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Source and propagation effects on the ratio of Love to Rayleigh waves in ocean generated seismic noise

Céline Hadziioannou, Djamel Ziane, and Carina Juretzek
University of Hamburg, Institute of Geophysics, Hamburg, Germany (celine.hadziioannou@uni-hamburg.de)

Although verified theories for the oceanic generation of Rayleigh waves in ambient seismic noise exist, the significant portion of Love wave energy is not completely understood yet. The observed Love wave energy in the ocean-generated seismic wavefield can be attributed to either source-side effects, or to conversions along the propagation path between source and receiver.

We present results from numerical studies, where we consider propagation effects on the Love-to-Rayleigh ratio of the noise wavefield. For a vertical force source, we evaluate the contribution of realistic crustal heterogeneities and topography.

Additionally, we present observational results of the primary microseism. In previous studies, the contribution of Love waves to the primary micoseismic noise field was found to be comparable to those of Rayleigh waves. Here, we study the relevance of different source region parameters on the observed primary microseismic noise levels of Love and Rayleigh waves simultaneously.

The generation efficiency in different source regions was compared to ocean wave heights, peak ocean gravity wave propagation direction and bathymetry. Some coastal regions serve as especially effective sources for one or the other wave type. These coincide not only with locations of high wave heights but also with complex bathymetry.

A similar dependence of Rayleigh and Love waves on the local ocean wave heights indicates a coupled variation with swell height during the generation of both wave types. However, the wave-type ratio is also modulated depending on peak ocean wave propagation directions. This could indicate a variation of different source mechanism strengths, but also hints towards an imprint of an effective source radiation pattern.