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Absence of small-scale fluctuations of high-Pr buoyant scalars in stratified turbulence HIDESHI HANAZAKI, TAKEHIRO MIYAO, Kyoto University — Diffusion of scalars in turbulent flows, such as heat and salt, is important in geophysical systems since it indirectly but definitely determines the circulation of the atmosphere and ocean. It has often been assumed that fluctuations of scalars with small molecular diffusivities (Prandtl number $Pr > 1$) can survive at length scales smaller than the Kolmogorov scale. This is indeed true to passive scalars whose distribution does not affect the fluid motion. However, we demonstrate here that it would not be true to buoyant/active scalars such as heat and salt, whose distribution affects the fluid motion. Results of direct numerical simulations for a double-diffusive system, i.e., a system with two active scalars which constitute density stratification, show that the fluctuations of active scalars with high Prandtl number disappear at the Kolmogorov scale. This implies that the fluctuations of heat ($Pr = 6$) and salt ($Pr = 600$) in the ocean, would disappear at much larger scales than have been considered. This suggests also the possibility of realizing numerical simulations with much coarser computational grids than have ever been thought. Similar results would be applied to other active scalars controlled by external restoring forces, such as electric or magnetic forces.

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