5.3 New developments in RAP/HRRR physical parameterizations: MYNN-eddy diffusivity/mass-flux PBL scheme with a mixing length revision

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The 13-km Rapid Refresh (RAP) and 3-km convection-allowing High-Resolution Rapid Refresh (HRRR) are hourly-updating forecast models that support short-range forecasting interests within the contiguous United States. The current operational version of these models uses the Mellor–Yamada–Nakanishi–Niino (MYNN) planetary boundary layer (PBL) scheme and the Grell–Freitas–Olson (GFO) shallow-convection scheme. In an attempt to improve the coupling of the small-eddy turbulence and larger plume-like turbulence in the RAP/HRRR, a merged eddy diffusivity/mass-flux (EDMF) version is developed. The expected benefits include a unified treatment of subgrid-scale clouds and more control over the delegation of work for local and non-local mixing in convective environments. Special effort is made to incorporate scale-aware aspects in both components of the new EDMF scheme and to ensure proper coupling to the radiation parameterization.

Parallel efforts to improve the eddy diffusion component of the EDMF include a revision of the mixing length formulation in the MYNN PBL scheme. The primary motivation is to improve simulations of the stable boundary layer by testing a more "z-less" mixing length approach. Case studies show some improvements in low-level jets and cold pool formation/maintenance. The new EDMF scheme improves several aspects of the RAP/HRRR forecasts, which have particular importance for renewable energy and convective forecast applications.