MODEL DEVELOPMENT AND ENHANCEMENT RESEARCH TEAM
Quarterly Report for October-December 2007
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With contributions from Geoff DiMego and Mary Hart (NCEP/EMC);
Stan Benjamin, John Brown, Steve Weygandt (NOAA/ESRL/GSD);
Jordan Powers, Roy Rasmussen (NCAR);
Ming Xue (OU/CAPS)
Compiled and edited by Holly Palm and Stan Benjamin

Executive Summary

Task 08.5.1: Infrastructure support related to operational running of the RUC and North American Mesoscale (NAM) operational modeling systems.

- RUC cloud analysis revised for improved use of METAR cloud data, crisis change implemented on 8 Jan 2008, see http://ruc.noaa.gov/gif/ruc13/RUC-crisis-change-Jan08-summary.pdf .
- Summary on RUC/Rapid Refresh plans from 11 Dec presentation to NCEP model review http://www.emc.ncep.noaa.gov/research/NCEP-EMCModelReview2007/RUC-NCEP-OperReview-Dec07-RRb.pdf
- 1 Nov summary on RUC upgrade now available at http://ruc.noaa.gov/ruc13_docs/RUC-upgrade-early08.pdf . Lots of new verification, examples.
- Testing continues at NCEP for RUC upgrade package code (radar reflectivity assimilation, TAMDAR, radiation, Grell/Devenyi upgrade) , very good results (surface, convection, ceiling/vis, precip) evident for Sept-Dec. Implementation now planned for spring 2008. See real-time comparisons in http://wwwt.emc.ncep.noaa.gov/mmb/ruc2/para .

Task 08.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

- New Rapid Refresh summary at http://ruc.noaa.gov/rr/RR-TR-Oct07.pdf
- Hourly RR conventional observation files being created at NCEP, transferred to GSD, and utilized in GSI as part of the Rapid Refresh real-time test cycle.
- Web-page comparing cold start and hourly cycled RR at http://rapidrefresh.noaa.gov/RapRef

Task 08.5.6: Develop, test, and evaluate the performance of the nonhydrostatic WRF modeling system.

- Continued progress toward WRF version 3 planned for March 2008.

Task 08.5.8: Improve model physics for aviation forecasts.

- Non-local subsidence temperature tendencies tested in Grell-Devenyi scheme now producing a significant further improvement for convection forecasts in both NCEP parallel RUC and in GSD dev RUC13.

Task 08.5.15: Develop improved methods of cloud and moisture analysis for use in the WRF modeling system.

- Large improvements now forthcoming for complete use of METAR clouds in RUC and RR-GSI.
- Incorporation of updated and parallelized cloud analysis in latest cycling GSI version complete

Detailed report – MDE – Oct-Dec 2007

Task 08.5.1: Infrastructure Support Related to Operational Running of the RUC and North American Mesoscale (NAM) Systems

GSD

RUC upgrade continues in parallel testing at NCEP. Please see the October report for more details on RUC upgrade. Key components:

- Assimilation of new observations: radar reflectivity, TAMDAR aircraft, mesonet winds
- Model physics changes – RRTM radiation (new), Grell-Devenyi convection with non-local subsidence warming, snow density in land-surface model.

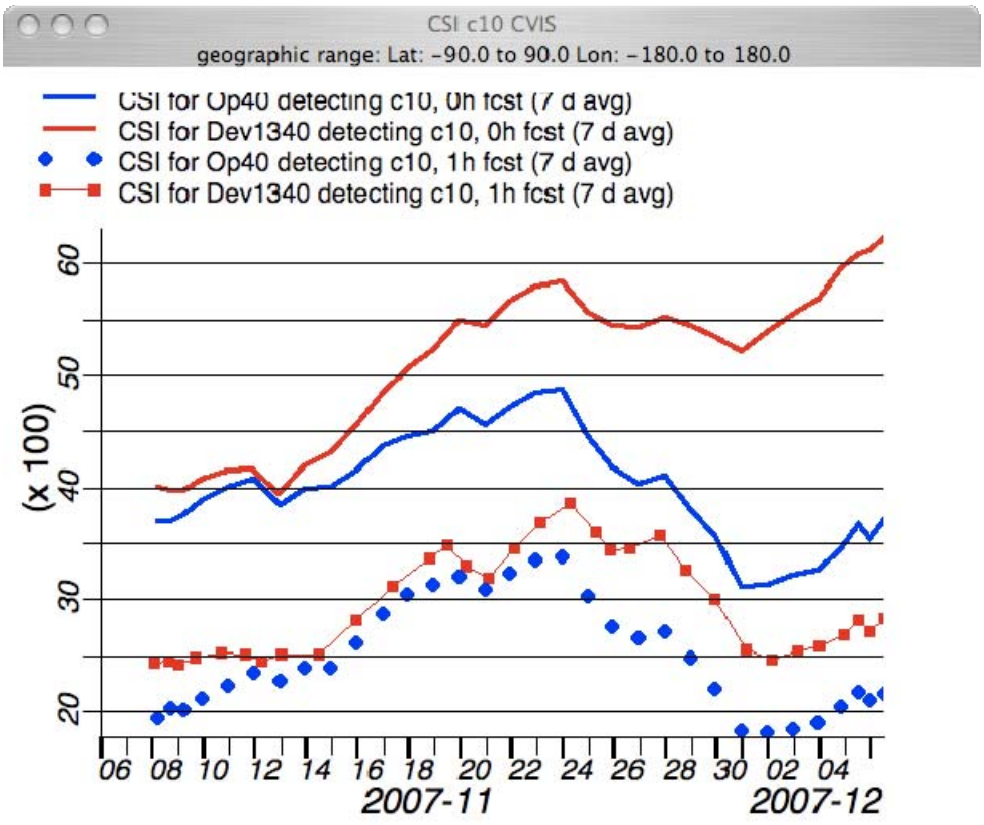
Effect of changes:

- Much improved precipitation, new reflectivity products.
- Elimination of 2m temp warm bias in summer and cold bias in winter.
- Improved lower tropospheric temps, winds, RH, clouds (TAMDAR, physics)

A new update on the RUC upgrade is available from the 11 Dec 2007 presentation at http://www.emc.ncep.noaa.gov/research/NCEP-EMCModelReview2007/RUC-NCEP-OperReview-Dec07-RRb.pdf

A 44-slide summary of RUC upgrade at http://ruc.noaa.gov/ruc13_docs/RUC-upgrade-early08.pdf and a November post to the RUC forum on RUC upgrade available at http://ruc.fsl.noaa.gov/forum/f2/Welcome.cgi/read/1713

Crisis change: GSD also developed improved processing of the RUC cloud analysis to ensure assimilation of METAR cloud observations failing to meet criteria for inclusion. Previous criteria in the cloud analysis were well-intentioned but found to be removing up to 30% of all METAR cloud observations. Using the new modified RUC cloud analysis code, a much higher percentage of METAR cloud obs are now captured in the RUC cloud analysis. A figure shown below depicts the CSI for 0h (analysis) and 1h forecast for 1000-ft ceiling over the RUC domain for the operational RUC and the development RUC13 (using the new cloud analysis). The accurate of both (analysis, short-range forecasts) is now much improved. Change implemented to NCEP oper RUC on 8 Jan 08 12z.



