MODEL DEVELOPMENT AND ENHANCEMENT RESEARCH TEAM
Monthly Report for November 2007
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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 planned for Jan 2008.
- 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
- 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 also from 11 Dec RUC/RR review at NCEP – start at slide 35 in http://www.emc.ncep.noaa.gov/research/NCEP-EMCModelReview2007/RUC-NCEP-OperReview-Dec07-RRb.pdf
- Hourly RR conventional observation files being created at NCEP and transferred to GSD
- 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 nearly complete

Detailed report – MDE – November 2007

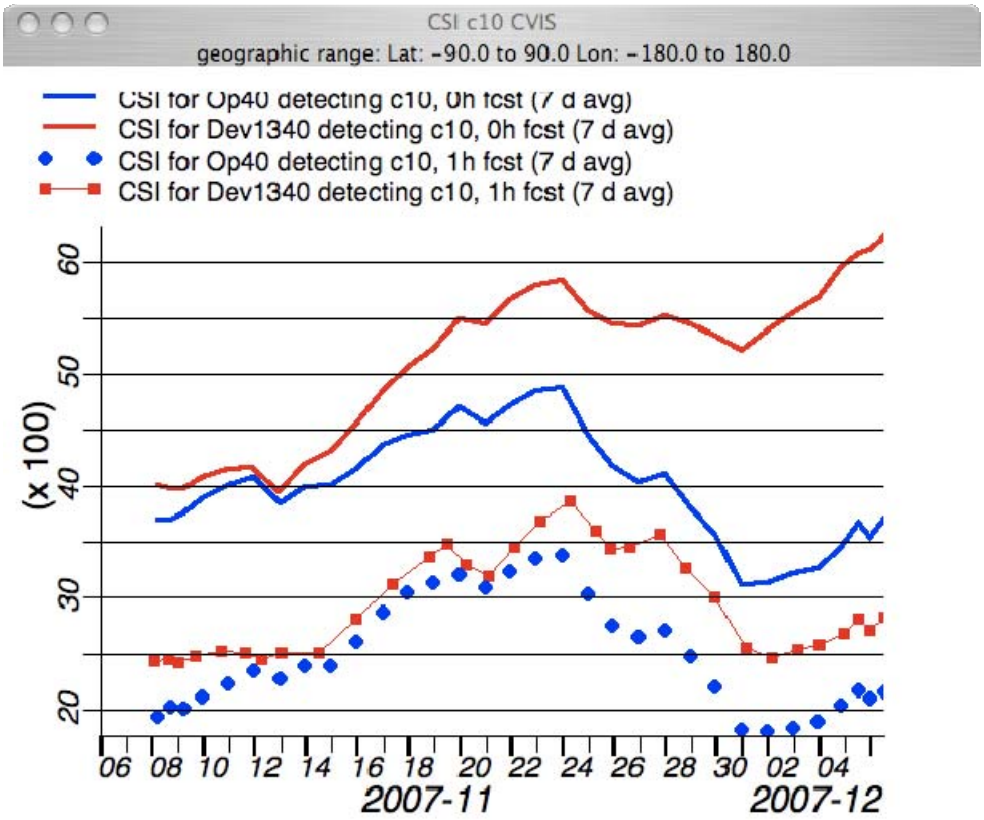
Task 08.5.1: Infrastructure Support Related to Operational Running of the RUC and North American Mesoscale (NAM) Systems

GSD

RUC upgrade in parallel testing at NCEP. No further changes to RUC upgrade code since last monthly report, and no further expected except a few variables to be added in post-processing. Please see the October report for more details on RUC upgrade. 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 November post to RUC forum on RUC upgrade at http://ruc.fsl.noaa.gov/forum/f2/Welcome.cgi/read/1713

GSD also developed improved processing of the RUC cloud analysis to ensure assimilation of METAR cloud observations failing to meet criteria for inclusion. Thee criteria 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 is now much improved.



A crisis change implementation has been submitted to NCEP/NCO by GSD and NCEP/EMC and implementation is now planned for early January after the end of the current change moratorium.

