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Ambient Noise Green's Function Simulation of Long-Period Ground Motion

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Long-time correlation of ambient seismic noise has been demonstrated as a useful tool for strong ground motion prediction [Prieto and Beroza, 2008]. An important advantage of ambient noise Green's functions is that they can be used for ground motion simulation without resorting to either complex 3-D velocity structure to develop theoretical Green's functions, or aftershock records for empirical Green's function analysis. The station-to-station approach inherent to ambient noise Green's functions imposes some limits to its application, since they are band-limited, applied at the surface, and for a single force. We explore the applicability of this method to strong motion prediction using the 2007 Chuetsu-oki, Japan, earthquake (Mw 6.6, depth = 9 km), which excited long-period ground motions in and around the Kanto basin almost 200 km from the epicenter. We test the performance of ambient noise Green's function for long-period ground motion simulation. We use three components of F-net broadband data at KZK station, which is located near the source region, as a virtual source, and three components of six F-net stations in and around the Kanto basin to calculate the response. An advantage to applying this approach in Japan is that ambient-noise sources are active in diverse directions. The dominant period of the ambient noise for the F-net datasets is mostly 7 s over the year, and amplitudes are largest in winter. This period matches the dominant periods of the Kanto and Niigata basins. For the 9 components of the ambient noise Green's functions, we have confirmed long-period components corresponding to Love wave and Rayleigh waves that can be used for simulation of the 2007 Chuetsu-oki earthquake. The relative amplitudes, phases, and durations of the ambient noise Green's functions at the F-net stations in and around the Kanto basin respect to F-net KZK station are fairly well matched with those of the observed ground motions for the 2007 Chuetsu-oki earthquake.