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Cloud botany - shallow cumulus organization in an LES ensemble

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Many mesoscale patterns in trade-wind cloud fields appear to result from the self-organisation of sub-mesoscale cumulus convection. To advance our understanding of these self-organising processes and the role they play in regulating radiation from the trades to space, we have run an ensemble of idealised large-eddy simulations on domains larger than 100 km using the DALES model. Each simulation is run in an environment described by six free parameters, which are co-varied over ranges that characterise the trades, including the parameter combinations observed during the 2020 EUREC4A field campaign. This demands large number of simulations on large domains; we manage the computational challenge that results by leveraging the novel Fugaku supercomputer. We quantify the cloud patterns in our simulations by using a set of organisation metrics. These metrics form a phase space, in which the simulations evolve. By analysing how cloud patterns vary over the phase space with the parameters describing the environment, we aim to better understand which portion of trade-wind cloud patterns can be attributed to small-scale processes, how these processes depend on their environment, and what their effect is on cloud feedbacks.

Figure caption: Cloud scenes located in a space of organization metrics

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