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A 3D numerical study on the impact of channel geometry on the trapping of internal tides

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Internal tides are generated when the barotropic tide encounters a sloping bottom, for instance over the margins of the continental shelf. In that case, internal tides will propagate away from the shelf, partly in the direction opposite to that of the incoming barotropic tide. The internal tidal beams propagate downwards, maintaining a certain angle with respect to the horizontal. As a result, they will be reflected at the bottom. When the bottom has enough curvature, due to sloping side walls, this is accompanied by refraction towards the cross-channel direction. This may lead to trapping of the internal tides. This process is studied with a three-dimensional numerical model based upon the Miami Isopycnic Coordinate Model. We use a channel-geometry with an open boundary in the west and a continental slope in the east, having a zonal length-scale of 1000 km. The horizontal resolution is 3.75 km and there are 43 layers of 100 m depth. The meridional width of the channel and the bottom profile are varied. In a suite of experiments we show how channel geometry affects the propagation of internal tides, and discuss the zonal penetration scale of wave-energy, away from the continental slope. The results from the numerical model are compared with the theory of Maas and Lam (1995, JFM 300, 1-40) on geometric focusing of internal waves.