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

NCEP

Dennis Keyser reports that tests of both "new science" GOES 1x1 f-o-v cloud data and GOES 1x1 f-o-v PW data (replacing current 5x5 f-o-v products) are underway. There are random cycles where all of the "new science" cloud data have missing latitude and longitude. This is due to a combination of the NESDIS encoding 1 or 2 reports at the beginning of their files with missing lat/lon and the NCEP data dump duplicate checking program not recognizing this properly. A change request has been submitted to NCEP/NCO to correct this problem in the duplicate checking code. Parallel testing of TAMDAR aircraft data is now currently underway. Surface marine (ship, buoy, C-MAN, tide gauge) data had 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. This was corrected on 2 November. Cooperative Agency Profiler (CAP) and RASS data are not yet available through an alternate ESRL MADIS feed.

Geoff Manikin reports that the operational RUC experienced a failure on 2 November due to incorrect information in a dropsonde report near Hurricane Noel. After investigating by GSD, it was found that the sounding report told the model to expect wind data for 6 levels, but it did not provide it. The data processing code for the model should have been able to deal with this inconsistency, but it did not. Revised data processing ode was prepared by GSD and EMC to deal with this situation, but with the rare occurrence of this sort of error and a heavily-burdened NCO staff, the code has not yet been implemented. Instead, the code is ready to be implemented at a moment's notice should this situation arise again.

Issues of memory usage in the RUC runslot have surfaced. These cause a new IBM memory monitor to kill the RUC job an very rare occasions. EMC's IBM software analyst has been recruited to look into the causes and possible solutions. GSD, EMC, and NCO have discussed these issues.

Meanwhile, EMC continues to run a parallel version of the RUC model, with the primary feature of this code 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 individual stations, a change in the longwave radiation scheme from Dudhia to RRTM, a modification to the snow component of the land-surface model to decrease excessively cold 2-meter temperatures over fresh snow at night, and a modification to the convective scheme to use non-local subsidence warming. Parallel testing of this code continues with implementation likely during 3Q FY 2008 (spring).

Shun Liu continues to work with NCO to build a new radar data decoding and QC package. He is also working with Dennis Keyser to modify scripts and codes for preparing to JIF radar reflectivity mosaic package.

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

GSD

A Rapid Refresh home page was introduced during October and has since been considerably expanded. 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. 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.

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)
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 RR cycles continue to run at GSD on the 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). Work is underway to upgrade these to 1-h cycling using the newly available NCEP hourly prepBUFR files and to add the satellite radiance assimilation. Work toward switching the internal I/O format from netcdf to binary has been put on hold to the cycle is fully updated to hourly (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.

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 is making 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.

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. 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.

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 will be implemented into the GSD RR runs.

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

Wan-Shu Wu adapted a low resolution NAM/NDAS system to evaluate and redesign the strategy for NDAS, including optimally incorporating the global flow development in the GFS into the regional system. A control experiment with continuous 12-hour cycling of the NMM system for the month of January 2007 was completed. Two more experiments are running: one with a partial cycle and a cold start from the GFS at the beginning of each 12-hour cycling; the other without the 12-hour cycling but with the GFS first guess and a regional analysis to produce the initial conditions for the free forecasts. The effort of using the MESONET wind direction showed that when the non-linear forward operator used the direction and the speed separately the overall convergence of the 3DVar was significantly degraded. Another way to use the directional information was to adjust the U/V observations proportionally to maintain the first guess wind speed while keeping the observational wind direction. A week-long cycling test of this option showed a slight positive impact on the 3 hour forecast winds with the parallel NAMY as control.

Dave Parrish reports that work continues on attempts to improve the performance of the GSI regional strong constraint to match that of the global version. The regional version uses a constant Coriolis parameter and map factor in the definition of normal modes, which is not the case for the global version. Some tests have been completed to measure the impact of this assumption by embedding the regional domain in a full global domain and applying the global strong constraint. For simple test functions, the difference between global and regional solutions can be up to 30% for wind corrections. But when running the regional constraint with different values of Coriolis parameter, the local agreement is better than 5% within +/- 10 degrees of latitude. This suggests using a blended combination of several solutions for different values of Coriolis parameter and map factor. Modifications are in progress to try this option.

