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A stochastic parameterization for deep convection

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Parameterization schemes in weather forecast and climate models are usually determinstic, producing a unique output for a given resolved-scale flow. In recent years there has been increasing recognition that the deterministic assumption may be problematic: resulting in insufficient ensemble spread for instance. Here, we present an alternative type of parameterization: specifically, a stochastic method for the representation of deep convection.

The form of the scheme is motivated through a combination of theoretical arguments and results from cloud-resolving models. The scheme is intended to be competitive with existing parameterizations if operated in its deterministic mode, when it becomes a spectral scheme of entraining plumes. In its stochastic mode, the variability produced by the scheme has a natural, physical origin. It describes the fluctuations about the equilibrium produced when the atmosphere is allowed to adjust fully to a constant, uniform forcing. Under such conditions, a known probability distribution function defines the chance of finding a plume of given cloud-base mass flux within each grid box of a large-scale model.

Both technical and conceptual aspects of the stochastic scheme have successfully been tested with a single-column model, demonstrating the feasibility of the parameterization for practical use. The scheme has recently been implemented into the DWD Lokal Modell and the UK Met Office Unified Model and preliminary testing will be described.