

MDE Product Development Team
(Based on Work Plan for 12-month Period from 1 April 2014 through 31 March 2015)
April 2014 Monthly Report
Submitted 15 May 2014

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(Compiled and edited by S. Benjamin and B. Johnson)

Executive Summary

Task 1: Improve Turbulence Guidance From NWP Forecasts From RAP, HRRR, NAM, NAM-Nests and Eventually NARRE And HRRRE

- Operational RAPv2 continues to run reliably at NCEP.
- RAPv3 and HRRR code now frozen for 2014 warm season exercise, on 5 April for RAPv3 and 10 April for HRRR.
- Development continues for further assimilation and model improvements in RAP.

Task 2: Improve Quality Of Convective Weather Forecasts From RAP, HRRR, NAM, NAM-Nests and Eventually NARRE And HRRRE

- HRRR in April and May performing particularly well in many convection cases.
- New RAPv3 showing much less night-time cold bias over snow than oper RAPv2.
- Warm and dry bias in 2-m temperature and dew point in prefrontal southerly flow in RAPv3 is under active investigation.

Task 3: Improve Quality Of Icing Weather Forecasts From RAP, HRRR, NAM, NAM-Nests and Eventually NARRE And HRRRE

- Extensive set of the physics changes, along with data assimilation and other model improvements to both the RAP and HRRR forecast systems were implemented for the 2014 warm season evaluation as summarized in the following report: <http://ruc.noaa.gov/pdf/ESRLRAPHRRRchanges2014.pdf>

Task 4: Develop Convection-ATM-Specific Improvements To Guidance From The HRRR (And Later, HRRRE) and Interact With CoSPA (Or Other) Program Partner Labs And The FAA

- GSD froze all data assimilation and model changes for ESRL RAPv3/HRRRv2 as of 10 April 2014 on Jet and Zeus. The ESRL RAPv3/HRRRv2 changes will be implemented at NCEP in 2015.
- The real-time frozen ESRL RAPv3/HRRRv2 system will continue to run with gridded field dissemination during the CoSPA season that began on 17 April 2014 and will run until 01 November 2014.
- ESRL HRRR "failover" capability to use feed from Zeus instead of Jet during Jet downtime continues to work.
- ESRL HRRR output format changes for alignment with the NCEP HRRR operational implementation will be coordinated with COSPA program partner labs. A final CoSPA planning telecon was held on 07 April 2014 with the partner labs and the FAA to provide more detailed information regarding the ESRL HRRRv2 changes implemented on 10 April 2014.

Task 1: Improve Turbulence Guidance From NWP Forecasts From RAP, HRRR, NAM, NAM-Nests and Eventually NARRE And HRRRE

Improving turbulence forecast quality involves efforts to improve initial conditions for the RAP and NAM (and HRRR and NAM Nest models) and to improve the models (WRF-Advanced Research WRF (ARW)-RAP and NOAA Environmental Modeling System (NEMS)- Nonhydrostatic Multi-scale Model – B (NMMB)).

Tasks will include:

- Continuing evaluation of RAPv3 toward 2015 implementation at NCEP, incorporating changes developed in 2013 and early 2014
- Development of RAPv4 toward 2016 implementation at ESRL and subsequent implementation at NCEP
- Collaborating on developing and testing best approaches for use of hybrid/EnKF/3DVAR data assimilation within common GSI coding structure.

ESRL

Regarding the operational NCEP RAP

The RAPv2 continues to run well in NCEP operations, without any model or post-processing issues during April.

The RAP web page <http://rapidrefresh.noaa.gov> is updated with information on the operational RAPv2 configuration including a February 2014 NWS webinar ppt on RAPv2 - <http://ruc.noaa.gov/pdf/RAPv2-NWSwebinar-18feb2014-FINAL.pdf>. A link to the RAPv2 Technical Implementation Notice is there also. A webpage on RAP output grids from NCEP is at <http://ruc.noaa.gov/rr/RAP-NCEP-output-grids.html>.

RAPv3 model testing and evaluation

Final changes were made to the warm-season RAPv3 configuration in the RAP-primary cycle at GSD on 5 April. See deliverable E1 below. This cycle continues to drive the HRRR-primary running at GSD in support of the 2014 warm-season exercise. We expect to keep this cycle frozen through 30 September 2014. A summary has been published on the web <http://ruc.noaa.gov/pdf/RAPv3-HRRR-April2014.pdf> with a more detailed description available at <http://ruc.noaa.gov/pdf/ESRLRAPHRRRchanges2014.pdf>. This version has been running well, with a substantially reduced nighttime cold bias in the forecast, particularly over snow cover, relative to that of the operational RAPv2. (See FY2014Q2 report, Task 3 for changes made to mitigate this cold bias.)