Shun Liu is testing and examining all codes related radar radial wind assimilation in GSI because the analyzed radial wind can be directly compared with radar wind observation on the same observation location after radar data volume ID and scan ID are available in level II BUFR. He continues to work on transferring the codes related to vertical

velocity analysis to new version of GSI to improve radial wind assimilation.

Details on upcoming NCEP/EMC plans for mesoscale modeling from Geoff DiMego's presentation on 11 Dec 07 is available at
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)
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 nearly complete.

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.

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.

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 has recently been added and indicates reasonable Agreement. Detailed statistical evaluation awaits incorporation 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.

Deliverables

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

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.

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

NCAR/MMM

WRF minor release 2.2.1 was completed and issued. This included bug-fixes and other mods to the WRF repository addressing model physics and numerics: (a) allowing for radiation to be called every timestep; (b) improving the hydrostatic pressure computation; (c) preventing the zero-out in the lowest layer of stress terms for w in a diffusion option; and (d) correction of a sign error for the curvature effect on v. Various NCAR personnel also worked on the preparation of features for WRF V3.0, the next planned major release.

Jim Dudhia of NCAR worked with Mukul Tewari (NCAR) on a problem found at NCEP in the snow evaporation modifications implemented earlier this year in the Unified Noah LSM. In the situation of 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.

Dudhia and Joe Klemp (NCAR) improved the upper boundary vertical velocity (w) Rayleigh damping with Joe Klemp. This was added to the WRF repository.

Dudahi tested the double-moment microphysics scheme developed by Hugh Morrison (MMM). This is being considered for inclusion as an ARW option, and may be released in V3.0. Dudhia also worked on linking an LES turbulence parameterization to physics fluxes in the model. This was added to the repository.
These mods were also merged with similar changes from Cal Tech in the current version of the Global ARW.

GSD

A final version of the DFI capability was completed and submitted to NCAR for inclusion to the WRF repository (Tanya Smirnova, Steven Peckham). NCAR is reviewing this code but hopes to include it within WRF v3.

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.

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 early 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.

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. We are now testing with a thickness of 0.002 for the lowest layer—this has noise only slightly larger than with the original lowest-layer thickness of 0.003, and has run stably so far.

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. This GSD-developed backwards-forward diabatic DFI for WRF-ARW, similar to that in the RUC model, is now integrated into the 13-km RR cold start runs at GSD and 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. 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.

At CAPS, two versions (of NCEP and GSD) of the GSI code were ported to OU's Linux cluster. The generalized cloud analysis package has been incorporated within to GSI codes and packages passed initial tests. Forecasting test is underway with WRF-ARW.

At CAPS, two versions (from NCEP and GSD) of the GSI code were ported to OU's Linux cluster. The generalized cloud analysis package has been incorporated within GSI passed initial tests. Forecasting test is underway with WRF-ARW.

Continuing the work of October, the main efforts at CAPS were spent on further testing the impact of the cloud analysis by using the GSD version-based GSI with the 13 March 2006 case. An inconsistency in the values of threshold of sky cover (named thresh_cvr in the code) in subroutines in CloudCover_radar.f90 and CloudLayers.f90 was found and fixed. Experiments are being performed to investigate a set of semi-empirical parameters in the generalized cloud analysis on the WRF-ARW forecasts. At present, the experiments with 13-km resolution have been performed. Preparation for nested 4-km runs is underway.

Compared with the reflectivity mosaic data, the initial 3-hr forecasting results show a positive impact of adding cloud analysis. Special attention was paid the analysis of cloud water and cloud ice in stratiform v.s. convective conditions. Currently, the option is to either use the ARPS-based convection-tuned 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.

Assistance from Ming Hu, currently of GSD/DTC, is greatly appreciated

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.

08.5.17.3 (NCEP)
Provide vendors with gridded model data via Family of Services and the FAA Bulk Weather Data Telecommunications Gateway.

08.5.17.4 (NCEP)
Provide full grids from NAM, and HiResWindow on NCEP and NWS/OPS servers.

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.

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.

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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