**MDE Product Development Team**
**May 2010 Monthly Report – FY 2010**
**Submitted 15 June 2010**

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## Executive Summary

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

- NCEP RUC forecast skill much improved in May and fully comparable with ESRL experimental RUC versions after degraded performance from 2 March – 20 April due to implementation error.

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

- RR test cycle at NCEP using new versions for WRF (v3.2) and GSI (latest NCEP repository + cloud analysis) nearly complete after Geoff Manikin weeklong visit to GSD to work with Ming Hu
- Switch from WRFPOST to UNIPOST for model post-processing in GSD RR cycle
- Modifications to test rotated lat-lon horizontal grid for RR nearly complete
- Modification to RR cumulus parameterization scheme in testing to correct mid-level temperature bias

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

- RR GSI – updating complete to latest NCEP version (Q1FY10 version)
    - Commits to NCEP repository needed for RR completed in May

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

- WRFv3.2 released 2 April 2010. Contributions from NCAR to WRF model, especially on WRF physics, and from GSD on DFI and land-surface model. WRFv3.2 now being tested in HRRR and RR applications.

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

- Modifications to GSI for ingest of background hydrometeor fields and new observations accepted in NCEP GSI SVN repository
- Testing of METAR-cloud-based RH observations in variational humidity analysis in development RUC.

**Task 10.5.24/19: Development/testing of HRRR**

- HRRR reliability at highest point yet, 100% since 1 June, allowing for gaps up to 3h (allowed for CoSPA)
- A very minor modification was made to the WRF ARW namelist option to eliminate the CFL violation-related crashes that were occasionally occurring in the HRRR.
- Additional dedicated computer resources for a HRRR partial shadow system included in recent NOAA HPC procurement. Tests of HRRR improvements currently being evaluated from single extra run per day.
- New HRRR reflectivity forecast verification package developed and being applied in real-time to HRRR forecasts

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

**ESRL/GSD**

ESRL continues to monitor operational RUC at ESRL and NCEP verification websites. NCEP RUC forecast skill much improved in May and fully comparable with ESRL experimental RUC versions after degraded performance from 2 March – 20 April due to implementation error.

**NCEP**

Testing is complete for a major upgrade to the NCEP BUFR library that is scheduled for implementation in FY2010/Q4 or FY2011/Q1. Work continues on issues like radiosonde sites that report an invalid instrument type; late arrival of GOES 1x1 field-of-view cloud data; bringing in new SSM/IS data from DMSP F-16, F-17 and F-18 satellites to replace discontinued SSM/I products; use of TAMDAR data from AirDAT as a MADIS alternative; and the NRL-based aircraft QC code. The Florida and Georgia DOT and Aberdeen PG mesonet providers have been down for several months. GOES-13 cloud and precipitable water retrievals continue to be not used (as is the case since the switch from GOES-12 to GOES-13 on 14 April). On 26 May, 15 oil rig METAR reports were added to the NCEP database. These reports were added to the NCEP reject list due to uncertainties in their quality. A bug was later discovered in the data processing that has resulted in their surface pressures being available for assimilation in the RUC and NAM. An RFC has been submitted to correct this error. (Dennis Keyser)

**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**

**ESRL/GSD**

Progress in Rapid Refresh development during May toward operational implementation at NCEP can be found under Task 5.4 report.

**NCEP**

Eric Rogers has reported that parallel tests of the NEMS/NMMB model in the EMC NAM parallel system continue on the CCS, with two parallels being run; one a control run (NAMB) and the other an experimental run (NAMX) with model and/or analysis changes for inclusion in the control run. On 17 May the number of rows along the model boundary, upon which the lateral boundary conditions were specified, was increased from 1 to 5 in the control run after being tested in the parallel NAMX run since early April. Also on this date the NAMX parallel began testing a modified 60 level vertical level distribution, with a doubling (from 8 to 15) of the number of vertical levels above 200 mb.

On 17 May routine high-resolution forecasts started running, nested inside the NAMX 12km forecast. At 00z the 6 km Alaska nest is run and at 12z the 4 km CONUS nest is run. Both nests run out to 60 hours.

