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Covariability of trade-wind cloudiness and environmental conditions in large-eddy simulations and observations

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Shallow convection in the downwind trades occurs in form of different cloud patterns with characteristic cloud arrangements at the meso-scale. The four most dominant patterns were previously named Sugar, Gravel, Flowers and Fish and have been identified to be associated with different net cloud radiative effects.

By using long-term observations, we reveal that these differences can be mainly attributed to the stratiform cloud component that varies in extent across the patterns as opposed to the cloudiness at the lifting condensation level that is fairly constant independent of the patterns.

The observations reveal further, that each pattern is associated with a different environmental condition whose characteristics originate not solely from within the trades. Sugar air-masses are characterized by weak winds and of tropical origin, while Fish are driven by convergence lines originating from synoptical disturbances. Gravel and Flowers are most native to the trades, but distinguish themselves with slightly stronger winds and stronger subsidence in the first case and greater stability in the latter.

How well this covariability of cloudiness and environmental conditions is represented in simulations is important to project the occurrence of the patterns in a warmer climate and evaluated by realistic large-eddy simulations of the recent EUREC4A field campaign.