Flow structures and dynamics of stably stratified turbulence

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Abstract. The structural features of stratified turbulence and its relationship to the flow dynamics has been the subject of many recent investigations. In strongly stratified turbulent flows, the formation of large-scale quasi-horizontal vortices in layers with strong vertical variability has been observed in laboratory experiments. In this study, direct numerical simulations (DNS) of stably stratified turbulence are used to investigate the evolution of flows in terms of overturns and their relationship to mixing by visualizing the vertical density gradients. Isosurfaces of enstrophy of strongly stable flows indicate the emergence of randomly distributed 'pancake-like' structures with near horizontal orientation at later times. The vertical dynamics of such strongly stratified flows are dominated by linear internal waves and can be described using rapid-distortion theory (RDT) while their horizontal dynamics are dominated by nonlinear effects that cannot be described with RDT. This suggests a decoupling of the vertical and horizontal dynamics of the flow.