MODEL DEVELOPMENT AND ENHANCEMENT RESEARCH TEAM
Monthly Report for July 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.

- Transfer complete to NCEP for RUC upgrade package code, including compiling. Implementation now planned for 1/2008. Change package includes mods to RUC analysis (including mesonet winds, radar reflectivity), model changes (RRTM longwave radiation and updated convection), and postprocessing enhancements (forecast radar reflectivity fields). All changes continue in real-time testing in hardened backup RUC cycle at ESRL/GSD.

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

- Real-time WRF-RR 12-h cycle continues running on full North American domain and CONUS domain (GSD)
- Progress toward implementation of diabatic digital filter initialization in WRF-ARW.

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

- Deliverable 07.5.5E2 complete. GSD reporting bi-weekly to NCEP on progress toward pre-implementation version via telecom at NCEP GSI group meeting.
- Continued progress with GSI assimilation experiments and observation evaluation at NCEP.

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

- NCAR and DTC ran WRF-NMM tutorial in June.

Task 07.5.8: Improve model physics for aviation forecasts.

- RRTM longwave radiation implemented in GSD RUC with successful results for improving nighttime and daytime near-surface forecasts in warm and cold seasons.
- Development of microphysics improvements at NCAR for possible application in the RR.
- Modifications tested for Grell-Devenyi scheme feedback with improved convection forecasts..

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

- Work continues on use of hydrometeor background fields with merged GSI cloud analysis with RUC and ARPS components.

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

- NAM upgrade implementation now delayed until 2Q FY08.

Detailed report – MDE – July 2007

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

GSD

Visit to NCEP by Stan Benjamin in July for 2 days. Seminar on RUC upgrade package with emphasis on radar reflectivity assimilation in RUC, discussions with EMC and NCO on RUC changes and plans for Rapid Refresh.

GSD worked with NCEP to diagnose a RUC post-processing problem for 9-10 July, traced to diagnosis of the tropopause level (see NCEP section below). GSD has successfully tested new code that will be part of the RUC

GSD completed transfer of RUC change package code (initial version) to NCEP in July . All code has been successfully compiled at NCEP, and testing at NCEP is now beginning in August. Some further smaller changes are anticipated as NCEP testing starts.

This RUC analysis/model change package (implementation date now tentatively planned for early 2008) is currently running in the 13km dev RUC (http://ruc.noaa.gov/pig.cgi?13km_D2) and the hardened 13km backup RUC (http://ruc.noaa.gov/pig.cgi?13km_BU). Further changes were made in July, primarily with modifications to frequency of calls to the Grell-Devenyi (GD) scheme and horizontal scale of applied temperature/moisture feedback see http://ruc.fsl.noaa.gov/13km_RUC.changelog.html , changelog for developmental 13km RUC). To summarize the changes made in the development and backup RUC at GSD:

- Improved diabatic assimilation of 3-d radar reflectivity via diabatic digital filter initialization and convective suppression.
- Correction to RH observation errors for in-situ and precipitable water moisture observations, resulting in more accurate RH forecasts.
- Post-processing changes
    - Addition of three reflectivity products in RUC post-processing (column max, 1-km, 4-km) (all in RUC isobaric files – ruc_presm or pgrb)
    - Fix to tropopause level problem identified in July 2007.
    - Additional new products in RUC isobaric/pgrib files - 500 hPa vorticity, total accumulated convective and non-convective precipitation from initial time.
- Addition of lightning assimilation to complement the 3-d radar reflectivity assimilation. This adds building of convective areas where lightning strokes are evident and there is no 3-d radar reflectivity data (e. g. over oceans, outside of CONUS).
- RRTM longwave radiation package replacing current Dudhia longwave package. This change improves nighttime forecasts over snow cover (cold-season) and especially a long-standing warm bias in particularly moist areas.
- Land-surface model changes for improved 2m temperature over snow cover
- Change to Grell-Devenyi convective parameterization with improved (decreased) areal coverage for light convective precipitation and improved coherence in mesoscale organization for convective storms.
- 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

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

INTERFACE WITH OTHER ORGANIZATIONS:
Discussion between GSD and NCEP/EMC and NCEP/NCO on RUC changes, NSSL on 3-d radar data, NCAR on radar assimilation, NCEP on radar data availability.

