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Circulations driven by organization gradients in a cloud-resolving model

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Multicellular conglomerations of deep convection are commonly observed, but what is the larger-scale importance of this nonrandom spatial structure? We hypothesize (based on the common meaning of the word “organization”) that more-agglomerated convection will out-compete spotty convection for scarce resources of convection’s ecology: instability and moisture. But how exactly? Can we quantify organization's advantages in scalar metrics, and further understand that issue in the vertical domain of convection’s depth? To address these questions, idealized simulations were devised in large-domain simulations with Cloud Model 1 (CM1). A double-periodic domain is uniformly destabilized with a homogeneous cooling of -4K/day, with corresponding surface fluxes to compensate for the cooling. To generate and separate isolated and agglomerated deep convection, we first modulate the “organization gradient” across the simulated domain with nondivergent nudging of a zonal wind shear belt. Other approaches for manipulating organization gradients are also tried, including the latent to sensible ratio of surface fluxes at constant buoyancy flux, and autoconversion rates in the microphyiscs (a crude proxy for aerosol effects). Domain-scale circulations are generated, roughly in proportion to the organization gradient. Measures of that gradient by in some conventional indices of horizontal pattern clumpiness are checked or calibrated against uniform-domain simulations with and without shear, suggesting that these measures are adequate to characterize the organization gradient. Vertical-plane streamfunctions of the ‘zonal' (belt) averaged overturning exhibit multiple vertical cells and counter-cells with interesting dependences on the shear profile or other org-gradient producing mechanisms.