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Cold Pools in the Trades: External Drivers and Self-Organization Impact

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Recent observations of the trades highlight the covariability between cold pool (CP) properties and cloud cover, suggesting a potential impact of CPs on the cloud radiative effect (CRE). To explore this, we use an ensemble of 103 large-domain, high-resolution, large-eddy simulations (*Cloud Botany*). We investigate the extent to which the variability in CPs is driven by external conditions or convective self-organization. Our findings show that CPs are notably controlled by large-scale conditions, specifically (horizontal) wind speed and subsidence. The temporal evolution of CPs is tightly related to the diurnality in radiation. To understand the extent to which CPs vary with self-organization, we switch off the diurnality in radiation. Despite the absence of the diurnal cycle, CP time series still exhibit fluctuations. These fluctuations result from the recharge-discharge of thermodynamic and dynamic properties of the sub-cloud layer owing to CP-cloud interactions. Our results demonstrate that circulations induced by CPs reinforce the parent clouds, resulting in deepening and scale growth, followed by mesoscale arcs enclosing clear-sky areas. Finally, we show that CPs influence CRE, but only when they exist during the day. Our findings emphasize the importance of the relationship between the timescales of self-organization and the diurnal cycle of external conditions, greatly influencing the CRE dependency on self-organizing CPs.