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The effect of stratification and topography on high-frequency internal waves in a continental shelf sea

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Internal gravity waves (IWs) have been recognised as one of the main drivers of climate controlling circulation, sustaining fisheries in shelf seas and CO_2-pump system. High frequency IWs are particularly important to internal mixing in the shelf seas, where they contain an enhanced fraction of the available baroclinic energy. The origin, generation mechanism, propagation and spatial distribution of these waves are unfortunately still poorly understood since they are difficult to measure and simulate, and are therefore not represented in the vast majority of ocean and climate models.

In this study we aim to increase our understanding of high frequency IWs dynamics in shelf seas through a combination of observational (from moorings and ocean gliders) and modelling methods (MITgcm), and test the hypothesis that “Solitary waves are responsible for driving a large fraction of the vertical diffusivity at the shelf edge and adjacent shelf region”.

A new high-resolution (50m horizontal) MITgcm configuration is employed to identify the generation and propagation of IWs in a regional shelf sea and subsequently identify internal wave generation hotspots by using calculated Froude number and body force maps. We assess the likely impact of changing seasonal and climate forcing on IWs with a range of different density structures. Our model suggests that under increasing stratification, the IW field becomes more energetic at all frequencies, however the increase in energy is not evenly distributed. While energy in the dominant low frequency IWs increase by 20-40%, energy associated with high frequency waves increases by as much as 90%. These model results are compared to varying stratification scenarios from observations made during 2012 and 2013 to interpret the impact on continental shelf sea IW generation and propagation. We use the results from a turbulence enabled ocean glider to assess the impact that this varying wavefield has on internal mixing, and discuss the implications this might have on future climate scenarios.