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Internal waves trapped below a virtual seafloor

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Numerical simulations of tidal flow over random topography with the ocean seafloor spectrum reveal that the time-averaged tidal energy converted into far field internal wave radiation arises only from topography that rises above a local "virtual" seafloor (Zhang and Swinney, Phys. Rev. Lett. 112, 104502 (2014)). For topography below the virtual seafloor, destructive wave interference leads to no time-averaged far field internal wave power. The concept of a virtual floor extends the applicability of linear theory to global predictions of the conversion of tidal energy into internal wave energy in the oceans. The simulations show that for increasing topographic RMS height the emergent interference of internal waves from neighboring generation sites leads to a transition in the radiated power dependence on topographic height from quadratic to linear. The internal wave power radiated by random topography is found to increase as the horizontal spatial resolution scale is decreased, down to a length scale of typically 300 m, but smaller scales generate at most a few percent of the radiated power (Zhao, Zhang, and Swinney, Geophys. Res. Lett. 42, 8081-8087 (2015)). Tidal flow past 3D seamounts generates much less total internal wave power than that radiated by quasi-2D ridges (Zhang, Swinney, Comino, and Buijsman (2016)).