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Physical controls on the speed of growth of convective self-aggregation

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In idealized cloud-resolving models, convective self-aggregation develops from small dry patches that expand until they cover a large fraction of the domain. This study investigates mechanisms that control the timescale of transition from a non-organized to an organized state, as a first crucial step to potentially connect idealized simulations with observations of the real atmosphere. Indeed, making this connection is currently difficult because properties of aggregated states in equilibrium depend strongly on model configuration (domain size and shape, resolution, etc.) but the growth phase provides a different and unexplored angle to look for universal properties of self-aggregation.

We perform simulations with the System for Atmospheric Modeling (SAM). Dry patches are identified from closed boundaries where horizontal gradients of column relative humidity are locally maximum. This objective and domain-independent metric allows us to track the boundary expansion over time, quantify the net export of moist static energy from the dry region, and link them to the circulation strengthening and to the drying and cooling tendencies in the subsiding region. We assess the robustness of these controls for different SSTs and different domain configurations, before commenting on the possible role of self-aggregation in strengthening humidity gradients in the tropics.

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