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The hourly updated US High-Resolution Rapid Refresh (HRRR) storm-scale forecast model

Curtis Alexander, David Dowell, Stan Benjamin, Stephen Weygandt, Joseph Olson, Jaymes Kenyon, Georg Grell, Tanya Smirnova, Terra Ladwig, John Brown, Eric James, and Ming Hu

NOAA Research, Earth System Research Laboratory, Boulder, CO, United States (stan.benjamin@noaa.gov)

The 3-km convective-allowing High-Resolution Rapid Refresh (HRRR) is a US NOAA hourly updating weather forecast model that use a specially configured version of the Advanced Research WRF (ARW) model and assimilate many novel and most conventional observation types on an hourly basis using Gridpoint Statistical Interpolation (GSI). Included in this assimilation is a procedure for initializing ongoing precipitation systems from observed radar reflectivity data (and proxy reflectivity from lightning and satellite data), a cloud analysis to initialize stable layer clouds from METAR and satellite observations, and special techniques to enhance retention of surface observation information. The HRRR is run hourly out to 15 forecast hours over a domain covering the entire conterminous United States using initial and boundary conditions from the hourly-cycled 13km Rapid Refresh (RAP, using similar physics and data assimilation) covering North America and a significant part of the Northern Hemisphere. The HRRR is continually developed and refined at NOAA's Earth System Research Laboratory, and an initial version was implemented into the operational NOAA/NCEP production suite in September 2014. Ongoing experimental RAP and HRRR model development throughout 2014 and 2015 has culminated in a set of data assimilation and model enhancements that will be incorporated into the first simultaneous upgrade of both the operational RAP and HRRR that is scheduled for spring 2016 at NCEP.

This presentation will discuss the operational RAP and HRRR changes contained in this upgrade. The RAP domain is being expanded to encompass the NAM domain and the forecast lengths of both the RAP and HRRR are being extended. RAP and HRRR assimilation enhancements have focused on (1) extending surface data assimilation to include mesonet observations and improved use of all surface observations through better background estimates of 2-m temperature and dewpoint including projection of 2-m temperature observations through the model boundary layer and (2) extending the use of radar observations to include both radial velocity and 3-D retrieval of rain hydrometeors from observed radar reflectivities in the warm-season. The RAP hybrid EnKF 3D-variational data assimilation will increase weighting of GFS ensemble-based background error covariance estimation and introduce this hybrid data assimilation configuration in the HRRR.

Enhancement of RAP and HRRR model physics include improved land surface and boundary layer prediction using the updated Mellor-Yamada-Nakanishi-Niino (MYNN) parameterization scheme, Grell-Freitas-Olson (GFO) shallow and deep convective parameterization, aerosol-aware Thompson microphysics and upgraded Rapid Update Cycle (RUC) land-surface model. The presentation will highlight improvements in the RAP and HRRR model physics to reduce certain systematic forecast biases including a warm and dry daytime bias over the central and eastern CONUS during the warm season along with improved convective forecasts in more weakly-forced diurnally-driven events. Examples of RAP and HRRR forecast improvements will be demonstrated through both retrospective and real-time verification statistics and case-study examples.