A crisis change implementation was submitted to NCEP/NCO by GSD and NCEP/EMC and implementation occurred on 8 January 2008.

INTERFACE WITH OTHER ORGANIZATIONS:
Extensive interactions with NCEP and NOAA/MDL.

Subtasks

08.5.1.1 Maintain hourly RUC runs and provide grids of SAV and AIV guidance products.
During the fall, EMC began running a parallel version of the RUC model, with the primary feature being 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 and TAMDAR data, a change in the longwave radiative scheme from Dudhia to RRTM, a modification to the snow component of the land-surface model to decrease excessively cold 2-meter temperatures over fresh snow at night, and a modification to the convective scheme to decrease widespread coverage of light precipitation. Daily and statistical evaluation of the parallel runs will continue through the 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. EMC is also preparing a small change package of corrections to be implemented in early January 2008. NCO has alerted EMC to an issue with some forecasts pushing up against memory limits, so the number of processors used to run the model will be slightly reduced. Testing indicates that the forecast jobs will require only an extra minute to complete with the new configuration. In addition, a few errors with the assimilation of METAR data as well as a bug in the post processing of the precipitation rate will be corrected. (Manikin)

08.5.1.2 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)

08.5.1.3 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)

08.5.1.4 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

08.5.1.E1 1 October 2007 - 30 September 2008 EMC (NCEP, GSD)
Perform observation ingest, quality control, and preparation of both existing and new observations in support of the operational RUC runs.
CURRENT EFFORTS: On 2 October, ARINC corrected their BUFR encoding of MDCRS-ACARS mixing ratio, and the moisture statistics generated by NCEP have shown much better agreement with the guess since then. A study completed in October showed that the 13 August increase in the number of satellite ingest jobs run daily has indeed provided more of these data for the early-cutoff RUC dumps. Since the early October ERSL MADIS hardware upgrade, to speed up data flow, the amount of mesonet data available to the RUC assimilation has increased markedly. The following new mesonet providers/subproviders were added by ERSL MADIS: "INTERNET/XCEL" and "NonFedAWOS/SUPERAWOS" on 16 October; provider "NCECONet" on 17 October; and "MISC/Archbold" and "MISC/WxFlow" on 30 October. Testing has started for "new science" GOES 1x1 field-of-view cloud data and GOES 1x1 field-of-view precipitable water data (replaces the current 5x5 field-of-view product). There were random cycles where all of the "new science" cloud data had missing latitude/longitude, due to a combination of NESDIS encoding 1 or 2 reports at the beginning of the file with missing lat/lon and the NCEP data dump duplicate checking program not recognizing this. The NCEP problem was corrected on 11 December. Parallel testing of TAMDAR aircraft data has begun. Surface marine (ship, buoy, C-MAN, tide gauge) data did not have NCEP/OPC interactive QC from 18 June until 2 November due to a file permission problem. There was a 12-hour outage of GOES sounding and wind data on 3 October due to a DNS issue on the NCEP CCS. In response to a joint request from NOAA's Office of International Affairs and the WMO that certain ship call signs be restricted to internal NWS use, a change to restrict all unmasked ship reports in the NCEP surface ship dump and PREPBUFR files was implemented on 3 December. At the same time, NCEP began providing unrestricted ship reports to outside users in special files where the report id is masked. A PREPBUFR bundle implementation on 4 December added TAMDAR (via ERSL MADIS feed) and Canadian AMDAR aircraft data (both being tested in parallel), aircraft layer turbulence and icing for verification, and satellite wind quality indices. GOES-10 replaced GOES-12 as the east satellite from 5 to 17 December while an attitude anomaly in GOES-12 was corrected. During this period, only GOES-11 5x5 field-of-view layer precipitable water and 1x1 field-of-view cloud-top pressure was assimilated, but GOES-10 IR and water vapor winds were assimilated in place of those from GOES-12. There was a complete outage of GOES-10 and -11 satellite winds on 6 December due to a problem with the NESDIS data files. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ERSL MADIS feed. (Keyser)

PLANNED EFFORTS Add a new aircraft quality control module based on code from Naval Research Lab. Increase time window for aircraft data to improve track checking. Switch to a new PREPBUFR file that will feed both the future Rapid Refresh runs and the RUC. Change PREPBUFR processing to add report sub-type information so the analysis can use different obs errors and develop bias corrections based on data sub-types (e.g., airframes and ascent/descent tags, mesonet providers and sub-providers, radiosonde instrument type and on-site correction indicators). Complete RUC impact tests for new data types Canadian AMDAR and TAMDAR (from AirDAT vs. current ERSL MADIS feed), hourly WSR-88D 3-D reflectivity, 6-minute wind profilers, "new-science" GOES (-11 and -12) cloud data, 1x1 field-of-view GOES (-11 and -12) precipitable water data to replace 5x5 field-of-view data which NESDIS is terminating, mesonet wind and roadway data, and new mesonet data feeds (including "hydro", "snow", modernized COOP and UrbaNet). (Keyser)

08.5.1.E2 1 October 2007 - 30 September 2008 (GSD)
Perform configuration management for RUC, including thorough documentation, and respond promptly to any code malfunctions or performance issues.

08.5.1.E3 1 October 2007 - 30 September 2008 (GSD, NCEP)
Monitor RUC performance, respond to any problems detected by GSD, NCEP, or any RUC users, diagnose cause, develop solution to RUC software, test changes and coordinate with NCO on implementation.

