



A revised version of the Kain-Fritsch convective parameterization

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We have developed and implemented a revised version of the Kain-Fritsch (KF2) convective parameterization in which the vertical profile of updraft mass flux detrainment is revised in a manner consistent with observations. Compared with the original scheme, mass flux detrainment occurs through a deeper layer. One effect of this modification is to alter the vertical profile of cloud mass from the convection scheme (including cloud water and ice) supplied to the host model for explicit simulation by the grid-resolved dynamical equations and parameterized microphysical processes. Another effect is to reduce an unrealistic heating-cooling couplet near cloud top that has been a persistent characteristic of the scheme since its origin in the work by Fritsch and Chappell.

We tested these modifications and their sensitivity to horizontal resolution in simulations of the June-July 1993 flood in the central United States. The KF2 modifications affected the diurnal cycle of precipitation by reducing precipitation from the convective parameterization and increasing precipitation from more slowly evolving mesoscale processes. The modified KF2 reduced an afternoon bias of high precipitation rate in both low- and high-resolution simulations. The modifications interacted with grid resolution; specifically, they affected development of mesoscale precipitation systems only in the high-resolution simulations. Compared with simulations using high resolution or modified KF2 but not both, combining high resolution and modified KF2 produced more frequent and more realistically clustered propagating, nocturnal mesoscale precipitation events and agreed best with observations of nocturnal precipitation rate.