Session: C28 Poster: W48B

Using the stochastic multicloud model to improve tropical convective parameterization: A paradigm example

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Despite recent advances in supercomputing, current general circulation models (GCMs) poorly represent the variability associated with organized tropical convection. A stochastic multicloud convective parameterization based on three cloud types (congestus, deep, and stratiform), introduced recently by Khouider, Biello and Majda in the context of a single column model, is used here to study flows above the equator without rotation effects. The stochastic model dramatically improves the variability of tropical convection compared to the conventional moderate and coarse resolution paradigm GCM parameterizations. This increase in variability comes from intermittent coherent structures such as synoptic and mesoscale convective systems, analogs of squall lines and convectively coupled waves seen in nature whose representation is improved by the stochastic parameterization. Furthermore, simulations with sea surface temperature (SST) gradient yield realistic mean Walker-cell circulation with plausible high variability. An additional feature of the present stochastic parameterization is a natural scaling of the model from moderate to coarse grids which preserves the variability and statistical structure of the coherent features. These results systematically illustrate, in a paradigm model, the benefits of using the stochastic multi-cloud framework to improve deterministic parameterizations with clear deficiencies.