Task 08.5.4: Develop, test, and implement Rapid Refresh configuration of the WRF modeling system.

GSD

A Rapid Refresh home page (http://rapidrefresh.noaa.gov) was introduced during October and considerably expanded in November and December. This contains current information about the RR as well as access to real-time RR runs. A detailed PPT on Rapid Refresh status as of 1 Nov is now available at: http://ruc.noaa.gov/rr/RR-TR-Oct07.pdf An EVEN BETTER summary is included in the RUC Rapid Refresh update presentation at the NCEP model review on 11-12 Dec 2007 -- http://www.emc.ncep.noaa.gov/research/NCEP-EMCModelReview2007/RUC-NCEP-OperReview-Dec07-RRb.pdf

The 6-h cycle running on the full RR domain, as well as a similarly configured 3-h cycle on a smaller CONUS domain, continue to run on GSD's wJET computer. (The latter cycle was recently discontinued to make room for the1-hourly cycling testing discussed under subtask 1.) Graphical and image output from both these real-time cycles is available off the RR home page (the 13-km-Rapid-Refresh and 13-km CONUS links left side of page). Additional fields can be viewed using the RUC grib viewer also linked off this page. The cold-start version of the WRF-ARW, with the diabatic digital filter initialization (DDFI, reported on last quarter) also continues to run over the large RR domain every 12-h, but will likely be discontinued in the near future to make room for more frequent cycling (also using the DDFI) on the full RR domain. Rawinsonde verification of all these real-time RR forecasts was introduced in October and continues.

NCEP
A focused effort will continue in FY 2008 to configure the WRF model and the Gridpoint Statistical Interpolation (GSI) analysis for the Rapid Refresh (RR) replacing the RUC assimilation/model system. The transition from the RUC to the RR will be evolutionary, not revolutionary, by using model physics and assimilation techniques in the RR similar to those in the RUC that have proven beneficial to aviation weather forecasting.

PLANNED EFFORTS: Increase the cycling frequency to 1-h.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: DTC, NCEP, NCAR

UPDATES TO SCHEDULE: None.

Subtasks

08.5.4.1 30 December 2007 (GSD, NCEP) COMPLETE
Begin real-time hourly cycling of RR model with GSI over RR domain with availability at GSD of hourly prepBUFR files from NCEP having begun on 12 October 07.

CURRENT WORK: Two real-time RR cycles have run through most of FY08 1Q on the GSD wJET computer, a 6-h cycle on the full Rapid Refresh domain and a 3-h cycle of a smaller testing domain (for direct comparison with the RUC). Recently, we have started running 1-h cycling tests and testing a WRF version with the diabatic digital filter in the 6-h cycle. New work associated with this hourly cycling capability has included: 1) modifying the workflow scripts to separate the boundary condition processing (performed every 6 h) from the analysis forecast cycling (performed hourly), 2) modifying the WRF model to produce hourly output files for ingest by GSI and 3) modifying the observation data stream to use the new NCEP hourly prepBUFR files and to process the hourly radar reflectivity data. To allow for the 1-h cycling runs, we have recently tuned off the CONUS 3-h cycle. The 6-h real-time cycle continues to run.
EMC has provided the satellite bias correction code and testing is underway to add the satellite radiance assimilation into the hourly assimilation. Work toward switching the internal I/O format from netcdf to binary has been put on hold till some wJET MPI2 I/O issues are resolved (final output files will continue to be grib). In early December ESRL scientists travelled to NCEP to discuss use of the satellite data and other assimilation issues with colleagues from EMC.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:

INTERFACE WITH OTHER ORGANIZATIONS: NCEP, NCAR

UPDATES TO SCHEDULE: None

08.5.4.2 1 March 2008 (GSD)
Begin collaborative evaluation with planned NOAA Rapid Refresh users, including AWC, SPC, NWS in Alaska and Puerto Rico. Arrange to have GSD RR grids available to examine and solicit feedback on RR performance.

GSD has made information (domain, map-projection parameters, lat/lon of grid points, terrain elevation, land use, procedures for accessing analysis and forecast grids, probable physics configuration, etc.) available via a Powerpoint file sent to AWC, SPC, the NWS Alaska Region Scientific Services Division and other AWRP RTs that will need to prepare for the RR implementation. NWS Alaska Region and NCEP Aviation Weather Center have both approved the new domain plans. Stan Benjamin will visit with NWS Alaska Region in January for a briefing on Rapid Refresh progress (and TAMDAR impact studies with RUC).

08.5.4.3 1 March 2008 (GSD)
Begin collaborative evaluation of Rapid Refresh with Inflight Icing, Turbulence, National Ceiling/Visibility, and Convective Weather RTs. Arrange to have GSD RR grids available to examine and solicit feedback on RR performance.

GSD has made this information available to these RTs (see subtask 4.2 above) so that they can commence specific code and script preparations for obtaining and processing RR-domain output from GSD.

08.5.4.4 30 May 2008 (GSD, NCAR, NCEP)
Report on status of tactical planning for making RR-WRF code for 2012 in compliance with Earth System Modeling Framework (ESMF) as specified in the Sept 2007 Rapid Refresh MOU between NCEP and GSD.

The design of the digital filter initialization (DFI) code in the WRF-ARW for the Rapid Refresh includes much code

above the level of the particular dynamic core. This design has been accepted as the DFI framework for WRF version 3, scheduled for release in March 2008. This simplifies application of DFI to the NMM dynamic core, possibly a component of the 2012 RR ensemble.

08.5.4.5 Ongoing (GSD)
Further enhancement to WRFpost version for Rapid Refresh application, including modifications for generation of RUC-specific fields.

Plots of analysis and forecast output from the new wJET RR cycles, as well as the cold-start runs, are now being generated for web access on a routine basis. Output from the full-domain and CONUS-domain RR cycles are both available, as well as that from the full-domain cold-start runs (NOTE: the 3-h CONUS cycle was discontinued on 10 Jan 2008 to make run for the hourly cycle, but plots from previous runs are still available on the CONUS-domain web-page). Refinement of the presentation style (e.g., color tables) of these plots has been made to facilitate comparison with output from the various RUC hourly cycles running at GSD and NCEP. Recently, visibility, ceiling, and cloud-top height plots have been added for the RR cycled runs and have proven helpful in evaluating the cloud analysis performance (see tasks 08.5.5 and 08.5.15).