We are also seeing some continued warm and dry bias east of the Rockies under conditions of mostly clear skies and low-level southerly flow with dry soil conditions, although RAPv3 performance in this regard is better than for the RAPv2 now running at NCEP. Related to this, when there is a southern-plains dry line, it often tends to be slightly too far east. This situation, which we have seen in previous years, is under investigation (see Task 3).

NARRE-related activities

More discussions occurred between GSD and EMC staff on planning for the NARRE. An updated MDE plan presented to the Numerical Modeling Strategic Planning Team (FAA) included this information. This information is summarized in a report in http://ruc.noaa.gov/pdf/Benj_DTC_RAP-NARRE-Apr14.pdf

Isidora Jankov in AMB with some help from Ming Hu has successfully run the NMMB on Zeus, including the same version of the Unified PostProcessor (UPP) as used in the RAP, over the RAP domain in single-case tests (no cycling).

Subtasks

14.5.1.1 Ongoing **(NCEP, GSD)**
Maintain hourly RAP and HRRR runs and provide grids of SAV and AHP guidance products.

Ongoing. The RAP ran in production in April with no issues. Work is underway to implement the HRRR into NCEP operations in September. (Manikin)

14.5.1.2 28 July 2014 **(NCEP, ESRL & CAPS)**
Groups collaborate on developing and testing best approaches for use of hybrid/ EnKF/3DVAR and 4d-ens-var within common GSI coding structure.

ESRL

Ming Hu has performed new experiments for different localization options for the hybrid/EnKF data assimilation for the RAP. He found that the current configuration, although with relative small localization scales, seems to produce equal or optimal results.

NCEP

Work has not begun as of April. (Carley, Wu, Parrish)

14.5.1.3 30 Sept 2014 **(CAPS, GSD, EMC)**

Test and evaluate direct radial velocity and reflectivity data assimilation within the 40-20km/13km dual resolution hybrid system. (Resolution dependent on computing resources)

EMC

Radial wind assimilation in GSI was revisited. The bias between radial wind observation and NAM 12 km background were examined. The impact of quality control options for radial wind was evaluated. An effort was made to use more radial wind observations in GSI, but test results are mixed. Positive impact was found on 3-hr wind forecasts for the 00 z runs while the impact negative was for 12z runs. (Liu, Carley)

14.5.1.4 1 Jan 2015 **(ESRL, CAPS)**

Test the 40/13 km dual-resolution system with hourly DA cycles including all observation types, including radar reflectivity data via cloud analysis and DDFI.

14.5.1.5 28 Feb 2015 **(NCEP, ESRL & NCAR)**

Groups collaborate on developing and testing physics schemes between WRF and NEMS' physics layer.

NCEP

The Thompson microphysics added to the NEMS/NMM-B parallel system in 2013 was tested at NCEP, and the forecast performance was comparable to the WSM6 microphysics and the Ferrier-Aligo microphysics. The biggest challenge is that the model forecasts require more resources to run. Further code modifications may be needed to improve the coupling between the microphysics and RRTM radiation, particularly in providing effective radius information from the microphysics to the radiation. (Ferrier, Aligo, Jovic)

14.5.1.6 28 Feb 2015 **(NCEP)**

Complete testing of improved or extended 88D processing and quality control, taking advantage of dual-pol where possible.

Supplemental Adaptive Intra-Volume Low-Level Scan (SAILS) test data were available at NCEP. Effort was made to check if current radar data decoder could handle SAILS data. (Liu)

14.5.1.7 15 Mar 2015 **(ESRL, CAPS, NCEP)**

Complete readying of initial regional ensemble data assimilation capability to initialize real-time parallel RAP version and NAMRR.

NCEP

Codes to generate/create NMMB (NAMRR) ensemble members from the Global Data Assimilation System's EnKF members were committed to the NEMS Preprocessing System repository. (Carley, Wu, Parrish)

14.5.1.8 28 Mar 2015 **(NCEP and ESRL)**

Negotiate Data Mining List priorities with NCEP Central Operations and external points of contact associated with the most desirable new sources of observations.

