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Spin-up of a stratified fluid in a square cylinder with a sloping bottom M.R. FOSTER, Rensselaer Polytechnic Institute, R.J. MUNRO, University of Nottingham,UK — We consider the spin-up of a linearly stratified fluid, contained in a closed rectangular cylinder whose bottom is sloped at a small angle α. The full three-dimensionality of this flow leads to effects not evident in axisymmetric containers. We discuss asymptotic results for small Ekman number, E, and Rossby number $\epsilon \ll E^{1/2}$, and a series of experiments conducted at the University of Nottingham. Provided that $\alpha \gg E^{1/2}$, motion occurs on four timescales. The adjustment begins with impulsive motion, caused by the fact that the vertical walls are not streamlines of rigid rotation, and then in times of order α^{-1}, internal waves driven by the sloped bottom wall arise. Ekman-layer eruption on the $E^{-1/2}$ time scale damps this periodic motion, after which the fluid near the lower wall is fully spun up, but the whole of the fluid interior is not. On the E^{-1} time scale, final adjustments occur, to bring the fluid up to the new rotation rate. In the four experiments performed, the rectangular cylinder was $38\,\mathrm{cm} \times 38\,\mathrm{cm}$ in cross-section, with an average depth of $52\,\mathrm{cm}$, and a base slope $\alpha = 10°$. In all cases, the Rossby and Burger numbers were between 0.019-0.022 and 3.1-6.8, respectively, with Ekman number $O\left(10^{-5}\right)$. Throughout each experiment, horizontal-plane velocity components (and corresponding vertical vorticity) were obtained using 2D PIV.

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