MODEL DEVELOPMENT AND ENHANCEMENT
PRODUCT DEVELOPMENT TEAM
Monthly Report for January 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 of changes planned for summer RUC change package -- RUC analysis (including mesonet winds, radar reflectivity) and model changes running in real-time devRUC13.

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

- Real-time WRF-RR 12-h cycle now running on full North American domain and CONUS domain (GSD)

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

- Testing at NCEP with assimilation of WVSS-II aircraft humidity observations
- Testing at GSD with assimilation of mesonet winds with new mesonet provider uselist.

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

- Successful tests of radar-reflectivity assimilation into the RUC: Real-time cycled tests of radar-based latent heat nudging in RUC diabatic digital filter initialization.
- Retrospective cycled tests of combined RUC/ARPS cloud analysis (assimilating METAR cloud and GOES-cloudtop data) within GSI-WRF framework.

Detailed report – MDE – July FY06

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

NCEP

Dennis Keyser reports that Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ESRL MADIS feed. On 8-9 January, NESDIS made an unscheduled change in its GOES satellite wind processing which led to corrupted BUFR files and no data availability. The Colorado Avalanche Information Center (CAIC) was added to the sources of Mesonet data assimilated by the RUC on 11 January.

GSD

GSD continued to monitor real-time RUC performance among the operational NCEP version and 4 different experimental GSD versions, via daily inspection of verification and real-time graphic products (http://ruc.noaa.gov) and verification using observations from rawinsondes, surface stations, GPS precipitable water, and precipitation. A new verification capability has been developed by Bill Moninger to verify RUC (and other) models against rawinsondes at 10-mb intervals instead of the usual mandatory-level intervals.

Work continues at GSD to test an upcoming RUC analysis/model change package (planned for implementation at NCEP by early summer 2007), currently running in the 13km dev RUC (http://ruc.noaa.gov/pig.cgi?13km_D2). A number of the changes promised in the January report last month are now running in real-time, including:

- Land-surface model changes for improved 2m temperature over snow cover
- Change to Grell-Devenyi convective parameterization with improved (decreased) areal coverage for light convective precipitation (see 07.5.8 on both topics).
- Assimilation of 3-d radar reflectivity via specified latent heating in the RUC diabatic digital filter initialization
- Analysis changes to:
    - Assimilate mesonet winds using a new "mesonet provider uselist"
    - Differentiate wind observation error between GPS rawinsondes and non-GPS rawinsondes
    - Assimilate TAMDAR aircraft observations, if they become available for operational use
- Post-processing changes – new products for radar reflectivity and tropopause theta.

INTERFACE WITH OTHER ORGANIZATIONS:
Discussion between GSD and NCEP/EMC on upcoming RUC changes.

Subtasks

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

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

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

07.5.1.4 Maintain access to model verification data.

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:
Ongoing

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

NCEP

Steve Lord, director of EMC, has drafted a document (Requirements for Maintenance, Enhancement and Transition to Operations for the Rapid Refresh System in the context of the more general document Requirements for Maintenance, Enhancement and Transition to Operations at the NCEP Environmental Modeling Center – see attached at end of this MDE report) to make clear the responsibilities and ramifications of the choice of dynamic core for Rapid Refresh.

GSD

GSD and NCEP have discussed the document described above. Responsibilities for GSD regarding maintenance of the Rapid Refresh will be similar to those with the current RUC model, but with some responsibility taken also by NCAR if the ARW core is selected.

Discussions continue both internally within GSD and with DTC and NCEP on implications of choice of either WRF core for the RR model component. In addition, GSD continues to run and verify WRF forecasts initialized with RUC over the CONUS domain and cycled with GSI over the RR domain; see details below.

PLANNED EFFORTS: NCEP will decide on which dynamical core to use for the RR using recommendation and subsequent discussions from GSD.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS: DTC, NCEP

UPDATES TO SCHEDULE: None.

