MODEL DEVELOPMENT AND ENHANCEMENT RESEARCH TEAM
Quarterly Report for July-September 2007
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Executive Summary

Task 07.5.1: Infrastructure support related to operational running of the RUC and North American Mesoscale (NAM) operational modeling systems.

- Testing ongoing at NCEP for RUC upgrade package code, very good results (surface, convection, ceiling/vis, precip) evident in September and October. Implementation now planned for early 2008. Change package includes mods to RUC analysis (including radar reflectivity, mesonet winds, TAMDAR obs), model changes (RRTM longwave radiation and updated convection), and postprocessing enhancements (forecast radar reflectivity fields). All changes continue in real-time testing in hardened backup RUC cycle at ESRL/GSD. See comparisons in http://wwwt.emc.ncep.noaa.gov/mmb/ruc2/para .

Task 07.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

- Diabatic digital filter initialization now working in (single-exec) WRF-ARW planned for Rapid Refresh (not with radar assimilation yet, but this prerequisite code is now working).
- GSD/NCEP agreement to use ARW code for initial Rapid Refresh, with ensemble RR using both ARW/NMM in ESMF by 2012.
- Hourly conventional observation files being created at NCEP and transferred to GSD

Task 07.5.6: Develop, test, and evaluate the performance of the nonhydrostatic WRF modeling system.

- Progress toward WRF version 3 planned for March 2008.

Task 07.5.8: Improve model physics for aviation forecasts.

- Evaluation of RRTM longwave radiation implemented in GSD and NCEP parallel RUC -- significant improvement in removing nighttime/daytime near-surface warm bias in warm and cold seasons.
- Non-local subsidence temperature tendencies tested in Grell-Devenyi scheme now producing a significant further improvement for convection forecasts, will also be included in RUC upgrade.

Task 07.5.15: Develop improved methods of cloud and moisture analysis for use in the WRF modeling system.

- Coding to parallelize the combined cloud analysis for GSI nearly complete.

Task 07.5.17: Infrastructure support for running operational WRF model in North American Mesoscale and HiResWindow models at NCEP. (Rapid Refresh to be added in FY09)

- NAM upgrade implementation delayed until 2Q FY08.

Detailed report – MDE – July - September 2007

Task 07.5.1: Infrastructure Support Related to Operational Running of the RUC and North American Mesoscale (NAM) Systems

GSD

Over the last 3 months, GSD has provided new RUC code to NCEP and now assisting with NCEP on testing new software for RUC upgrade package (see paragraphs below from NCEP).

This RUC analysis/model change package (implementation date now tentatively planned for early 2008) is currently running in the NCEP parallel RUC (real-time product comparisons available at http://wwwt.emc.ncep.noaa.gov/mmb/ruc2/para/). The change package is also running and being evaluated in real-time in the 13km dev RUC (http://ruc.noaa.gov/pig.cgi?13km_D2) and the hardened 13km backup RUC (http://ruc.noaa.gov/pig.cgi?13km_BU). A significant further improvement to the Grell-Devenyi (GD) convection code was developed and tested were made in August and September (new non-local application of temperature change from subsidence). To summarize the changes made in the development and backup RUC at GSD:

- Hourly assimilation of 3-d radar reflectivity via diabatic digital filter initialization and convective suppression.
- Additional analysis changes to:
  - Assimilate mesonet winds using a new "mesonet provider uselist" augmented by an additional mesonet *station* uselist
  - Assimilate TAMDAR aircraft observations (available for NCEP operational use)
  - Differentiate wind observation error between GPS rawinsondes and non-GPS rawinsondes
- Correction to RH observation errors for in-situ and precipitable water moisture observations, resulting in more accurate RH forecasts.
- Post-processing changes
  - Addition of three reflectivity products in RUC post-processing (column max, 1-km, 4-km) (all in RUC isobaric files – ruc_presm or pgrb)
  - Fix to tropopause level problem identified in July 2007.
  - Additional new products in RUC isobaric/pgrib files - 500 hPa vorticity, total accumulated convective and non-convective precipitation from initial time, RH relative to precipitable water.
- RRTM longwave radiation package replacing current Dudhia longwave package. This change improves nighttime forecasts over snow cover (cold-season) and especially a long-standing warm bias in particularly moist areas.
- Land-surface model changes for improved 2m temperature over snow cover
- Major improvements in Grell-Devenyi convective parameterization: 1) non-local application of subsidence-induced warming, 2) modifications in closure weighting for improved (decreased) areal coverage for light convective precipitation and improved coherence in mesoscale organization.

In addition to the work on the RUC change package, GSD continued to monitor real-time RUC performance among the operational NCEP version and 4 different experimental GSD versions, using observations from rawinsondes, surface stations, GPS precipitable water, and precipitation.

INTERFACE WITH OTHER ORGANIZATIONS:
Discussion between GSD and NCEP/EMC and NCEP/NCO on RUC changes, NSSL on 3-d radar data, NCAR on radar assimilation, NCEP on radar data availability.
Discussions between GSD and RUC users in NWS and private sector on RUC performance.

NCEP

Subtasks

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

The RUC experienced some run failures on 9 and 10 July due to diagnosed values of the tropopause height outside of the acceptable range to the NCEP code that writes out grib2 files, causing crashes of the post processor scripts. The problem was traced by GSD and EMC to a uncharacteristically deep, stacked cyclone along the northern border of the domain, and it was determined that a condition of potential vorticity greater than 2 extending all the way to the ground caused unrealistic values when linear interpolation was performed among levels with potential vorticity values near 2. A revised code will be implemented as part of the next model upgrade or sooner if the problem is repeated; it is believed that this incident was an extremely isolated event, so an emergency fix was not required. GSD has delivered code to EMC for the next model upgrade.

