Wave radiation from seamounts

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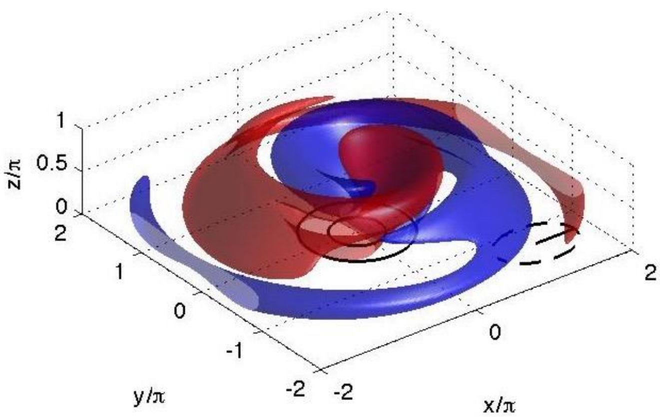
Project description: When oceanic tides oscillate over underwater mountains, the mountains radiate a type of fluid dynamical waves called "internal tides". The restoring forces that sustain these oscillations are the buoyancy and Coriolis (fictitious) forces, and they can propagate for hundreds, if not thousands, of kilometres before dissipating or encountering topography. When they dissipate by breaking, they cause turbulence that mixes deeper, denser, and colder waters with shallower, lighter, and warmer waters. In doing so, they participate in the large-scale energy circulation in the oceans.



Our groups have been developing analytical models to predict the internal tide field around topographies (Grisouard & Bühler, 2012; Papoutsellis et al., 2023; Zemskova et al., *in prep.*), and we wish to compare these models with the results produced by numerical simulations that solve more general equations for fluid mechanics. Our most recent analytical model (in prep.) exhibits unexpected breakings in symmetry in the radiated wave field that we wish to validate independently.

You will familiarize yourself with the different theoretical radiation models and adapt a numerical setup we used in the past (e.g., Zemskova & Grisouard, 2021) to the problem of an internal tide, radiating from an isolated seamount. You will compare your results with our analytical predictions by visualising the near-field three-dimensional wave field patterns, and computing the far-field energy fluxes.

Requirements: you have notions of vector calculus and partial differential equations, as well as some basic experience in programming. Knowledge about fluid dynamics and Python will be useful, but not expected prior to the start of the project.

Bibliography

Grisouard, N., & Bühler, O. (2012). Forcing of oceanic mean flows by dissipating internal tides. *Journal of Fluid Mechanics*, *708*, 250–278. https://doi.org/10.1017/jfm.2012.303

Papoutsellis, C. E., Mercier, M. J., & Grisouard, N. (2023). Internal tide generation from non-uniform barotropic body forcing. *Journal of Fluid Mechanics*, *964*, A20. https://doi.org/10.1017/jfm.2023.358

Zemskova, V. E., & Grisouard, N. (2021). Near-inertial dissipation due to stratified flow over abyssal topography. *Journal of Physical Oceanography*, *51*(8), 2483–2504. https://doi.org/10.1175/JPO-D-21-0007.1

Zemskova, V. E., Musgrave, R.C., & J. A. Lerczak. Internal tides at the coast: energy flux of baroclinic tides propagating into the deep ocean in the presence of supercritical shelf topography. In revisions, *Journal of Physical Oceanography.*