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Convection in a stratified atmosphere: from isolated thermals to the convective boundary layer CHIEL VAN HEERWAARDEN, JUAN PEDRO MELLADO, Max Planck Institute for Meteorology — We have used direct numerical simulations to study the transition between an isolated turbulent plume penetrating a stably stratified layer and the convective boundary layer, one of the archetypes of the atmospheric boundary layer. Our simulation setup consists of a stably stratified fluid that is heated from below by thermals that form over patches with high surface heat fluxes. The patches are surrounded by regions without surface flux. We have defined a non-dimensional system that allows for studying the transition by varying only one parameter: the ratio of the characteristic length scale of the largest turbulent motions to the distance between two individual patches of high heat flux. By varying its value from zero, which defines the isolated thermal, to the threshold at which the patches are so close that the statistics resemble those of the convective boundary layer, we span the entire transition. Our results show that when the thermals are sufficiently close, the presence of nearby thermals limits their lateral expansion. Rather than merging with neighboring thermals, each thermal organizes into a rising core surrounded by narrow regions of subsiding motions. Nonetheless, in this case many flow statistics resemble those of the convective boundary layer.

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