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Cloud patterns in four dimensions

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Quantifying, interpreting and classifying meso-scale patterns in shallow trade-wind cloud fields has recently received considerable attention. Typical patterns have i.a. been identified by expert visual inspection, machine learning and several "organisation metrics". In this work, we compute 21 frequently used or recently developed organisation metrics for 5000 satellite-observed shallow trade wind cloud fields. By projecting this dataset onto its principal components, we show that the 21 metrics primarily vary along only four, interpretable dimensions: 1) The dominant scale of clouds, 2) the size of clear sky patches between clouds, 3) the degree to which clouds align with a dominant direction and 4) cloud-top height variance across the cloud field. Linear combinations of these dimensions form an excellent description of organisation. The corresponding organisation distribution over our dataset is unimodal, continuous and does not possess distinct classes. Finally, we relate our pattern description to cloud physical processes from LES and cloud-controlling variables from reanalysis to search for mechanisms that drive the organisation into various regimes of our distribution.

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