Discussions between GSD and RUC users in NWS and private sector on RUC performance.

NCEP

Dennis Keyser reports that Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ERSL MADIS feed. Efforts are underway to determine why moisture data from MDCRS-ACARS UPS units are unreasonably high in the BUFR feed from ARINC. Testing of both "new science" GOES 1x1 cloud data and GOES 1x1 PW data (replacing current 5x5 product) is underway.

Geoff Manikin reports that the RUC experienced some run failures on 9 and 10 July due to diagnosed values of the tropopause height outside of the acceptable range to the NCEP code that writes out grib2 files, causing crashes of the post processor scripts. The problem was traced to a climatologically deep, stacked cyclone along the northern border of the domain, and it was determined that a condition of potential vorticity greater than 2 extending all the way to the ground caused unrealistic values when linear interpolation was performed with levels with values near 2. A revised code will be implemented soon; it is believed that the problem was an extremely isolated event, so an emergency fix was not required.

GSD has provided new code to EMC for the RUC upgrade package including radar reflectivity assimilation, and will be giving additional new code to EMC in August, as needed. Parallel testing will begin at NCEP later in the month.

Shun Liu has filed JIF's for the updated radar quality control which includes reflectivity and processing required to ultimately produce reflectivity mosaics required for the RUC upgrade. Both he and Geoff DiMego have been working with NCO to get these implemented.

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.

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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.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

INTERFACE WITH OTHER ORGANIZATIONS: GSD & NCO.

UPDATES TO SCHEDULE: Complete 30 September 2007.

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

NCEP, GSD, NCAR, and DTC have continued discussions on the Rapid Refresh dynamic cores and use of WRF and ESMF frameworks. These discussions continued up to and through the WRF Executive Oversight Board meeting in Boulder on 31 July 2007. Some agreements are hoped for within the next few weeks. Earlier in July, the focus of these discussions was a draft report written in June by Stan Benjamin, Proposal for WRF – NCEP-ESMF Intertransferability, describing options for transferring the ARW dynamic core from WRF into the NCEP realization of ESMF. Under discussion is a proposal to proceed with the initial RR implementation using the WRF-

ARW under the WRF infrastructure in 2009, and a subsequent RR implementation of the ARW under ESMF and totally independent of the WRF code architecture in 2011. The transfer to the ESMF framework necessary for the 2011 implementation under ESMF would involve essentially exercising option 3 discussed in Benjamin's report.
GSD

In July, GSD continued to run WRF forecasts cycled with GSI over the RR domain on iJET. WRF-RR runs without cycling are also being made on wJET using WRFv2.2 and WPS. Additional tests were conducted with the full script (via the GSD-developed Work-Flow Manager) for the WRF-RR w/ full cycling in July, but this is not yet fully working.

Some important progress was made with the digital filter initialization (DFI) in the WRF-ARW model in July (Tanya Smirnova, Steven Peckham). GSD has developed a backwards-forward diabatic DFI in WRF-ARW, similar to that in the RUC model. However, this only seems to work reliably at coarse 60-km resolution but not yet at 13-km resolution. Thanks to NCAR (Tom Henderson, Xiang-yu (Hans) Huang) for their assistance.

GSD conducted some additional tests with RR-experimental prepBUFR files produced by Dennis Keyser at NCEP/EMC. The files now seem to be suitable for usage both by the RR and RUC systems.

PLANNED EFFORTS: Add cycling with the GSI analysis package to the wJET cold-start WRF-RR runs to complete the cycling loop and increase the cycling frequency from once per 12 hours. Execute a new diabatic Digital Filter Initialization prior to starting the free forecast to control initial noise.

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: The wJET computer and file systems are likely to continue to require periods of down time over the next 2 months for installation of additional security patches and to address file-system performance issues.

INTERFACE WITH OTHER ORGANIZATIONS: DTC, NCEP, NCAR

UPDATES TO SCHEDULE: None.

