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Modelling seismic noise body waves

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Secondary microseismic noise is generated by non-linear interactions between ocean waves at the ocean surface. We present the theory for computing the site effect of the ocean layer upon body waves generated by noise sources distributed along the ocean surface. We show that the ocean site effect can be described as the constructive interference of multiply reflected P-waves in the ocean that are then converted to either P-waves or SV-waves at the ocean-crust interface.The site effect varies strongly with period and ocean depth and that it is is stronger for P-waves than for S-waves.

We validate our computation by comparing the theoretical noise body-wave sources with the sources inferred from beamforming analysis of the three seismogram components recorded by the Southern California Seismic Network. We use rotated traces for the beamforming analysis, and we show that we clearly detect P-waves generated by ocean gravity wave interactions along the track of typhoon Ioke (September 2006). We model the variability of the recorded P-waves associated with the typhon. We do not detect the corresponding SV-waves, and we demonstrate that this is because their amplitude is too weak to be detected.