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

The availability of the web displays noted above is now facilitating this evaluation. This enabled recognition that skin temperature was being initialized to 271K in areas of sea ice coverage by the module that sets the initial fields in WRF. A fix to this problem has been proposed by GSD to the NCAR WRF developers and was implemented into the GSD RR runs in December.

Deliverables

08.5.4.E1 30 Aug 2008 (GSD)
Have available for delivery to NCEP initial 'experimental level' WRF Rapid Refresh code for start of EMC testing toward 2009 Rapid Refresh implementation.

Task 08.5.5: Develop, test, and implement improvements to the operational WRF 3DVARs for Rapid Refresh and North American Mesoscale runs.

NCEP

Details on upcoming NCEP/EMC plans for mesoscale modeling are available from Geoff DiMego's presentation on 11 Dec 07 at the NCEP Production Suite Review:
http://www.emc.ncep.noaa.gov/research/NCEP-EMCModelReview2007/EMC-MMB-ProdSuiteRev.Dec07.pdf .

GSD
Subtasks

08.5.5.1 31 December 2007 (GSD and CAPS) COMPLETE
Progress report on testing and evaluation of the generalized cloud/hydrometeor assimilation (including GOES cloud-top data and METAR cloud/visibility/weather data) within a cycled GSI on the full Rapid-Refresh domain.

Ming Hu's work to fully incorporate the updated and parallelized cloud analysis into the latest version of GSI that is being used for the cycling Rapid Refresh runs is complete. Real-time cycled runs with the cloud analysis are ongoing on the GSD wJET computer Analysis of results is ongoing and has revealed issues that have been corrected. Recently, visibility, ceiling, and cloud-top height plots have been added for the RR cycled runs and have proven helpful in the evaluation of the cloud analysis performance. A progress report on the cloud analysis has been prepared for submission at the AMS ARAM conference and will be placed at:

http://ruc.noaa.gov/GSI_cloud_analysis_report.pdf

08.5.5.2 31 December 2007 (NCEP and GSD)
Report on testing of 2DVAR GSI assimilation of high spatial and temporal mesonet surface data using analysis grids with 5-km or finer resolution.

A new forward model to use the wind direction was introduced and tested in an effort to use the directional information of the low speed biased MESONET wind data. The tests showed that the solutions were unbounded if the wind directions were assimilated without the wind speeds. It was also shown that adjusting the U/V observations proportionally, to maintain the first guess wind speed while fitting the observational wind direction, produced better 3dvar convergence than using the direction and the speed separately. Using the adjusted U and V components also produced positive impact to the NDAS system while using the direction and speed produced negative impact. (Wu)

08.5.5.3 31 January 2008 (NCEP and CAPS)
Further refine the radial velocity analysis component of GSI in response to model resolution changes. Examine data impact at higher assimilation frequencies and higher spatial resolutions. Consider issues on data quality, super-obbing, and optimal decorrelation scales.

All codes related radar radial wind assimilation in GSI were examined and tested, since the analyzed radial wind can be directly compared with radar wind observations at the same observation location once radar data volume ID and scan ID are available in level II BUFR. Shun Liu and Duk-Jin Won also continue to examine the impact of vertical velocity as a control variable and/or a diagnostic variable from the vertical velocity equation in GSI to improve the assimilation of Level II 88-D radial wind observations. Shun Liu also transferred the codes related to vertical velocity analysis to the new GSI. Following the WRF-NMM model update, Shun Liu also updated his scripts to use the IJK version of WRF-NMM model and corresponding WRF-post to examine the impact of radar data on forecasts. (Liu)

08.5.5.4 28 February 2008 (GSD)
Report on statistical evaluation of Rapid Refresh forecasts initialized with the GSI, including examination of upper-level winds, surface fields, and precipitation.

Radiosonde verification of the cold start and cycled RR runs was added during Quarter 1 and indicates reasonable agreement of model forecasts with observations. Detailed statistical evaluation awaits improved reliability of the hourly cycle and the full satellite assimilation.

08.5.5.5 31 July 2008 (NCEP)
Based on case-study testing and refinement of the research quality code, deliver result in an 'experimental' code for an upgrade package (e.g. improved use of WSR-88D data and satellite radiances and covariances) to the WRF-GSI for FY2009 change package to the NAM-WRF.
Manuel Pondeca has developed a module that computes ensemble-based background error covariances in the GSI. The module is undergoing testing by Yoshiaki Sato, a visiting scientist from JMA. Preliminary forecast scores from cycling experiments that used the global and regional ensemble to define the GSI background error covariances have shown promise. Manuel Pondeca also reports that he has developed the Lanczos-based estimation of the analysis error covariance matrix for the GSI. The method has already been implemented in the GSI-2DVar, which is used with the Real Time Mesoscale Analysis, and is being tested for the global GSI. (Pondeca)

Deliverables

08.5.5.E1 30 March 2008 (NCEP)
Subject to NCEP Director approval implement upgrades to WRF-GSI used in NAM/NDAS.

CURRENT EFFORTS: An impact study showed that by using larger horizontal diffusion in the forecast model

during data assimilation the NDAS system could be improved. A low resolution NAM/NDAS system was used to evaluate and redesign the strategy for NDAS, including optimally incorporating the global flow development in the GFS into the regional system. The impact of partial cycle with a cold start from the GFS at the beginning of each 12-hour cycling and downscaling with the GFS first guess and a regional analysis to produce the initial conditions for the free forecasts were tested. For reference a third experiment with the GFS analysis interpolated to the regional grid as initial condition to the free forecast is also being tested. The latest GSI changes including code update, new observations and new background error statistics are tested in the mesoscale parallel. The package is expected to be implemented in February 2008. (Wu)

The GSI tangent linear normal mode constraint (TLNMC, formerly known as strong constraint) has been very successful in the global data assimilation system (GDAS) and was a primary factor in replacing the SSI with GSI on May 1, 2007. Unfortunately, this has not been the case for the regional version of TLNMC. Performance is improved for single analyses, but degrades over time when used in cycling mode in the RDAS. This appears to be related to large scale errors, which are now known to exist in the operational RDAS and are further increased by the addition of TLNMC. An intensive effort has been started to combine the global and regional TLNMC, by spectral decomposition of the regional state into large and small scale parts and applying global TLNMC to the large scale and regional TLNMC to the small scale, blending the results.

