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The role of cold pools and microphysics schemes in the organization of convection

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Convective self-aggregation can spontaneously appear in radiative-convective equilibrium (RCE) simulations using idealized experiments with cloud-resolving models and it has been suggested that cold pools could play an important role in the development of organization, by delaying its onset when the cold pools have larger radii. Cold pool radius is determined by the amount of precipitation produced by microphysical schemes (precipitation efficiency) and the strength of the evaporation. We demonstrate this using idealized RCE experiments with the WRF model that convective cold pool characteristics can differ dramatically between 5 of the standard schemes commonly used in the model. We then systematically increase/decrease the cold pool size by changing the evaporation of rain in the 5 microphysics schemes to observe the impact on convective aggregation. One complication in interpreting the results of such experiments is that a change in the evaporation of rain also produces a change in the profile of net convective heating that could also impact organization. To isolate this effect, a second set of experiments is performed by artificially increasing (decreasing) the horizontal wind speed used in the surface flux calculation for all grid points determined to lie within cold pool interiors to produce a faster (slower) cold pool recovery and impact their ultimate radii. The ensembles of the experiments show that the larger the cold pool radii, the larger the spatial variance of the water vapor path is in the equilibrium state and they also demonstrate how the cold pool size impacts the strength and even the sign of the surface latent heat contribution to aggregation. Nonetheless, the strong forcing of aggregation by radiation feedbacks in these experiments means that the cold pool changes do not produce large modifications to the aggregation onset time. Thus the aggregation onset may be more strongly impacted by the microphysical processes that determine the convective anvil size and low-level cloud cover, and thus ultimately the cloud-radiative forcing. This is under investigation in ongoing experiments that modify the ice fall speed and the autoconversion of cloud water to rain in the 5 microphysical schemes, which will also be reported in the presentation.