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Internal Tide Generation by Submarine Canyons

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Approximately 70% of the global dissipation of the barotropic tide occurs in the waters of the continental margins, due to bottom friction on the shelves and internal tide generation at the continental slopes. Here we are interested in the latter process, and how it depends upon the presence of submarine canyons, which are a ubiquitous feature of continental slopes. Whilst there have been modeling studies of internal tide generation at particular canyons (e.g., Monterey), our emphasis is on understanding the effects of canyon geometry more generally, given the diversity of canyons that exist across the globe.

To do this, we study idealised canyon configurations cutting through idealised continental slopes, enabling us to define and then explore a relevant parameter space (canyon length, width, depth, etc.). For forcing by a prescribed barotropic tide, taking the form of a Kelvin wave with predominantly alongshore flow, we investigate both the amplitude and direction of the implied radiating internal tides, and generate scaling laws for how the tidal dissipation varies across parameter space.

Such a study would be challenging and extremely time consuming with traditional ocean circulation models, because of the small length scales of both the canyons and the internal tides. For efficiency, we thus use the multi-modal linear modelling strategy of Griffiths and Grimshaw (2007), but solved with cutting-edge numerics in the form of a Discontinuous Galerkin Finite Element methodology. We have generated high-quality multi-scale triangular meshes to resolve the canyons, and can deploy a range of test-function orders and numerical fluxes therein. This methodology is a key part of this study.