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Modeling seismic noise by normal mode summation

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Microseismic noise is the continuous oscillation of the ground in the period band 5-20 s. We observe seasonal variations of this noise that are stable over the last 20 years. Microseism spectra display 2 peaks, and the strongest peak, in the period band 5-12 s, correspond to the so called secondary microseism. Longuet-Higgins (1950) showed that the corresponding sources are pressure fluctuations that are generated by the interaction of ocean waves either in deep ocean or due to coastal reflection. Considering an ocean wave model that takes into account coastal reflection, we compute the pressure fluctuation as a vertical force applied at the surface of the ocean. The sources are discretized in a spherical grid with constant grid spacing of 50 km. We then compute the synthetic spectra by normal mode summation in a realistic Earth model. We show that the maximum force amplitude is for periods 6-7 s which is consistent with the period of the seismic spectra maximum peak and that, for periods around 12 s, only the sources generated by coastal reflection have a strong influence for the microseism generation. We also show that the displacement of the ground is amplified in relation with the ocean bathymetry in agreement with Longuet-Higgins' theory. We obtain a good agreement between synthetic and real seismic spectra in the period band 5-12sec. Modeling seismic noise is a useful tool for selecting particular noise data such as the strongest peaks and further investigating the corresponding sources. These noise sources may then be used for tomography.