Subtasks

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

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

CURRENT WORK: The Rapid-Refresh real-time cycle is ongoing on the IJET supercomputer at ERSL. As of 12 February 2007, the new ESRL supercomputer (WJET) is available for use. We have been testing various components of the RR system on WJET and can now complete the full migration to WJET. There have been some issues with GSI on WJET (setting the endian and compiling the libraries) that Dezso Devenyi, Jacques Middlecoff and the computer staff are working to resolve. WJET will give provide increased capacity compared to IJET, so we can improve the cycle frequency from the current 12-h cycle.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: Delayed task is now completed

INTERFACE WITH OTHER ORGANIZATIONS: NCEP

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)

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

CURRENT WORK: The retrospective period chosen is the 10-day period 26 November to 6 December 2006. This period includes a good variety of weather, including a severe snow/ice storm and severe weather on 29-30 November over the Plains and Midwest. This retrospective period is already being used for testing impact of

TAMDAR observations under non-MD&E funding. It will also be available for tests needed for the summer-2007 RUC change package, if needed.

07.5.4.4 15 Nov 2006 (GSD) – Completed 15 Nov 2006.

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

CURRENT WORK: Web-viewing capability became available for real-time RR cycled runs over the CONUS domain in October, and is being extended to cover the full North American domain. Images and graphics from this can be viewed at http://www-frd.fsl.noaa.gov/mab/wrfruc. Objective verification is expected to be available soon.

07.5.4.5 Ongoing (GSD)

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

07.5.4.6 Ongoing (GSD, NCAR later)

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

07.5.4.7 1 Nov 2006 (GSD) - ongoing

Start to solicit input from other PDTs 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: Followup contacts have continued. This has resulted in an invitation from James Partain, Chief of the Alaska Region Scientific Services Division, to discuss RR current development and plans with forecasters and others at the Great Alaska Weather Modeling Symposium in Fairbanks in March.

INTERFACE WITH OTHER ORGANIZATIONS: NWS- Alaska Region

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)
Deliver report to NCEP on progress with WRF Rapid Refresh code toward FY09 Rapid Refresh implementation.

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

NCEP

Wan-Shu Wu worked on using the aircraft (WVSS-II) humidity observations in the NDAS. Besides the cycling impact, she also compared this data with other types of observations. The impact on the short (3-hour) forecasts from using the aircraft humidity is small. When examining the results she noticed that the analysis increments of humidity from the satellite data were of the opposite sign to the aircraft observations. A separate NDAS cycling system was set up to test the impact of reducing the influence of satellite data on the humidity analysis. These results showed that the precipitation spin down after each analysis was decreased by 20% and the first guess fit to the conventional data was improved for all variables. Because of the NCEP CCS upgrade she moved the code and scripts to the new IBM machine and tested various node-task combinations for optimal computational efficiency on the new machine. She also worked with Dennis Keyser to make use of or to monitor all the data currently available

to the operational system.

Dave Parrish reports that the strong constraint, which has been introduced into the GSI for global and regional applications, is undergoing modifications and documentation prior to the next release of the GSI sometime in February 2007. The ability to read WRF-NMM restart files in I,K,J (xzy) or I,J,K (xyz) ordering has been introduced to allow changeover to the faster I,J,K (xyz) version of WRF-NMM.

GSD

GSD has continued its parallel testing on TAMDAR data impact (under non-AWRP funding). Three presentations were made by GSD at the January AMS annual meeting. TAMDAR data is now showing fairly consistent improvement in RH forecasts from 900-400 hPa, especially in the 900-800 hPa and 600-400 hPa layers (see IOAS paper 9.2, Benjamin et al.). It also shows improved lower tropospheric temperature forecasts and a more modest improvement in wind forecasts.

GSD has also developed a capability to monitor wind speed biases stratified by mesonet providers and from this has developed a new mesonet wind provider uselist that will be used in the summer RUC change package and in the NCEP RTMA. (available at http://ruc.noaa.gov/pdf/RUC-mesonet-wind-uselist-14feb07.pdf)

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.

Report was completed 15 October 2006 and is available at http://ruc.noaa.gov/pdf/Verification_RUC_ARPS.pdf (Note that this is a 24Mb document; loading is very slow.)

Collaborative work continues between GSD and Ming Hu of CAPS to combine the ARPS and RUC cloud analysis and further test it within the RR-GSI CONUS environment, using Chris Harrop's workflow manager. Ming Hu has recently completed a 10-h cycled test (00z through 10z) for the 13 March 2006 Midwest severe weather outbreak case (see details in 07.5.15.4 and 07.5.15.E3).

