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Intrusive gravity currents in adjacent stratified fluids[1] BENJAMIN MAURER, University of California, San Diego, DIOGO BOLSTER, Universitat Politecnica de Catalunya, Spain, PAUL LINDEN, University of California, San Diego
— In two adjacent fluids, differing vertical density stratifications necessarily entail horizontal density gradients. The resulting baroclinic torques may drive Intrusive Gravity Currents (IGCs), the primarily horizontal flow of one fluid into another at an intermediate depth. The literature has traditionally addressed intrusions into a stratified ambient by a fluid of uniform density. However, many oceanic and atmospheric flows involve two or more adjacent fluids of non-uniform density profiles. We present an experimental and numerical study of IGCs between fluids of non-uniform densities, considering only the 'equilibrium' case in which adjacent fluids have equivalent depths and mean densities but differing, constant, non-zero buoyancy frequencies. Working from the available potential energy of the system and an assumed IGC thickness we develop an energy model to describe the speed of a mid-depth Boussinesq intrusion during its initial constant-velocity phase. We verify the theory over a range of buoyancy frequency ratios, using both laboratory measurements in a lock-exchange channel and corresponding two-dimensional direct numerical simulations. We also examine the role of internal waves in the interleaving process.

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Paul Linden
University of California, San Diego

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