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Role of subsidence vertical structure for stratocumulus precipitation and mesoscale organization - a CLARIFY case study

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Large scale subsidence co-determines lower tropospheric stability, boundary layer height, and entrainment into the boundary layer, and hence boundary layer cloud properties. Observations show substantial vertical structure in large scale subsidence in the lower troposphere. Such vertical structure is also present in global simulations. Here we examine the relationship between the vertical structure in large scale subsidence and stratocumulus properties, with a focus on precipitation and mesoscale organization. Specifically, we address the question whether the vertical structure in large scale subsidence is required to reproduce observed cloud properties. We use Lagrangian large eddy simulations that realistically simulate a transition from the closed- to the open cell stratocumulus state observed during the CLARIFY field campaign. The simulations match the satellite-retrieved cloud optical depth and effective radius over the course of the two-day simulations, and are consistent with aircraft in-situ profiles at its end. The simulations are driven by ERA5 reanalysis meteorology, which provides large scale subsidence. To study the role of vertical structure in large scale subsidence, we vertically homogenize it between the surface and 4000 m. Preliminary results indicate that the vertical structure in large scale subsidence in ERA5 is required to reproduce the observed stratocumulus evolution.

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