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Characterization of the spatial distribution of cumulus cloud populations using large-domain LES

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One of the challenges of present day climate and weather prediction modeling is the so-called grey zone problem. Due to the ever increasing efficiency of high-performance computers cumulus convection gets partially resolved. In response to this problem there is a focus on developing scale-aware parameterization schemes for boundary layer-scale processes, such as the formation of shallow cumulus clouds. To inform these new schemes, our ability to describe shallow cumulus cloud populations in terms of size and spacing needs to improve. Studying the spatial distribution of shallow cumulus clouds is not new, there are many studies on cloud size distributions and cloud organization. Early research used mainly satellite data to gain insight in the organization of clouds. Clustering of clouds was often found, as well as a relation between the size of clouds and their spacing. However, for reliable statistics on cloud populations the amount of data was too limited, since often only a few snapshots were available for analysis. Nowadays we have powerful computer models to our disposal which we can use to advance the research on the spatial distribution of clouds. For the current study we use data from an ICON simulation that is done over the tropical Atlantic, a location known for the regular occurence of shallow cumulus. As added benefit this location has homogeneous surface conditions which enable us to ignore possible effects of the surface. The simulation consists of 4 nested domains, we use the inner domain with a resolution of about 150 m and a size of 150x400 km. This big dataset is used to quantify the spatial distribution of the clouds. Several metrics that are able to express irregularity are applied. Some are known (e.g. SCAI and radial distribution functions), whereas others originate from different scientific fields and have not been applied this way yet (hierarchical clustering). All results are normalized by a spatially homogeneous field, making it possible to compare the outcome of the different metrics. This comparison gives the opportunity to establish which metric would perform best in informing scale-adaptive parameterization schemes on the irregularity of cumulus convection.