Subtasks

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

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

CURRENT WORK: Work continues toward establishing a 1-h cycle using WRF-ARW on the full RR domain. GSI can now work with netcdf files from WRF v2.2, and we expect to have a binary file capability in place soon. In response to earlier recommendations by the Alaska Region of the National Weather Service, we have expanded the WRF-ARW RR domain slightly so that it is farther away from Barrow and includes Dutch Harbor (54.0N/166.5W), the main civilian airport in the eastern Aleutians.

For effective 1-h cycling it is important to have a 1-h forecast that is free of spurious features. As has been noted many times over the years, the use of digital filter initialization (DFI) has been a key to the success of the RUC. Tanya Smirnova and Steven Peckham continue to work toward having a fully functional diabatic digital filter initialization in WRF-ARW v2.2 for use in 1-h cycling of the RR, controlled through the model's namelist.input file. They are building off work they did in 2005 that resulted in a DFI running in WRF v2.1. The main challenge with the current version of WRF-ARW is getting the adiabatic version of the model to run backward properly.

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

INTERFACE WITH OTHER ORGANIZATIONS: NCEP, NCAR

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

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

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

CURRENT WORK: The retrospective period chosen continues to be used very productively for testing impact of various observation systems, including effectiveness of the RUC hourly assimilation and its analysis code.

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

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

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

CURRENT WORK: Work continues on extending web-viewing capability to cover the full North American RR domain.

07.5.4.5 Ongoing (GSD)

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

CURRENT WORK: No work during July.

07.5.4.6 Ongoing (GSD, NCAR later)
Ongoing evaluation of real-time and retrospective runs of RR system for SAVs and AIVs

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

07.5.4.7 1 Nov 2006 (GSD) - ongoing

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

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

Deliverables

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

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

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

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

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

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

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

NCEP

Wan-Shu Wu tuned the background error and tested changes in the off-line parallel. Since positive impacts were found, these changes are being tested in the regional parallel. According to the results of global impact studies the QUIKSCAT data were turned off in the regional parallel. The strong constraint was also turned off because of bad forecast impact in the regional parallel NDAS. John Derber found that using the GOES 1x1 ozone channel caused the other channels to be rejected, so the ozone channels were turned off. This change was shown to produce little impact with an off-line parallel test.

Dave Parrish reports that the strong dynamic constraint option in GSI has been implemented into operations for the GFS. The experience with this constraint in a global application has been extremely positive, both for the NCEP GFS and the GMAO global model. This has not been the case for the regional application of the strong dynamic constraint. While there is always improvement in guess fit to surface pressure data with the strong constraint on, other variables are neutral to somewhat worse, especially wind. During parallel testing (see below Task 07.5.17) results were deemed too poor to proceed with the planned implementation of the NAM bundle. Subsequent to the decision to delay the NAM bundle, a thorough check of the regional version of the strong dynamic constraint code was performed by an independent party (data assimilation group lead John Derber) and an error was found. Correcting the error only causes a very small change to a single analysis. We are awaiting results from cycling to see the impact of this error.

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

GSD

Dezso Devenyi has downloaded the July 2007 version of GSI to replace the last GSD download from the September 2006 version. It has now been successfully tested at ESRL with both ARW and NMM initial conditions.

Subtasks

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

CAPS - Ming Hu has now parallelized the combined cloud analysis code within GSI that was reported on in the FY07 Q3 report.

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

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

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

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

07.5.5.6 31 July 2007 (NCEP)
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.

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.

Work continues toward improving the basic algorithm reported on earlier. Devenyi et al's paper at the AMS-NWP conference referenced earlier showed examples of PBL effect on the analysis increment using the GSI anisotropy option. Further evaluation awaits implementation of the RR 1-h cycle.

07.5.5.8 15 Feb 2007 (ESRL/GSD) Completed 15 Feb 2007
Development efforts produce an 'experimental' version of the GSI suitable for Rapid Refresh application (e.g. includes RR-specific modifications for cloud hydrometeor and surface observation assimilation).

Current work is on adding GSI to the WRF-RR cold start real-time runs on wJET to complete the cycling loop. GSI can now accept WRF-ARW wrfout (NETcdf) files; the use of binary files to reduce overhead is being worked on.

Deliverables

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

CURRENT EFFORTS: See NCEP summary under 7.5.5 above.

