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Clustering from a simple model for convective cold pool interaction

Jan Haerter (1), Steven Boeing (2), Olga Henneberg (1), and Silas Nissen (1)

(1) Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark (haerter@nbi.dk), (2) School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK

Convective organization may be the key to understanding of extreme events over land, leading to flash floods, and multiscale patterns over the ocean, such as the Madden Julian Oscillation. Yet, the organizational effect of cold pools has not been probed theoretically: cold pool gust fronts are now accepted to be involved in the triggering of new convective updrafts - but if this is the case, what are then the resulting consequences for convective self-organization? In particular, what qualitative differences are to be expected, when single cold pools excite new convective cells, as opposed to processes, where collisions between two or more cold pool gust fronts occur?

Within a conceptual model, we systematically explore the consequences of different interaction types theoretically and use large eddy simulations to back up our conclusions. The essentially parameter-free model we formulate is based on circles which increase in radius, as well as reactions that occur when the circles expand and interfere with other circles. The model is very simple, yet it yields surprisingly complex dynamics and, perhaps remarkably, clustering of convective cells.

We interpret our findings with regards to the diurnal cycle of convection, and comment on applicability of our model to radiative convective equilibrium simulations and the effect of self-aggregation.