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Entrainment in oscillatory zero-mean flow

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The dynamical processes associated with the stably stratified atmospheric boundary layer or in the ocean thermocline are less well understood than those of its convective counterparts. This is due to its complexity, and the fact that buoyancy reduces entrainment across density interfaces. We present results on a series of laboratory experiments where a sharp density interface generated by either salt concentration or heat, advances due to grid stirred turbulence.
We parametrize the level of buoyancy at the density interface by a local Richardson number defined in terms of the density difference across the interface, which may be due to a temperature or salinity jump. L is the integral lengthscale and u' is the r.m.s. velocity scale. So Ri = C L/u 2. The laboratory experiments were designed to compare the entrainment produced by zero-mean turbulence in heat or salt density interfaces. In the experiment we used a small perspex box of 15 by 10 cm in base, a small mesh grid (M= 0.8 cm) driven by a motor. So as to generate the density interface by disolving salt in the bottom layer of the water column or by heating the top layer, we added the top light layer, which had a density difference carefully set up by means of a sponge float.
The grid was set to oscillate with fixed frequency and stroke at the begining of the experiment and the velocity of advance of the interface Ve was measured by looking at a Shadowgraph or by video recording. The turbulent parameters are derived from previous measurements as a function of the distance between the grid center and the interface z as: l = 0.1 z and the turbulent velocity u´decays inversely proportinal to the distance z. There are several mechanisms that produce mixing across the density interface. And there is a dependence of the Prandtl number on the Entrainment law.
The entrainment is a power function of the local Richardson number, and the value of the empirical exponent n(Ri,Pr) is compared with previous results. The relationship between the Flux Richardson number and the Gradient or local one and the ways in which the interface extracts energy from the turbulence source via internal waves Internal gravity (or buoyancy) waves are characteristic of the stable boundary layer and contribute to its transport processes, both directly, and indirectly via internal waveinduced turbulence. These proceses are able to control entrainment across strong density interfaces as those defined by Kings et al (1989) in the Antartica. A comparison of the range of entrainment values from laboratory experiments with those ocurring in nature, both in the atmosphere and ocean shows the importance of modeling correctly the integral lengthscales of the environmental turbulence.