The main feature of this code is the assimilation of radar reflectivity data. Geoff Manikin has worked with Shun Liu to generate hourly reflectivity mosaic files to be ingested by the RUC, and the assimilation of the mosaic data is linked to the digital filter initialization to specify the 3-d profile of latent heating. Other changes include the assimilation of mesonet wind data from a list of approved providers, a change in the longwave radiation scheme from Dudhia to RRTM, a modification to the snow component of the land-surface model to decrease excessively cold 2-meter temperatures over fresh snow at night, and a modification to the convective scheme to decrease widespread coverage of light precipitation. (Manikin)

PLANNED EFFORTS: The RUC upgrade package of changes has been running in parallel at EMC since the middle of September and will be evaluated throughout the fall and winter. Retrospective testing on warm season cases will then be run to examine performance during the more active convective season. If the statistical and user evaluations are positive, implementation will occur during the spring or summer of 2008. (Manikin)

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

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). (EMC Team and NCO)

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

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/ . This includes hourly BUFR soundings, output grids which undergo no interpolation and, as such, are on the models' computational grid (so-called native-native grids). These now contain grids packed into GRIB2 format, see http://www.nco.ncep.noaa.gov/pmb/docs/GRIB1_to_GRIB2.shtml , and an index for each file is also provided. (EMC Team and NCO)

07.5.1.4 Maintain access to model verification data.

NCEP maintained its capability and provided access to routine verifications performed at NCEP of the operational RUC system forecasts. These include grid-to-station verifications (versus rawinsonde, surface, aircraft, Profiler, and VAD data) scores computed periodically at NCEP. Routine verifications have been performed and are accessible from NCEP's Mesoscale Branch's website: http://www.emc.ncep.noaa.gov/mmb/research/meso.verf.html (Rogers, Manikin, Keyser)

Deliverables

07.5.1.E1 1 October 2006 - 30 September 2007 EMC (Rogers, Manikin, Keyser)
Perform observation ingest, quality control, and preparation in support of the operational RUC runs.

CURRENT EFFORTS:
In July & August, Dennis Keyser and Stacey Bender investigated the source of bad aircraft moisture obs from MDCRS-ACARS. These obs were unreasonably high (by a factor of 10) in NCEP's BUFR feed from ARINC but

they were not high at the GSD site which does not get its data through ARINC. ARINC was contacted and a meeting was held with them and NWS' Dave Helms on 31 August. ARINC subsequently notified NCEP that they found an error in their recoding of the moisture data into BUFR which they said began 1 November 2006. ARINC corrected the problem on 2 October, 2007. The obs preprocessor will make a correction to this data when processing historical data in this period. On 7 August NCEP began pulling GOES 1x1 f-o-v sounding data from NESDIS' gp12 machine (24x7 support) rather than from their gp16 machine (8x5 support). On 13 August, the number of satellite ingest jobs run each day was greatly expanded. This change will ensure that as much data as possible will be available for the early RUC cut-off times. Testing of both "new science" GOES 1x1 field-of-view cloud data (replacing current product) and GOES 1x1 field-of-view precipitable water data (replacing current 5x5 field-of-view precipitable water) is underway. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ERSL MADIS feed. (Keyser)

JIFs (Job Implementation Forms) were filed with NCEP/NCO to implement the updated radar quality control (QC) which includes checking of reflectivity as well as radial wind and includes the processing required to produce reflectivity mosaics required for the RUC upgrade in 2008. This new QC performs more work and is taking longer to run and will take more resources (CPU's) to complete in the same time. Another complicating factor is the fact that the volume of Level II data arriving at NCEP will more than double in FY2008 with the implementation of the so-called super-resolution data feed. EMC is working with NCO to come up with a strategy (to be implemented in Q2 FY2008) to allow the Level II processing to be performed with a minimum (affordable) number of processors and in the required time. (Liu)

PLANNED EFFORTS: Switch to a new PREPBUFR file which will feed both the future Rapid Refresh runs and the RUC. Complete impact tests in RUC for several new data types: TAMDAR (direct from AirDAT vs. current MADIS feed) and Canadian AMDAR aircraft, hourly WSR-88D 3-dimensional reflectivity, 6-minute wind profilers, "new-science" GOES (-11 and -12) cloud data, 1x1 field-of-view GOES (-11 and -12) precipitable water data, mesonet wind and roadway data, and new mesonet data feeds (including "hydro", "snow", modernized COOP and UrbaNet). (Manikin, Keyser)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS: GSD & NCO.

UPDATES TO SCHEDULE: Complete 30 September 2007.

Task 07.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

Following the WRF Executive Oversight Board meeting in Boulder on 31 July 2007, a proposal was drafted by EMC concerning the future of RR and the matter of core choice and use of the WRF and ESMF model infrastructures. After discussion, this plan was put in final form and signed in early September by Lord and DiMego (EMC), Koch (GSD and DTC) and Benjamin (GSD). Under this plan, the GSD and EMC will work together to implement the RR in two phases. In Phase 1, to be ready for NCEP implementation by September 2009, and toward which GSD has been working since 2004, the initial RR operational implementation will use the WRF-ARW under the WRF infrastructure, together with GSD physics and GSI-based data assimilation including diabatic Digital Filter Initialization (DFI). In Phase 2, to be implemented in 2012, an ensemble-based RR capability will operate under the NCEP Earth System Modeling Framework (ESMF) Modeling System, or NEMS, currently under development by EMC. The RR ensemble will include, depending on the available computing, members with NMM and ARW dynamics and various combinations of EMC and GSD physics as well as perturbed initial conditions. Phase 2 will feature advanced data assimilation techniques to provide digitally filtered background and forecast fields, the ability to ingest and analyze time-varying (at least hourly) surface, aircraft and Doppler radar observations and an ensemble initialization technique. The Phase 2 RR will be built on a NAM-based hourly assimilation cycle under ESMF, totally independent of the WRF code architecture.

NCEP

In September, an agreement was signed by GSD and NCEP concerning a phased strategy for the the implementation

of Rapid Refresh (RR) at NCEP. Phase 1 calls for an RR to replace the RUC in FY2009 based on the WRF Common Modeling Infrastructure (CMI) and the ARW dynamic core.

GSD

As of 15 October, GSD nears re-implementation of the Rapid Refresh cycling but now on the faster wJet/TG file system in the GSD computer system. There have been computer snags along the way over this last quarter: In early August, GSD had to discontinue the WRF forecasts cycled with GSI over the RR domain that had been running on iJET since late 2006, due to removal of the large-memory opteron nodes necessary for the Standard Initialization. WRF-RR runs without cycling continue on wJET using WRFv2.2 and WPS, but were briefly interrupted in late September. A change made to the GFS postprocessor to bitmap out soil temperature and moisture values in 1X1 degree squares considered to be water caused the WRF Preprocessing System used to read these grib files and generate initial conditions for the WRF-RR forecasts to produce unrealistically large values of soil moisture and temperature near coastlines. At the end of September, NCAR provided a patch to WPS that at least temporarily fixed the problem.

Integration of cycling into the GSD-developed Work-Flow Manager is nearly complete, but has been hampered by a security patch to wJET that interfered with I/O for both the GSI and the WRF REAL packages. While the security patch issue is being resolved, a partial workaround has been utilized. Using the workaround, a 3-h cycle has been run by hand on wJET for a reduced domain and work is proceeding to fully automate the scripts. In related work, hourly prepbufr observation files are now being created at NCEP and transferred to GSD.

