Abstract Submitted
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Turbulent mixing due to Holmboe wave instability in stratified shear flows at high Reynolds numbers[1] HESAM SALEHIPOUR, University of Toronto, COLM-CILLE CAULFIELD, BP Institute & DAMTP, University of Cambridge, W. RICHARD PELTIER, University of Toronto — We consider numerically the transition to turbulence and associated mixing in parallel stratified shear flows with hyperbolic tangent initial velocity and density distributions. When the characteristic length scale of density variation is sufficiently sharper than that of the velocity variation, this flow is primarily susceptible to Holmboe wave instability (HWI) which perturbs the interface to exhibit characteristic cusped interfacial waves. Unlike previous low-Re experimental and numerical studies, in the high-Re regime in which our DNS analyses are performed, the primary HWI triggers a vigorous yet markedly more long-lived turbulent event compared to its better known relative, the Kelvin-Helmholtz instability (KHI). HWI 'scours' the primary density interface, leading to substantial irreversible mixing and vertical transport of density displaced above and below the (robust) primary density interface which is comparable in both absolute terms and relative efficiency to the mixing associated with an equivalent KHI. Our results establish categorically that, provided the Reynolds number is high enough, shear layers with sharp density interfaces and associated locally high values of the gradient Richardson number are sites of substantial and efficient irreversible mixing.

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