07.5.5.2 Based on parallel testing and refinement of the experimental code, deliver a "pre-implementation" version of WRF-GSI to replace Eta 3DVAR in NAM /NDAS (Oct '06)

07.5.5.3 Report on testing of 2DVAR WRF-GSI assimilation of high spatial and temporal mesonet surface data using analysis grids with 5km resolution and higher. (15 Dec '05)

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.

The super-obbed radial velocity assimilation capability is included in GSI. Initial tests done at CAPS showed positive impact of the radial velocity data on WRF-NMM prediction at the convective scale. CAPS continues to collaborate with NCEP, in particular Shun Liu, in more systematically evaluating the impact of radial velocity data on WRF-NMM forecasts using standard verification scores. Due to the reduction of FY2007 funding, CAPS direct contribution in this area of research will be limited, as the main emphasis will be placed on task 07.5.15E3.

07.5.5.5 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. (15 May '07)

07.5.5.6 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. (Jul '07).

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.

Overall efforts in this area, including work by Dezso Devenyi, Tom Schlatter and Steve Weygandt are summarized in the following report, available at http://ruc.fsl.noaa.gov/pdf/RR-GSI_sfc_assim_dec06.pdf:

Devenyi, D., T. Schlatter, S. Weygandt, and S. Benjamin, 2006: "Assimilation of surface data in the PBL for Rapid Refresh within the GSI analysis system", 11 pp.

Work by Dezso Devenyi continues in this area (using the September 2006 version of GSI) focusing on qualitatively assessing the amplitude control of the filters when inhomogeneity is involved. The work is being done using the anisotropic option in GSI with background fields from RUC (1-h forecasts mapped to WRF grid with SI routines). GSD is collaborating with M. Pondeca and J. Purser (developer of the anisotropic filtering algorithm) at NCEP.

07.5.5.8 15 Feb 2007 (GSD) COMPLETE
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).

Experimental versions of the combined RUC/ARPS cloud analysis and the anisotropic surface observation assimilation have both been included in an experimental version of the GSI and testing and refinement continues. Ming Hu of CAPS has recently completed a 10-h cycled test of the cloud analysis and Dezso Devenyi is doing additional tests with the anisotropic surface observation assimilation. These tests demonstrate that this milestone for this experimental version of GSI is complete, but further development will continue to refine these techniques.

Deliverables

07.5.5E1 30 March 2007 (NCEP)
Subject to NCEP Director approval implement upgrade to WRF-GSI used in NAM/NDAS.

07.5.5E2 15 July 2007 (ESRL)
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).

Work continues on testing and refinement of Rapid-Refresh specific aspects of the GSI package (See 07.5.5.1 and 07.5.5.7) and refinements to real-time test cycles running on ESRL computers (see 07.5.4.1)

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

GSD, in collaboration with NCAR/MMM and NCEP/EMC

WRF v2.2 was completed as reported last month. DTC and GSD will be conducting tests with WRFv2.2 in the near future.

NCAR

NCAR hosted an ARW tutorial on January 22-26, 2007. The attendance was about 60 students, the maximum that could be accommodated. Topics included the WPS, physics, software framework, and WRF-Var, and practicums were offered. This tutorial was an NCAR deliverable.

Dudhia of NCAR improved PBL (planetary boundary layer) vertical mixing of ice clouds in the MRF and GFS PBL options, where previously it had been ignored. In addition, because the cloud tendency from the MYJ PBL scheme was ignored when running Ferrier microphysics, Dudhia addressed the incorporation of Ferrier microphysics-MYJ PBL scheme interactions

in the ARW. (This had already worked in the NMM core.) Also in the ARW, Ferrier microphysics was similarly made to interact with cloud tendencies from the the MRF and YSU PBL schemes.

Dudhia and Klemp (NCAR) finalized work on Rayleigh damping of vertical velocity. This new damper works on the small time-step, so can be very effective. It is also applicable to real-data cases, unlike the existing Rayleigh damper which needs a 1d sounding to damp temperature and momentum.