A major achievement was successful modification to WRF model code to allow backward-forward digital filter initialization (DFI) in the WRF-ARW (Tanya Smirnova, Steven Peckham, with consulting help from Stan Benjamin). This required a DFI section to be added to the namelist to control the beginning and ending times of the backward adiabatic and forward diabatic steps, as well as to input parameters that define the digital filter. Modifications to mediation-level code, as well as addition of DFI code, were necessary to have the DFI run as part of the same job stream instead of running as 3 separate jobs. This GSD-developed backwards-forward diabatic DFI for WRF-ARW, similar to that in the RUC model, is now working on the 13-km RR grid using GFS data processed through WPS as input. Some further tuning of the DFI is anticipated to optimize its effectiveness, once cycling over the RR domain using WRF-ARW begins in earnest. Thanks to NCAR (Tom Henderson, Xiang-yu (Hans) Huang) for their assistance.

PLANNED EFFORTS: Add cycling, including the diabatic DFI similar to RUC, with the GSI analysis package to the wJET cold-start WRF-RR runs to complete the cycling loop and increase the cycling frequency from once per 12 hours.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None other than the Jet problems already noted, with solutions underway.

INTERFACE WITH OTHER ORGANIZATIONS: DTC, NCEP, NCAR

UPDATES TO SCHEDULE: None.

Subtasks

07.5.4.1 15 Nov 2006 (original due date), deferred to 15 Jan 2007. Completed 10 Dec 2006. (GSD)

Begin real-time cycling of the RR model with GSI over RR domain at degraded resolution.

CURRENT WORK: Replacement of the Rapid refresh cycle that was running on iJET with a new version running on wJET is nearly complete, but has been hampered by a security patch to wJET that is interfering with I/O for both the GSI and the WRF REAL packages. While the security patch issue is being resolved (expected within a few weeks), a workaround has been found for the REAL I/O problem, but the problem still persists for GSI reads of large domain files. Using the REAL workaround, a 3-h cycle has been run by hand on wJET for a CONUS domain

(smaller domain allows the GSI read to be successful) and work is proceeding to fully automate the scripts and upgrade the cycle to hourly. As an interim solution to allow us to further evaluate cycled forecasts on the large Rapid Refresh domain, a coarse resolution (26-km) RR configuration has been created and work toward wJET cycling is proceeding (the GSI I/O works for the 26-km RR domain because the file size is smaller than the 13-km RR domain). Real-time hourly transfer from NCEP to GSD of full Rapid Refresh domain observation files (another essential element for hourly cycling over the RR domain) was also accomplished this month.

For effective 1-h cycling it is important to have a 1-h forecast that is free of spurious features. As has been noted many times over the years, the use of digital filter initialization (DFI) has been a key to the success of the RUC. As noted above, Tanya Smirnova is successfully running the diabatic DFI (first backwards adiabatically, then forward diabatically) to initialize the WRF-RR using GFS initial data. In addition to the benefit provided by diabatic DFI to the 1-h forecast, it will permit diabatic initialization of the WRF-RR runs after coupling with the GSI generalized cloud analysis (See Task 07.5.15).

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: See comment on wJET above.

INTERFACE WITH OTHER ORGANIZATIONS: NCEP, NCAR

UPDATES TO SCHEDULE: This task for which we previously requested a 2-month delay (from 15 Nov 2006 to 15 Jan 2006) is now complete.

07.5.4.2 15 Jan 2007 (GSD, DTC) Completed 5 Jan 2007

Build retrospective period capability including different seasons for testing of RR with cycling.

CURRENT WORK: The retrospective period chosen continues to be used very productively (continuing in August) for testing impact of various observation systems, including effectiveness of the RUC hourly assimilation and its analysis code. A summer retrospective period has been chosen and is currently being built.

07.5.4.3 Build graphics and web viewing capability for display of ESRL RR real-time and retrospective runs. The previous web-page for experimental RR forecasts has been re-activated with links to the new cold-start version of the full domain Rapid Refresh, currently running on wJET. Products from cycled versions will be added soon. The web-link is: **http://www-frd.fsl.noaa.gov/mab/wrfrr13arw/**

CURRENT WORK: NCL scripts are ready to accept output from RR cycling once it becomes available.

PLANS: Previous web pages for experimental RR graphics will be re-aimed at new directories forced by disk storage limitations.

07.5.4.4 Further enhancement of WRF-post version for Rapid Refresh application, including modifications to generation of RUC-specific fields.

Build graphics and web viewing capability for display of GSD RR real-time and retrospective runs.

CURRENT WORK: Bill Moninger's grib viewer has been extended to allow viewing RR GRIB data covering the full North American RR domain.

07.5.4.5 Ongoing (GSD)

Further enhancement to WRFpost version for Rapid Refresh application, including modifications to generation of RUC-specific fields.

CURRENT WORK: No significant work during July-September quarter.

07.5.4.6 Ongoing (GSD, NCAR later)

Ongoing evaluation of real-time and retrospective runs of RR system for SAVs and AIVs

CURRENT WORK: GSD has extended a rawinsonde verification system to include Rapid Refresh forecasts from preliminary real-time tests.

07.5.4.7 1 Nov 2006 (GSD) - ongoing

Start to solicit input from other AWRP Research Teams and NWS forecasters in Alaska and Puerto Rico regarding how they wish to use the RR and particular forecast challenges for which the RR might be able to provide guidance.

CURRENT WORK: No additional work this quarter (but see previous Q2 report on GSD visit to Alaska on the RR).

Deliverables

07.5.4.E1 15 October 2006 (GSD)
Complete a technical report describing the GSD preliminary real-time and retrospective testing of the WRF Rapid Refresh system.

Completed 1 September 2006. GSD report was sent to NCEP (see FAA-AWRP MD&E FY06 Q4 report) and made available on the web at http://ruc.fsl.noaa.gov/coretest2 /

07.5.4.E2 15 July 2007 (GSD) Completed 26 June 2007
Deliver report to NCEP on progress with WRF Rapid Refresh code toward FY09 Rapid Refresh implementation.

