On mixing across a stable density interface

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Abstract

Stratified turbulent fluids have the propensity to spontaneously form sharp density interfaces. Following the seminal experimental work of Rouse & Dodu (1955) performed in Grenoble, mixing across stable density interfaces has been thoroughly addressed by Emil Hopfinger and collaborators over the last 40 years. This led to a better understanding of what sets the interface shape and the entrainment rate across the interface. We will first review those important contributions, and second present a novel approach to the problem based on a statistical model. Indeed, turbulent mixing in stratified fluids involves a huge number of degrees of freedom, which renders extremely difficult a deterministic approach to the problem. Our model describes the temporal evolution of the probability to measure a given buoyancy level at each height, and accounts for the feedback of buoyancy fluctuations on the mean buoyancy profile. This leads to a hierarchy of subgrid-scale models describing restratification effects and the spontaneous emergence of sharp but finite density interfaces.

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