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Organisation of potential vorticity during severe convective weather

C. Weijenborg, P. Friederichs, and A. Hense
University of Bonn, Meteorological Institute, Germany (cwborg@uni-bonn.de)

Mesoscale weather extremes are generated by large and/or local scale instabilities. During extreme events conserved quantities are redistributed in order to reduce these instabilities. Hence, they may play an important role in the dynamics of extreme weather. One aim 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). PV is known to be a fundamental property of the atmospheric flow on synoptic and planetary scales, but investigations on the atmospheric mesoscale are relatively new.

Our investigations are based on ensemble forecasts of the COSMO-DE mesoscale weather prediction model. We concentrate on two convective weather situations during 05-06-2011 and 22-06-2011. The latter consists out of convection along a cold front, while at 05-06 convection took place more locally. On the convective weather scale (about 10 km) the PV is characterised by dipoles centred around a storm updraft. We hypothesise that the wind shear can organise the PV into bands. Composites of PV and wind speed show that the dipoles are consistent in strength and direction. This is confirmed by spectral analysis. Moreover, the composites suggests that the dipoles are at least quasi-stable. Anomalies of helicity and the dynamical state index, which measures the deviation from the stationary, adiabatic state, are also significant. Therefore the PV dipoles may be used as predictors for e.g. severe convection or related extreme events like wind gusts.