Two presentations pertaining to Rapid Refresh development were given at the 22nd Conference on Weather Analysis and Forecasting/18th Conf. on Numerical Weather Prediction at Park City UT, 25-29 June 2007:
Benjamin, Weygandt, Brown, Smirnova, Devenyi, Brundage, Grell, Peckham, Schlatter, Smith (all ESRL/GSD) and Manikin (NCEP/EMC): From the Radar-enhanced RUC to the WRF-based Rapid Refresh.
http://ams.confex.com/ams/pdfpapers/124827.pdf

Devenyi, Weygandt, Schlatter, Benjamin (all ESRL/GSD) and Hu (CAPS): Hourly data assimilation with the Gridpoint Statistical Interpolation for the Rapid Refresh. http://ams.confex.com/ams/pdfpapers/124535.pdf

These links give detailed reports on the status of RR development as of early June 2007.

Task 07.5.5: Develop, test, and implement improvements to the operational WRF 3DVARs for Rapid Refresh and North American Mesoscale runs.

NCEP

See below under Deliverable 07.5.5.1.

GSD

Dezso Devenyi continued his work on optimizing the use of the anisotropic correlation structure. Following advice from James R. Purser of NCEP, Dezso is examining individual neighboring aspect tensors in order to find optimal smoothing procedure to avoid noise in resulted correlations. The approach is still based on the RUC method (PBL height computation and correlation scaling according to elevation of PBL). Dezso also ran tests of GSI to compare the use of the current hourly RUC observation files and the new large domain hourly files now being transferred from NCEP. Ming Hu has completed coding work to parallelize the GSI general cloud analysis and is now evaluating tests with different observation sources (comparing results with single-processor runs) to resolve any remaining issues and verify that the parallel version is working correctly within the GSI framework. Steve Weygandt has worked with Ming and Dezso to test, document and resolve various wJET-related GSI I/O issues. Additional work has focused on updating the workflow manager scripts and testing GSI in the two interim configurations (CONUS 13-km and North American 26-km) that are being used until the wJET security patch issue is resolved.

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Subtasks

07.5.5.1 15 Oct 2006 (GSD and CAPS) Completed 15 Oct 06
Report on testing of RUC-like cloud/hydrometeor assimilation (including GOES cloud-top data and METAR cloud/visibility/weather data) within WRF-GSI on the full Rapid-Refresh domain.

07.5.5.2 Oct 2006 (NCEP/EMC) - Completed Oct 2006
Based on parallel testing and refinement of the experimental code, deliver a "pre-implementation" version of WRF-GSI for 2007 upgrade to NAM /NDAS.

07.5.5.3 Dec 2006 (NCEP/EMC) – Completed Dec 2006
Report on testing of 2DVAR WRF-GSI assimilation of high spatial and temporal mesonet surface data using analysis grids with 5km resolution and higher.

In collaboration with Sei-Young Park and Jim Purser, Manuel Pondeca has added the capability to generate 'space-filling Hilbert curve'-based subsets of data for cross-validation to the GSI. The subsets are not overlapping and tend to be more evenly distributed in space than the complete data set. He has also developed and tested code for generating dynamic lists of surface observations that are of poor quality based on the GSI 'diagnostics file' and should not be used in the GSI analysis. (Pondeca) complete

07.5.5.4 15 January 2007 (CAPS/ NCEP)
Further refine the radial velocity analysis component of GSI in response to model resolution changes. Consider issues on data quality, super-obbing, and optimal decorrelation scales.

07.5.5.5 15 May 2007 (NCEP/EMC)
Development efforts will produce a "research quality" code for an upgrade package (improved covariance and use of WSR-88D, satellite radiances and covariances) to the WRF-GSI.

07.5.5.6 31 July 2007 (NCEP) (Delayed per NCEP paragraphs above).
Based on case-study testing and refinement of the research quality code, deliver resulting an "experimental" code for an upgrade package (improved covariance and use of WSR-88D satellite radiances and covariances) to the WRF-GSI for the March 2008 change package to the NAM-WRF.

A lower-resolution NAM assimilation-forecast system was developed in order to test the use of the ensemble-based background error covariance matrices in the GSI in a time-efficient manner. (Pondeca, Jovic) A retrospective test of FGAT (first guess at appropriate time) and simplified 4DVAR (now referred to as first-order time extrapolation to observation or FOTO) were completed. These tests consisted of 24 hours of assimilation followed by an 84 hour forecast. After the bug (found last quarter) was fixed, these results were no longer negative but were still essentially neutral. Preliminary tests were conducted with a simple form of digital filter initialization (Dave Parrish prefers to call it digital finalization) where the forecast is run forward only, and time averaging is done centered around the analysis time to create a time smoothed background. (Parrish)

Shun Liu and Duk-Jin Won completed tests showing positive impact of adding a vertical velocity variable to GSI to help in the assimilation of radar radial wind observations. For the first time, radar radial wind data is showing a small positive impact over a control run without radar data. This is for verification of 24hr forecasts during 1 week of assimilation on the NAM central domain.

07.5.5.7 15 Dec 2006 (ESRL) Completed 15 Dec 2006
Report on testing of RUC-like surface observation assimilation (including use of inferred PBL depth, terrain and land mask constraints, and soil temperature/moisture adjustment) within WRF-GSI on the full Rapid-Refresh domain.

07.5.5.8 15 Feb 2007 (ESRL/GSD) Completed 15 Feb 2007

Development efforts produce an 'experimental' version of the GSI suitable for Rapid Refresh application (e.g. includes RR-specific modifications for cloud hydrometeor and surface observation assimilation).

Deliverables

07.5.5E1 **31 March 2008** (original - 31 March 2007) EMC
Subject to NCEP Director approval, implement WRF-GSI in NAM/NDAS.

CURRENT EFFORTS: Impact studies on the bug-fixed strong constraint, the latest GSI code release (releases are made quarterly and keeping up with them in parallel testing is a necessity), and retuned background errors were conducted. The new GSI code and tuned background error produced neutral and positive impacts respectively and were added to the regional parallel baseline system. Because of the negative results of concurrent global impact studies, QUIKSCAT data were turned off in the regional parallel. The strong constraint was also turned off because of bad forecast impact in the regional parallel NDAS. It was found that using the GOES 1x1 ozone channel caused some of the other channels to be rejected, so the ozone channels were turned off. This change was shown to produce little impact with an off-line parallel test. A local ensemble Kalman filter method was studied and tested on a small regional domain. No further action was taken since it required sizable computer resources and management support. Testing has begun of increasing the horizontal diffusion in the forecast model during just the data assimilation to decrease the very small scale features in the first guess. (Wu)