Dudhia continued work on LES real-data applications in preparation for hi-res WRF hurricane tests on the NCAR supercomputer Blueice. He added moisture flux to the code provided by Bao and Grell of NOAA, to allow for operation with the 3d TKE diffusion option.

Lastly, Dudhia developed a temperature-damping routine to act as a restoring force to a specified 1d sounding, which is sometimes used instead of radiation physics in idealized runs.

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

UPDATES TO SCHEDULE: Possible shift to July with combined ARW/NMM workshop, under discussion.

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

GSD

In addition to the efforts on the Grell-Devenyi scheme discussed below, GSD has also continued to evaluate the real-time performance of a revised version of the Smirnova 2-layer snow model planned for the summer RUC change bundle. This revised scheme avoids excessive nighttime temperatures over snow cover for recently fallen snow. GSD also has conducted new tests of the RRTM longwave radiation scheme to consider it for replacing the Dudhia longwave radiation scheme currently used in the RUC model.

Subtasks

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

CURRENT WORK: Under other-agency funding Georg Grell is leading efforts to improve the ensemble weighting in the Grell-Devenyi ensemble convective scheme so as to improve the prediction of convective precipitation. A particular goal is to reduce excessive areal coverage of light amounts of convective precipitation. We expect the improvements resulting from this work will be tested for inclusion in a RUC change bundle later this year. Performance will also be examined in RR cycles at GSD.

07.5.8.5 30 June 2007 (GSD)
Improve handling of moist processes in candidate PBL scheme for use in the RR-WRF.

As part of his responsibilities with the WRF Physics working group, John Brown is collaborating in evaluation of existing WRF boundary-layer schemes.

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.

An analysis of stratocumulus schemes from the NASA/Glenn in-flight icing project has been identified as a critical component of this task. Evaluation of these schemes has started. Available stratocumulus schemes are being identified for evaluation. Aerosol schemes are also being identified for inclusion in the testing and evaluation.

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.

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

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

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.

CURRENT WORK: GSD continued its development and testing of code for radar reflectivity assimilation into the diabatic digital filter initialization (DFI) within the 13-km RUC model (prototype for WRF-RR DDFI). In the algorithm, latent heating is forced to be consistent with the hydrometeor field from the observed radar data during the forward DDFI step. Encouraging results were obtained for a Jan. 2007 squall-line test case (lower-tropospheric divergent and upper-level divergent wind fields). Based on these results, on 9 Feb. 2007 this code was introduced into a real-time experimental 13-km cycle run at GSD (including pre-processing of the NSSL reflectivity fields, computation of the latent heating field using the RUC cloud analysis, and application of the latent heating derived temperature tendency in the RUC model diabatic DFI). Qualitative assessment of the results from the real-time cycle indicates the radar reflectivity assimilation successfully initializes ongoing precipitation areas that are often missing or displaced otherwise (see Fig. 1 – next page). Especially encouraging is the fact that the radar data are projecting onto both the explicit and parameterized model precipitation processes. Some instances of over specifying precipitation have been noted and sensitivity experiments are continuing to further calibrate the algorithm. In particular, we are examining the sensitivity to: 1) strength of the latent heat temperature tendency, 2) inclusion of hydrometeors in addition to the latent heating, 3) specification of a low-level cold pool, and 4) moistening of the near-storm environment. GSD and NCEP are discussing including this technique in a summer 2007 upgrade to the operational RUC at NCEP and this work will serve as the basis for the inclusion of a similar technique in the WRF-based Rapid Refresh.

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

CURRENT WORK: Collaboration with Ming Hu of CAPS, who has recently conducted a series of cycled experiments (using Chris Harrop's workflow manager) to test the combined RUC/ARPS cloud analysis. See 07.5.15.E3 below for more details.

Deliverables

07.5.15.E2 15 July 2007 (GSD)
Report on progress of GSI cloud analysis code to NCEP to be part of FY08 Rapid Refresh. (see subtask 07.5.5.1. and below)

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.

