Statistical methods to quantify and visualise the complex behaviour of clouds in the climate system

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This work uses statistical emulation to visualise the transitions between spatial regimes of clouds in the context of select, varying environmental parameters. The UK Met Office/NERC Cloud model (MONC) has been used to study the transition between open-cell and closed-cell organisation caused by changes in three key boundary layer properties for stratocumulus formation and development.

A great barrier to fully exploring complex cloud feedbacks is the computational cost required to simulate enough one-at-a-time tests to understand how all of the individual processes interact. Statistical emulation combats this problem by requiring a much-reduced number of simulations to be run on a complex model that can then be used as a training set to approximate aspects of the model's output. This approximation, the emulator, provides a response surface that relates a number of parameters of interest, varying over specified ranges, to the model's output. For two or three parameters the response surface can be visually explored in 2- and 3D to understand how the varying parameters interact and affect the cloud's behaviour. This means we can observe regions of multi-dimensional parameter space where different cloud regimes can be observed and so further understand the complex processes at work.

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