The strong dynamic constraint, which has been so successful in the global application, has consistently caused problems when used in the regional NDAS. One small error was found by John Derber, but the impact was negligible. A significant difference between the global and regional versions of the strong constraint is that the linear model used to define gravity wave modes does not include variation of Coriolis parameter and map factor in the regional version. The regional version is based on work of Briere (MWR, 1982), whose model domain was 6 times smaller in extent than the full continental domain of the NAM. To overcome this, work was started on embedding the regional domain in a full global domain and applying the global version of the strong constraint. (Parrish)

The 2DVAR-GSI assimilation of surface observations was extended to the Alaska NDFD domain and JIF's filed for the system's operational implementation. Pondeca also worked on the estimation of the analysis error covariance matrix in the GSI with the help of the Lanczos method for solving large scale eigenvalue problems. Tests performed within the 2DVAR-GSI framework have shown satisfactory results. (Pondeca)

PLANNED EFFORTS: Test the impact of increased horizontal diffusion in the parallel. Start retrospective testing of the modified strong constraint (embedding regional inside a global application), using a low resolution NDAS launcher. (Wu, Parrish, Jovic, Saito)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS:

UPDATES TO SCHEDULE: NCEP Director approval has not been granted so the upgrade to NAM GSI has been delayed into 2008.

07.5.5E2 15 July 2007 (ESRL). Completed 15 July 2007
Based on real-time parallel and retrospective testing and refinement of the experimental code, report to NCEP on progress toward a 'pre-implementation' version of WRF-GSI suitable for Rapid-Refresh application (to replace RUC 3DVAR in FY09).

07.5.6 Develop, test, and evaluate the nonhydrostatic Weather Research and Forecasting (WRF) Model Incorporate physics improvements into the WRF software infrastructure 30 September 2007 (NCAR/MMM)

NCAR/MMM

The funded work in NCAR/MMM was primarily performed by Jimy Dudhia. First, he helped to finalize the unified Noah LSM code and resolved issues of consistency in use of mixing ratio and specific humidity within Noah. The unified Noah was committed to the repository in August.

NCAR/MMM worked with the Developmental Testbed Center (DTC) and NCEP on an issue of occasional bad values in the 2-m air temperature output by WRF. This appeared in low-wind situations where an exchange coefficient became unrealistically small. The fix was added to the WRF repository in August.

Dudhia added fixes to the repository on behalf of Jack Kain (Kain-Fritsch cumulus scheme), Mike Ek (unified Noah LSM), Mukul Tewari (Urban Canopy Model), and Greg Thompson (Thompson microphysics). A new vertical velocity (w) Rayleigh damping option developed by Joe Klemp of NCAR was added to the repository as a future method for preventing wave reflection problems. This option is now used routinely in the global WRF tests.

Dudhia began working with visitor Guenther Zaengl (Univ. of Munich) on implementing several new features into WRF. These include a new generalized vertical coordinate, modifications to stabilize and improve diffusion, and modifications to allow for terrain slope and shadowing in the solar radiation scheme.

An ozone capability for the Dudhia shortwave radiation scheme, a scheme computationally cheaper than the Goddard, was developed. With the RRTM longwave radiation scheme, a fix was tested for the input of surface skin temperature, rather than extrapolated atmospheric temperature (done inadvertently in the RRTM implementation). This fix was added to the repository in August. It has a generally small effect on results, except over water regions like the Great Lakes where skin temperature might be quite different from air temperature.

Dudhia worked on resolving water budget issues in idealized WRF runs with surface fluxes. The main problem was traced to the new 6th-order diffusion option, which is not recommended for budget studies.

FDDA grid nudging was fixed for restarts by adding the time-check for the input stream allocated for FDDA. This was added to the repository in August.

NCAR developed physics tuning parameters for ensemble applications. These parameters are controllable with the namelist and are as follows: (i) an entrainment constant in the YSU PBL scheme, (ii) the rain intercept parameter in the WSM5 and WSM6 microphysics schemes, and (iii) the sub-grid cloud radius in the KF cumulus scheme.

NCAR/MMM tested the new Global WRF (ARW) capability. Dudhia and Bill Skamarock (MMM) resolved issues pertaining to the radiation scheme's handling of ozone effects in the upper stratosphere, the initialization of moisture in low-pressure and low-RH conditions, the initialization of sea ice and soil moisture from ECMWF data, and the use of the new Rayleigh w damping to prevent unrealistic reflection from the model top. With these changes the global ARW is running successfully.

In real-time hurricane forecasting using the ARW, NCAR tested new formulations for the moisture exchange coefficient in high-wind conditions. The latest formulation increases the enthalpy exchange coefficient for hurricane strength winds to improve the intensity forecasts (underestimated for the standard formulation).

MMM also worked with GSD to enter fixes for use of RUC initial conditions including 3-d cloud hydrometeors and RUC land-surface variables in WPS and in the WRF model to initialize either ARW or NMM with different physics configurations.

PLANNED EFFORTS: Work has been completed for FY07 on this subtask.

UPDATES TO SCHEDULE: None.

WRF for Rapid Refresh
31 March 2007 (NCAR/MMM)

CURRENT EFFORTS: NCAR/MMM's work on this task was completed in FY07, Q2 and is described in the FY07Q2 quarterly report.

PLANNED EFFORTS: Work has been completed for FY07 on this subtask.

UPDATES TO SCHEDULE: None.

Deliverables

07.5.6.E1 30 June 2007 (NCAR/MMM, DTC) Completed July 2007
Conduct a WRF Users' Workshop and tutorials on the ARW core (NCAR) and the NMM core (DTC) for the user community --

CURRENT EFFORTS: NCAR/MMM's work on the first ARW tutorial for FY07 was completed in Q2 and is described in the FY07Q2 quarterly report.

NCAR/MMM conducted the 8th WRF Users' Workshop on June 11-15, 2007 in Boulder, CO. The completed work for that subtask is described in the previous quarterly report, that for FY07Q3.

NCAR/MMM conducted a second WRF tutorial for FY07 on July 23-27.
This was jointly produced with the DTC, and both the ARW and NMM cores were covered. The tutorial included lectures on the WRF system and WRF-Var, as well as practice sessions. 61 people attended.

PLANNED EFFORTS: Work has been completed for FY07 on this subtask.

UPDATES TO SCHEDULE: None.

Task 07.5.8: Improve physics in the WRF model, especially including those that affect aircraft icing.

