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Unified boundary layer and convection parameterization: simulation of the transition from stratocumulus to shallow cumulus boundary layers

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Low level clouds are abundant in the Earth's atmosphere. Not only do they play a key role in local climate, but low clouds also significantly influence global climate and thus play an essential role in climate change. Global climate and weather models do not reproduce low-level clouds in a realistic way. In addition, it is becoming clear that a significant part of the uncertainty in climate change projection is a result of the uncertainty in low-level cloud response.

We argue that a significant improvement of the simulation of moist convective boundary layers and thus low-level clouds can be achieved by a more integrated parameterization of the subgrid-scale turbulence and convection. In this context, a new boundary layer parameterization is developed, which unifies the parameterization of boundary layer mixing and shallow convection. The new scheme is implemented in a single-column-model (SCM). Along with a realistic representation of moist physics, the SCM with the new parameterization can represent stratocumulus and shallow-cumulus toped boundary layers and the transition between those two regimes.