European Conference on Severe Storms 2015
14–18 September 2015, Wiener Neustadt, Austria
ECSS2015-99

Upscale feedbacks associated with supercellular thunderstorms sampled during MPEX

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Deep convective storms are well known to modify the 3D temperature, moisture, and wind distributions of their local environment via adiabatic and diabatic processes. There are still uncertainties, however, about the duration and areal extent of such modifications as a function of the mode of convection, including supercellular thunderstorms. These uncertainties served to motivate one of the research foci of Mesoscale Predictability Experiment (MPEX), which specifically regarded convective upscaling and its feed back to the convective-scale dynamics and predictability. Using balloon-borne GPS radiosondes, such upscale feedbacks were sampled during the MPEX field phase, which was conducted 15 May through 15 June 2013 within the Great Plains region of the United States.

Analyses of the MPEX soundings collected in the immediate environment of supercellular thunderstorms are indicating that the sampled supercells produced a significant, persistent upscale feedback mostly near the ground, in the form of a surface-based cold pool. This was realized as a marked reduction of environmental convective available potential energy, and as a slight modification of the vertical wind shear. Thus, as confirmed using complementary idealized model simulations, the strength, areal extent, and depth of the cold pool were critical to the upscale feedback, which highly influenced how rapidly the local atmosphere could return to its pre-convective state.

Significant feedbacks aloft tended to be transient, moving with the storm rather than trailing in the wake or otherwise extending well beyond the storm's confines. For example, the largest modifications to the vertical wind shear were near-storm and owed to mesocyclonic enhancements of the midlevel winds. Similarly, the mid-level lapse rates were modified mostly within translating updraft regions. The additional contribution of anvil-level radiative effects is under investigation.

Other MPEX cases, especially those involving non-supercellular convection, are being analyzed in tandem with model simulations to explore the veracity and implications of these findings.