PLANNED EFFORTS: Test the impact of using the aircraft observations, new Quikscat winds and JMA satellite motion winds. Complete the effort to combine the global and regional TLNMCs (strong constraint) in the GSI. (Wu, Parrish)

08.5.5.E2 30 August 2008 (GSD)
Rapid Refresh code delivery date to NCEP/EMC for initial testing of RR version of GSI.

08.5.5.E3 30 September 2008 (NCEP and CAPS)
Deliver enhancement package for radial velocity data analysis for further implementation testing.

CURRENT EFFORTS: Shun Liu tested the updated radar quality control (QC) and reflectivity mosaic package in parallel. An MPI-version of decoding code for reflectivity mosaic product was developed and run in parallel for GSD. Reflectivity mosaic products are generated hourly for RUC parallel experiments. He is also working with NCO to build a new radar data decoding and QC package so that the package can easily handle both current Level II data and the upcoming super-resolution Level II data. Radar data volume ID and scan ID information are being added to BUFR decoder. The ingest codes and GSI codes were modified to use them. After this update, the radar volume scan can be reconstructed using Level II BUFR. (Liu)

PLANNED EFFORTS: Shun Liu will use a new set of scripts that use real-time data from operational data flow in his small test domain to further examine the impact of radar radial wind on forecast and analysis. After mesoscale retrospective system becomes available, Shun Liu will examine the performance of the latest improvements in radar radial wind assimilation in full NAM domain with this system. (Liu)

Task 08.5.6 <u>Develop, test, and evaluate the performance of the nonhydrostatic Weather Research and Forecasting (WRF) modeling system.</u>

NCAR/MMM

Incorporate physics improvements into the WRF software infrastructure - 30 September 2008 (NCAR/MMM)

CURRENT EFFORTS: In November NCAR issued WRF minor release 2.2.1. This provided various bug-fixes to V2.2 addressing model physics and numerics (discussed in previous report). NCAR is working on the preparation of the next major release, WRF V3.0, targeted for Spring 2008.

The YSU PBL scheme was modified with changes from its developer, Songyou Hong (Yonsei Univ.), to allow for more mixing in stable, windy conditions. This addressed a problem seen in the scheme's scalar transports at night. The YSU PBL scheme was also modified to yield better round-off accuracy in its vertical mixing.

The WSM6 microphysics scheme was adapted to use a new method for the fall speeds of snow and graupel. The technique combines the fall speeds of snow and graupel in a grid box to simulate the properties of partially-rimed particles.

Several small bugfixes were made to the diffusion module based on user comments. Work continues on another problem related to use of the scheme with vertical layers much smaller than the horizontal grid-size over complex terrain; a potential solution is being evaluated.

The new Morrison 2-moment microphysics scheme was implemented in WRF. And, a new Rayleigh w-damping upper boundary condition was finished. A capability to update sea ice with input data in long model runs (e.g., regional climate simulations) was also added to WRF. All of this code has been added to the repository and will be released in V3.0.

Jim Dudhia and Mukul Tewari (NCAR) addressed a problem found at NCEP in snow evaporation modifications implemented in 2007 in the Unified Noah LSM. With graupel/snow on the ground in warm conditions, unrealistic surface temperatures were found possible. The snow evaporation was modified to account properly for warm conditions.

From work of Cindy Bruyere and Dave Gill of NCAR/MMM, a new observational analysis program, compatible with WPS, has been developed. The new program is Obsgrid, and it parallels the MM5's Little-r capability. Obsgrid will initially be released to limited users.

Dudhia worked with Guenther Zaengl (University of Munich) on implementing a generalized vertical coordinate, on modifications to stabilize and improve diffusion, and on modifications to allow for terrain slope and shadowing in the solar radiation scheme. Dudhia also worked with Veniamin Perov (SMHI, Sweden) on implementing a new PBL option into WRF, the QNSE PBL scheme.

PLANNED EFFORTS: Work will continue at NCAR through this fiscal year on model physics capabilities and improvements. WRF V3.0 is planned for release in Spring 2008.

Subtasks

08.5.6.1 15 May 2008 (NCEP)
Commit to WRF Repository the changes embodied in operational WRF codes used in NAM upgrade package of March 2008.

08.5.6.3 30 July 2008 (NCEP)
Maintain and further develop WRF Preprocessing System (WPS) and Land-Surface Model static fields, including updates to all documentation, in response to community requirements.

08.5.6.5 1 September 2008 (NCEP)
Maintain and further develop WRF Post-processing system including necessary RUC capabilities and updates to all documentation, in response to community requirements.

08.5.6.6 30 June 2008 (NCAR/MMM and DTC)
Deliver a WRF Users' Workshop and a tutorial on the ARW core (NCAR) and a tutorial on the NMM core (DTC) for the user community.

Deliverables

08.5.6.E1 30 June 2008 (NCAR/MMM and DTC)
Deliver a WRF Users' Workshop and a tutorial on the ARW core (NCAR) and a tutorial on the NMM core (DTC) for the user community.

CURRENT EFFORTS: NCAR/MMM is working on the next WRF tutorial, scheduled for January 14-18, 2008. This will be produced with the DTC, with both the ARW and NMM cores covered. The tutorial will include lectures on the WRF system and WRF-Var, as well as practice sessions. The class limit of 60 people has been reached in the registration.

NCAR has begun planning the 9th WRF Users' Workshop. This will be held in Boulder (NCAR Center Green facility) on June 23-27, 2008.

PLANNED EFFORTS: The first WRF tutorial in FY08 will be in January 2008.
The WRF users' workshop will be in June 2008.

08.5.6.E2 30 September 2008 (NCAR/MMM)
Incorporate physics improvements from the user community, GSD, and NCEP into the WRF software infrastructure for use in the Rapid Refresh model. Perform code testing to permit implementation into WRF repository. In collaboration with GSD, assist in the evaluation of those physics schemes for the RR that may be tested using the ARW.

Task 08.5.8: Improve physics in the WRF model, especially that bearing on prediction of aircraft icing.