GSD

GSD continued to evaluate real-time performance in both WRF and RUC of versions of the Grell-Devenyi convective scheme with various new features. The RRTM longwave radiation scheme is also in the dev-13km RUC cycle at GSD. In August, the dev-13km cycle continued to show dramatic improvement in nighttime and daytime warm bias over the central and southeastern US as compared to the operational RUC. The revised RUC LSM and the RRTM are both included in the planned RUC change bundle, along with changes in the Grell-Devenyi convective scheme described under 07.5.1.

Subtasks

07.5.8.4 30 January 2007 (GSD) Completed 30 January 2007
Carefully evaluate candidate convective schemes and their interaction with other physics for RR application.

CURRENT WORK:
The Grell-Devenyi scheme continued to be the subject of experimentation during the quarter. The small-scale detail and absence of sufficient mesoscale organization noted in instantaneous RUC reflectivity fields and discussed in the FY07 Q3 report continues to be addressed by testing in the developmental 13km RUC at GSD. In the current operational RUC, as well as the backup RUC13 at GSD, the subsidence outside of cloud necessary to compensate the saturated updrafts within (parameterized) clouds is assumed to occur entirely within the individual grid column where the convection is occurring. Georg Grell has developed for WRF a version of the Grell-Devenyi scheme that spreads this subsidence into nearby grid columns, and has implemented this scheme into the 13km developmental RUC at GSD. Various assumptions concerning the spatial distribution of subsidence in adjoining grid columns are being tested in the dev13 RUC and evaluation is continuing. One conclusion so far is that the proportion of grid-scale precipitation in areas of convection can be increased by a more uniform spreading of the subsidence into adjoining grid columns rather than having most or all of it occur in the same grid column as the convection which it compensates. Comparison of performance of this latest version of the Grell-Devenyi scheme running in GSD's Dev13km against what is running in the backup RUC13 at GSD indicates the latest version produces better

Equitable Threat Scores, particularly at amounts per 12h of 0.25 to 1.00".

07.5.8.5 30 June 2007 (GSD). Complete 30 June 2007
Improve handling of moist processes in candidate PBL scheme for use in the RR-WRF.
No further work on this subtask during the quarter.

07.5.8.6 1 August 2007 (NCAR)
Test and evaluate current stratocumulus parameterizations for the prediction of icing and if necessary develop a new parameterization for the formation of icing including freezing drizzle in stratocumulus clouds. This will involve comparison to observations of well observed cases such as January 31 case from Cleveland, Ohio as part of the NASA/Glenn in-flight icing field studies and the use of LES modeling with WRF to simulate the processes forming super-cooled liquid water and drizzle. This task will be linked to the aerosol task due to the finding that CCN concentration often plays a dominant role in the formation of drizzle in these types of clouds.

Ben Bernstein is writing up his preliminary analysis of the Cleveland stratocumulus cases in preparation for the final report. These truth datasets will be used to improve the simulation of stratocumulus icing in the bulk scheme, including possible modifications to the PBL scheme.

07.5.8.8 15 August 2007 (GSD, NCAR/RAL)
In collaboration with NCAR/RAL, investigate potential for RR application of existing physics schemes that combine PBL processes with prediction of PBL-driven stratocumulus or shallow cumulus.

GSD: J. Brown continues to look into a class of boundary-layer mixing schemes developed by Bretherton et al and discussed at the WRF workshop. These schemes couple a Mellor-Yamada-type local mixing scheme, which is applied in the subcloud layer in contact with the surface, to a parameterization of shallow cumulus in the cloud-bearing layer. These schemes are not yet in the WRF repository.

Deliverables
07.5.8.E2 15 June 2007 (GSD) Completed 15 June 2007
Report to NCEP and AWRP on testing of revised versions of microphysics and other physical parameterizations into WRF Rapid Refresh model.

See paper by Benjamin et al noted in July report under Task 07.5.4 and supplemental material provided in FY07 Q3 report.

07.5.8.E3 30 June 2007 (GSD) Completed 30 June 2007
Report on overall performance of physics parameterizations in pre-implementation version of RR at annual WRF Workshop in Boulder, CO.

See paper by Benjamin et al noted in July report under Task 07.5.4 and supplemental material provided in FY07 Q3 report.

07.5.8.E4 30 September 2007 (NCAR)
Report on development of a predictive capability in the NCAR microphysics for aerosol concentration and mixing ratio that can be used to determine CCN and IN as a function of cloud updraft velocity, temperature, pressure, and background aerosol concentration. Sources and sinks of aerosol particles will need to be taken into account. This task will be closely linked to the stratocumulus task given above.

Task 07.5.15 Develop improved methods of cloud and moisture analysis for use in the WRF Modeling System.

Subtasks

07.5.15.2 15 May 2007 (GSD)
Develop and evaluate performance of diabatic digital filter initialization (DDFI) in the RR WRF model for initial cloud and hydrometeor fields.

The radar reflectivity assimilation code within the 13-km RUC DDFI has continued to yield impressive results in real-time parallel test at GSD. Code for this package has been transferred to NCEP for real-time and retrospective testing in advance of the planned January 2008 operation upgrade. Related collaborative work between GSD, EMC, and NSSL has yielded progress on the related task of generating at NCEP real-time quality-controlled radar reflectivity tiles. Working with Geoff Manikin and Shin Liu at NCEP, Ming Hu was able to parallelize the program that reads the 8 radar reflectivity tiles and maps them to the RUC grid. The resultant time savings in the execution of the program is essential for the radar pre-processing routines to reliable finish in time to meet the RUC hourly cycle data cutoff time.

Tanya Smirnova has successfully coded the diabatic DFI for the WRF-ARW using a single executable (see task 07.5.4), This is an important accomplishment that surmounts the main obstacle to porting the radar assimilation package (including the use of lightning data) to the WRF-based Rapid-Refresh system. Scientific information about the radar algorithm and results are summarized in a conference paper presented at the 33rd Conference on Radar Meteorology in early August. The paper title and link is:
Radar-based assimilation of precipitation systems using a diabatic digital filter

07.5.15.4 15 July 2007 (GSD and CAPS) Completed 15 July 2007
Develop a revised version of the GSI cloud assimilation treatment of satellite and METAR cloud data in its cloud analysis.

Deliverables

07.5.15.E2 15 July 2007 (GSD) Completed 15 July 2007
Report on progress of GSI cloud analysis code to NCEP to be part of Rapid Refresh.

Verbal summary of progress being provided at bi-weekly GSI telecoms. A paper summarizing the algorithm has been written by Ming Hu. The paper title and link are: "Development and testing of a new cloud analysis package using radar, satellite, and surface observations within GSI for initializing Rapid Refresh".
Authors: Ming Hu, Steve Weygandt, Ming Xue, Stan Benjamin

07.5.15.E3 15 September 2007 (GSD and CAPS)
Complete further revisions and testing of the generalized cloud analysis package within GSI for stratiform cloud (using GOES cloud top and METAR cloud data) and initial treatment for convective cloud at parameterized scale assimilating radar reflectivity.

