration with GSD, NCAR/MMM will work to evaluate convection-permitting (e.g., 3-km) forecasting by the ARW core for ultimate application in the HRRR. It will perform and evaluate convection-permitting forecasts using the radar-enhanced RR (13-km) grids from GSD for initial conditions, in order to identify strengths and weaknesses of the model at high resolution. This will include analyses, for selected cases, of the evolution of convective storm mode during first 1–3 hours of model transition from 13-km resolution to 3-km resolution. NCAR will collaborate with GSD in the process and submit a summary of results.

This work is ongoing in conjunction with NCAR personnel (including David Dowell, Jenny Sun, Mei Xu, James Pinto, Jimy Dudhia), with monthly meetings to exchange information. Issues that have been examined include domain size, grid-resolution, and choice of background grids, microphysics options, and surface temperature biases (related to model post-processing). In additional, as part of the 2009 retrospective verification, GSD is re-running specific cases (09 through 15 UTC, 29,30,31 July) and transferring files to NCAR and MIT/LL for CoSPA retrospective processing.

10.5.24.3 30 Sept 2010 (GSD, NCAR/RAL)

Complete 2010 HRRR summer exercise using modeling and assimilation modifications determined in 2010 exercise. Collaborate on analysis of HRRR tests and deliver summary of results.

10.5.24.4 30 May 2010 (NCAR/RAL)

Conduct sensitivity runs with respect to physical parameterization schemes and initial conditions for multiple high-impact weather days, collaborating with ESRL/GSD. Examine possible reasons for forecast success (or not) for these cases with regard to storm location, timing, intensity, and structural organization.

David Dowell, Mei Xu, and Jenny Sun have conducted a series of sensitivity experiments and completed real-time verification work, which will be presented at the CW PDT science meeting. Barry Schwartz and Steve Weygandt

have completed HRRR reflectivity verification at a series of coarsened scales. Results confirm two expectations. First, significant "neighborhood skill" exists indicating that the HRRR often produces storms that suffer only a minor phase error for observed counterparts and that these small phase errors significantly degrade the skill measured on the native grid. Second, this near miss phenomenon is worst just after convective initiation time, when storms are very small-scale.

10.5.24.5 30 July 2010 (GSD)
Analyze and evaluate the results with regard to sensitivity for prediction of turbulence, icing, and winter weather (including ground de-icing) conditions. Collaborate with relevant RT members on evaluation of results.

The CONUS HRRR now being tested in real-time for FY10 will be particularly strongly tied to the Turbulence RT and allows a HRRR-based GTG, especially for mountain-induced turbulence. This additional 0.5 FTE support will facilitate this interaction also. We are in communication with the other RTs (beyond CW) about transferring HRRR files for examination.

Deliverables:

10.5.24.E1 30 Sept 2010 (GSD)
Complete FY10 test (likely with full CONUS domain) with 3-km High-Resolution Rapid Refresh running every 1 h.

- **Conduct real-time summer 2010 HRRR forecasts using 3-km WRF initialized with radar-enhanced Rapid Refresh over full CONUS domain, monitor performance, modify code/scripts as needed, maintain high reliability working with ESRL computer facility**
- **Coordinate with other AWRP users and other collaborators, including coordination of HRRR grid transfers**
- **Provide project management**
- **Lead writing of report on summer 2010 HRRR experiments**

In late Oct. 2009, GSD began running in real-time an hourly cycled CONUS HRRR. The CONUS HRRR runs take about 50 min. of wall clock time on 840 cores. GSD worked with NCAR and MIT/LL too make sure cut down (2/3 CONUS) versions of the key HRRR output files were in place to allow uninterrupted product generation as CoSPA is switched to full CONUS. Following this checkout, the GSD 2/3 CONUS HRRR runs were discontinued. Work is ongoing to further optimize the HRRR code and scripts for reliability and runtime.

10.5.24E2 30 Sept 2010 (NCAR/MMM)
Collaborate with GSD on analysis of convection-permitting forecast cases for 3-km ARW initialized with RUC-RR radar-initialized DFI grids. Draft and deliver summary of conclusions and results.

