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Evolution of conserved variables related to storm cells during severe convection in a mesoscale model

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The WEX-MOP project aims at a next generation ensemble prediction system for the mesoscale. One goal of WEX-MOP is to quantify the role of conserved quantities during extreme convective weather. Conserved variables might offer new insight in the predictability of those events. An important conserved quantity is potential vorticity (PV), a fundamental property of the atmospheric flow on synoptic and planetary scales. However, investigations thereof on the atmospheric mesoscale are relatively new. PV has a close relation to rotation and balance, which is important in storm dynamics. Here we characterize the evolution of storm cells in terms of PV to provide new insights into storm dynamics.

Tracking of storm cells has been frequently performed using radar and/or satellite data. It received less attention using model data. We present storm cell tracks for two cases of severe convection in June 2011 simulated using the non hydrostatic COSMO-DE weather model. The two cases have a very different background: on 5 June 2011 the convection was primarily locally forced by CAPE, while on 22 June there was strong forcing due to a cold front. For each of the two cases vertical velocity maxima are tracked. High intensity cells in both cases show a high correlation between PV and vertical velocity anomalies. This has been attributed to a strong environment storm relative helicity and/or CAPE close to the surface. For both cases there is a high variability in the cell characteristics. However, the PV anomalies on 22 June are larger than those on 5 June and have a higher correlation between vertical velocity and PV, consistent with the larger wind shear and helicity in the environment at this day. Study of further cases is necessary to test the hypothesis that a high helicity environment leads to more intense long lasting cells.