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Outflow Surges in Simulated Supercell-Like Storms and their Influence on Tornado Development

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In the past years many modeling and observational studies have noted the importance of rear flank outflow surges in tornadogenesis and maintenance, while others found the surges to disrupt the tornadic circulation. On the one hand outflow surges could be able to not only increase the local vertical vorticity, but also direct it along kinematic boundaries and feed it into the developing vortex as vorticity rivers. Also, the associated rear flank gust front tends to increase low level convergence and could help keep the tornado-like vortex below the low-level mesocyclone as the gust front is wrapped around the area of increasing circulation. On the other hand, the unsteadiness of strongly surging outflow could interrupt existing vorticity rivers or the developing tornado and decrease vertical accelerations, if the air is cold and less buoyant.

In an attempt to gain a better understanding of the influence of internal surges on supercell tornados, we are using idealized simulations in the Cloud Model 1 to create artificial heat sinks, embedded in the outflow area. The strength of these heat sinks is set to periodically change with time, to reproduce the pulsing character of downdrafts. Different configurations of heat sink size, number, position and frequency were implemented and their influence on the storm structure and vortex development are tested. Preliminary results show strong anticyclonic vortices forming in our first simulations with time-dependent heat sinks. Furthermore, we will explore why the pseudostorms keep their supercell-like structure longer, if the general outflow is pulsing. Possibly, the weaker phases of the heat sink enable a reset of the configuration of up- and downdraft regions.