NCEP

No new items were requested so Data Mining List remained unchanged. (Keyser, Whiting)

14.5.1.9 31 March 2015 **(NCEP)**

Establish a pre-implementation version of the hourly updated NAMRR with a goal to use the common regional ensemble data assimilation.

NCEP

No work was done in April. (Carley)

14.5.1.E6 20 Dec 2014 **(ESRL)**

Report on RAPv3 model and data assimilation configuration and progress. This will include a report on wind verification and its improvements in RAPv3 vs. RAPv2.

14.5.1.E7 31 Jan 2015 **(ESRL and NCEP)**

Finalize code for RAPv3 to NCO for implementation at NCEP.

NCEP

ESRL has started testing the RAPv3 code. It will not be given to EMC until after the HRRR implementation. (Manikin)

14.5.1.E8 31 Jan 2015 **(ESRL, NCEP)**

Pending NCEP computer readiness and EMC and NCEP initial recommendations, Requests for Change (RFCs) are filed to submit code changes as part of upgrade for RAP v3 software to NCO.

NCEP

This work will not begin until after the HRRR implementation. (Manikin)

14.5.1.E9 31 March 2015 **(NCAR/MMM)**

Incorporate physics and dynamics improvements into WRF from the user community, GSD, and NCEP for use in the RAP and HRRR. Oversee code preparation and integration of these improvements into the WRF repository for future model version releases and FAA use. Assist in the implementation of bug fixes. In collaboration with GSD, assist in the development and evaluation of physics schemes for the RAP and HRRR that are contributed to the ARW.

GSD, and NCEP for use in the RAP and HRRR. Oversee code preparation and integration of these improvements into the WRF repository for future model version releases and FAA use. Assist in the implementation of bug fixes. In collaboration with GSD, assist in the development and evaluation of physics schemes for the RAP and HRRR that are contributed to the ARW.

NCAR released WRF Version 3.6 on April 18, 2014. This major release contains WRFDA 3.6, as well as updates to WPS, HRRR, and WRF-Chem. This represents months of preparation and oversight, summarized in previous reports. Details of WRF V3.6 may be found at: <http://wrf-model.org/users/release.php>.

Jimmy Dudhia (NCAR/MMM) and Ming Chen (NCAR/MMM) investigated and corrected an issue with the Penn State shallow convection scheme that is under development. The problem appeared in differences in results from serial and parallel runs, and they passed the fix back to Penn State. This scheme is being prepared for a future WRF release.

Dudhia and Pedro Jimenez (CIEMAT, Spain) have been testing a new oceanic surface roughness formulation, evaluating it via verification of WRF forecast winds with ocean wind energy site observations. The formulation appears more suitable for shallow seas, and development is ongoing.

Dudhia consulted with Jim Bresch (NCAR/MMM) in work toward robust changes for the use of WRF diffusion option `diff_opt=2` (diffusion along horizontal surfaces) in complex terrain. They are seeking formulations that reduce diffusion in steep terrain gradients in complex terrain. While the WRF V3.6 version of `diff_opt=2` had a fix that included a slope-dependent factor (designed by Joe Olson of GSD and now being used in the HRRR, NCAR sees need for further options and they are now testing a deformation-dependent component.

PLANNED EFFORTS: The development and incorporation of new physics and dynamics for WRF for the RAP and HRRR will continue through this quarter.

UPDATES TO SCHEDULE: NONE

14.5.1.E10 31 March 2015 **(ESRL and NCEP)**

Deliver progress report on development of NARRE.

NCEP

The NARRE-TL was upgraded with RAP V2. (Du, Zhou, Yang, Jovic)

Deliverables	Delivery Schedule
Task 1: Improve Turbulence Guidance From NWP Forecasts	
A. Finalize RAPv3 and HRRRv2 for summer 2014 real-time exercise.	APR 2014 COMPLETE
B. Code for RAPv3 and HRRRv2 finalized for transfer to NCEP/EMC for 2015 implementation.	OCT 2014
C. Complete the testing of the 40-20313 km dual-resolution hybrid DA system for RAP with 3-hourly cycles with conventional data.	OCT 2014
D. Report on RAPv3 model and data assimilation configuration and progress. This will include a report on wind verification and its improvements in RAPv3 vs. RAPv2.	DEC 2014
E. Finalize code for RAPv3 to NCO for implementation at NCEP.	JAN 2015
F. Report on wind accuracy from RAP and HRRR by quarter for previous year strongly related to turbulence guidance.	MAR 2015
G. Requests for Change (RFCs) filed to submit code changes as part of upgrade for RAPv3 software to NCO.	MAR 2015
H. Deliver progress report on development of NARRE.	MAR 2015

Task 2: Improve Quality Of Convective Weather Forecasts From RAP, HRRR, NAM, NAM-Nests and Eventually NARRE And HRRRE

Subtasks

14.5.2.1 15 April 2014 **(GSD)**

Report on enhancements to RAP 13-km and HRRR 3-km radar data assimilation for beginning 2014 warm-season evaluation using the ESRL-updated version of the HRRR (i.e., HRRRv2).