Since many obs-processing activities listed under Task 10.5.1 and 10.5.4 also pertain to the NAM, they are not duplicated here. For the NAM specifically, Dennis Keyser reports most Alaskan radiosondes have now moved up their launch time so they are available for use by the NAM-GSI. The exception is Shemya (70414) where a later launch time at 12Z, likely due to staffing issues, results in no data availability until the GFS cutoff time. We will contact Alaska Region to get more information on this issue. The drop out team's investigation on the effect of: 1) removing U.S. (and Alaska) synoptic surface data from the GFS-GSI, and 2) updating the latitude, longitude and elevation for many Canadian and U.S. METAR sites and many Canadian synoptic sites based on the latest METAR and synoptic dictionaries, found a neutral to slight positive impact. This investigation was done because many U.S./Alaskan synoptic sites have incorrect elevations and thus erroneous surface pressures, but most U.S. synoptic sites are coincident with METAR sites having correct surface pressures. An RFC is being prepared by

NCO to put these changes into production. 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 be monitored. Reduced Level 2 88D radar data dump counts on the IBM P6 (vs. the P5) 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-superob) and production NAM/NDAS dumps of METOP IASI radiances, GPS-RO data and SBUV-2 data are being created. These changes to obs monitoring are being tested in Eric Rogers' real-time parallel NDAS/NAM. Replacing the current synthetic wind data bogus with 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. 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 for Guam is using the expanded set of observations generated from a geographical domain which includes the region around Guam. It is also testing the use of low-level satellite-derived winds.

Yali Mao is continuing work begun in April on CIP transition, starting from datasets.

**NCAR**

CURRENT EFFORTS:

NCAR continued its planning of the 11th WRF Users' Workshop. This will be held at NCAR from June 21-25. The workshop announcement was sent out, and the sessions have been scheduled. On the first day, June 21st, there will be lectures on microphysics modeling. June 22-24 will have the core plenary, topic, and poster sessions. June 25th will feature mini-tutorial sessions on selected topics.

NCAR is also preparing the next WRF tutorial. This will be held July 26-30, 2010 at the Foothills Lab in Boulder. The first week will cover the basic WRF tutorial, with the second addressing specialized aspects such WRFDA and WRF-Chem.

Jimy Dudhia of NCAR/MMM finished his work on code from Yuqing Wang (U. Hawaii) for the Tiedtke cumulus scheme for future inclusion in WRF. Dudhia and Wang also provided a fix to enable the SAS (Simplified Arakawa-Schubert) cumulus scheme to work with WRF-ARW; previously only WRF-NMM had the option available.

Dudhia added fixes to the WSM, WDM, and Morrison microphysics schemes to work at low pressures, where the relative humidity computation was causing problems. This only affects levels above about 3 hPa, so few users would have tops high enough to be affected. However, some applications are starting to go to the strato-pause at 1 hPa. The bug-fixes were added to repository.

Dudhia is working with Mukul Tewari (NCAR/RAL) on tracing a reported problem of WRF V3.1.1 having cooler surface temperatures than V3.0. This seems partially due to an ozone fix for the RRTM longwave radiation scheme in V3.1.1, but the investigation continues.

Dudhia is working with visitor Pedro Jimenez (Univ. Complutense Madrid, Spain) on evaluating the effect of different stability functions on the surface wind. This is being analyzed through seasonal statistics reflecting WRF at 2-km grid sizes in Spain.

Lastly, Dudhia fixed a new tracer feature to work in non-chemistry applications of the ARW, and added the fix to the repository. The code was tested on the Iceland volcanic eruption case of April 2010, which included testing of a scavenging term due to microphysics.

PLANNED EFFORTS: The 11th WRF Users' Workshop will be held in June, followed by the WRF Tutorial in July. The development and implementation of new physics will continue.

UPDATES TO SCHEDULE: NONE

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

**ESRL/GSD**
Progress continues toward the RR implementation at NCEP. The RR continues performing better than the RUC for most forecast fields, and as of early June, new versions of the RR code (WRFv3.2, GSI-trunk) have run in a test 6h cycle (soon to be hourly) at NCEP.

Rapid Refresh primary and dev 1-h cycles continue to run on wJet/hJet at GSD. A change log on the primary RR 1h cycle is maintained at **http://ruc.noaa.gov/internal/RR_runs/RR_1h_info.txt** .

**Upgrades to RR cycles at GSD:**
During the month, continued testing occurred using the latest version of GSI-FY10 (top-of-NCEP-repository-trunk plus cloud analysis code) coupled with WRFV3.2 in special 3-h test cycle at GSD. This code was introduced into, first, the RR 1-h development cycle at GSD and subsequently the RR-h primary cycle during the month.

