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Turbulent buoyant convection from a maintained source of buoyancy in a narrow vertical tank DAAN D.J.A. VAN SOMMEREN, C.P. CAULFIELD, University of Cambridge - BP Institute/ DAMTP, ANDREW W. WOODS, University of Cambridge - BP Institute — We describe new experiments to examine the buoyancy-induced mixing which results from the injection of a small constant volume flux of fluid of density ρ_s at the top of a long narrow vertical tank with square cross-section that is filled with fluid of density $\rho_0 < \rho_s$. The injected fluid vigorously mixes with the less dense fluid that initially occupies the tank, such that a dense mixed region of turbulent fluid propagates downwards. The density at any height within this mixed region increases with time. For an ideal point source of constant buoyancy flux B_s, we show that the height of the mixed region grows as $h \sim B_s^{1/6} d^{1/3} t^{1/2}$ and that the reduced gravity $g' = g(\rho - \rho_0)/\rho_0$ at the top of the tank increases as $g'(0) \sim B_s^{5/6} d^{-7/3} t^{1/2}$, with d the width of the tank. Once the mixed region reaches the bottom of the tank, the turbulent mixing continues, and we demonstrate that the reduced gravity at each height increases approximately linearly with time. Our results are consistent with Prandtl's mixing length theory, which suggest that the local turbulent flux is given by $J = \lambda d^2 (\partial \overline{g'}/\partial z)^{3/2}$, with λ an $O(1)$ constant. We solve the corresponding nonlinear turbulent diffusion equation, and show a good agreement with experimental profiles obtained with a dye attenuation technique.

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