GSD

The planned 2008 RUC change bundle now in parallel testing at NCEP (see Task 08.5.1) includes replacement of the current Dudhia long-wave radiation scheme with the RRTM and incorporates changes in the Grell-Devenyi convection scheme. Both these changes are discussed in the FY07Q4 report. Revisions to the RUC LSM (discussed in FY07Q2 report) are also part of this change bundle. In comparisons with the oper RUC13, this change bundle has shown substantially improved Equitable Threat Scores and bias at all forecast times and for most precipitation amounts. Particularly for the 0-6h period, much of this improvement can be attributed to the hydrometeor assimilation. Nevertheless, the convective scheme is also contributing to this improvement. GSD continues to evaluate real-time performance of this scheme in both WRF and RUC, and further modifications are possible. See slide 40 in http://ruc.noaa.gov/ruc13_docs/RUC-upgrade-early08.pdf for RUC precipitation verification statistics for old and new versions.

Subtasks

All Option A unless noted otherwise.

08.5.8.1 31 Dec 2007 (GSD)

Begin systematic GSD evaluation of physics performance in GSD 1-hour RR cycle and address issues that arise in preparation for 2009 RR implementation. Particular attention will be given to microphysics and interactions between microphysics and the other parameterized physical processes.

Initial qualitative and quantitative evaluation of the RR cycled runs has begun, revealing specific issues that are being addressed, including a fix for the update of Arctic ocean sea-ice. This evaluation will continue as the RR cycle is further refined.

08.5.8.2 15 May 2008 (NCEP)
Development efforts produce a 'research quality' code of physics upgrades for consideration in the 2009 NAM-WRF change package.

08.5.8.3 1 July 2008 (NCAR)
Expand the current one moment microphysical scheme to two moments and add a variable for aerosol particles in order to improve forecasts of freezing drizzle and icing. Computer storage and run time considerations will be

considered as a constraint on the development.

Observational cases in support of the above task continue to be developed. A critical part of the task is to 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 task is critical for 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.

08.5.8.4 15 July 2008 (NCEP)
Based on case-study testing and refinement of the research quality code, deliver an "experimental" code of physics upgrades for the 2009 NAM-WRF change package.

08.5.8.5 31 Mar 2008 (DTC, GSD)
Report on GSD-DTC RR retrospective testing of land-surface model formulations for snow, and, as appropriate, other physics.

GSD is conducting tests of the effect of changes in the configuration of the WRF model layers on the behavior of the RUC LSM. Originally our RR WRF runs discussed under Task 4, above, used sigma-layer thicknesses of 0.003, 0.006 and 0.009, for layers 1, 2 and 3, respectively, above ground. This put the midpoint of the bottom sigma layer about 12-13m AGL instead of the 5-m lowest level in the RUC. This larger value has implications for the surface energy budget in the RUC LSM, since the surface energy budget is for the mass of atmosphere between the ground surface and half-way up to the midpoint of the bottom sigma layer (i.e, for the mass in the lowest ¼ of this bottom sigma layer), together with the mass of soil between the ground surface and half-way down to the first computational level in the soil. When we reduced the thickness of the bottom layer to 0.001 in sigma in our cold-start RR runs (with appropriate adjustments in the first several layers above, but keeping the total number of layers unchanged at 50), we got increased noise in the atmospheric part of the model and on one occasion the model crashed. For over a month now we have been testing with a thickness of 0.002 for the lowest layer--and with appropriate adjustments for the next 3 layers above—this has noise only slightly larger than with the original lowest-layer thickness of 0.003, and has run stably.

INTERACTIONS: GSD discussions with NCEP/EMC on 10 Dec 2007 on LSM issues.

08.5.8.6 1 August 2009 (GSD)
(NOTE: Gloria, Warren, this date should be Aug 2009.)
Begin to explore possibilities for enhancing treatment of sea ice and tundra (including spring- time pooling) in Rapid Refresh domain.

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 continued to analyze data from Cleveland stratocumulus cases. The data from these cases will be regarded as truth datasets to improve the simulation of stratocumulus icing in the bulk scheme, including possible modifications to the PBL scheme.

08.5.8.7 1 September 2008 (NCAR) Option B
Upgrade the microphysics and boundary layer scheme to appropriately simulate freezing drizzle and icing in stratocumulus clouds.

08.5.8.8 30 September 2008 (NCAR) Option C

Implement the above upgrades into the WRF model and test on IMPROVE, AIRS-II and stratocumulus case studies. The evaluation will include supercooled liquid water, freezing drizzle, as well as snowfall rate and precipitation type and ceiling and visibility.

NCAR
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.

Deliverables

08.5.8.E1 30 March 2008 (NCEP)
Subject to NCEP Director approval, the physics upgrades become Operational at NCEP as part of the 2008 change package for WRF-NMM. (Will supplement physics progress toward Rapid Refresh.)

08.5.8.E2 30 Aug 2008 (GSD, NCEP)
Have available for delivery to NCEP initial 'experimental level' WRF Rapid Refresh code, including physics routines, for start of EMC testing toward 2009 Rapid Refresh implementation.

08.5.8.E3 30 September 2008 (NCAR)
Provide an improved microphysics scheme to GSD for evaluation in WRF Rapid Refresh.

07.5.8.E4 30 September 2007 (NCAR)
Report on the stratocumulus task given above.

The final report on this task was delivered on September 27, 2007.

Task 08.5.15: Develop improved methods of cloud and moisture analysis for use in the WRF Modeling System.

Subtasks

08.5.15.1 31 October 2007 (NCEP)
Based on parallel testing and refinement of the experimental code, deliver the 'pre- implementation' code to NCO including improved diabatic initialization (e.g. nudging to analyzed precipitation and GOES cloud-top) for the March 2008 NAM change package.

08.5.15.2 30 Jan 2008 (GSD)
Develop and evaluate performance of diabatic digital filter initialization (DDFI) in the RR WRF model without use of radar data

CURRENT WORK: As noted in the MDE FY07Q4 report under task 4, WRF model code has been successfully modified to allow backward-forward diabatic digital filter initialization in the WRF-ARW. The GSD design of the DDFI was intended to impact the core-dependent parts of the WRF code as little as possible. 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 and modifications to mediation-level code, in addition to the DFI code itself, 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, has been functioning well in the 13-km RR cold start runs at GSD for over 2 months. The DDFI demonstrably reduces noise by over 50%, as measured by the time-step to time-step change in surface pressure, over simply starting the model with the initial state as it comes out of WPS without the DDFI. We will soon switch the cycled runs over to the DDFI version of the ARW model (Task 4). Some further tuning of the DDFI is anticipated to optimize its effectiveness, once more frequent cycling over the RR domain using WRF-ARW begins.