**RR at NCEP:**
We have worked more closely yet with Geoff Manikin of NCEP/EMC since May on implementing the RR at NCEP. Based on Geoff's visit to ESRL/GSD for 1 week in June, all of the updated RR components are now compiled and working on NCEP's computers (cirrus and stratus). Ming Hu, Steve Weygandt, Curtis Alexander, and others from ESRL worked with Geoff closely during this week.

**RR Post-processing:**
UniPost upgrades developed at GSD during FY10Q2 have been passed on to NCEP for testing and eventual inclusion into the NCEP repository.

**Rotated lat-lon projection for RR:**
This transition is next in priority to upgrades in the generalized cloud analysis for GSI and satisfactory performance in RR1-h cycles at GSD. Wrfout files from the rotated lat-lon grid can be read successfully as background fields for GSI, and it appears that cycling with the rotated lat-lon grid should be no problem. The UniPost incorporates recently developed NCEP enhancements to post process wrfout files from the ARW when the ARW is run using the rotated lat-lon grid option. However, interpolation of native lat-lon output to NCEP grids using copygb requires some additional functionality in the latter. Work is continuing.

**NCEP**
NCEP continues to generate experimental Rapid Refresh (RR) PrepBUFR files containing WindSat data (non-superob) and 50 km ASCAT which are copied to a private ESRL directory on the NCEP ftpprd server. RR dumps of Level 2 and expanded (time-window) Level 2.5/3 88D radial wind data and hourly lightning data are also being copied to a public ftp directory. These are being tested in ESRL's experimental RR runs, along with early (T+0:26 minute) parallel dumps for 0000 and 1200 UTC. Future data tests will include Multi-Agency Profiler winds and METOP-2 radiances. EMC and GSD have requested the ROC start their hourly processing of Level 2.5 88D data 10 minutes earlier so more data will arrive before the RR cutoff. This is critical for the Alaska portion of the expanded RR domain, where the only source of radial wind data is the Level 2.5/3 because of no current funding

for Level 2 data over Alaska. Level 2 data from 8 DOD CONUS sites are expected to become available in November 2010. (Dennis Keyser)

Geoff Manikin reports that GSD continues to build the Rapid Refresh system and transport some of the codes to EMC for the eventual construction of an NCEP parallel system. EMC hopes to have a parallel Rapid Refresh system running by early July. Geoff Manikin visited GSD in June to work directly with them to finish their code development and accelerate code transfers necessary for EMC to build its parallel system.

***Subtasks:***

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

**NCEP**
Nothing to report at this time. (Manikin)

**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 when measured against rawinsondes. RMS vector wind errors at all levels at 3 and 12h from the RR primary 1-h cycle continue to be equivalent or consistently better than the backup RUC. We have determined that the upper-level wind forecast skill is dependent on how many cycles have taken place since the last GFS partial cycling, with lower error when partial cycling was invoked most recently (09z, 21z).

During May, we have been seeing warm temperature biases developing at mid levels during the forecasts. Efforts to better understand the causes of this bias, particularly their possible relation to the convective parameterization, are underway.

We are also still seeing periods of systematically too high near-surface mixing ratio over the eastern US for RR forecasts initiated during daylight hours. We will continue to monitor this situation, particularly as we evaluate the procedure for introduction of latent heating based on radar reflectivity in the diabatic digital filter initialization.

**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. An update to the RR Charter was written on 14 May and sent to Geoff DiMego.

***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**

**10.5.4E3 (30 September 2010) NCEP**
**(Manikin)**

**Pending EMC, and NCEP Center initial recommendations, Request for Change (RFC) forms are filed to submit Rapid Refresh software to NCO.**

CURRENT EFFORTS: Recommendations are pending since system testing isn't complete yet.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: A schedule backlog has developed for implementations on the new P6 computers.

