Improvements to ceiling and visibility forecasts from the 2019-20 US HRRR/RAP short-range forecast models

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More accurate ceiling, visibility, and near-surface forecasts have resulted from changes to the US NOAA-NCEP HRRR (3km, High-Resolution Rapid Refresh) and RAP (13km, Rapid Refresh, HRRR-parent) hourly-updated models in July 2018. The HRRR and RAP forecasts for wind, moisture/cloud, and vertical motion fields are the backbone for the US aviation hazard forecasts. Previous HRRR/RAP predictions from NCEP show deficiencies in ceiling/visibility forecasts. These latest and further upcoming improvements in 2020 to US aviation forecasts from HRRR/RAP models result from better cloud and surface assimilation (including 3km ensemble assimilation). Introduction of improved subgrid-scale clouds into the MYNN PBL scheme are shown to be particularly essential for improved cloud and ceiling accuracy for the upcoming 2020 HRRR/RAP change.

In this paper, we describe data assimilation improvements essential for these upcoming NOAA/NCEP changes including the introduction of an hourly 3km ensemble data assimilation method using 36 members at 3km resolution. We also describe improvements to the boundary-layer, cloud microphysics, and land-surface schemes designed to address ceiling and visibility forecast deficiencies.