08.5.15.3 30 March 2008 (GSD and CAPS)
Further refine the generalized cloud analysis for the target RR resolution, model physics scheme and use of additional data. Perform forecast test evaluations to document the impact of the cloud analysis refinements.

Within the RUC, several enhancements have been made to more fully use METAR cloud information leading to a much improved analysis of ceiling (see Task 1). These code changes are being transferred to the updated cloud analysis being incorporated into the latest version of GSI being used for the RR cycled runs.

Work has been completed by Ming Hu to add lightning data (NLDN and BLM data from Alaska) to the generalized cloud analysis within GSI. Work is ongoing to evaluate the forecast impact for a case study (10 July 2007).

During this quarter, two versions (from NCEP and GSD) of the GSI code were ported to OU's Linux supercomputer. A significant account of efforts at CAPS were spent on resolving a code crash problem of GSI versions and testing their correctness on OU's Linux cluster. Subsequently, forecast experiments were performed to test the impact of the cloud analysis by using the GSD version-based GSI with the 13 March 2006 case. A set of semi-empirical parameters in the generalized cloud analysis was investigated for the WRF-ARW forecasts. Compared with the reflectivity mosaic data, the initial 3-hr forecasting results show a positive impact of adding the cloud analysis.

Special attention was paid to the analysis of cloud water and cloud ice in stratiform v.s. convective conditions. Originally, the option is to either use the ARPS-based deep-convection-oriented cloud analysis scheme or the RUC-based stratiform-tuned scheme. For the 13 March case, the squall line forecast is somewhat better using the convective scheme. Effects are being made to merge the ARPS and RUC-based codes at the lower level so that the decisions to use stratiform versus convective treatments are made locally on the analysis grid. The first step in the scheme is to perform the partition of convective and stratiform. Currently, the code is mostly completed and initial tests with several cases show the partition is effective. However, misclassification occurs in some conditions such as the developing stages of convective cells. Further improvement and more tests will be needed.

The CAPS received $70,000 FY2007 funds in August 2007. In this quarter, about $15000 (loaded) was spent on salary, with $45,420.0 remaining.

FUTURE EFFORTS:
Testing of GSI cloud analysis in RR testing, revision of GSI cloud analysis with updates to RUC cloud analysis as reported under 08.5.1.

08.5.15.4 30 May 2008 (NCEP)
Based on development efforts, deliver 'research quality' diabatic initialization upgrades (e.g. initial use of Level II reflectivity) for consideration in the March 2009 change package for NAM.

08.5.15.5 30 Mar 2008 (GSD)
Include radar reflectivity-based latent heating within diabatic digital filter initialization (DDFI) in the RR WRF model.

CURRENT WORK: The DDFI without radar-reflectivity-based latent heating is now included in the GSD's 13-km cold start WRF-RR runs and the cycled RR runs will soon be switched to the DDFI version of the ARW (see Task 4, above). This is a necessary step in preparation for upcoming work to complete this subtask.

08.5.15.6 30 July 2008 (NCEP)
Based on case-study testing and refinement of the research quality code, an 'experimental' WRF code is delivered with diabatic initialization upgrades (e.g. initial use of Level II reflectivity) for the March 2008 change package for NAM.

Deliverables

08.5.15.E1 30 March 2008 (NCEP)
Subject to NCEP Director approval, the WRF-NMM code with upgraded diabatic initialization capability (e.g. nudging to analyzed precipitation and GOES cloud-top) becomes Operational at NCEP as part of the March 2008 change package to NAM.

08.5.15.E2 30 Aug 2008 (GSD)
Complete testing of GSI generalized cloud analysis for Rapid Refresh and deliver code to NCEP as part of Rapid Refresh package delivered to EMC, pending availability of NCEP testing capability.

Task 08.5.17: Infrastructure Support for operational running of WRF-based modeling system in North American Mesoscale and HiRes Window at NCEP.

NCEP

Dennis Keyser reports that on 16 November, a CRISIS change turned off the assimilation of NOAA-18 AMSU-A channel 9 in the NAM-GSI due to a sudden increase in the noise for both space and warm counts. Surface marine (ship, buoy, C-MAN, tide gauge) data has not had the benefit of NCEP/OPC interactive quality control since 18 June due to a file permission problem that was discovered in late October and corrected on 2 November. NCEP is in the process of switching its processing to high-resolution BUFR JMA winds, following a period of testing. This should be completed 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 radiances over water (replacing current 5x5 field-of-view GOES-12 radiances), AIRS every f-o-v radiances, QuikSCAT 0.5 deg. scatterometer wind superobs, mesonet winds filtered by provider via NOAA/GSD's "uselist", and MODIS IR and water vapor satellite winds. In early December, the NAM GSI will start using dropwindsonde moisture from NOAA (P-3 and Gulf Stream) and USAF aircraft, and aircraft turbulence and icing data will be available for verification. Efforts to speed up the dump processing of NEXRAD Level II data are being explored.

Eric Rogers has submitted all JIFs to NCO for the upcoming NAM bundle and continues to run a pair of real-time parallels. He has constructed the retrospective parallel system that will run over the 2007 summer period mid-July through mid-August. The Technical Information Notice (TIN) for this bundle has been written, authorized and disseminated 6 December 2007 http://www.nws.noaa.gov/om/notif.htm .

Subtasks

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

08.5.17.2 (NCEP)
Maintain four-per-day HiResWindow runs and provide SAV and AIV guidance.
NCEP maintains 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)

08.5.17.3 (NCEP)
Provide vendors with gridded 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)

08.5.17.4 (NCEP)
Provide full grids from NAM, and HiResWindow 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)

08.5.17.4 (NCEP)
Maintain access to model verification data.

OPTION D ONLY
08.5.17.5 (NCEP)
Provide assistance to Inflight Icing, Turbulence, Convective Weather, Ceiling and Visibility and Oceanic Weather PDTs when their algorithms and product generation systems are ready to transition into NCEP's operational Production suite.

08.5.17.6 Provide assistance to Inflight Icing, Turbulence, Convective Weather, Ceiling and Visibility and Oceanic Weather PDTs when their algorithms and product generation systems are ready to transition into NCEP's operational Production suite.