CAPS
Complete further revisions and testing of the generalized cloud analysis package within GSI for stratiform cloud (using GOES cloud top and METAR cloud data) and initial treatment for convective cloud at parameterized scale assimilating radar reflectivity.

During this quarter, A generalized cloud analysis package based on the ARPS and RUC cloud analysis packages with further enhancement has been developed within in the GSI framework. Results of initial testing were reported in a conference paper (Hu et al. 2007). Further efforts were made in improving the efficiency of the package within GSI by parallelizing both radar data ingesting and cloud analysis system itself. The new system is able to read and process 8 radar Mosaic reflectivity tiles using 8 CPUs at the same time, which leads to significant reduction of the wall time. Systematic testing with RR configurations and over extended period will continue. Such work was carried out on GSD's computing platforms to avoid the need for porting.

Ming Hu also found that extra large snow mixing ratio in upper atmosphere when uses Thompson snow retrieval method is caused by the large snow intercept parameter of the Thompson scheme (twenty times larger than Lin

scheme). This issue will be studied further when Thompson based retrieval is needed.

On August 31, Ming Hu completed his employment with CAPS. He started working for GSD from September 3rd. CAPS hired a new scientist, Aimei Shao, to continue the FAA-supported work. She started on 28 August.

In September, significant efforts were spent at CAPS, with help from Ming Hu, on porting GSI to OU's Linux cluster (dual-processor Pentinum4 Xeon EM64T running Enterprise Linux 4.0 with Intel ifort 9.1 compiler). Initial plan was to port the GSD version of GSI, because it was already running on GSD's Linux system. The GSD version is based on a somewhat older version of GSI from NCEP and contains many undocumented changes, and the package we obtained was missing many sub-packages in source code form. Some progress was made by using precompiled modules from GSD.

Focus was then shifted to porting currently released package of GSI from NCEP, an additional source package (mpeu) needed on non-IBM platforms was obtained from GSD (used in GSD version) and combined with the NCEP version. Source code changes had to be made to file balmod.f90 to overcome what is believed to be an Intel compiler bug, and additional changes had to be made to make files and source codes to pass the compilation. The latter are mostly related to non-standard Fortran codes that Intel compiler failed to compile. Currently, the executable of GSI has been successfully produced, but the parallel MPI run is crashing with a floating point exception (SIGFPE) error. Further work will be done to resolve this problem and to test the correctness of the system with a test data set. Assistance from Ming Hu and Russ Treadon of NCEP are greatly appreciated. After passing the correctness test, the generalized cloud analysis package from will be added to this (NCEP) version of GSI to allow for continued testing and enhancements.

Reference cited:

Hu, M., S. S. Weygandt, M. Xue, and S. G. Benjamin, 2007: Development and testing of a new cloud analysis package using radar, satellite, and surface cloud observations within GSI for initializing rapid refresh. 22nd Conf. Wea. Anal. Forecasting/18th Conf. Num. Wea. Pred., Salt Lake City, Utah, Amer. Meteor. Soc., CDROM P2.5.

GSD

GSD has tested new experimental GOES cloud-top data from NESDIS using the RUC cloud analysis. GSD found errors in the cloud-top temperature in this data, resulting in poorer stratus initialization over marine regions. NESDIS has subsequently corrected this problem, and it appears that the new GOES cloud-top data will be appropriate for the operational RUC. Additional related testing was conducted in August for use of single-field-of-view (SFOV) precipitable water (PW) data in the RUC. Current operational GOES PW data is from 5x5 FOVs, but successful tests have been carried out at NCEP using the new 1x1 FOV information.

07.5.17 Infrastructure Support for Running the Operational WRF Model in North American Mesoscale and HiRes Window Modes at NCEP.

Subtasks

07.5.17.1 Maintain four-per-day North American Mesoscale runs and provide SAV and AIV guidance.

The planned NAM implementation for September 2007 was postponed until the second quarter (January-March) of FY08. The primary reason for this postponement was degraded performance of the parallel NAM during June-July parallel testing which subsequent and concurrent analysis determined was caused by the new strong mass-wind balance constraint in the GSI analysis component of the NAM upgrade bundle (see Task 07.5.5). By delaying this change package until next year, a new version of the GSI analysis with re-tuned background errors and other improvements will be ready for implementation, along with several WRF-NMM model changes, including IJK loop & storage ordering (for faster running), gravity wave drag/mountain blocking, unified Land-Surface physics, and a new passive advection algorithm. The codes will be finalized and delivered to NCO by late October in order for NCO to run it through their process and implement in January 2008. (Rogers)

07.5.17.2 Maintain four-per-day HiRes Window runs and provide SAV and AIV guidance.

The upgrade package to the HiResWindow system was implemented into NCEP operations on 11 September 2007. This change package, driven largely by a request by the Storm Prediction Center, includes the latest WRF code representing an upgrade from v1.3 to v2.2, the new IJK storage and loop ordering which is 10-15% faster than the IKJ code, plus all the WRF-NMM updates which have occurred in the last two years, expanded integration domains and increased model resolution. NMM grid-spacing was increased from 5.1 km to 4 km and ARW grid-spacing was increased from 5.8 km to 5.1 km – both will continue to use 35 levels in the vertical. Daily HiResWindow runs of both the WRF-NMM and the WRF-ARW are now made for expanded large domains covering Alaska (18z), West-Central CONUS (06z) and East-Central CONUS (00z & 12z) plus small domains covering Hawaii (00z & 12z) and Puerto Rico (06z & 18z). (Rogers, Pyle, NCO)

In addition, NCEP has maintained twice-per-day runs of six WRF-based members (3 running NMM and 3 running ARW) of the Short Range Ensemble Forecast (SREF) system with aviation guidance available from http://wwwt.emc.ncep.noaa.gov/mmb/SREF/SREF.html which now includes Alaska and Hawaii (eastern Pacific). (EMC and NCO)

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

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). (EMC Team and NCO)

07.5.17.4 Provide full grids from NAM, and the HiRes Window on NCEP and NWS/OPS servers.

NCEP maintained real-time availability of full resolution gridded data from the operational 4/day NAM and the HiResWindow (HRW) suite of WRF-NMM and WRF-ARW runs via anonymous ftp access via the NCEP server site ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com . For NAM, this includes hourly BUFR soundings and output grids which undergo no interpolation and, as such, are on the models' computational grids (so-called native-native grids). HRW run output is now mapped to 5 km output grids and packed into GRIB2 format, see http://www.nco.ncep.noaa.gov/pmb/docs/GRIB1_to_GRIB2.shtml .
A limited set of fields from the HiResWindow (HRW) runs (and other NCEP models) can also be viewed at http://www.nco.ncep.noaa.gov/pmb/nwprod/analysis/ (EMC Team and NCO)

07.5.17.5 Maintain access to model verification data. (see subtask report under Task 07.5.1.4)

07.5.17.6 Provide assistance to In-Flight Icing, Turbulence, Convective Weather, C&V and Oceanic Weather PDT when their algorithms and product generation systems are ready to transition into NCEP's operational production suite.

