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Does the ECMWF IFS Convection Parameterization with Stochastic Physics Correctly Reproduce Relationships between Convection and the Large-Scale State?

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Important questions concerning parameterization of tropical convection are how should subgrid-scale variability be represented and which large-scale variables should be used in the parameterizations? Here the statistics of observational data in Darwin, Australia, are compared with those of short-term forecasts of convection made by the European Centre for Medium-Range Weather Forecasts Integrated Forecast System. The forecasts use multiplicative-noise stochastic physics (MNSP) that has led to many improvements in weather forecast skill. However, doubts have recently been raised about whether MNSP is consistent with observations of tropical convection. It is shown that the model can reproduce the variability of convection intensity for a given large-scale state, both with and without MNSP. Therefore MNSP is not inconsistent with observations, and much of the modeled variability arises from nonlinearity of the deterministic part of the convection scheme. It is also shown that the model can reproduce the lack of correlation between convection intensity and large-scale CAPE and an entraining CAPE, even though the convection parameterization assumes that deep convection is more intense when the vertical temperature profile is more unstable, with entrainment taken into account. Relationships between convection and large-scale convective inhibition and vertical velocity are also correctly captured.