Following extensive testing and evaluation, a RAP/HRRR change bundle was made in late March 2014. The package includes changes to both the data assimilation and model portions of both the RAP and HRRR forecast systems and is summarized in the following report: <http://ruc.noaa.gov/pdf/ESRLRAPHRRRchanges2014.pdf>

The testing involved single-case study experiments, retrospective evaluations, and real-time parallel cycles of individual changes and grouping of changes to check all aspects of the change bundle. The change bundle was a mix of addressing known issues and adding new capabilities. Highlights of the change bundle for the RAP include enhancements to the hybrid data assimilation and the cloud analysis, improvements in the snow cycling and dew point assimilation, and upgrades to the Grell-Freitas (GF) cumulus parameterization and the MYNN planetary boundary layer scheme. Highlights for the HRRR include most of the RAP enhancements plus adding a hybrid assimilation procedure and adjustments to the strength of the reflectivity-based diabatic heating. Also, both the WRF model and GSI analysis were updated to the latest community repository versions.

Statistical evaluation of both the RAP and HRRR retrospective and real-time parallel runs showed broad improvement in nearly all aspects (upper-air, surface, precipitation, reflectivity, etc.). Recent real-time performance has been quite good, with impressive skill demonstrated for recent convective cases as shown in Fig. 1.

14.5.2. 15 May 2014 **(GSD)**

Improved (optimized weight factors, and observation selection) 15-min HRRR-based RTMA.

14.5.2. 1 5 August 2014 **(GSD)**

Complete testing of updated version of 3-km sub-hourly radar assimilation within HRRR pre-forecast cycling period.

Changes made for 2014 warm season evaluation, resulting in reduction of high bias during first few HRRR forecast hours.

