Geophysical Research Abstracts
Vol. 15, EGU2013-6320, 2013
EGU General Assembly 2013

Shear Induced Mixing: Does the route to turbulence matter to its efficiency and to the effective buoyancy flux?

Alireza Mashayekhi and William Richard Peltier
Physics department, University of Toronto, Canada (amashaye@atmosp.physics.utoronto.ca)

Motivated by the importance of diapycnal mixing parameterizations in large scale ocean general circulation models, we provide a detailed analysis of high Reynolds number mixing in density stratified shear flows which constitute an archetypical example of the small scale physical processes occurring in the oceanic interior that control turbulent diffusion. Our focus is upon the issue as to whether the route to fully developed turbulence in the stratified mixing layer is in any significant way determinant of diapycnal mixing efficiency as presented by an effective turbulent diffusivity. We characterize different routes to fully developed turbulence by the nature of the secondary instabilities through which a primary shear instability evolves into a turbulent state. We will then demonstrate that different mechanisms of turbulence transition lead to considerably different values for the efficiency of diapycnal mixing and also for the effective vertical flux of buoyancy. We show that the widely employed value of 0.2 for the efficiency of mixing in shear-induced stratified turbulence based upon both laboratory measurements and similarly low Reynolds number numerical simulations might be not well justified in the high Reynolds number regime characteristic of geophysical flows. One of the important aspects of this work from the perspective of our theoretical understanding of stratified turbulence is the demonstration that the inverse cascade of energy, which is facilitated by the vortex merging process that is typical of laboratory experiments and of the low Reynolds number simulations of shear flow evolution, is strongly suppressed by increase of the Reynolds number to values typical of geophysical flows.