

## Criticality in Tropical Rainfall: A Simple Water Budget Model

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Observational studies from the past decades indicate that tropical convection may be an instance of self-organized criticality (SOC):

(i) Rain rate as a function of column water vapor follows a clear “pickup curve”, shifting from essentially zero to sharply increasing, once surpassing a critical moisture value.

(ii) Rain events and clusters, defined as groups of contiguous rainy points in space and/or time, have size distributions well described by power laws.

The first result indicates a phase transition, separating a non-raining “inactive” phase from a rainy “active” one. The second result suggests a proximity to the critical transition point, where “scale-free” power law distributions are expected. Indeed, typical moisture values are found near this critical value.

While various models have been proposed, no complete theory exists on how criticality may arise from convective processes that also links rainfall to moisture and includes spatial aspects. We explore what progress can be made by presenting a simple model of the atmospheric water budget. Each site represents an atmospheric column, where water can enter through surface evaporation, leave as surface rain, or get horizontally redistributed due to convective induced flows. The water transports around rain clusters in a cloud resolving model in radiative-convective equilibrium are examined, in order to identify local “rules” used in our simple model.

Hence, we apply a simple model approach to try answering whether local water rearrangements can explain the seeming criticality of tropical rainfall. If successful, this might highlight key convective scale interactions responsible for larger scale organization.

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