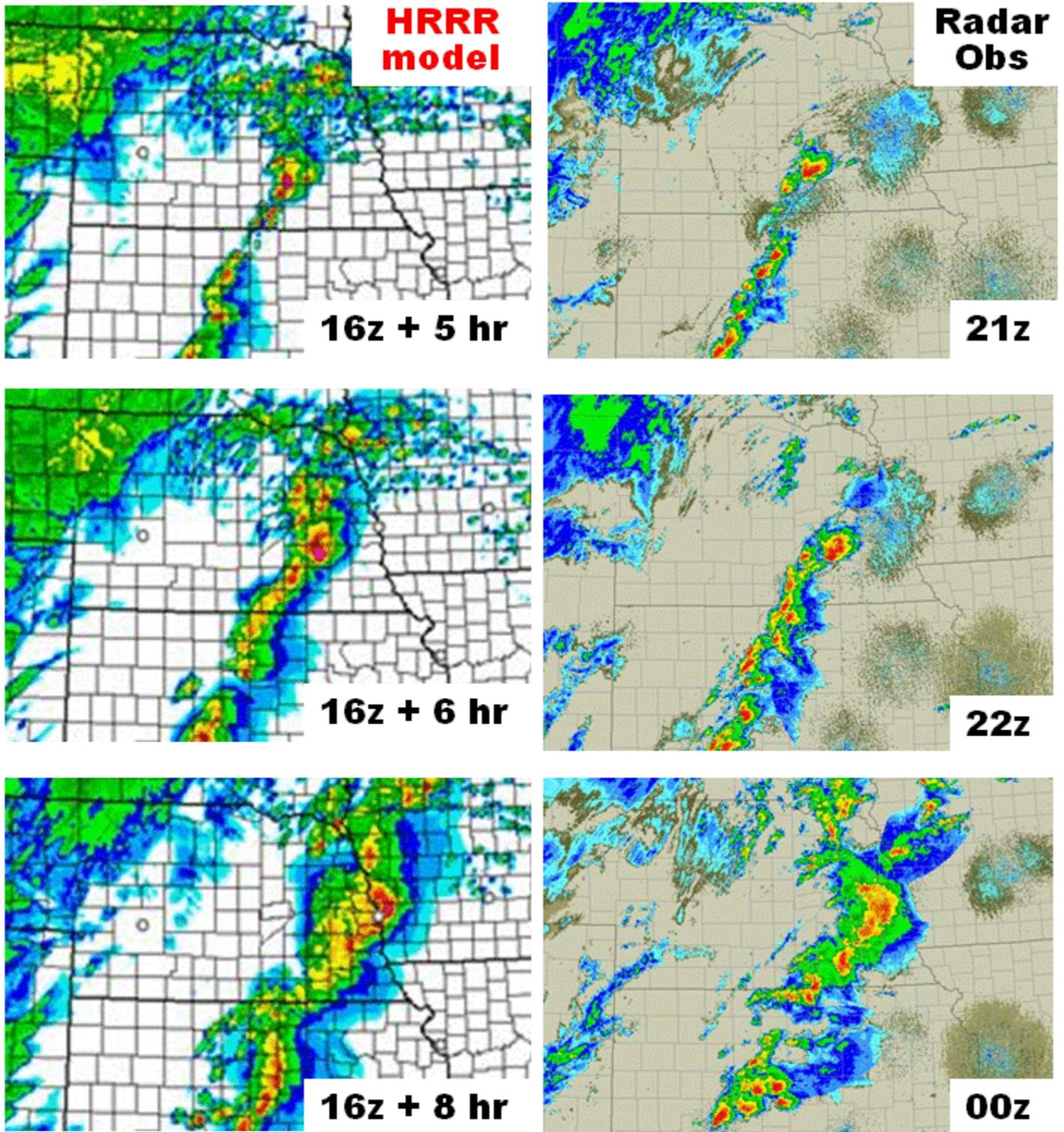


Fig. 1. Radar observed (left) and real-time HRRR forecast reflectivity (right) for broken line of storms on May 11, 2014. Comparison of HRRR 5, 6, and 8 hour forecasts with the radar observations reveals good HRRR depiction of overall storm mode and structure, as well weaknesses and gaps in the line, and even location of individual cells.

14.5.2. 20 Oct 2014 (GSD)
Complete 2014 HRRR summer evaluation using modeling and assimilation modifications determined in 2013 exercise. Collaborate on analysis of HRRR tests and deliver summary of results.

14.5.2. 15 Dec 2014 (GSD)
Based on 2014 RAP and HRRR results, provide update report on development and testing of data assimilation and model enhancements important for improving forecasts of convective weather within the RAP and HRRR.

14.5.2. 1 5 Dec 2014 (GSD)
Single-case test of storm-scale ensemble data assimilation completed for HRRR over small Northeastern U.S. domain.

14.5.2. 15 March 2015 (NCEP)
Establish routine verification of NCEP suite of convective weather guidance and begin design of calibration strategy for ensemble systems.

NCEP

Several severe storm items have been in the verification for some time now, including surface-based CAPE and Best CAPE. Recent additions (to be implemented with the Q4 upgrade) for the severe storm community are verification of the 0-6 km vertical shear and also the Brooks-Craven Severe Parameter. A new capability in the grid2grid verification system, Fraction Skill Score (FSS), was added. Jacob Carley tested this new function in NAMRR reflectivity verification. This new function will be added into NCEP's operational verification package. (Zhou, Du, Yang, Shafran)

Deliverables

14.5.2.E1 1 August 2014 (NCEP and ESRL)
HRRRv1 implemented at NCEP pending available computing resources.

NCEP

This is mostly on track, but current efforts target September for implementation. The HRRRv1 has been running in parallel since February. Efforts are nearly complete to convert the codes to conform to NCEP standard and best practices. A very preliminary handoff of codes to NCO started in late April. (Manikin)

14.5.2.E2 1 April 2014 (NCEP)
Subject to NCEP Directors' approval, upgrades to HiResWindow and initial convection-allowing-scale ensemble (NSSE) becomes Operational at NCEP.

NCEP

The HiResWindow V6 upgrade began its NCO-run official 30-day parallel test on 15 April. Performance of the parallel system continued to be monitored, and queries from people evaluating the parallel were answered. This package includes the addition of new cloud output fields: low/middle/high cloud fraction, total column condensate, and total column values for condensate subspecies (water, ice, rain, snow). (Pyle)

14.5.2.E3 1 April 2014 (NCEP)
With approval of NCEP Director, RTMAv6 upgrade package is implemented at NCEP.