Work ongoing with monthly meetings. See discussion in 5.24.2

10.5.24E2 30 Sept 2010 (NCAR/RAL)
Deliver report summarizing all HRRR experimental results on sensitivity to physical parameterizations, initial conditions and assessment of HRRR results for key case studies from high impact weather days.

10.5.24.E3 30 July 2010 (GSD)
Complete a report on initial applications of HRRR forecasts to icing, winter weather, and turbulence forecasts.

Task 10.5.19 Develop and refine techniques to assimilate radar radial velocity and reflectivity data through GSI and Rapid Refresh toward the HRRR.

GSD

GSD is conducting set of summer 2009 retrospective HRRR experiments to systematically evaluate the different radar assimilation configurations within the RUC / RR and the HRRR. The experiment will help us finalize the configuration to be used in the summer 2010 summer convection. The will also allow us to document the impact of a recently discovered scripting error that caused GSD real-time RUC runs (that are used to initialize the HRRR) to be run without the DDFI radar assimilation for the summer 2009 convective season. This problem was discovered in mid December and fixed immediately. We have selected the 29-31 July high aviation weather impact period for these re-runs. We are evaluating different combination of DDFI radar assimilation on the parent RUC / RR grid and on the 3-km HRRR grid itself. Testing and evaluation is still ongoing (including work in conjunction with NCAR/RAL), but initial results, confirm that a modest degradation of the HRRR forecasts due to this omission did occur during summer 2009, but that the skill of the HRRR runs initialized from the RUC (even without the radar assimilation) was remarkably good. Based on previous testing in 2009 and results so far, we expect that the configuration used for the summer 2020 will be a 2-pass DDFI-based radar reflectivity assimilation on the RR and HRRR grids with filtering of the hydrometeor fields excluded on the RR domain (where the convection is parameterized), but included on the HRRR domain (where the convection is explicitly resolved). Testing, evaluation and implementation of the optimized system is expected by the end of February.

See below under subtasks.

NCEP

Shun Liu has integrated codes for dumping BUFR format VAD winds into the radar quality control package. CCS jobs and scripts were modified to generate a VAD wind BUFR tank and are undergoing parallel tests. A new 2009 version of the radar quality control package is being tested. The LAPACK library is used in the NSSL QC codes is not available on NCEP's super computer, so Shun has adapted the QC codes to use similar subroutines in the ESSL libraries on NCEP's supercomputer as a replacement for those in LAPACK. Occasional test runs initializing 4 km runs of NMM with the extended GSI use of radial winds continue.

Shun Liu reports the 2009 version of Level-II radar data QC package is under parallel testing. The LAPACK library is used in the original NSSL codes but is not available at NCEP. Similar subroutines in the ESSL on NCEP's supercomputer were used to replace LAPACK. Test results showed that the impact is very small after replacing LAPACK with ESSL. The 2009 QC also rejects too many radar observations; the reason is under investigation. The new QC also runs slower than the QC package in operations. Efforts were made by EMC and NSSL to remove unnecessary codes and simplify some other codes in the new QC package. The code for dumping BUFR format VAD wind was integrated into QC package. Job scripts were modified to generate the VAD wind BUFR tank and are in parallel testing.

CAPS

NCAR/RAL

Subtasks

10.5.19.1 1 Dec 2009 (GSD, NCAR/RAL, CAPS)
Select initial case studies from summer 2009 for 3-km HRRR data assimilation case studies.

GSD has re-run specific cases (09 through 15 UTC, 29, 30, 31 July) selected in conjunction with NCAR and MIT/LL for high weather-related aviation impact. Output has been transferred to NCAR and MIT/LL for CoSPA retrospective processing. GSD also worked with CAPS to select a mini-retrospective case study period (June 15-16, 2009). This period has initially been used for Rapid Refresh testing of reflectivity and radial velocity assimilation, but will also be used for follow-up 3-km HRRR assimilation testing. Lastly, a specific case study period (June 17, 2009) was selected for use in initial tests of the 3-km diabatic DFI-based reflectivity assimilation.

10.5.19.2 31 August 2010 (GSD, NCAR/RAL)
Run case studies from 2009-2010 using 3-km HRRR on GSD jet computer using different RR-based initial conditions

- **Radar-DFI enhanced RR**
- **Test of 3-km radar-enhanced diabatic digital filter initialization (DDFI)**

Initial work ongoing for 3 different case study test periods. See description in 5.19.1

10.5.19.3 30 Sept 2010 (CAPS)
Complete new 3-km GSI data assimilation experiments toward improved assimilation of radial wind.

