Abstract View

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Shear Instability in a Highly Stratified Estuary

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ABSTRACT

Shear instability is found to be the principal mechanism of vertical exchange within the pycnocline of a salt wedge estuary. A field program involving high-resolution velocity and density measurements, as well as high-frequency acoustic imagery, allowed direct comparison of instantaneous Richardson number distributions to the occurrence of shear instability. The theoretical stability threshold of 0.25 is consistent with the measurements, based on estimates of gradients that contain the mean as well as fluctuations due to internal waves. An effective stability threshold based on mean gradients is found to be approximately one-third, reflecting a significant contribution of internal wave shear. The integral effect of the mixing process is to homogenize the *gradients* of velocity and density, producing linear profiles of these quantities across the pycnocline. A turbulent Prandtl number of unity is suggested by the vertical distributions of velocity and density during periods of active vertical mixing. Based on these observations, a simple model for mixing in stratified shear flows is proposed, which is applicable to estuaries and other environments with a dominant mean shear.