NCEP

The RTMA/URMA upgrade version 2.2.1 was implemented on January 28, 2014, following a successful briefing to the NCEP Director, which was also attended remotely by the various NWS Regions. Beside science improvements, the package introduced analysis grids for 10-m wind gust and surface visibility for all RTMA domains, increased the resolution of RTMA-Alaska from 6-to 3km, and added a new domain covering the Northwest River Forecast Center (NWRFC) area of responsibility. For CONUS and NWRFC, the package also introduced the Unrestricted Mesoscale Analysis, or URMA, which is a 6-hour delayed rerun of the analysis to include observations that arrive too late to be included in the RTMA (Manuel Pondevca, Steve Levine, Yanqiu Zhu, Ying Lin, Jeff McQueen, Geoff Manikin, Jim Purser, Dave Parrish, Yuqiu Zhu)

14.5.2.E4 15 July 2014 (ESRL)
Report on status of enhancements to HRRR for 2014 version, based on retrospective and real-time testing. .

14.5.2.E5 15 Oct 2014 (ESRL)

Complete 2014-summer evaluation with revised 3-km HRRR running every 1 h.

- Conduct real-time summer 2014 HRRR forecasts using 3-km WRF with 3-km assimilation initialized with radar-enhanced Rapid Refresh over full CONUS domain, monitor performance, modify code/scripts as needed, maintain high reliability working with ESRL computer facility
- Coordinate with other AWRP users and other collaborators, including coordination of HRRR grid transfers
- Provide project management
- Lead writing of report on summer 2014 HRRR experiments

14.5.2.E5.1 31 Mar 2015 (ESRL)

Report on convective weather forecast accuracy from HRRR by quarter for previous year.

14.5.2.E6 15 Nov 2014 (ESRL and NCEP)

Based on real-time parallel and retrospective testing, HRRRv2 code finalized and ready for transfer to NCEP/EMC

Note: Already, this date may need to be deferred since the HRRRv1 implementation is now planned for Sept 2014.

NCEP

HRRRv1 must be implemented at NCEP before any transfer to EMC of the HRRRv2 code currently being tested at ESRL can be considered. (Manikin)

14.5.2.E7 15 Jan 2015 (ESRL, assistance from CAPS under 5.1 support)

Report on initial retrospective test of storm-scale ensemble data assimilation for small Northeast U.S. domain.

14.5.2.E8 31 Jan 2015 (ESRL/GSD, NCEP)

Pending NCEP computer readiness and EMC and NCEP initial recommendations, Requests for Change (RFCs) are filed to submit HRRR code changes as part of upgrade for HRRR v2 software to NCO.

NCEP

This work has not yet started. (Manikin)

14.5.2.E9 1 Feb 2015 (ESRL and NCEP)

Provide revised 15-min RTMA surface analyses as improved alternative for frontal diagnostics and other diagnostics from surface analyses for CoSPA.

NCEP

Much progress has been made on adding 10-m wind speed, 2-m dew point, daily maximum and minimum temperatures, mean sea level pressure, and significant wave height as new control variables of the RTMA-GSI. Work continues to downscale the HRRR model forecast to provide an improved first guess for RTMA-CONUS. Work is underway to improve the efficiency of the recursive filter in RTMA-GSI, so that an acceptable runtime is maintained even as new control variables are added to the system. (Manuel Pondeva, Steve Levine, Jim Purser)

14.5.2.E10 15 March 2015 (ESRL)

Finalize all changes to the HRRR for the summer 2015 exercise into a frozen version of HRRR (and parent experimental RAP). This will include latest results on reflectivity verification.

Deliverables	Delivery Schedule
Task 2: Improve Quality Of Convective Weather Forecasts	
A. HRRRv1 implemented at NCEP pending available computing resources	AUG 2014
STATUS: Now planned for Sept 2014 as of May 2014.	
B. Report status of enhancements to HRRR for 2014 version, based on retrospective and real-time testing.	JUL 2014
C. Complete 2014-summer evaluation with revised 3-km HRRR running every 1 h. Conduct real-time summer 2014 HRRR forecasts using 3-km WRF with 3-km assimilation initialized with radar-enhanced Rapid Refresh over full CONUS domain, monitor performance, modify code/scripts as needed, maintain high reliability working with ESRL computer facility Coordinate with other AWRP users and other collaborators, including coordination of HRRR grid	OCT 2014

scheme. Interact with WRF-Chem experts for aerosol source datasets, surface emission inventories, and translation of specific aerosol variables into the constituents needed by the microphysics scheme.

