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US NOAA HRRR/RAP Model/Assimilation System 2016-17 Improvements for Aviation Weather Applications

Stan Benjamin, Curtis Alexander, Stephen Weygandt, Ming Hu, Tanya Smirnova, Joseph Olson, John Brown, Jaymes Kenyon, Eric James, Isidora Jankov, and Terra Ladwig

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

To improve US short-range forecast guidance for aviation (and severe weather and energy applications), an operational upgrade of the Rapid Refresh (RAP, 13km) and High-Resolution Rapid Refresh (HRRR, 3km) model systems at NOAA's NCEP occurred in August 2016. This coordinated upgrade (RAP version 3 and HRRR version 2, RAPv3/HRRRv2) includes enhancements to the data assimilation, model, and post-processing formulations that result in significant improvements to aviation forecasts for upper-air, surface, cloud and precipitation, and thunderstorms. Key changes will be described toward the next NCEP operational implementation (RAPv4/HRRRv3), planned for early 2018. Additional work is focused testing and refinement in related areas, including a real-time prototype High Resolution Rapid Refresh Ensemble (HRRRE), a post-processing-based HRRR-time-lagged ensemble (HRRR-TLE), and a HRRR domain covering Alaska (HRRR-AK).

In this presentation, a recap of the RAPv3/HRRRv2 upgrade and forecast improvements will be provided, followed by a description of the planned improvements for RAPv4/HRRRv3 and impacts for aviation guidance for winds (turbulence), clouds (ceiling and visibility) and near-surface (terminal) forecasts. ESRL is now showing strong further improvements from model and assimilation improvements from the new RAPv4/HRRRv3 including further enhancements to the model physics components (aerosol-aware Thompson microphysics, MYNN PBL scheme, Smirnova land-surface model), and testing of a new vertical coordinate). The interaction of the various physics modules has been a particular research focus area, with modifications in place that further reduce various physics-related model biases. HRRRv3/RAPv4 data assimilation enhancements include improved radar and cloud assimilation, addition of data from TAMDAR aircraft, radar radial velocity data, and GOES cloud-top cooling rate data).

HRRR time-lagged ensemble products are now being produced in real-time for many variables, with grids being transferred to the US Aviation Weather Center and other operational centers to estimate hourly-updating likelihood probabilities of various weather hazards for aviation over the CONUS out to 24 hours. These weather hazards include both convection (intensity and radar echo-top heights) and low ceiling/visibility (including flight rules). In addition, a full 3-km HRRR ensemble with 40-member data assimilation was tested in real-time during the spring of 2016, with additional real-time testing scheduled to resume in March 2017. A brief overview of these efforts will be presented.