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The role of cold pools in tropical convective systems

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Convective systems in the tropics have received less attention than their midlatitude counterparts, despite their important influences on the global circulation and the state of the tropical atmosphere. It is widely accepted that cold pools play key roles in the intensity, maintenance, and propagation of midlatitude organized convective systems. In the tropics, however, cold pools are weaker because the boundary layer is more humid, and the cold pools may interact with the convective systems differently than in the classic midlatitude system archetype, as suggested by recent studies. The goal of this research is to investigate the physical mechanisms by which cold pools impact tropical convective system intensity and propagation.

To address this goal, a simulation of radiative-convective equilibrium (RCE) on a large (3000 km by 200 km) channel domain with an ocean SST of 300 K was conducted at 1 km horizontal resolution, as an idealized representation of the tropical atmosphere. Two different long-lived, organized convective systems – one more intense than the other – were selected from the base RCE simulation and simulated at higher (250 m horizontal) resolution. Next, the cold pools were effectively eliminated by shutting off the sub-cloud evaporation, in order to elucidate their roles in the convective systems' behavior. Surprisingly, the cold pools did not impact the propagation of either convective system. However, they did impact the intensities – cold pools acted to weaken one system but intensify the other system. Through composite analysis and additional simulations including tracers within the cold pools, the physical mechanisms explaining these results have been analyzed and will be presented.