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.**

**ESRL/GSD**

Following the update of the GSD RR cycle to use the latest top of the NCEP SVN trunk version of GSI (FY10) and successful submission of the GSD cloud analysis modifications back to the NCEP SVN (Ming Hu work with Mike Lueken), Geoff Manikin visited GSD for a week to work intensively with Ming Hu and Curtis Alexander on getting the RR cycle running on cirrus at NCEP. Based on the work by Geoff and Ming, nearly all components of the RR (including the latest GSI version with the GSD cloud analysis) are now being run by Geoff on cirrus. At the end of Geoff's visit, the 6-h boundary condition cycle, the full hourly cycle and the GFS partial cycle were all running, with just a few details to resolve related to the evolution of the surface model fields. The work included restructuring the organization of the codes, scripts and fixed file information to correspond with NCEP NCO standards, modifying some programs and libraries for the NCEP IBM environment (as opposed to the GSD Linux environment) and recompiling all codes. We anticipate Geoff Manikin will begin a 2-month parallel test cycle of the RR around July 1. There is one additional modification to the GSI that may be submitted to the GSI repository later this month, a modification to account for the terrain height difference between the model domain and the actual observation in the surface observation forward model. This was original coded in the GSI in a manner that required significant additional memory (problematic for large domains), but Ming Hu has moved the code change to be after the GSI domain decomposition. A bit of additional testing is needed to confirm the results before submitting the change to the NCEP SVN.

**NCEP**

The current NAM parallel (see below) contains updates to the GSI analysis including the following new datasets: WindSat, ACARS humidity, NOAA-19 hirs & amsu-a radiances, IASI radiances, NASA-aqua AMSU-A radiances and GPS-Radio Occultation soundings. The new GSI now comes from the Subversion trunk and includes an updated CRTM among many other refinements.

Dave Parrish reports no additional progress on installation of the new anisotropic recursive filter normalization code. The principal work this month was with Ricardo Todling (GMAO) and Russ Treadon to maintain the existing capability of the hybrid ensemble option in GSI while substantial changes were introduced by Todling to complete generalization of control and state variables, started earlier by Yanqiu Zhu. The primary new addition to GSI is the module gsibundlemod.f90, created by Todling from concepts borrowed from ESMF. Gsibundlemod.f90 is a powerful utility, almost independent of other parts of GSI, which can be used to group together variables in a

very general way. When this work is completed, it will be easier for developers to add new analysis variables to GSI and/or use GSI for only a single variable if desired.

Wan-Shu Wu worked on ozone analysis in NAM/NDAS and on fixing the negative ozone mixing ratio imported from the global system. The fix replaced any ozone mixing ratio (near the area of negative values) that was smaller than the ozone background error with the background error. In order to perform the ozone analysis with the regional repression test, SBUV observation and global forecast files for the ozone first guess were retrieved from HPSS. The ozone data observational error adjustment was done in the OZINFO file. There were also changes to the input parameters and the analysis scripts. After tuning the ozone background errors, she ran successful regression tests before merging the code with fixes for regional ozone analysis in the GSI_SVN trunk. Tuning on the ozone analysis affected the assimilation of satellite radiances. An off-line parallel is used to spin up the bias corrections of the satellite data and to evaluate the impact of the ozone analysis.

Consideration is being given to using the RTMA's quality control measures in the NAM GSI as part of an effort to test surface mesonet temperature and moisture observations (mesonet winds and pressure are used I NAM today). RTMA uses a) network & station use-lists from ESRL/GSD, station reject-lists gathered by/from NWS regions and a dynamic reject list based on recent history of GSI diagnostic files containing fit to guess and analysis among other things. (DiMego, Pondeca, Wu)

***Deliverables**:*

**10.5.5.E3 16 Sept 2010 (revised date, previously requested) (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.**

On schedule. GSD changes to the GSI for the RR have been submitted to NCEP GSI SVN repository and the updated GSI (version FY10+ with cloud analysis) is running at GSD and in Geoff Manikin's NCEP RR test system. Plan to begin full real-time parallel RR testing at NCEP by 1 July.

**10.5.5.E4 30 Sep 2010 – deferred to FY2011 in previous reports - NCEP (Wu, Rogers)**
**Subject to NCEP Director approval implement NEMS/NMMB version of GSI (e.g. strong constraint, revised bkgs+obs errors) in NAM/NDAS.**

CURRENT EFFORTS: Upgraded the GSI code to a latest SVN trunk version. The new features of the GSI include importing ozone field in NAM/NDAS from the global system for use in radiance assimilation via the CRTM, updating the 10m winds, 2m T, and 2m q fields in the NEMS/NMMB. Test the impact of the latest version and turn on GPS RO (Radio-Occultation) data on the short term forecasts. Small positive impact on temperature and humidity fields was observed from the GPS RO data. (Wu)

PLANNED EFFORTS: Work on ozone analysis in NAM/NDAS and fixing the negative ozone mixing ratio imported from the global system. (Wu) Test sensitivity of results to differences between the analysis grid and the model grid and between the regional models (WRF/NAM and NEMS-NMMB) and the generic tangent linear model using global dual resolution GSI code which has been developed for more efficient hybrid ensemble and 4dvar applications. (Parrish)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: A schedule backlog has developed for implementations on the new P6 computers.

