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How do ocean temperature anomalies favor or disfavor the aggregation of deep convective clouds?

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Convective organization at mesoscales (hundreds of kilometers) is ubiquitous in the tropics, but the physical processes behind it are still poorly understood, despite its strong societal and climatic impact. Organization can be forced by the large scales, such as surface temperature gradients. But convective organization can also arise from internal feedbacks, such as "self-aggregation" feedbacks. Self-aggregation refers to the spectacular ability of deep clouds to spontaneously cluster in space despite spatially homogeneous conditions and no large-scale forcing, in high-resolution cloud-resolving models (CRMs).

Because of the idealized settings in which self-aggregation has been studied (typically radiative-convective equilibrium (RCE) over homogeneous sea-surface temperature (SST)), its relevance to the real tropics is debated. In this presentation, we will investigate the impact of removing some of these idealizations on the aggregation process. Specifically, we will investigate the impact of inhomogeneous SSTs on convective aggregation.

In a first step, we will investigate how an idealized warm circular SST anomaly, referred to as "hot-spot", helps organize convection, and how self-aggregation feedbacks modulate this organization. The presence of a hot-spot significantly accelerates aggregation, particularly for larger domains and warmer/larger hot-spots, and extends the range of SSTs for which aggregation occurs. In that case, the aggregation onset results from a large-scale circulation induced by the hot-spot.

In a second step, we will investigate the interaction of aggregation with an interactive surface (local SST evolving according to the surface energy budget). The results will be interpreted in light of a simple model for the boundary layer circulation.

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