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Generation and impacts of internal tides over the northern Mid-Atlantic Ridge

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We report recent results on the generation, propagation and dissipation of internal tides using a high-resolution numerical model in a region over the northern Mid-Atlantic Ridge near the Azores.

The lifecycle of internal tides is first described. Major sites for the generation of internal tides are identified and exhibit strong disparities between different locations, both in wave amplitude and length scale. In particular, large amplitude isolated seamounts generate low-mode internal tide, while rough topographic irregularities over the ridge are associated with smaller wavelength modes. As a result, wide portions of the ridge dissipate more energy in the internal tide field than they gain from the barotropic tide conversion, a surprising result which evidences the scattering of low-mode internal tide into higher modes, up to dissipation. Based on these results, we characterize the tidally-induced deep-ocean mixing in this region.

Specific aspects of the internal tides are then discussed, focusing on specific regions of the water column. Near the seafloor, we investigate the interaction of the internal waves with a submesoscale bottom-constrained current and show that internal tide is a significant forcing for this deep circulation. Near the surface, we find that low mode internal tide exhibits a strong amplification in summer, and we provide a quantitative explanation for the associated mechanism by means of linear theory. We show that it has a strong impact on the seasonality of the near-surface kinetic energy and is sensitive to the details of the stratification near the base of the mixed layer.