INTERFACE WITH OTHER ORGANIZATIONS: GSD

UPDATES TO SCHEDULE: Due to issues with slow progress on strong constraint and NMMB physics tuning and due to implementation schedule backlog, we must request this milestone be moved into FY2011.

**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 through the fall, winter and early spring producing at least equal results to the RUC in 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, including the present examination of a recent warm temperature bias at mid levels, will be conducted up to the transfer of RR code to NCEP/NCO, but these results including the physics now appear adequate.

WRFv3.2 official code release was made by NCAR on 2 April 2010. WRFv3.2 includes improvements in efficiency in generation of lookup tables for the Thompson microphysics (from NCAR) and prediction of temperature in sea ice and accumulation and ablation of snow on sea ice in the RUC land-surface model (from GSD). 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. Performance remains satisfactory. These enhancements were included in of the WRF v3.2 release on 2 April 2010. Tanya Smirnova presented a poster on the RUC LSM including these sea-ice enhancements at the CIRES (Cooperative Institute for Research in the Environmental Sciences) Rendezvous in Mid-April. She, along with Curtis Alexander and Ming Hu received CIRES Science Awards at the Rendezvous for their contributions to development and implementation of the RUC diabatic radar initialization and being used also in the RR.

**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.**

Discussions have commenced with Ola Persson and other Arctic experts in ESRL's Physical Sciences Division. They point out that the major uncertainty in the surface energy budget over snow in the Arctic is the emissivity of low clouds. Ice clouds have much lower emissivity than water clouds. Ice clouds have much lower emissivity in the infrared wavelengths than water clouds. They have collected high-quality data that may be of use to us in diagnosing model issues in the far north. To incorporate these effects will require enhancements to the existing coupling between microphysics and radiation in the RR, and will not be incorporated in the initial RR implementation.

**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:

A new case study has been developed based on the April 28, 2010 dust in snow event. High winds in the Nevada and Four Corners region led to snow in the Front Range of Colorado with lots of dust residue. This case is currently being used to test the dust modules in the microphysics scheme (emission and wet deposition). We are also testing to see if the enhanced dust levels had an impact on the precipitation.

PLANNED EFFORTS:

Continue testing the new aerosol scheme.

PROBLEMS/ISSUES ENCOUNTERED OR ANTICIPATED:

None

INTERFACE WITH OTHER ORGANIZATIONS:

GSD

**Task 10.5.15 Develop improved methods of cloud and moisture analysis for use in the Rapid Refresh and NAM Modeling Systems.**

**GSD**

GSD continues to monitor performance of the cloud analysis within both the RUC and Rapid Refresh. RR GSI cloud analysis components have also been ported to EMC GSI SVN repository (see Task 5.5).

***Subtasks***

**10.5.15.E2 16 Sept 2010 (revised date, previously requested) (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.**

The hydrometeor background field ingest code and special observation ingest code in now part of the NCEP GSI repository and is now being run by Ming Hu in the GSD real-time RR cycle and by Geoff Manikin on cirrus at NCEP.

**10.5.15.E3 30 Aug 2010 (GSD)**

**Complete testing of revised cloud analysis for part of FY11 change package to Rapid Refresh.**

Initial testing of ideas for this, including use of cloud residuals to create relative humidity innovations, are currently being testing in the development RUC at ESRL and will be moved over to a test version of the RR over the next few months. This capability will require substantial modifications in GSI (much in the RUC 3dVAR), and will be deferred to the FY11 change package for the RR. Preliminary results from testing of this capability in the RUC were presented at the GOES-R Annual Review on 10-11 June 2010 by Steve Weygandt.

**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.**

The HRRR has had very good reliability for past 2 weeks, 100% (allowing for gaps of up to 6h).
A very minor modification was made in the WRF ARW namelist option file to limit the amount of heating per time step coming from the explicit microphysics scheme, which has eliminated the CFL-related occasional HRRR crashes that had been occurring. Comparison experiments indicated extremely small differences in the forecast fields and negligible differences in the statistical skill scores.

