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Advection and buoyancy-induced turbulent diffusion in a narrow vertical tank DAAN D.J.A. VAN SOMMEREN, C.P. CAULFIELD, University of Cambridge, BP Institute and DAMTP, ANDREW W. WOODS, University of Cambridge, BP Institute — We describe experiments to examine the turbulent mixing due to a source with constant buoyancy flux B_s at the top of a vertical tank (with dimensions $40d \times d \times d$) in which an upward flow with speed u_b is present. Dense source fluid vigorously mixes with the less dense fluid of the upward flow. The mixed region of fluid is characterised by an unstable density gradient, which drives a turbulent flow which is dominated by eddies of the size of the width of the tank. These turbulent eddies are associated with the downward flux of dense fluid, which is modelled as a diffusive process. The upward flow with speed u_b is associated with the advective upward flux of dense fluid. During the late-time steady mixing phase, the diffusive and advective flux of dense fluid are in balance. The mixed region then extends a distance $h_{st} = 3d\lambda^{4/3}/\mathrm{Frn}$ from the top of the tank, where Fr is a Froude number defined by $\mathrm{Fr} = \mathrm{u_b}/(\mathrm{B_s}^{1/3}\mathrm{d}^{-1/3})$, and λ is an $O(1)$ constant relating the width of the tank to the characteristic mixing length of the turbulent eddies. We use a dye-attenuation technique to obtain vertical profiles of the horizontally-averaged reduced gravity, and show a good agreement between experiments and theory.

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