14.5.3.4 1 May 2014 (NCEP)

Perform case-study simulations of high-impact weather events in order to evaluate NMMB model running the existing and newly added Thompson et al (2008) microphysics schemes.

NCEP

Uncycled NMMB retrospective cases tested the Thompson and WSM6 microphysics for a wide range of high-impact events. Nine cases were run at 12 km to see the effect on forecast cold biases; however, little if any positive impact was found. About an equal number of cases were run at 4 km, focusing on a wide range of severe weather events identified by SPC with a mix of cool-season and warm-season conditions. The 4-km experiments formed the basis for developing the Ferrier-Aligo microphysics, in which roughly more than a dozen changes were made based on comparisons of simulated radar reflectivity against radar observations. The Thompson, WSM6, and Ferrier-Aligo microphysics provide comparable skill in terms of simulated radar structures useful for severe weather forecasts, as well as in terms of QPF, near surface and upper-air objective scores, and in forecasts of cloud ceiling heights and visibility useful for aviation. Adjustable parameters within these microphysics schemes can produce different forecasts that impact the presence of super cooled liquid droplets and drops, making it difficult to evaluate impacts on aircraft icing. (Ferrier, Aligo)

14.5.3.5 1 Jun 2014 (NCAR/RAL)

Test and evaluate the ice initiation mechanisms via aerosols to ensure the water-ice balance is relatively un-changed versus the prior scheme or else the updated scheme may result in significant loss of skill of aircraft icing forecasts since water is rapidly depleted by ice when too many ice crystals are supplied.

14.5.3.6 1 Sep 2014 (NCAR/RAL)

Continue to increase the complexity and interactions between the newly added aerosol variables in the microphysics with the PBL, radiation, convection, and shallow convection schemes. Particular focus will be the depletion of aerosols nucleated by sub-grid-scale eddies, the effects of which are represented by the PBL and convection schemes.

Current efforts: There were no efforts on any tasks in April 2014 because funding did not arrive at NCAR until the month of May.

Future work: NCAR-RAL will assist NOAA-GSD to adopt/utilize the new scheme. Trude Eidhammer will resume additional testing of the ice initiation by aerosols in the next month or two.

Problems encountered/Delays: A gap in funding from end of FY13 to start of FY14 caused us to pause activity on this task. The integration of the aerosol-aware microphysics scheme depends on availability of NOAA-GSD personnel. Interface with other organizations: None.

Deliverables

(All Option A unless noted otherwise)

14.5.3.E1 1 Aug 2014 (NCAR)

Submit updated cloud microphysics code to WRF repository; document changes and purpose of changes in a report.

14.5.3.E2 31 Aug 2014 (ESRL)

Complete initial evaluation of aerosol-aware microphysics in RAP/HRRR test evaluation/demonstration at GSD for its suitability for future NCEP implementation.

14.5.3.E3 1 Dec 2014 (NCAR)

Submit a report and possible journal manuscript related to the aerosol-ice sensitivity experiments including specific application to aircraft icing.

14.5.3.E4 20 Dec 2014 (ESRL)

At the annual NCEP Product Suite Review report on RAP / HRRR physics upgrades. This will include metrics on improvement to cloud and RH forecasts from these physics upgrades.

14.5.3.E4.1 31 Mar 2015 (ESRL)

Report on RH/cloud forecast accuracy from RAPv3 and HRRRv2 by quarter for previous year, related to icing guidance.

14.5.3.E5 31 Jan 2015

(ESRL/GSD, NCEP)

Pending NCEP computer readiness and EMC and NCEP initial recommendations, Requests for Change (RFCs) are filed to submit WRF physics code changes as part of upgrade for Rapid Refresh v3 software to NCO.

NCEP

This work has not yet started. (Manikin)

Deliverables	Delivery Schedule
Improve Quality Of Icing Weather Forecasts	
A. Complete initial evaluation of aerosol-aware microphysics in RAP/HRRR test evaluation/demonstration at GSD for its suitability for future NCEP implementation.	AUG 2014
B. At the annual NCEP Product Suite Review report on RAP/HRRR physics upgrades. This will include metrics on improvement to cloud and RH forecasts from these physics upgrades.	DEC 2014
C. Requests for Change (RFCs) are files to submit WRF physics code changes as part of upgrade for Rapid Refreshv3 software to NCO.	JAN 2015
D. Report on RH/cloud forecast accuracy from RAPv3 and HRRRv2 by quarter for previous year, related to icing guidance.	MAR 2015

Task 4: Develop Convection-ATM-Specific Improvements To Guidance From The HRRR (And Later, HRRRE) and Interact With CoSPA (Or Other) Program Partner Labs And The FAA

Subtasks

14.5.4.1 15 Aug 2014

(GSD)

Initial testing toward variational / ensemble cloud analysis scheme within the GSI framework.