Deliverables

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

CURRENT EFFORTS: On 02 October ARINC corrected their BUFR encoding of MDCRS-ACARS mixing ratio, and moisture statistics generated by NCEP have shown much better agreement with the guess since then. A study completed in October showed that the 13 August increase in the number of satellite ingest jobs run each day has indeed provided more of these data for the early-cutoff NAM dumps. As of 16 October, all NAM observational data are now processed within the expanded NAM domain, using a mask developed by Eric Rogers that allows only observations within the exact domain to be selected. This change is in preparation for the FY08/Q2 NAM-GSI update. In early October, a new source of Automatic Dependent Surveillance (ADS) aircraft reports was added to the AIREP aircraft data assimilated by the GSI. In late October, a key Alaskan radiosonde (Shemya, 70414) became available to the early-cutoff NAM GSI after its launch time was changed at the request of NCEP and NWS Alaska Region. Surface marine (ship, buoy, C-MAN, tide gauge) data did not have NCEP/OPC interactive QC from 18 June until 2 November due to a file permission problem. There was a 12-hour outage of GOES sounding and wind data on 3 October due to a DNS issue on the NCEP CCS. On 16 November, a CRISIS change turned off the assimilation of NOAA-18 AMSU-A channel 9 in the NAM-GSI due to a sudden noise increase for both space and warm counts. In response to a joint request from NOAA's Office of International Affairs and the WMO that certain ship call signs be restricted to internal NWS use, a change to restrict all unmasked ship reports in the NCEP surface ship dump and PREPBUFR files was implemented on 3 December. At the same time, NCEP began providing unrestricted ship reports to outside users in special files where the report id is masked. A PREPBUFR bundle implementation on 4 December added moisture from NOAA and USAF dropwinsondes (now used by the GSI), MODIS IR and water vapor satellite winds and QuikSCAT 0.5 degree scatterometer wind superobs (all being monitored by the GSI and tested in parallel for the FY08/Q2 NAM-GSI update), TAMDAR (ERSL MADIS feed) and Canadian AMDAR aircraft data (for GSI monitoring and testing after the FY08/Q2 NAM-GSI update), aircraft layer turbulence and icing for verification, and satellite wind quality indices. In addition, JMA IR and visible satellite winds on the edge of the expanded NAM domain now come from JMA's high-density BUFR feed, replacing their low-density SATOB feed which will be discontinued in 2008. GOES-10 replaced GOES-12 as the east satellite from 5 to 17 December while an attitude anomaly in GOES-12 was corrected. During this period, only GOES-11 5x5 field-of-view layer precipitable water and 1x1 field-of-view cloud-top pressure was assimilated, but GOES-10 IR and water vapor winds were assimilated in place of those from GOES-12. There was a complete outage of GOES-10 and -11 satellite winds on 6 December due to a problem with the NESDIS data files. Parallel testing of the following new

data types is currently underway for the Q2 NAM-GSI update: GOES-11 and -12 single field-of-view radiances over water (replacing the current 5x5 GOES-12 radiances), AIRS every field-of-view radiances, and mesonet winds filtered by provider via GSD's "uselist". Efforts to speed up the dump processing of NEXRAD Level II data are being explored. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ERSL MADIS feed. (Keyser)

PLANNED EFFORTS: Add a new aircraft quality control module based on code from Naval Research Lab. Increase time window for aircraft data to improve track checking. 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 tags, mesonet providers and sub-providers, radiosonde instrument type and on-site correction indicators). Complete impact tests in NAM for several new data types: TAMDAR (direct from AirDAT vs. current ERSL 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 (eventually using "new science" QuikSCAT); mesonet mass, wind and roadway data, and new mesonet data feeds (including "hydro", "snow", modernized COOP and UrbaNet); MODIS IR and water vapor satellite winds; 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 mesonet data from sources other than ERSL MADIS (e.g., LDAD and/or MesoWest). Add a new QC module for WSR88-D NEXRAD Level II radar reflectivity. Coordinate with the field to speed up Alaskan RAOB processing so that they arrive in time for the NAM dumps. Attempt to retrieve as much data as possible over Alaska (especially mesonet, aircraft and coastal surface). Add GSI events to the NAM PREPBUFR files. In the GSI, make use of the actual or estimated anemometer, barometer and thermometer heights on ships. Generate and QC high vertical-resolution aircraft profile data near airports. (Keyser)

08.5.17.E2 (NCEP).
As requested by other PDTs, incorporate new AIV calculations into Operational WRF Model post-processor and product generator

Task 08.5.19: Develop ability to assimilate WSR-88D radial velocity and reflectivity data through GSI and Rapid Refresh toward High-Resolution Rapid Refresh.

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Subtasks

OPTION B.

08.5.19.1 30 November 2007 (GSD, NCAR/RAL, CAPS)
Select initial case studies from summer 2007 for 3-km HRRR data assimilation case studies.

08.5.19.2 28 Feb 2008 (GSD)
Develop and test 3-km version of radar-reflectivity-based diabatic digital filter initialization (DDFI) and perform initial tests on cases. Revise during FY09 based on GSD tests and associated testing to be performed by NCAR/RAL.

08.5.19.3 30 March 2008 (NCAR/RAL)
Provide wind/temperature/moisture profiles for HRRR case studies using VDRAS for case studies. Provide these profiles to CAPS for GSI data assimilation experiments for 3-km HRRR.

08.5.19.4 30 June 2008 (NCAR/RAL)
Complete case study tests using radar-DDFI-enhanced WRF-HRRR model at 3-km. Report on effect on 0-3h forecasts using 3-km radar-DDFI assimilation.

08.5.19.5 31 August 2008 (CAPS)

Complete 3-km GSI data assimilation experiments for potential application within the HRRR assimilating radial wind and RAL-provided VDRAS profiles. Evaluate impact using 3-km HRRR-WRF model configuration as used by GSD.

08.5.19.6 January 2008 (NCEP)
Prepare for the expected doubling of Level II data volume due to the modified and additional VCP strategies.

08.5.19.7 15 July 2008 (NCEP)
Report on progress towards incorporating Level II reflectivity through the GSI analysis into the WRF model runs.

Deliverables

OPTION B.
08.5.19.E1 31 August 2008 (GSD, CAPS, NCAR, MIT/LL)
Report on radar assimilation results for HRRR from summer 2008 test under the lead of GSD with contributions from each organization.

08.5.19.E2 30 March 2008 (NCEP)
Subject to NCEP Director approval, implement upgrade package to WRF-GSI (e.g. improved use of Level II radial velocity) in the NAM and NDAS runs.

Task 08.5.20: Develop ensemble-based probabilistic products for aviation users.

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