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Representation of turbulence in deep convective clouds at gray-zone resolutions.

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The limited-area atmospheric models provide nowadays kilometer-scale forecasts and within a few years hectometer-scale forecasts. A these fine scales, the convective motions and turbulent processes strongly interact, the former being considered explicitly resolved and the latter being located in the gray zone of turbulence. This study aims at evaluating and improving the parameterization of subgrid turbulence in deep convective clouds simulated by numerical cloud resolving model at kilometer scale.

For that, a LES of a deep convective cloud with a 50-m resolution is performed with the Meso-NH model. Then, the fields of this LES are averaged at kilometer and hectometer resolutions in order to obtain reference turbulent fluxes. Diagnostic assessment, from the reference fields, of the current parameterization of the Meso-NH model shows that turbulent kinetic energy is largely underestimated in the clouds, related to an underestimation of thermal production. The countergradient structure of turbulent fluxes is not reproduced, the local K-gradient formulation is not suitable. An alternative parameterization of some turbulent fluxes, proposed in the litterature, based on horizontal gradients, gives a better representation of the thermal production of turbulence in the cloud, with a good representation of countergradient areas. The on-line evaluation at 1-km resolution confirms the improvement, with an increase of subgrid turbulence and a significant decrease of vertical velocities in convective clouds.