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Tidal bores, turbulence and mixing above deep-ocean slopes

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A tidally driven, stably-stratified turbulent boundary layer over supercritically sloping topography is simulated numerically using a spectral LES approach (Winters, 2015, 2016). The near boundary flow is characterized by quasi-periodic, bore-like motions, whose temporal signature is compared to the high-resolution ocean mooring data of van Haren (2006). The relatively thick bottom boundary layer remains stably stratified owing to the regular cycling of unmixed ambient fluid into the turbulent boundary layer and episodic expulsion events where fluid is ejected into the stratified interior. The effective diffusivity of the flow near the boundary is estimated by means of a synthetic dye tracer experiment. The average dissipation rate within the dye cloud is computed and combined with the diffusivity estimate to yield an overall mixing efficiency of 0.15. Both the estimated diffusivity and dissipation rates are in reasonable agreement with the microstructure observations of Kunze at al (2012) when scaled to the environmental conditions at the Monterey and Soquel Canyons and to the values estimated by van Haren and Gostiaux (2012) above the sloping bottom of the Great Meteor Seamount in the Canary Basin.