With the help of Steve Weygandt of GSD, Ming Hu of CAPS conducted 4 experiments with assimilation cycles for the 13 March 2006 central US squall lines case to study the impacts of cloud analysis when used in RUC CONUS environment. The workflow of GSD is used to manage the assimilation cycles, which are from 0000 to 1000 UTC 13 March at 1-h intervals. Within each cycle, 1-h forecast of WRF-ARW is started from either regular GSI analysis with conventional observations (without cloud analysis) or with the inclusion of one of three cloud analysis procedures implemented in GSI. These three procedures are, respectively, based on the RUC, the ARPS cloud analysis packages, and a newly developed package as the combination of RUC and ARPS schemes.

Initial examination on the results indicate that the cloud analysis improves precipitation prediction by reducing spurious precipitation, building up part of the squall line, and enhancing precipitation related to the surface low.

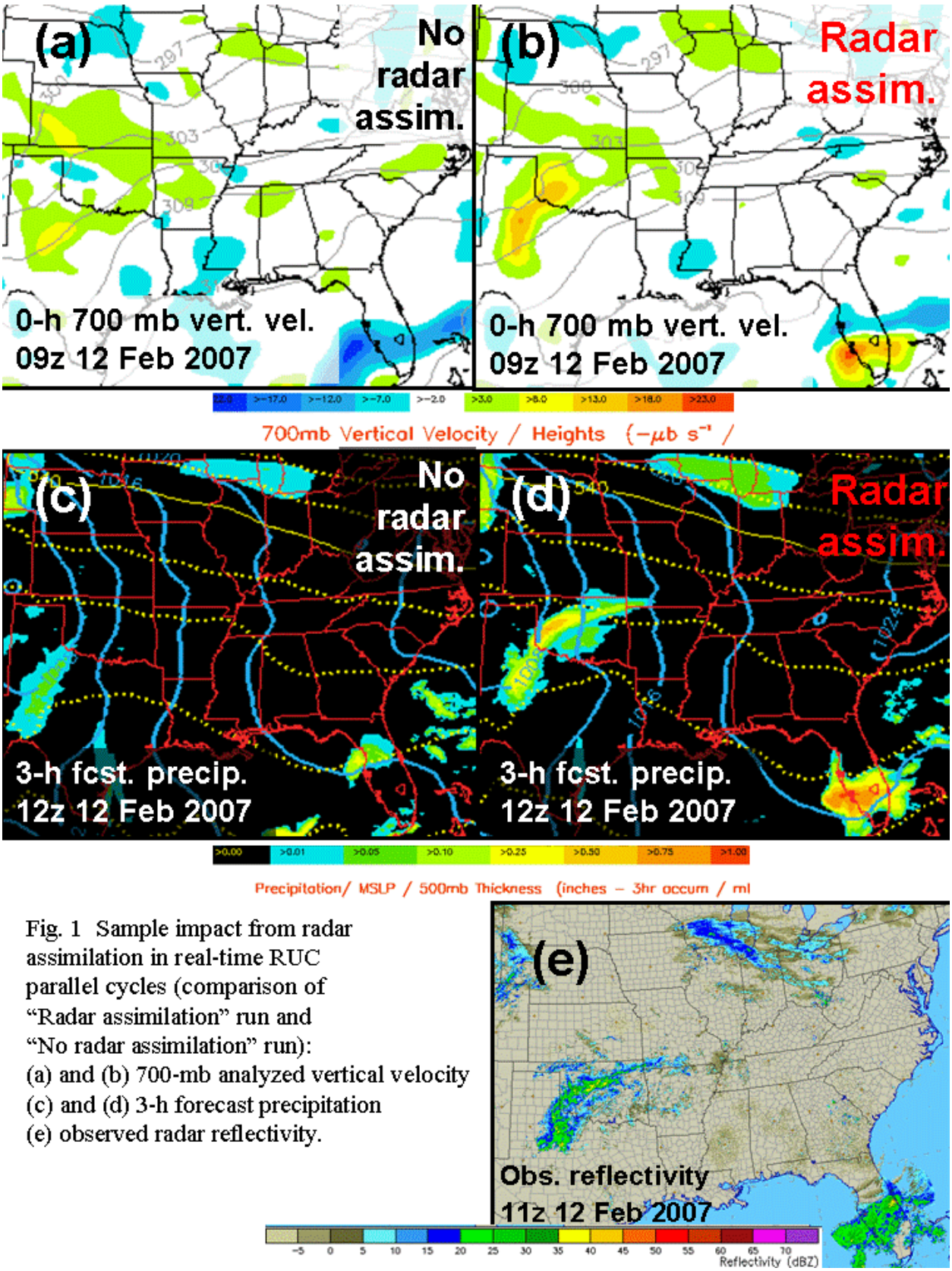

Fig. 1 Sample impact from radar assimilation in real-time RUC parallel cycles (comparison of "Radar assimilation" run and "No radar assimilation" run):
(a) and (b) 700-mb analyzed vertical velocity
(c) and (d) 3-h forecast precipitation
(e) observed radar reflectivity.

