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A stochastic multicloud model for organized tropical convection

We propose a stochastic model for representing the missing variability in global climate models due to unresolved features of organized tropical convection. We use a Markov chain lattice model to represent small scale convective elements which interact with each other and with the large scale environmental variables through convective available potential energy (CAPE) and middle troposphere dryness. Each lattice site is either occupied by a cloud of a certain type (congestus, deep or stratiform) or it is a clear sky site. The lattice sites are assumed to be independent from each other so that a coarse-grained stochastic birth-death system, which can be evolved with a very low computational overhead, is obtained for the cloud area fractions alone. The stochastic multicloud model is then coupled to a simple tropical climate model consisting of a system of ode's, mimicking the dynamics over a single GCM grid box. Physical intuition and observations are employed here to constrain the design of the models. Numerical simulations showcasing some of the dynamical features of the coupled model are presented below.

Joint work with J. Biello and A. Majda.