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Coupling a thermal population model to a discretized spectral convection scheme

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Understanding cloud-circulation coupling in the Trade wind regions, as well as addressing the grey zone problem in convective parameterization, requires insight into the genesis and maintainance of spatial patterns in cumulus cloud populations. In this study a simple toy model for recreating populations of interacting convective objects as distributed over a two-dimensional grid is formulated and coupled to a spectral EDMF convection scheme. A key element is the formulation in terms of discrete object number, for capturing binary behavior at small population sample sizes. The object birth rate is represented stochastically through a Bernoulli process, while advection of object number between gridboxes is also discrete. Implied scaling behavior is discussed a priori a simple offline application representing a population of relatively short-lived but interacting convective thermals. Adopting concepts from game theory, simple rules of interaction are introduced reflecting observed physical behavior in single cumulus clouds, including pulsating growth and environmental deformation. Under these rules, thermals can occur isolated but also part of a longer-lived cluster or chain. The realism of the self-organizing spatial patterns emerging under these rules is assessed. The associated cluster size distributions are then provided to EDMF. First results with DALES-EDMF including this population model are discussed.

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