10.5.19.4 30 Sept 2010 (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 FY09.

Case studies to examine the benefit of a 2nd pass 3-km application of the radar reflectivity DFI method was completed for the 17 June 2009 case study. Results were extremely encouraging, indicated that application of the 3-km radar DFI allows latent heating to induce very realistic balanced storms (including hydrometeor fields). This results in a very realistic forecast for the first few hours. Curtis Alexander and Ming Hu are now conducting more extensive tests of the 3-km DDFI-based radar assimilation (in conjunction with various radar assimilation options on the parent RUC / RR grids) for both the 17 June 2009 case and the 29-31 July 2009 periods.

Deliverables:

10.5.19.E1 30 April 2010 (CAPS)
Provide new radial wind assimilation in 13km GSI designed specifically to improve HRRR initial conditions to be applied in summer 2010 HRRR exercise.

Experiments have been performed with the June 16, 2009 test case using the same domain and resolution as the 3-km HRRR grid of March 2009 which covers approximately the eastern 2 / 3 of CONUS. The HRRR used the same options as the current RR except that cumulus parameterization is turned off. Hourly assimilation cycles were performed over a 12 hour period, with the first analysis performed at 18 UTC, June 15, 2009, using 3-hour RR forecast from 15 UTC as analysis background. 12-hour forecasts were launched from each of the hourly analyses. For the verification, the HRRR forecast results were then interpolated to the same resolution as the RR but in much smaller domain which only covers the main part of the MCS. The GSS scores of HRRR and RR forecasts are shown in Fig. 2. In this set of tests, only radar data were used on the HRRR grid and the default horizontal de-correlation scale was used. For these comparisons, the RR forecasts also used the default de-correlation scale. The HRRR using only radar data get higher scores in the first few hours of forecast than the RR

with all the available data. The lower scores of in the later hours may be due to the lack of traditional data. Additional experiments that use all data on the HRRR grid are being performed. These will provide a more clean comparison between the RR and HRRR forecasts.
Due to limitation to the real-time data transfer capability, only level-2.5 radar data are available at GSD/ESRL at this time. The level-2.5 data are super-obed at the radar sites from the level-2 data, to 5 km radial resolution and 6-degree azimuth resolution. Data are available at hourly intervals. In the future, a more generalized formulation that chooses the stratiform and convective options based on an objective classification of precipitation type will also be developed and tested.

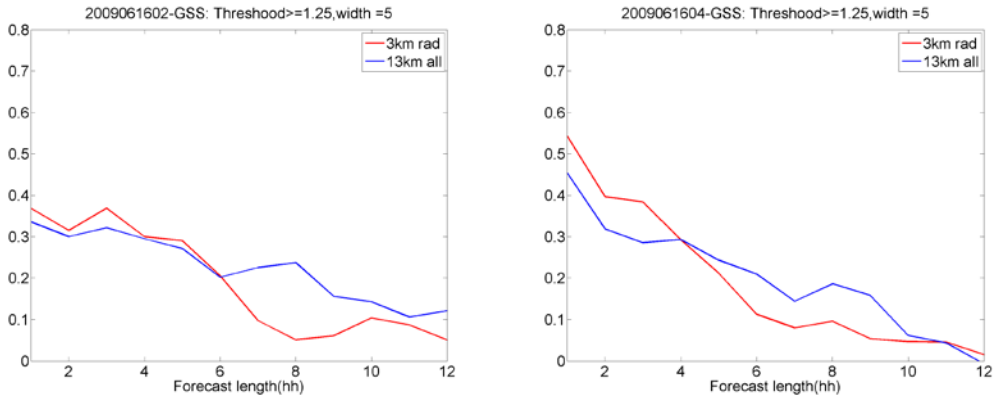


Fig. 2 Precipitation GSS scores for forecasts of different horizontal grid spacing. The red one is for the 3-km HRRR grid and the blue for the 13 km RR grid. The scores are calculated on the 13 km grid in the verification domain over the MCS region. The initial time of the forecast is 0200 UTC on the left and 0400 UTC on the right. Note that in the HRRR tests, only radar data were used in the assimilation while in the RR, all available data were used including the traditional one; this may be the reason for lower scores in the later hours of HRRR forecasts.

