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Understanding the moisture variance in precipitating organized shallow cumulus convection

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Precipitation from shallow cumulus clouds often leads to cloud organization on larger scales (e.g. clusters or mesoscale arcs). The precipitation and the associated organized motions influence the second order moments, especially the variances and covariances of moisture and heat. In the present work, idealized highly resolved large-eddy simulations are used to investigate the impact of precipitating shallow cumulus convection on the moisture variance and third order moments of moisture. The simulations are based on Rain in Cumulus over the Ocean (RICO) field experiment. The study addresses the moisture variance-precipitation-cloud organization dynamics and associated feedbacks by focusing on various aspects such as, the temporal evolution of moisture variance, the budget equations for the second and third-order moments of moisture, and the interaction of the moisture perturbations among the sub-cloud, the cloud, and the cloud inversion layers. The precipitation induced downdrafts and updrafts are proposed as the mechanism for the generation of moisture variance. The budget analysis for the precipitating LES reveals that the microphysical component due to accretion acts as an additional sink term in the budget of second and third order moments of moisture, but there is no direct contribution of the evaporation of rain to the production of moisture variance and third-order moments of moisture. Turbulent transport also plays key role in the second and third-order moments of moisture budgets, particularly near the interfacial layers. Furthermore, the conditional averaging demonstrates the role of cloud active and non active areas and the contribution of horizontal transport between these regions are also examined.