AWRP algorithms now running at AWC are being examined at NCEP with the eventual goal of transitioning them to run on NCEP's CCS. This is in anticipation of final decisions by upper management at NWS and FAA on the precise path & funding for this effort. A computer, to which NCEP will have access, is being integrated into the AWC computer network. This will allow test data (input obs and intermediate results) to be extracted and compared to results obtained from ported codes and capabilities running at NCEP. There will be a visit of NCEP's contractor to AWC in October. (Trojan)

Deliverables

07.5.17.E1 1 October 2006 - 30 September 2007 EMC (Parrish, Derber, Wu, Keyser)
Perform observation ingest, quality control and preparation in support of the operational North American Mesoscale WRF runs.

CURRENT EFFORTS: An implementation on 7 August allowed NCEP to began pulling GOES 1x1 field-of-view sounding data from NESDIS' gp12 machine (24x7 support) rather than from their gp16 machine (8x5 support).

Also on 7 August, NESDIS began sending NOAA-18 data to an additional ground station in Sweden. This has eliminated the "blind orbit" problem and has increased/stabilized the number of data available in the 0000 UTC runs. An implementation on 13 August greatly expanded the number of satellite ingest jobs run each day. This change will ensure that as much data as possible will be available for the early NAM (and RUC) cut-off times. The reason why moisture data from MDCRS-ACARS UPS units is unreasonably high in the BUFR feed from ARINC is due to their being coded into BUFR one order of magnitude too large (see Task 07.5.1.E1). Tests using the new, high-resolution BUFR JMA IR and visible winds (replacing the current low-resolution SATOB JMA winds which will be discontinued in December) have been completed. The high-resolution JMA winds will become operational sometime in early December. Parallel testing of the following new data types is currently underway in preparation for the FY08/Q2 NAM-GSI update: GOES-11 and -12 single field-of-view (aka 1x1) radiances over water (replacing current 5x5 field-of-view GOES-12 radiances), AIRS every field-of-view radiances, QuikSCAT 0.5 deg. scatterometer wind superobs, mesonet winds filtered by provider via NOAA/GSD's "uselist", MODIS IR and water vapor satellite winds and dropwindsonde moisture from NOAA (P-3 and Gulf Stream) and USAF. All data here are processed within the new, expanded NAM domain, using a new domain mask developed by Eric Rogers (this mask allows only those observations within the exact domain to be selected for dumping). This domain will become operational in October. Efforts to speed up the dump processing of NEXRAD Level II data have resulted in a proposed script change which is being considered by NCO. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ESRL MADIS feed. (Keyser)

PLANNED EFFORTS: Add a new aircraft quality control module based on code developed at Naval Research Lab (also affects RUC). Increase time window for aircraft data in order to improve track checking (also affects RUC). Change PREPBUFR processing to add report sub-type information so analysis can use different obs errors and develop bias corrections based on data sub-types (e.g., airframes and ascent/descent tag for aircraft data, providers and sub-providers for mesonet data, instrument type and on-site correction indicator for radiosonde data) (also affects RUC). Complete impact tests in NAM for several new data types: TAMDAR (direct from AirDAT vs. current MADIS feed) and Canadian AMDAR aircraft; GOES-11 and -12 single field-of-view radiances over water; AIRS every field-of-view radiances; QuikSCAT 0.5 deg. scatterometer wind superobs; mesonet mass, winds and roadway data, and new mesonet data feeds (including "hydro", "snow", modernized COOP and UrbaNet); MODIS IR and water vapor satellite winds; dropwindsonde moisture from NOAA (P-3 and Gulf Stream) and USAF; METOP-2 1B HIRS-4, AMSU-A and MHS radiances; aircraft moisture; RASS temperatures; JMA and CAP profiler winds; 3.9 micron and visible satellite winds; WindSat scatterometer wind data; GPS radio occultation data; and METEOSAT-9 IR and visible satellite winds. Tap into additional mesonet data from non-MADIS sources (e.g., LDAD and/or MesoWest). Add aircraft layer icing and turbulence data into PREPBUFR files for verification purposes. Add a new quality control module for WSR88-D NEXRAD Level II radar reflectivity. Coordinate with the field to speed up the processing of Alaskan RAOBS (esp. Shemya) so that these data arrive in time for the NAM dumps. (Keyser)

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: GSD & NCO.

UPDATES TO SCHEDULE:

07.5.17.E2 1 October 2006 - 30 September 2007 EMC (Parrish, Derber, Wu, Keyser)
As requested by other PDT's, incorporate new AIV calculations into Operational WRF Model post-processor and product generator.

CURRENT EFFORTS: No requests were made by other PDTs during this period.

Simulated radar reflectivity (previously added to NAM output as requested by NWS field and SPC) is now being generated by the HiResWindow and by the 'Matt Pyle' run for SPC . In addition, NWS Eastern Region and NCEP's AWC, HPC and SPC have requested simulated GOES imagery be added to the WRF-post. This has been accomplished by Hui-Ya Chuang by incorporating the Community Radiative Transfer Model (CRTM) into the post processor. This capability will be implemented by Rogers into the NAM in early FY2008. Due to its longer runtime, a special run of the post to generate the simulated GOES is being added so there will be no delay in the production of all the existing NAM output. Ferrier et al. have been evaluating this product and iterating on the

proper conversion from brightness temperature to 8-bit brightness values (0-254). In the meantime, NCEP will generate brightness temperatures and leave the conversion to the individual users.

PLANNED EFFORTS: Refine forward model for simulated reflectivity and satellite channels.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None

INTERFACE WITH OTHER ORGANIZATIONS: NESDIS, GSD & NCO

UPDATES TO SCHEDULE: None