Mixing efficiency of eddies in a confined volume.

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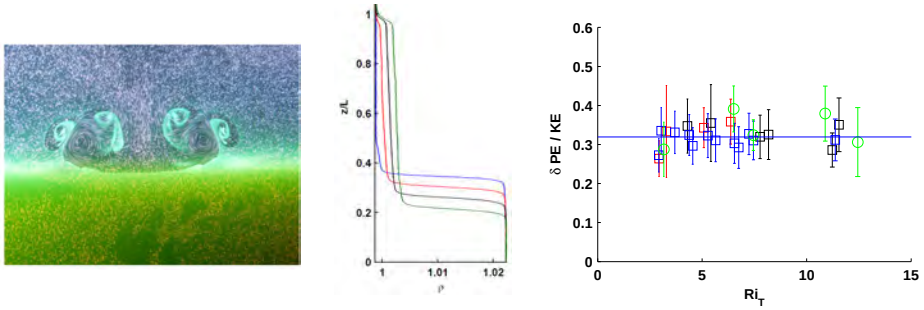
There is tantalising evidence that mechanically driven stratified flows may tend towards a state of constant mixing efficiency [Oglethorpe *et al.*(2013), Park *et al.*(1994)]. In this discussion, we provide insight into the energy balance leading to the constant mixing efficiency and isolate the responsible mechanism. The work presented will demonstrate an important mixing efficiency regime for externally driven stratified flows.

Stratified turbulent mixing is often characterized by the associated eddies within the flow. These eddies are the dominant mixing mechanism in stratified turbulent mixing [Turner(1986)]. Here, we study mixing induced by vortex rings in order to characterize the mixing induced by an individual eddie. By generating independent vortex ring mixing events in a density stratified fluid with a s sharp pycnocline, we determine the mixing effeciency of each ring. After an initial adjustment period, it is found that the mixing efficiency of each vortex ring is constant. By studying the mixing mechanism here, we demonstrate the generic features of this mixing regime.



(i) (ii) (iii)

Fig. 1: (i) Photograph captured during the interaction of a vortex ring with a sharp stratification. (ii) Density profiles through the fluid at n = 10,200,400,600. (iii) Plot of the Mixing efficiency versus bulk Richardson number for many different runs.

References

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[Turner(1986)] TURNER, J. S. 1986 Turbulent entrainment: the development of the entrainment assumption, and its application to geophysical flows. *Journal of Fluid Mechanics* **173**, 431–471.

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