10.5.19.E2 30 Sept 2010 (GSD, CAPS, NCAR/RAL)
Report on results from improved version of 13km/3km radar assimilation techniques for demonstration in FY10 exercise.

10.5.19.E3 30 Aug 2010 (GSD, CAPS, NCAR/RAL)
Provide additional report on radar assimilation results for HRRR from winter 2009-10 case studies under the lead of GSD with contributions from each organization.

10.5.19.E4 15 Sept 2010 (NCEP)
Demonstrate mini-NDAS data assimilation system using HRRR-like design constructed to precede HiResWindow runs or Matt Pyle's SPC runs using hourly updates with GSI.

Deliverables

10.5.19.E4 15 September 2010 (Liu, Pyle, Parrish)
Demonstrate mini-NDAS data assimilation system using HRRR-like design constructed to precede HiResWindow runs or Matt Pyle's SPC runs using hourly updates with GSI.

CURRENT EFFORTS: (See also Liu activities under 10.5.5 above) In preparation for eventual regional data assimilation using ensemble information, the hybrid ensemble method (Wang et al, 2008) has been installed and tested in GSI. This is based on the formulation reported in Wang et al, 2008, and the development has been done in collaboration with Xuguang Wang. The code does not yet read ensemble perturbations. For testing

purposes, ensemble perturbations were generated internally from random vectors sampled from the existing fixed background error. Initial hybrid ensemble code installed and tested in GSI. (Parrish)

PLANNED EFFORTS: Add interface to read existing regional ensemble perturbations from SREF. (Parrish)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: GSD, University of Oklahoma

UPDATES TO SCHEDULE: None

10.5.19.E5 15 Sept 2010 (CAPS, NCEP and GSD)
Report on the design and initial development of EnKF data assimilation for Rapid Refresh scale

Task 10.5.20 Develop ensemble-based probabilistic products for aviation users.

GSD
Doug Koch and Curtis Alexander conducted HCPF sensitivity tests and further examined the HCPF skill and documented the skill improvement by adding additional time-lagged ensemble members. In addition statistical reliability plots were created. Additional work has focused on developing a linear regression-based procedure for specify non-constant ensemble member weighting factors as a function ensemble member lead time. They have also conducted a retrospective evaluation of HCPF skill sensitivity to various parameters including the number of included time-lagged ensembles (documenting the HCPF improvement by adding older forecasts).

NCEP
Jun Du, Binbin Zhou, and Yali Mao visited AWC on 16-19 November to discuss SREF aviation products. Jun overviewed the NCEP SREF system including its current system configuration, methodology, aviation products and future plans. Binbin talked about the development status of the VSREF products for future NextGen aviation probabilistic products. Jun and Yali talked to AWC duty forecasters to learn how the forecasters are using NWP products and what kind of aviation-specific products they derive. AWC provided a product wish-list for future SREF implementations, organized into three tiers: short (within 1 year), medium (2 years) and long (3 years and beyond) in terms of their availability to the user community.

BinBin Zhou continues to maintain the web page for VSREF and is continuing work on adding fog to the ensemble product generator, variables from SPC and variables for AFWA as well as on SREF's echo-top verification with the mosaic dataset.

Subtasks:

10.5.20.1 28 Feb 2010 (NCEP)
Complete 'research quality' version of upgrade to SREF (e.g. higher resolution, NEMS members, and more physics diversity or stochastic physics) for consideration in November 2010 SREF upgrade package.

The new upgraded SREF was implemented into NCEP production on 27 October. It includes an increase in resolution for the NMM and RSM members, replacement of some Eta ensemble members with WRF NMM and ARW members, and a switch to hourly SREF output for the first 39 hours of the individual member's forecast over

the CONUS. Four new aviation products were also added: icing (probability), clear air turbulence (probability), ceiling (mean and probability) and flight restrictions (probability). The work related to the next SREF upgrade aiming for an implementation in November 2010 has started, with the first tests of a precipitation bias correction scheme. (Du)

10.5.20.2 15 Feb 2010 (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).

