P10 Achieving scale-independent convection representation with the Kain-Fritsch scheme

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A major impediment to high-resolution (~3 to ~15 km) modeling for weather prediction and climate projections is the lack of a seamless convection parameterization that works across many scales. Many modeling studies at those "gray scales" highlight the issue of excessive precipitation during warm periods (e.g., summer). Thus, the focus of our presentation is on the development and testing of a new multiscale version of the Kain-Fritsch (KF) convection parameterization scheme suitable across a range of spatial scales down to 1 km. First, we proposed a scaling parameter to introduce scale-dependence in the KF scheme for use with various convection parameters, and then we developed new formulations for (1) the convective adjustment timescale, (2) the entrainment of environmental air, (3) the fallout of condensates from updrafts, and (4) the stabilizing capacity. These scale-dependent formulations make the KF scheme operable at all scales down to about sub-kilometer grid spacing. Furthermore, we have introduced methodologies for (5) adjusting grid-scale vertical velocity with convective updrafts and downdrafts; and (6) eliminating double counting of precipitation due to concurrent usage of grid-scale and subgrid-scale cloud formulations for any grid cell.

Regional weather simulations using the WRF model for a period of 10 days will be presented to demonstrate the effects of these updates to the KF scheme. Additionally, we present spatial and/or temporal variation of the reformulated convection parameters to understand their impacts on model-simulated surface precipitation.