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Turbulent Mixing of Unstably Stratified Fluids in a Vertical Tube
MICHAEL PATTERSON, Yale , COLM CAULFIELD, BPI & DAMTP - Cambridge, STUART DALZIEL, DAMTP - Cambridge, JOHN WETTLAUFER, Geology & Geophysics - Yale — Quantitative time dependent measurements of irreversible mixing caused by the development of the Raleigh-Taylor instability (RTI) on an initially unstable two-layer stratification of miscible fluids are taken from a series of laboratory experiments. The experiments are carried out in high-aspect ratio tanks of both square and circular cross-section, and are observed until the flow becomes quiescent. The effects of vertical wall roughness, Atwood number and rotation on the evolution of the time-dependent flow is investigated using a light attenuation technique in conjunction with the available potential energy framework. We obtain detailed time-dependent measures of the irreversible mixing, and its efficiency during flow evolution. We find that the flow passes through four distinct phases which have distinct mixing characteristics. During the turbulent phase of the flow the turbulent mixing is highly efficient, with almost precisely half the potential energy lost from the flow leading to irreversible mixing, with the other half being lost to dissipation.

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