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3D experiments with a stochastic convective parameterisation scheme.

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Many climate and NWP models are run at resolutions that are too coarse to resolve convection explicitly, but with grid boxes that are too small to justify the local equilibrium that conventional convective parameterisations assume. Stochastic parameterisation of convection solves this problem by removing the assumption that a given large-scale situation will always produce the same, averaged, sub-grid scale convective response. Instead, for each timestep and gridpoint, one of the many possible convective responses consistent with the large-scale situation is randomly selected. This allows the variability of a given atmospheric setup to be more accurately modelled.

The scheme used in this study is the Plant-Craig stochastic convective parameterisation scheme, which derives the distribution of possible convective responses using statistical mechanics theory treating individual clouds as analogous to point particles. It has been developed and tested in single-column model experiments, where it has been shown to yield behaviour that is consistent with its theoretical formulation and comparable to some generic stochastic methods. Assessment of the scheme is here extended to three-dimensional experiments. An idealised radiative-convective equilibrium setup, homogeneous in the horizontal with bicyclic boundaries, is used. The variability produced by the scheme is compared with that expected from cloud resolving models, and correlation length and time scales for averaging large scale variables are obtained. The scheme will also be applied to a case study of a mesoscale convective weather system and variability will be compared with conventional parameterisations.

This methodology is particularly relevant to ensemble forecasting because model variability, as well as variability in initial conditions, can be incorporated into the ensemble spread.