PLANNED EFFORTS:

PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED:
A new delay to Jan-Mar 2008 for this implementation is necessary, as described under 07.5.17.

UPDATES TO SCHEDULE: Delayed until Jan-Mar 2008.

07.5.5E2 15 July 2007 (ESRL). COMPLETED 15 July
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).

CURRENT EFFORTS: See GSD summary above under 7.5.5.

INTERFACE WITH OTHER ORGANIZATIONS: NCEP
PROBLEMS / ISSUES ENCOUNTERED OR ANTICIPATED: None.

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

MMM conducted a WRF tutorial July 23-27, the second one in 2007. This was jointly produced with the DTC, and both the ARW and NMM cores were covered. The tutorial included lectures on the WRF system and WRF-Var, as well as practice sessions. A total of 61 people attended.

Dudhia of NCAR tested a fix in the RRTM longwave radiation scheme for the input of surface skin temperature, rather than extrapolated atmospheric temperature (done inadvertently in RRTM). The fix has a generally small effect on results, except over water regions like the Great Lakes; there, surface skin temperature might be quite different from the atmospheric temperature, and the fix may affect low-level temperatures more.

Some fixes (from Wei Yu (NCAR/RAL)) for FDDA nudging were developed to address issues of reading the wrong time in restarts. Dudhia worked on their implementation. As these relate to I/O infrastructure, some software engineering work remains before commitment to the repository.

Dudhia investigated water budget issues in idealized WRF runs with surface fluxes. The main problem was traced to the 6th-order diffusion option, which we now recommend not using for budget studies.

Dudhia worked with visitor Joe Galewsky (New Mexico University) on idealized cases for sea breeze and radiative convective equilibrium. The new initialization examples are aimed for a future community release and would expand the idealized physics options. Dudhia also worked with Changhai Liu (NCAR/MMM) to add forcing terms for convective simulations with specified large-scale forcings of heat, moisture, and momentum. This method is often used in tropical semi-idealized, cloud-resolving simulations. This may become a new WRF nudging option.

CURRENT EFFORTS:

PLANNED EFFORTS: Work will continue at NCAR through the end of the fiscal year on model physics capabilities and improvements.

UPDATES TO SCHEDULE: None.

Deliverables

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/MMM, DTC)

CURRENT EFFORTS: NCAR hosted an ARW tutorial on January 22-26, 2007. NCAR's work in that was completed in FY07 -Q2 and is described in the previous quarterly report (for FY07Q2).

PLANNED EFFORTS:

UPDATES TO SCHEDULE: None.

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 in both WRF and RUC of a revised version of the RUC-Smirnova 2-layer snow model. The RRTM longwave radiation scheme is also in the dev-13km RUC cycle at GSD. In July, the RRTM showed an even larger improvement in nighttime and daytime warm bias has plagued the RUC over the central and southeastern US

for several years. The revised RUC LSM and the RRTM are both included in the planned RUC change bundle.

Subtasks

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

CURRENT WORK: The Grell-Devenyi scheme continues to be the subject of experimentation. The small-scale detail and absence of sufficient mesoscale organization noted in instantaneous RUC reflectivity fields and discussed in the FY07 Q3 report is now being addressed by modifying the assumption about the spatial distribution of subsidence surrounding convective cloud updrafts. Currently, this subsidence outside of cloud necessary to compensate the saturated updrafts within (parameterized) clouds is assumed to occur entirely within the individual grid column where the convection is occurring. Georg Grell has developed for WRF a version of the Grell-Devenyi scheme that spreads this subsidence into nearby grid columns, and has implemented this scheme into RUC. Experiments on a couple of cases so far indicate that this change does result in more coherent mesoscale organization, with much more grid-scale precipitation than the present operational version of the scheme, and greater impact on surface wind and temperature fields. Extensive testing in a cycling environment will be necessary before this change can be said to be an improvement over the present operational RUC version of the scheme.

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

No further work on this subtask in July.

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

Ben Bernstein continued to analyze Cleveland stratocumulus cases to build truth datasets. These truth datasets will be used to improve the simulation of stratocumulus icing in the bulk scheme, including possible modifications to the PBL scheme.

