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Stochastic Parameterisation: Is Sophistication Useful?

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The theoretical arguments and practical justifications are becoming well established for the introduction of some stochastic component(s) to the physical parameterisations used by weather forecast and climate models. For example, many general-circulation models are known to have have insufficient high-frequency, small-scale variability of convective heating rates and precipitation in the tropics, which may damage their ability to represent low-frequency, large-scale climate variability. A wide variety of stochastic methods have been investigated, ranging from the simple (e.g. varying some uncertain model parameter) through to the more complicated, which may attempt to deal directly with the physical mechanisms that lead to variability near to the model gridscale. I will outline one of the more complex methods (which recognizes that the number of convective elements in a grid box need not be large) and discuss results from this and some simpler methods in order to address the question posed in the title. Or, in other words, might the results obtained from more complicated methods ultimately provide a justification for the use of simpler approaches in practice? Alternatively, is a generic inclusion of noise sufficient or does the physical origin of the small-scale variability impose any necessary or desirable constraints on the character of the noise?