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Impact of sub-grid mixing on spontaneous organisation of convection

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Convective organisation depends on interactions with radiation, entrainment, and cold pool processes. Focusing on the entrainment process, a set of radiative-convective equilibrium simulations with a 2km convection-permitting resolution show organisation to be dependent on the turbulence mixing scheme, which at these resolutions solely represents the entrainment process. Choices of mixing schemes that neglect the horizontal derivative of the vertical velocity fail to produce organised states. This shows that the entrainment mixing process appears to be a crucial, necessary but (not necessarily) sufficient component for organisation, despite recent emphasis on radiative feedbacks as the main driver for organisation. This also leads to the slightly concerning conclusion that the occurrence and eventual strength of feedback depends on the sub-grid scale turbulence formulation in convection-permitting models. Results are quantified using a new diagnostic technique called organisation index, which is used to extract precise information about the level of organization. The results indicate that far higher horizontal resolution simulations may be required in order to explicitly represent the entrainment process and view the state of organisation with confidence.