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

GSD: J. Brown has begun to look into a class of boundary-layer mixing schemes developed by Bretherton et al and discussed at the WRF workshop.

Deliverables

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

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

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

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

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

Ben Bernstein and Greg Thompson are starting to work on reporting the 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.

GSD has continued to test and evaluate performance of the radar reflectivity assimilation code within the 13-km RUC DDFI, which serves as a prototype for a similar system in the WRF Rapid Refresh. Results, as measured by the verification of short-term precipitation forecasts, and subjectively by comparing observed and forecast reflectivity patterns during the first few hours of the forecast, continue to be very encouraging. This radar assimilation algorithm is included in the code package that was transferred to NCEP to begin parallel testing. The algorithm and results are summarized in a conference paper presented at the 33rd Conference on Radar Meteorology in early August. The paper title and link are:
Radar-based assimilation of precipitation systems using a diabatic digital filter (by Steve Weygandt, Stan Benjamin and John Brown)

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

Collaborative work continues between GSD and Ming Hu of CAPS to evaluate and further refine the generalized cloud analysis (created from the ARPS and RUC cloud analysis) within the RR-GSI CONUS environment, using Chris Harrop's workflow manager (see subtask 07.5.15.E3 for additional details).

Deliverables

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

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

07.5.15.E3 15 September 2007 (GSD and CAPS)
Complete further revisions and testing of the generalized cloud analysis package within GSI for stratiform cloud

(using GOES cloud top and METAR cloud data) and initial treatment for convective cloud at parameterized scale assimilating radar reflectivity.

CAPS
The main efforts have focused on improving the efficiency of the generalized cloud analysis procedure by parallelizing both radar data ingesting and cloud analysis itself. The new system is able to read and process 8 radar Mosaic reflectivity tiles using 8 CPUs at the same time, which leads to noticeable reduction of the wall time of the cloud analysis from original 628s to 463s. Ming Hu is currently working on the parallelization of cloud analysis.

Ming Hu also found that extra large snow mixing ratio in upper atmosphere when uses Thompson snow retrieval method is caused by the large snow intercept parameter of the Thompson scheme (twenty times larger than Lin scheme). This issue will be studied further when Thompson based retrieval is needed.

GSD
GSD has tested new experimental GOES cloud-top data from NESDIS using the RUC cloud analysis. GSD found errors in the cloud-top temperature in this data, resulting in poorer stratus initialization over marine regions. NESDIS has subsequently corrected this problem, and it appears that the new GOES cloud-top data will be appropriate for the operational RUC. Additional related testing is now underway for use of single-field-of-view (SFOV) precipitable water (PW) data in the RUC. Current operational GOES PW data is from 5x5 FOVs, not the new 1x1 FOV information.

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

NCEP

Eric Rogers reports that the planned NAM implementation for September 2007 was postponed until the second quarter (January-March) of FY 2008. The primary reason for this postponement was degraded performance of the parallel NAM during June-July caused by the strong mass-wind balance constraint in the GSI analysis component of the NAM upgrade bundle (see Task 07.5.5). By delaying this change package until next year, a corrected version of the GSI with strong constraint is expected plus several model changes currently under development (gravity wave drag/mountain blocking, momentum mixing in the WRF-NMM convective parameterization, new horizontal diffusion algorithm) can be sufficiently tested for possible implementation in the production NAM run. Code will need to be finalized by late October to early November in order for NCO to run it through their process and implement in February 2008.

Dennis Keyser reports that Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ERSL MADIS feed. Efforts are underway to determine why moisture data from MDCRS-ACARS UPS units are unreasonably high in the BUFR feed from ARINC. NCEP is in the process of switching its processing to high-resolution BUFR JMA winds, following a period of testing. Parallel testing of the following new data types is currently underway in preparation for the FY08/Q2 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", MODIS IR and water vapor satellite winds. All data here are processed within the new, expanded NAM domain, using a new domain mask developed by Eric Rogers (this mask allows only those observations within the exact domain to be selected for dumping). By early Fall 2007, dropwindsonde moisture from NOAA (P-3 and Gulf Stream) and USAF will start being used by the GSI, 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.