Patrick Hofmann of ESRL completed coding of a new HRRR verification package that is now running in real-time to provide statistics on HRRR performance as a function of valid and lead time, and threshold. In addition to verification on the native 3-km HRRR grid, a key feature is the inclusion of interpolation of HRRR forecasts and NSSL reflectivity data to 10-km, 20-km and 40-km grids for “upscaled” verification. This upscaled verification allows the determination of “neighborhood” skill – the ability of the HRRR to depict regions of convection, even if the storms are not exactly in the right location. A recent GSD hire, Eric James, has been subjectively evaluating HRRR forecasts.

***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

As of early May 2010, all HRRR related code, scripts, hardware in frozen state. No changes are expected, except minor fixes as needed. The configuration includes real-time RUC with digital-filter-based radar reflectivity assimilation running at GSD to supply initial and boundary conditions to the HRRR. HRRR (using WRF v3.2+) running on ~1000 fully dedicated cores producing a 15-h forecast each hour with ~ 2-h latency. Hardware enhancements (besides the fully dedicated cores include redundant files systems, expanded capacity internal file transfer, and redundant ftp server for external file transfer.

Late May update – HRRR system is running with high reliability and real-time evaluation is ongoing. See details above

**INTERACTIONS:**

ESRL/GSD scientists Curtis Alexander and John Brown have visited SPC to participate in the Spring Program, evaluating HRRR performance for aviation, severe weather, and hydro-meteorological applications.

**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**

In recognition of the need for a HRRR partial shadow test system, in which possible improvements to the HRRR forecast system can be systematically tested and evaluated, additional dedicated computer resources were included in recent NOAA HPC procurement. This action to obtain the partial shadow system capability is critical for advancing the HRRR component of the CoSPA system and was made possible through a revision to the GSD RWI tasking for FY10. The action was completed in late May, just ahead of a NOAA HPC deadline that would have delayed the procurement of additional dedicated HRRR cores by 9-12 months. The new computer cores should be available in August 2010. Prior to that time, GSD is using existing resources to fit in one additional HRRR run per day, initialized at the convectively active time of 00z. We are currently evaluating a change package with reduced latent heating (“1/3 TTEN”) and improved convective suppression.

**NCEP**

Shun Liu tested the impact of the DFI time window on a forecast. DFI is applied to the background field to first eliminate the imbalance caused by interpolation. After assimilating radar radial wind, DFI is applied again to remove imbalances due to wind field changes and to establish a balance between the wind and other model variables. The experiments showed that with an increase in DFI time window, relatively large temperature increments can be obtained. However, a larger cold bias is shown in short-term forecasts. Also, the longer DFI time window can help improve 18 to 36 hour forecasts, but not the very short-term forecasts, in HiRes domain. Shun is also working on merging GSI codes from old version into the current Subversion trunk version in order to test the assimilation of radar data using the NMMB.

***Deliverables:***

**10.5.19.E5 15 Sept 2010 (CAPS, NCEP and GSD)**

**GSD**

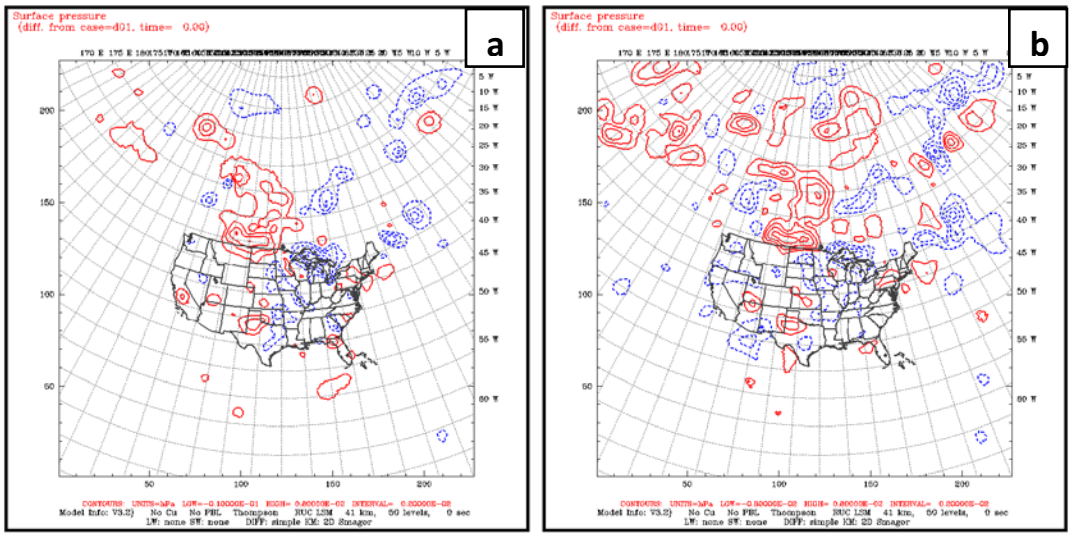
June 15th update – Good progress being made, with bi-weekly meetings involving ESRL GSD and PSD personnel and OU CAPS. Groups is monitoring progress by Kefeng Zhu, who has gotten good results on initial test comparing EnSRF analysis increments with standard GSI 3DVAR increments.

