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Non-linear internal waves (NLIWs) are a prominent feature on the continental slope and shelfs of all major upwelling regions. They are known to enhance diapycnal mixing and associated nutrient fluxes, thereby fueling biogeochemical cycles. Furthermore, NLIWs are capable of transporting mass through Stokes drift and are thus potentially contributing to cross-shelf exchange. They are generated by the interaction of barotropic and low-mode baroclinic tides with sloping topography, which also causes a bottom-enhanced diapycnal mixing distribution above the continental slope and shelfs. Using turbulence data from more a multi-cruise program to the Mauritanian and Peruvian upwelling region we show that dissipation rates of turbulent kinetic energy increase by about an order of magnitude between 50 to 100m above the bottom. According to the continuity equation, this setting leads to a diapycnal downwelling velocity in the bottom enhanced turbulent layer, which must be balanced by diapycnal upwelling in the bottom boundary layer. Indeed, a tracer injected into the bottom boundary layer at 250m depth in the Peruvian upwelling suggest upward diapycnal velocities of about 0.5-1 m/day. Using velocity records from a mooring we also show that onshore transport of non-linear internal waves in upwelling regions can be quite large and may exceed offshore Ekman flow in low-wind upwelling regions like the Peruvian shelf. The presented results challenge our understanding of the dominant physical processes in upwelling regions.
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