Tracking of convective rain events in idealized and realistic large eddy simulations

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Abstract

Object oriented analysis methods are increasingly favored tools for statistical evaluations of data sets showing complex convective environments. These could be both model data as well as observations like radar data sets. I present a tracking algorithm that is particularly suited for the study of convective rainfall events and their interaction with neighboring convective cells. While some of these cells just form, grow, and finally disappear without interacting with other cells, others merge with their neighbors to form larger, more intense cells. In particular, repeated merging may be regarded as the preliminary stage of clustering and convective aggregation, as it is e.g. found in simulations of radiative convective equilibrium (RCE).

I will first discuss the properties of the tracking method on the basis of an application to idealized large eddy simulations (LES). For tracks that do not merge or split (termed "solitary"), many of these quantities show generic, often nearly linear relations that hardly depend on the forcing conditions of the simulations, such as surface temperature (Fig. 1). Furthermore, I will present a more realistic application on a limited area simulation with ICON for a domain covering Germany with 600 m grid spacing: In a land use change experiment, the whole domain is afforested by mixed forest, and the feedback on convection is investigated. It was found that convective cells are more intense in the afforested simulation, compared to the control simulation.

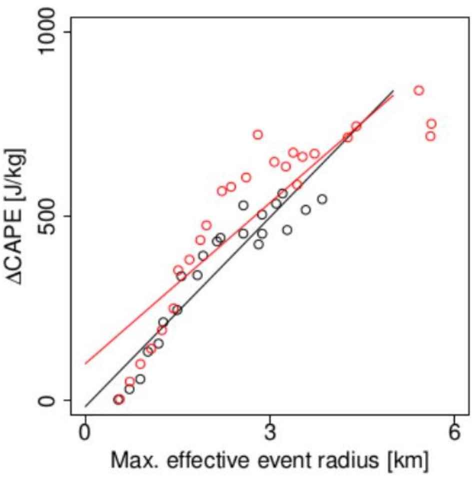

Fig.1: Approximately liner relation between the maximal extent of an isolated convective rain event, and the difference in Convective Available Potential Energy (CAPE) between the beginning and the end of the rainfall event. Two simulations are shown, one with 2 K higher surface temperature (red circles) compared to the other (black circles). The relation remains surprisingly robust with respect to the surface forcing (Moseley et al., 2018).

An important factor for the organization of convection is the role of cold pools. Similar as the convective cells that they originate from, cold pools can be regarded as individuals. As an outlook, I will discuss a tracking methods for cold pools, and speculate how it could be combined with the presented rain cell tracking into one single framework.

References:

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