**CAPS**

CAPS modified the global EnSRF code from Dr. Jeff Whitaker of ESRL and linked this EnSRF package with the regional GSI for RR application. Our initial test results suggested the adaption of the global EnSRF code for RR application was successful.

The EnSRF test domain was of 227 x 227 grid points at 40 km grid spacing that covers the entire RR domain. Tests were carried out on the GSD WJET machine with components from WRF WPS 3.2, WRFDA 3.2, GSI version as of Aug, 2009, WRFV 3.2 and several newly-developed interface programs. As an initial test only conventional observations were assimilated. The state variables updated were temperature, U and V winds, dry surface pressure, and water vapor mixing ratio. Forty ensemble members were used, and the initial ensemble perturbations were generated using the WRFDA random_cv utility, as were the lateral boundary condition (LBC) perturbations. An inflation factor of 1.1 and a localization scale of 1000 km were used. The increments were then compared with GSI increments as an initial examination of correctness (Fig. 1). Figure 1 will show that the general pattern of increments by the EnSRF package, from the first analysis cycle, was similar with that of GSI, which indicates that the adaptation, including the development of new data interfaces, of the global EnSRF code for the RR regional domain, with the use of RR data sets, was generally correct.

Cycling tests will be performed next, followed by forecasts on the 40 km ensemble grid and the 13-km RR grid, starting the EnSRF analyses. Systematic comparisons of the forecasts with the current GSI-based RR forecasts will be made. The use of global ensemble initial and LBC perturbations and the development of a dual-resolution version of the EnSRF are among the future plan, as is the eventual inclusion of radar data for RR and HRRR grids.



