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The diurnal cycle can trigger convective self-aggregation

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Convective self-aggregation (CSA) is an established modelling paradigm for large-scale thunderstorm clusters, as they form in mesoscale convective systems, the Madden-JulianOscillation or tropical cyclo-genesis [1]. The onset of CSA is characterized by the spontaneous formation of persistently dry patches with suppressed deep convective rainfall. Recently another type of spatio-temporal pattern formation was observed in simulations where the diurnal cycle was mimicked by a sinusoidally varying surface temperature [2]. This diurnal aggregation (DA) is characterized by clusters of intense rain that correlate negatively from one day to the next.

Here we demonstrate that the diurnal cycle can also act as a trigger of persistently dry patches resembling the early stages of CSA. When the surface temperature is held constant, CSA has been shown to occur within simulations of coarse horizontal model resolution, but not when the resolution was increased [3]. We show that, when a temporally periodic surface temperature forcing is imposed, persistently convection free patches occur even faster when the spatial resolution is increased. The failure to achieve CSA at high horizontal resolution has so far been attributed to the more pronounced cold pool effects at such resolution. In our simulations these cold pools in fact play a key role in promoting CSA. Our results have implications for the origin of persistent convective organization over continents and the sea — and point a path towards achieving such clustering under realistic conditions.

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