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Internal wave topography interactions in the presence of a steady surface current

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Wave--topography interaction is one of the primary mechanisms through which internal wave energy cascades to small length scales in the oceans. At small length scales, internal waves become unstable and break down, leading to turbulent diffusion and mixing. Precise diffusivity parametrisations are crucial for modeling ocean flows accurately. We study the interactions of a mode-1 internal wave with an isolated topography in the presence of a steady, stable surface current. For various amplitudes of the surface current, we investigate scattering caused by Gaussian shaped topographies by independently varying height and slope. In the presence of a surface current, a mode-1 wave that propagates in the direction of the current (denoted by M1W) has different properties compared to a mode-1 wave that propagates against the current (denoted by M1C), and we focus on both M1W and M1C. For all the heights considered, for both M1W and M1C, the current does not have a singular effect: it can reduce or increase scattering depending on the slope of the topography. Scattering due to large amplitude topographies (even with a small slope) can be quite different in the presence of a surface current. However, scattering caused by small amplitude topographies does not change significantly even in the presence of strong surface currents. Topographies with very high slopes (commonly known as supercritical topographies) scatter M1C more compared to M1W. Finally, we provide a brief analysis of the generation of superharmonic waves due to wave--topography interactions that occur in the presence of a surface current.