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Improved short-range cloud/surface forecasts from US models at 12-km and 3-km scale

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Biases in 2m temperature and downward shortwave radiation have been reduced from physics improvements in late 2018 for short-range (6h-24h) forecasts in the US NOAA HRRR (3km, High-Resolution Rapid Refresh) and RAP (13km, Rapid Refresh, HRRR-parent) hourly-updated models. These improvements will be implemented at the NOAA/NCEP in early 2020 These refinements are critical for improved energy (solar and wind), aviation (ceiling), and severe storm (convective environment) prediction. Previous HRRR/RAP predictions from NCEP show a deficiency in cloud attenuation and excessive precipitation. These future improvements result from better radar/cloud assimilation and better PBL physics. The introduction of 3-km ensemble data assimilation for the HRRR is the most important assimilation modification. Improved subgrid-scale clouds into the MYNN PBL scheme were shown to be essential for improved cloud and boundary-layer depth accuracy.

In this paper, we describe data assimilation improvements (3km ensemble assimilation – 36 members) essential for these upcoming NOAA/NCEP changes. We also describe improvements to the boundary-layer, cloud microphysics, and land-surface schemes (including introduction of a small lake model to avoid significant temperature biases in spring and fall) designed to address cloud/precipitation forecast deficiencies. Treatment of real-time fire emissions (from MODIS and VIIIRS) to allow addition of smoke treatment in HRRR and RAP also improves 2m temperature forecasts under some conditions.

This physics suite for the HRRR/RAP models, found to be increasingly effective for mesoscale phenomena, is also being tested for global 7-10-day application with NOAA's global model (FV3). The HRRR/RAP physics suite (including the Grell-Freitas convection parameterization) is now being found to be approximately equivalent in skill to that from current operational NOAA global model physics. These results will also be reported in this presentation.