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Exploring a Stratocumulus-to-Cumulus Transition: A Perturbed Parameter Ensemble of Large-Eddy Simulations

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The transition from stratocumulus to cumulus clouds that takes place as air is advected from the subtropics towards the equator causes a decrease in cloud radiative effect, with cloud fraction halving from start to finish. The transition is initiated by increasing sea surface temperatures, and it is widely agreed that the lower tropospheric stability plays a key role in the timing of the transition. In this work, we study the relative importance of five atmospheric initial conditions: specific humidity in the boundary layer and free troposphere, free tropospheric potential temperature, inversion height and initial aerosol distribution. We simulate a Lagrangian trajectory of a stratocumulus-to-cumulus transition, using the Met Office/NERC cloud model coupled with a bulk microphysics scheme and a radiation scheme. From this base simulation we make 60 perturbations to simulate the transition under different combinations of the atmospheric initial conditions mentioned. Additionally, we include a model parameter from the Khairoutdinov and Kogan autoconversion parameterisation from 2000. We discuss here the relative importance of these so-called parameters, in particular the role of aerosol, and we explore whether a much faster transition by drizzle takes place in simulations with lower aerosol concentrations.