Task 07.5.17 Infrastructure support for running operational WRF model in Rapid Refresh, North American Mesoscale and HiResWindow modes at NCEP.

NCEP

Subtasks

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

Dennis Keyser reports that in addition to the work noted in Task 07.5.1 above, a CRISIS change was made on 8 January to correct an array overflow error that resulted in the failure to process Level 3 radial wind data. These data provide a backup to the primary Level 2.5 data. The NEXRAD Level 2 radial wind data have not been processed since late September due to an upstream formatting change. This will hopefully be corrected within the next month.

Eric Rogers reports that due to a significant degradation in data quality, a crisis change was made to turn off the assimilation of NOAA-16 AMSU-A channel 4 satellite radiance data. To minimize any adverse impact from other NOAA-16 AMSU-A products, all of the NOAA-16 AMSU-A data was down-weighted relative to other AMSU-A data from other satellites.

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

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

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 5 km nested runs of the HiResWindow (HRW) suite of WRF-ARW and WRF-NMM runs via anonymous ftp access via the NCEP server sites. 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). NCEP provides anonymous ftp access on ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/. GRIB and BUFR output are sent to the NCEP ftp server (ftp://ftpprd.ncep.noaa.gov/mmb/mmbpll/ in the directories east08.t18z, central08.t12z, west08.t06z and alaska10.t00z). HRW run output remains on the standard 8 km Lambert grids #243-254. NWS FTP Services: Both GRIB1 to GRIB2 data are currently available on the new gateway system (http://tgdata.nws.noaa.gov). To conserve bandwidth, GRIB2 data is being transferred to tgdata and then converted to GRIB1. For that reason, GRIB2 data will be available one to two minutes earlier on average than GRIB1. Both sets of data will remain on the TOC FTP server for a minimum of 180 days after the system is declared operational. (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.

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:
Ongoing.

0.5.17.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:
Ongoing

PLANNED EFFORTS: Refine forward model for simulated reflectivity.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None

INTERFACE WITH OTHER ORGANIZATIONS: GSD & NCO

UPDATES TO SCHEDULE: None

Attachment from Geoff DiMego and Steve Lord, NCEP/EMC –
(referred under 07.5.4)

Requirements for Maintenance, Enhancement and
Transition to Operations for the Rapid Refresh System
23 January 2007

Generic requirements for Maintenance and Enhance (M&E) activities for the WRF Rapid Refresh (RR) system are as in the Attachment.

In the case of the RR with the Advanced Research WRF (ARW), NCEP EMC is not able to perform M&E support for the model or the data assimilation. Therefore, GSD and NCAR must provide this M&E support.

In addition, since NCEP is migrating to an ESMF-based model, data assimilation and product generation infrastructure, which will house all NCEP operational systems except the RR, the organizations supporting the RR must transform the RR to operate in this infrastructure in a consistent manner as the remainder of NCEP's operational systems. A copy of the infrastructure code is available upon request.

Requirements for Maintenance, Enhancement and Transition to
Operations at the NCEP Environmental Modeling Center
DRAFT
21 January 2007

The Environmental Modeling Center (EMC) mission is to enhance and maintain numerical forecast systems in support of national and international forecast requirements and to support transition to operations of new forecast technologies. Execution of EMC's mission covers all operational systems in NCEP Production Suite (PS) for weather, ocean, hydrological, short-term climate, air quality and homeland security prediction. Maintenance and transition to operations activities cover all aspects of data assimilation, model physics, ensemble techniques, post-processing, numerical methods, maximizing computational efficiency and adaptation to new hardware, monitoring performance and fixing bugs and maintaining consistency with changes at NCEP Central Operations.

