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Idealized testing of the sensitivity of mesovortices to low-level CAPE variations

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High-shear, low-CAPE environments are frequently associated with severe wind gusts. In particular, nearly 40% of the German annual derecho number can be attributed to high-shear, low-CAPE situations. On radar images, such events are associated with narrow cold-frontal rain bands and embedded small-scale mesovortices. Forecasting of mesovortices is challenging due to their rapid development and small size that make them difficult to detect by operational radar networks.

With this work, we will use idealized simulations of Cloud Model 1 (CM1) to analyse the occurrence of mesovortices along narrow cold-frontal rain bands in high-shear, low-CAPE environments. The model is initialized with a typical profile found for cold-season derechos in previously analyzed simulations of the COSMO model. In a first run of simulations, we will test with different bottom boundary conditions (no slip, free slip, semi-slip) for low-level impacts on the mesovortices and will proceed with the best suited set of bottom boundary conditions. Mesovortices are analyzed using a vortex identification method.

We will analyse these simulations with respect to small changes of the lapse rate in the environmental profile in order to study the impact of changes in low-level CAPE on such vortices. Vertical wind shear and low-level moisture are not changed. The results are analysed with respect to the number and intensity of simulated mesovortices.