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Effects of a modified stochastic backscatter model on simulations of convection

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Simulations of deep convection with cloud resolving models are often rather badly resolved. Therefore, the influence of the subgrid-scale parameterization models used in these kind of models can not be neglected. Former studies suggest that the resolution of turbulent structures in the sub-cloud layer is crucial for a correct simulation of deep convection. A lack of convergence with increasing resolution has also been related to deficiencies in the subgrid-scale parameterization models.

Therefore an effort to improve the SGS parameterization was made and a modified version of the stochastic backscatter model was implemented in the Met-Office Large-Eddy Model (LEM). In contrast to earlier model versions this version minimizes the effect of the vertically stretched grid and guarantees that energy is backscattered isotropically. A systematic study of the influence of backscatter on poorly resolved dry convective boundary layers has been performed and its influence on simulation results of shallow and deep convective cases is currently tested.

Such backscatter is on to scales which are just resolved and cannot compensate for the loss of smaller scale energy, which in poorly resolved simulations may be significant in overall transports. Therefore, its effect is biggest in cases where resolved and subgrid-scale contributions are of the same order of magnitude. The results of the study show a convective boundary layer which is similar in overall flow structure to that occurring without backscatter but has increased resolved variances especially in the horizontal velocity fields leading to more isotropic flow statistics.

Moreover, backscatter leads to a slight increase in entrainment and time series show that the results with stochastic backscatter move to equilibrium more quickly. Simulations of developing convection have shown that backscatter leads to an ealier onset of convection and reduces overshoots.