Transition to operations of new capabilities occurs as a partnership between EMC and external scientists. A rigorous testing program is designed for the transition. Codes must satisfy four major criteria for acceptance into NCEP's PS: IT compatibility, forecast benefits (demonstrated by quantitative performance scores), efficiency and sustainability. Sustainability is synonymous with maintenance and enhancement (M&E). Details of the criteria are given for each of NCEP's major systems (web site XXXX).

Typically, EMC provides M&E in concert with community partners and also as a result of its own internal development. Maintenance for new code originating from non-EMC sources occurs through EMC's scientific staff learning all aspects of the new code and henceforth being able to enhance the code itself or accept upgrades from partners.

Due to limited human resources, however, EMC may not be able to perform all maintenance and enhancements for the entire NCEP PS in the future. Growth of PS capabilities, e.g. ecosystems, may introduce scientific disciplines outside of EMC's expertise. Introduction of new, complex forecast systems may also be beyond EMC's capacity for M&E support. In this case, partners may be requested to provide M&E support in order for an operational implementation to occur.

The following pages list the generic M&E activities performed by EMC and expected of requested partners.

Environmental Modeling Center (EMC)
Maintenance, Enhancement and Transition to Operations Activities
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1. Operational Analysis and Data Assimilation System
- Formulate, tune and maintain observation errors
- Formulate, tune and maintain background errors
- forward (and adjoint, linear tangent) operators
- diagnostics
- data selection techniques
- execute and monitor parallel runs when appropriate
- port to new platforms, code efficiency

2. Forecast Models
- physical parameterizations
  - o convection
  - o PBL
  - o surface physics and hydrology
  - o radiation and cloud/radiation interactions
  - o cloud microphysics
  - o diffusion
  - o gravity wave drag
  - o ozone and tracers
  - o vertical mixing in ocean models
  - o generation and dissipation in wave forecast models
  - o coupled ocean atmosphere physics for seasonal forecasts
  - o sea ice
- numerics
- resolution changes
- coupling codes with other systems (e.g. land surface)
- incremental changes and tuning
- port to new platforms
- restructure code to improve efficiency
- execute and monitor parallel runs when appropriate

3. Diagnostics and Forecast Model System
- Diagnose system performance with standard metrics versus observations and analyses
- Examine impact of system changes on downstream applications (e.g. global system on hurricane forecast performance, NAM performance on Air Quality) and rectify as required
- Assess and evaluate parallel runs, compare with other NWP Center products

4. Quality Control, Data Access and Formatting for Data Assimilation
- gather and prepare observations for ingest
- maintain observations preprocessor for all modeling systems
- develop advanced quality control techniques
- monitoring, tuning and performance assessment for all observation platforms
- implement and monitor parallel runs when appropriate
- coordinate real time delivery of observations to specialized users
- maintain boundary forcing data sets as appropriate (SST, sea ice, etc)

5. Integrate and Test New Observations and Evaluate Observing Systems
- operational data access and routine delivery (coordinate with NCO)
- formatting and "tanking"
- time window extraction
- interface with analysis
- analysis development (e.g. forward, adjoint, linear tangent model)

- preliminary ("passive" evaluation)
- quality control
- develop new algorithms to improve retrieval accuracies
- develop diagnostics and evaluation criteria
- full testing and evaluation in data assimilation and forecast mode
- operational implementation

6. Code Maintenance and New Product Generation
- Code infrastructure, portability, efficiency, non-science layers including graphics
- Maintain use of NCEP standard GRIB utilities
- Maintain use of NCEP standard BUFR utilities
- Maintain use of other NCEP standard libraries
- AWIPS product support
- algorithms for postprocessing
- regridding, interpolation, resolution changes
- new products (statistical and other empirical techniques, e.g. neural net)
- disk management for individual and parallel runs
- interface with Central Operations, preparation of UNIX scripts and codes for implementation (e.g. code documentation and DOCBLOCKS)
- Prepare briefings for EMC, NCO and NCEP Directors

7. Community Service, Outreach, Education
- Liaison with product users and scientific community, including responding to user requests for product and system information and supporting non-NCEP system users as required
- Produce and provide access to experimental data sets as needed
- Maintain Web pages on NCEP Public Server