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Numerical choices in Large-Eddy Simulations influence their ability to represent length scale growth in shallow convection

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A growing body of evidence suggests that shallow circulations play a key role in organising trade-wind clouds at the mesoscales. In turn, many of these mesoscale circulations appear to emerge directly from the shallow convection itself. We infer a very simple model for explaining this feedback from Large-Eddy Simulations of a classical numerical experiment with minimal physics (BOMEX), which depends only on the turbulent transport of liquid water in cumulus clouds and the mean environment. Since the dominant scales of the cumulus convection driving the organisation are constrained around a kilometer, we hypothesise that simulations of the development of mesoscale cloud patterns through this mechanism are sensitive to choices in the numerical representation of the cumulus convection. We show that the timescale over which mesoscale cloud structures develop can more than double in our model, merely by modifying its grid spacing or advection schemes. Hence, rather high resolutions (<100m) or significantly improved unresolved scales models may be required to faithfully represent certain forms of trade-wind mesoscale cloud patterns in models, and to understand their influence on the cloud feedback more accurately.

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