Jun Du, BinBin Zhou, Geoff DiMego and Yali Mao visited AWC on 16-19 November to discuss SREF aviation products. Jun overviewed the NCEP SREF system including its current system configuration, methodology, aviation products and future plans. Binbin talked about the development status of the VSREF products for future NextGen aviation probabilistic products. Jun and Yali talked to AWC duty forecasters to learn how the forecasters are using NWP products and what kind of aviation-specific products they derive. AWC provided a product wish-list for future SREF implementations, organized into three tiers: short (< 1 year), medium (2 years) and long (3 years+) in terms of their availability to the user community. The short-term requests will be developed for the Nov 2010 SREF implementation. Geoff DiMego attended the AWC Testbed meeting on R2O Issues. (Du)

10.5.20.4 31 Aug 2010 (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.

10.5.20.5 30 April 2010 (GSD, NCEP)

Improve preliminary (developed in FY09) procedure appropriate for aviation users from Very Short-Range Ensemble Forecast (VSREF) system using high-resolution RR and NAM existing runs toward a future High-Frequency Probabilistic Forecast (HFProb) generator to be used in NextGen, including common post-processor, obs-based statistical post-processing, optimized member weighting

Steve Weygandt provided code from the RUC Convective Probability Forecast (RCPF) time-lagged ensemble to Binbin Zhou, who has incorporated the algorithm into is SREF infrastructure. Discussion and collaboration is ongoing. Steve met in person with Binbin during an early Dec. visit to NCEP. Areas for possible modification of the VSREF algorithm were identified, including using a statistical method (such as linear regression) to obtain weights for the various time-lagged members and to obtain threshold values for the predictors. Curtis Alexander and Doug Koch have developed a real-time HRRR-based convective probability Forecast (HCPF), which is running on real-time at GSD with web-based display and verification. It was recently switched to run off of the HRRR and provide CONUS coverage. Verification results have been very encouraging.

NCEP

Binbin Zhou has completed development of the web page for VSREF and continues to maintain the web page for VSREF. He is continuing work on adding fog, variables for SPC and variables for AFWA to the ensemble product generator. (Zhou, Du)

10.5.20.6 1 July 2010 (GSD, NCEP)

Further calibrate probabilities and potential echo-top (improve statistical reliability) ensemble cumulus information.

NCEP
Work continues on SREF's echo-top verification with the mosaic dataset. (Zhou)

Deliverables:

10.5.20.E1 30 June 2010 (NCEP, GSD)
Subject to NCEP Director Approval, implement at GSD initial VSREF product generation for turbulence. Work toward future NCEP implementation [products will not be distributed as Operational but are generated routinely within the RR script as part of NCEP's Production Suite].

NCEP
CURRENT EFFORTS: The probabilistic verification of SREF composite reflectivity and echo-tops using Shun Liu's implementation of NSSL's 88D national mosaics has started. (Zhou)

PLANNED EFFORTS: Work will continue on convection products in VSREF, by adopting GSD's convection code. An echo-top ensemble product as well as other aviation and convection products will be added using the ensemble product generator. (Du, Zhou)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: AWS, GSD

UPDATES TO SCHEDULE: None.

10.5.20.E2 30 Aug 2010 (GSD, NCEP)
Demonstrate products from experimental VSREF probabilistic forecasts updated hourly.

NCEP
CURRENT EFFORTS: VSREF development has led to routine running of an experimental VSREF which is now updated hourly. Results for evaluation purposes can be seen at (**http://www.emc.ncep.noaa.gov/mmb/SREF_avia/FCST/VSREF/web_site/html/vsref.html**). (Zhou)

PLANNED EFFORTS: Binbin Zhou and Jun Du plan to (1) develop and include the aviation products listed in the AWC's short-term request and (2) to adapt SPC convection products such as Probability of Thunderstorm (also requested by AFWA) into the SREF ensemble product generator for the Nov. 2010 implementation. (Du, Zhou)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: No ceiling/cloud amount is available from ARW SREF members, and no reflectivity is available from the Eta members and some RSM members.

INTERFACE WITH OTHER ORGANIZATIONS: AWS, GSD

UPDATES TO SCHEDULE: None.