**Hydrostatic and Non-hydrostatic Convective Self-aggregation in the DOE Energy Exscale Earth System Model (E3SM)**

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With the increase of computational resources, high-resolution atmospheric modeling becomes affordable in the foreseeable future to directly simulate small-scale processes that are important to weather and climate. At such resolutions, hydrostatic approximation in the current generation of global climate models breaks down, and the non-hydrostatic dynamics has to be addressed. Using the Department of Energy (DOE) Energy Exscale Earth System Model (E3SM), we examined the non-hydrostatic effect on convective self-aggregation, a physical process that is closely related to organized convection in the atmosphere. The model results show that the non-hydrostatic effect varies with the underlying sea surface temperatures (SSTs) in Radiative-Convective Equilibrium (RCE) simulations. At relatively low SSTs, non-hydrostatic dynamics tends to accelerate convective self-aggregation by promoting up-gradient frozen moist static energy (FMSE) transport from the dry to moist regions. This effect, however, is not due to the vertical velocity change directly resulted from non-hydrostatic dynamics which mainly concentrates in moist convective regions, but the change of the vertical gradient of vertical velocity in the driest areas associated with non-hydrostatic dynamics induced clear-sky radiative cooling change. At relatively high SSTs, convective merging becomes more influential to self-aggregation and is insensitive to non-hydrostatic dynamics in E3SM, the timescale to self-aggregate is thus nearly unaltered. These results imply the importance of including non-hydrostatic dynamics in simulating the lifetime of clustered convection, as well as the timing of the associated intense precipitation, when running E3SM at a resolution of 10 km or finer.