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Critical phenomena in tropical precipitation

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Characterizing the onset of moist convection is key to improving convective parameterizations in climate models, including recent stochastic parameterizations. Statistical physics offers techniques for such transitions. From what began as a "long-shot" discussion between the authors, a set of methods has evolved that we argue has practical applications for analysis of precipitation statistics. Tropical Rainfall Measuring Mission precipitation data exhibit properties of critical phenomena. The power law pick-up of the ensemble-average precipitation as a function of column water vapor on tropospheric temperature is determined, providing a test for convective parameterizations. The frequency of occurrence of strong precipitation has a characteristic sharp drop as the system approaches the critical point, with exponential decay above critical. A large fraction of the precipitation occurs near and above critical. Nontrivial scaling of the precipitation variance implies long range correlations associated with mesoscale convective systems, with implications for convective schemes.