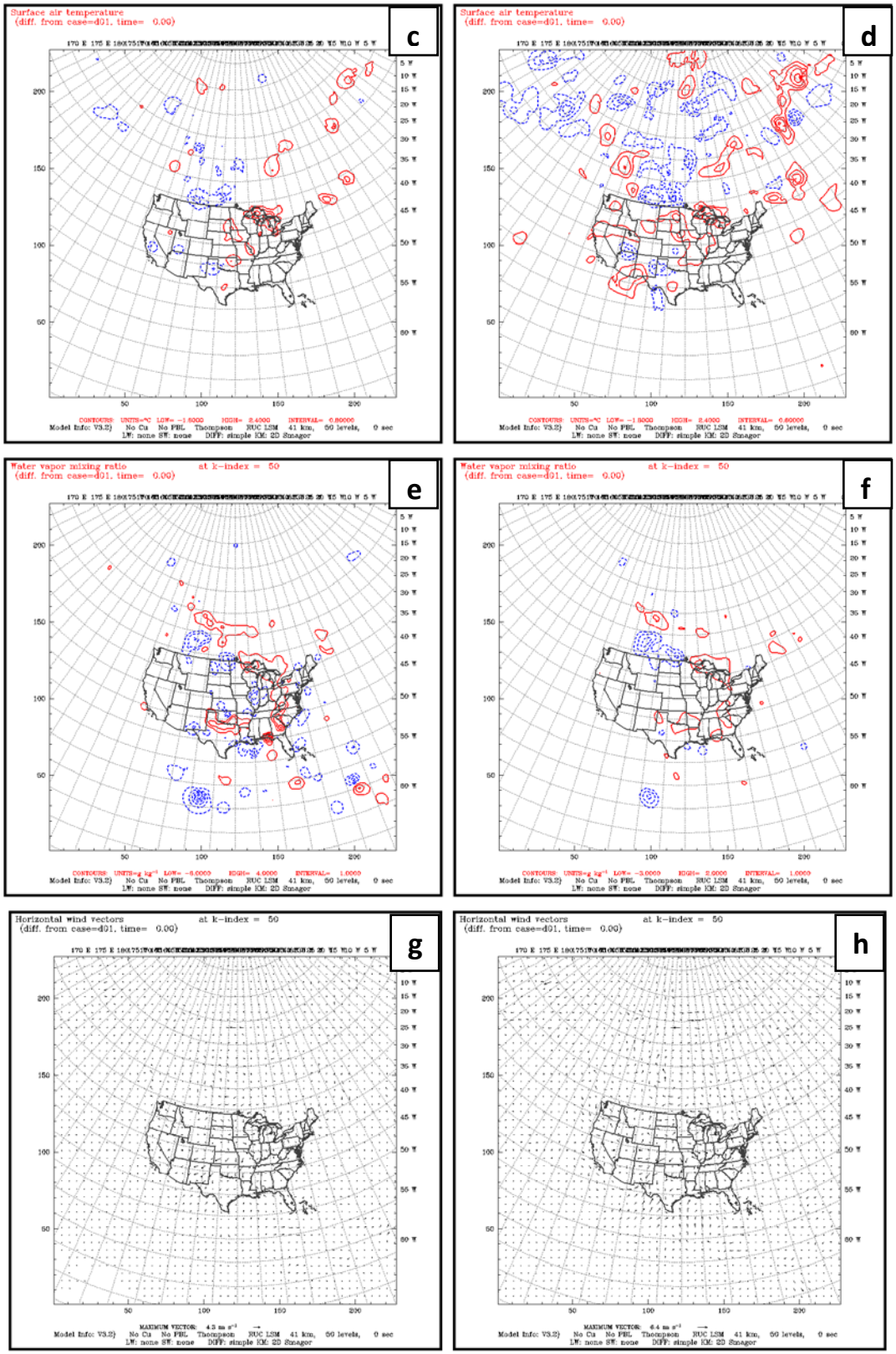



*Fig.1. GSI analysis increments (left column) versus EnSRF analysis increments (right column), valid at 12 UTC June 15 2009, for surface pressure (1st raw), surface air temperature (2nd row), water vapor mixing ratio (3rd row), and wind vectors (4th row).*

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

**GSD**

June 15th update – Doug Koch continues his work on logistic regression approach to obtain HCPF wrights and has switched the HCPF output to RUC 20-km grid to match the VSREF output. GSD group (Steve Weygandt, Curtis Alexander, Eric James, and Doug Koch) had a telecon with Binbin Zhou (NCEP EMC), who has created the VSREF, to discuss collaboration and ways to further incorporate GSD strategies into the VSREF. Binbin supplied a VSREF Tarball to GSD and Eric James will begin examining it.

Doug Koch has coded a preliminary threshold adjustment procedure that ensures statistical reliability. Initial evaluation reveals that it reduces the maximum realized probabilities down to about 60%.
GSD (Curtis, Steve, Stan) has interacted with MIT/LL (Haig, Colleen) to produce a HCPF-like convective probabilistic forecast for CoSPA.

**NCEP**

Jun Du reports that the work of building a new NEMS-based ensemble component for the 2011 operational SREF system upgrade continues. The NEMS-component ensemble can now successfully run and its job scripts have also been built into the operational SREF scripts, for easier implementation in the future. The plan is to use the NEMS-NMMB model to replace the Eta and RSM models currently used in the SREF system. The new SREF system will continue to have 21 members composed of 7 NEMS-NMMB, 7 WRF-NMM and 7 WRF-ARW members.

Binbin Zhou is working with NWS' Thomas Hultquist (Science and Operations Officer) and the forecasters at the Chanhassen, MN, WFO [twin cities area Minneapolis / St. Paul] to try to put VSREF data into their AWIPS, so they can have access to VSREF output for their local airport responsibilities which including Chicago airports. Binbin also generated a 2 member ensemble made up of the High-Res NMM and ARW models, so comparisons could be performed to verify that an ensemble mean of just two members does indeed yield better forecasts than either of the individual members.