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Behavior of Vertical-Vorticity Rivers in Simulated Supercells

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Persistent near-ground rotation in simulated supercells has been found to depend on so-called rivers of vertical vorticity that sometimes develop within thunderstorm outflow. Within these streams, vertical vorticity is transported into the vortex, whose longevity relies on the continued influx of vertical vorticity. Vorticity rivers emerge at the base of downdrafts where they are fed by mostly baroclinically-generated vorticity. If the vorticity rivers are interrupted, the supply of vorticity into the vortex ceases and the vortex decays, which typically happens as a result of a strong outflow surge. Moreover, in some cases instead of a coherent river, merely “patches” of vertical vorticity develop within the outflow, which fail to be channeled into the region beneath the updraft and consequently no persistent vortex develops.
Using idealized numerical simulations of the CM1 model, the study is focused on analyzing the factors that determine the different failure modes of vortex genesis and maintenance from the vorticity-river perspective. Preliminary results indicate that weak, spotty downdrafts fail to produce coherent rivers, while intense, unsteady downdrafts result in vorticity rivers that are prone to disruption. The optimum state for vortex maintenance appears to be strong and persistent downdrafts.