14.5.4.2 15 Nov 2014

(GSD, NCEP)

Finalize new cloud/hydrometeor analysis for 2015 RAPv3/HRRRv2

NCEP

No work done in April. (Liu)

14.5.4.3 15 Feb. 2015

(GSD, NCEP)

Report on progress toward variational/ensemble cloud analysis

NCEP

The GSI was updated in the official NDAS parallel for the last time before implementation. The code was tested to make sure that the cloud analysis was turned on in GSI compilation and the NDAS cycling. (Liu, Wu, Carley)

14.5.4.4 15 March 2015

(NCEP, ESRL)

Groups collaborate on initial work toward cloud analysis scheme for use in NARRE ensemble system.

NCEP

No work done in April. (Liu, Wu, Carley)

14.5.4.5 31 March 2015

(ESRL, NCEP)

Establish routine verification of NCEP suite of ceiling & visibility guidance and begin design of calibration strategy for ensemble systems.

NCEP

Visibility has been included in verification for several years. Currently we verify a cloud base height and we are currently working on a strategy to verify ceiling. The visibility grid2grid verification package was built and tested against the 2.5km URMA. This new verification will be added into NCEP's operational verification package. (Zhou, Shafran, Du, Yang)

Deliverables

14.5.4.E1 1 April 2014

(NCEP)

With approval of NCEP Director, RTMAv6 upgrade package is implemented at NCEP (including visibility).

The RTMA/URMA upgrade version 2.2.1 was implemented on January 28, 2014, following a successful briefing to the NCEP Director, which was also attended remotely by the various NWS Regions. Beside science improvements, the package introduced analysis grids for 10-m wind gust and surface visibility for all RTMA domains, increased the resolution of RTMA-Alaska from 6-to 3km, and added a new domain covering the Northwest River Forecast Center (NWRFC) area of responsibility. For CONUS and NWRFC, the package also introduced the Unrestricted Mesoscale Analysis, or URMA, which is a 6-hour delayed rerun of the analysis to include observations that arrive too late to be included in the RTMA (Manuel Pondeca, Steve Levine, Yanqiu Zhu, Ying Lin, Jeff McQueen, Geoff Manikin, Jim Purser, Dave Parrish, Yuqiu Zhu)

14.5.4.E2 1 June 2014

(NCEP)

With approval of NCEP Director, SREF, HiResWindow and NAM upgrade packages are implemented at NCEP (including corrections to ceiling, visibility and cloud field prediction & diagnoses).

The HiResWindow V6 upgrade, which began the final pre-implementation parallel in April, is scheduled to become operational on 3 June. (Du, Zhou, Yang, Jovic, Pyle, Rogers)

14.5.4.E3 15 Dec 2014

(ESRL/GSD)

Finalize cloud/hydrometeor assimilation for RAPv3 and transfer code to NCEP.

14.5.4.E4 15 Feb 2015

(ESRL/GSD)

Report on variational / ensemble/hybrid cloud analysis development for RAP and NARRE

14.5.4.E5 31 March 2015

(NCEP)

Subject to NCEP Directors' approval, upgrades to RTMA/URMA (addition of total cloud and cloud base height [ceiling]) become Operational at NCEP.

Code necessary to produce RTMA/URMA analysis of ceiling has been obtained. Work toward merging this capability into the current RTMA/URMA parallel code is expected to begin in May 2014. (Pondeca, Carley, Levine)

Deliverables	Delivery Schedule
Task 4: Develop Convection-ATM-Specific Improvements	
A. Report on ATM impact related to skill of HRRR forecast.	FEB 2015
B. Complete implementation of new microphysics scheme and associated reflectivity and ET diagnostics in real-time ESRL/GSD RAP and HRRR prior to code freeze for 2015-exercise release.	MAR 2015
C. Report on baseline testing of the early 2015 HRRR version.	MAR 2015
D. Report on evaluation of revised Thompson aerosol-aware microphysics for RAP/HRRR for its effects on echo-top and reflectivity in ESRL RAP/HRRR.	MAR 2015