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Internal Wave Generation by a Combination of Tidal and Steady Currents

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In the presence of topography, two main contributors for internal wave energy are tide-topography interaction transferring energy from the barotropic tide to internal tides, and lee wave generation when geostrophic currents or eddying abyssal flows interact with topography. In the past few decades, many studies considered the respective contribution of the oscillating flows or steady background flows, but few investigations have considered both.

In this talk, we consider the joint effects of tidal and steady currents to investigate internal wave generation and propagation on the Amazon shelf, a hotspot for internal solitary wave (ISW) generation. The Amazon Shelf is off the mouth of the Amazon River in the southwest tropical Atlantic Ocean, affected by strong tidal constituents over complex bottom bathymetry and a strong western boundary current, the North Brazilian Current (NBC). Both satellite observations and numerical modelling are used in this study. Satellite observations provide a clear visualization of the wave characteristics, such as temporal and spatial distributions, propagating direction and its relation to background currents. Based on parameters from satellite observations and reanalysis dataset, we set up a model to numerically investigate the dynamics of the ISW generation. We demonstrate that the small-scale topography contributes to a rich generation of along-shelf propagating ISW, which significantly contribute to the ocean mixing and potentially cause sediment resuspension. Moreover, the ISW-induced currents also contribute to the sea surface wave breaking as observed by satellite measurements. In addition, statistics based on a decade of satellite images and numerical investigations on seasonal variations of the ISWs and the NBC improve our understanding of the generation and evolution of these nonlinear internal waves in the presence of background currents.