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On the small-scale vertical structure produced by sheared vortices in a stratified fluid

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Of particular interest in the study of stratified flows are the vertical length scale selection mechanisms. The vertical characteristic length scale constrains the energy and momentum exchanges and determines for instance the turbulence spectra observed in the atmosphere and in the oceans. The laboratory experiments reported by Godoy-Diana et al. [2004, *J. Fluid Mech.* **504**, 229–238] studying the evolution of pancake dipoles, evidenced a new viscous mechanism for the selection of vertical length scale. They proposed a physical model, the *viscous peel-off*, that explained the observed initial stages of the evolution where the outer layers of the structure decorrelate from the core layers. The limitations of the experiment are due to the low values of the Reynolds number that can be attained in the laboratory. The applicability of these results to real atmospheric and oceanic flows where the Reynolds number is very large remains thus to be justified. Here we report on the results of direct numerical simulations that address the pancake dipole problem. Initially we perform simulations that reproduce the laboratory experiments mentioned above in order to validate the code. Subsequent runs allow to explore points in the parameter space unaccessible in the laboratory experiments. The present results give insight on the mechanisms that may be responsible of generating small-scale vertical structure in geophysical flows where stratification dominates. Different regimes of evolution for strongly stratified flows are discussed in terms of the parameter ReF_h^2, where Re and F_h are, respectiveley, the Reynolds and horizontal Froude numbers.