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Subcloud layer circulation of isolated moist convection cells

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We analyze a single diurnal cycle simulated by the two large eddy simulation (LES) models UCLA-LES and the vector vorticity model VVM in an idealized setup, which show precipitating deep convection in the course of the afternoon. Both models use the same initial conditions, horizontal and vertical grid, but show significant differences in the total amount of precipitation, and in the size of the clouds. We identify individual convection cells by rain cell tracking, and build composites of the cells. We explain the main differences between the LES models by both the surface flux calculation, and the precipitation formation in the cloud layer due to different microphysics schemes.

Although the diurnal cycles of precipitation and associated cold pools are quite different, the subcloud layer circulation about 30 min before surface precipitation onset and has a similar structure for both models, and is approximately stationary. We propose an analytic subcloud layer model (ASLM) for the flow field within the boundary layer below convective clouds which, despite some degree of idealization, is capable to describe this subcloud layer circulation as found in the LES. The analytic model features two fit parameters with a physical interpretation , one being the level of neutral buoyancy below the cloud base, and the other being the Brunt–Väisälä frequency.

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