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Mixing efficiency in lock release gravity currents C.P. CAULFIELD, BPI & DAMTP, University of Cambridge, M.D. PATTERSON, J.N. MCELWAINE, S.B. DALZIEL, DAMTP, University of Cambridge — We consider numerically and experimentally mixing in Boussinesq lock release gravity currents. We show quantitatively that mixing is strongly dependent on the lower boundary condition. As the fluid in the current slumps and flows under gravity, Kelvin-Helmholtz billows grow at the current head, entrain ambient fluid as they are swept backwards, and then fall down over the current tail, interacting strongly with a thin layer of dense fluid which remains at the lower boundary. For flows with free-slip lower boundaries, the billows remain largely two- dimensional. Conversely, for flows with no-slip lower boundaries, the current front develops lobes and clefts as ambient fluid is engulfed horizontally and overrun vertically, thus leading inevitably both to convection, and also to strong three-dimensionality. Using the APE framework of Winters et al. (1995), we quantify the time-dependent mixing associated with the engulfed fluid, the overrun fluid, and the billows as they develop streamwise secondary instabilities which trigger turbulence. We also compare the cumulative mixing efficiency with laboratory experiments.

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