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A multi-modal approach for the internal tide in the Bay of Biscay

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A new linear and hydrostatic model for the generation and propagation of internal tides is presented. It is derived using a multi-modal approach, in which the topography is assumed to be "slowly varying" with respect to the internal-tide length scale. The forcing is due to the interaction between a large finite-amplitude topography and a barotropic tidal flow in a stratified ocean. The effects of earth's rotation are included by using the f-plane approximation.
The first step is to validate the approach with a cubic topography and a constant stratification and to compare results with a fully numerical linear hydrostatic internal-tide generation model. The second step is to use the model in a Bay of Biscay configuration, with a realistic topography and summer stratification. The numerical results show beams of internal-tide energy originating from the shelf break and which move downward into the abyss, in agreement with observations. After the first reflection on the ocean seabed, the beam is distorted in the thermocline region, around 120km from the shelf break, where interfacial waves are generated.
This model can be used for arbitrary topography and stratification and it offers the potential benefit of allowing a straightforward extension to a set of weakly nonlinear and nonhydrostatic equations.