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Mixing in density-driven exchange flows

T. Prastowo, R. Griffiths, **G. Hughes** and A. McC. Hogg

Research School of Earth Sciences, The Australian National University, Australia
(t.prastowo@anu.edu.au)

Laboratory experiments are used to study the characteristics of mixing in density-driven exchange flows. The experiments have particular relevance to improving predictions of mixing in deep overflows, as well as to understanding the dynamics of exchange flows between water bodies such as estuaries, marginal seas and the open ocean.

The experiments consist of two reservoirs separated by a contracting channel. Flow is initiated by lock-exchange, and density differences between the reservoirs drive bi-directional flow through the contraction. The flow can be divided approximately into two counter-flowing layers which, to first order, match the maximal hydraulically controlled solution. However, the strong shear between the two flowing layers generates stratified turbulence and mixing between the layers.

These experiments focus on two important issues: the efficiency of the mixing and its influence on the flux between the two reservoirs. Mixing efficiency is found to vary between 8% and 20%, and depends upon the density difference, the experimental run time and the minimum width of the contraction. On the other hand, the flux is found to be a constant fraction (80%) of predictions based on the (non-turbulent) hydraulic solution. These results are discussed in terms of scaling predictions.