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Organization of tropical deep convection in low vertical wind shears: The role of boundary conditions

Addisu Gezahegn Semie (1) and Adrian Mark Tompkins (2)

(1) The Abdus Salam International Centre for Theoretical Physics(ICTP), Università Degli Studi di Trieste, Trieste, Italy (addisugezahegn@gmail.com), (2) The Abdus Salam International Centre for Theoretical Physics(ICTP), Trieste, Italy, tompkins@ictp.it

Previous Experiments with convection-permitting models have documented the various roles of water vapor, cold pools, and radiative feedbacks in the self-organization of tropical deep convection. Most of these simulations were conducted using idealized conditions with fixed and spatially homogeneous sea surface temperatures (SST), and over large enough domains the feedback mechanisms lead to strongly organized convection. In its equilibrium state the convection occurs in a single organised cluster or band, depending on the system mean wind state, surrounded by regions that are extremely dry and free of deep convection. .

We hypothesize that radiative feedbacks involving the surface may provide a strong negative feedback to counter the organisation of convection. For example, the enhanced downwelling short-wave radiation in suppressed area should lead to enhanced SST (sometime termed SST hotspots). Which will ultimately lead to convection if the atmosphere moistens sufficiently to permit it. Similar feedback may occur over land. We therefore extend the numerical idealized experiment framework by including the effect of an interactive lower boundary sea and land conditions such as ocean and land with a range of soil moisture contents. To ascertain how this affects the self-organization of convection we construct a simple set of diagnostics to classify which mechanisms are operating, their relative importance and spacial scales.