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A combined source and site-effect study of ground motions generated by an earthquake in Port au Prince (Haiti)

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We present the preliminary results of a study with the aim of understanding how some combinations of source and site effects can generate extreme ground motions in the city of Port au Prince.
For this study, we have used the recordings of several tens of earthquakes with magnitude larger than 3.0 at 3 to 14 stations from three networks: 3 stations of the Canadian Broad-band network (RNCan), 2 stations of the educational French network (SaE) and 9 stations of the accelerometric network (Bureau des Mines et de l'Energie of Port au Prince and US Geological survey).
In order to estimate site effects under each station, we have applied classical spectral ratio methods: The H/V (Horizontal/Vertical) method was first used to select a reference station, which was itself used in a site/reference method. Because a true reference station was not available, we have used successively stations HCEA, then station PAPH, then an average value of 3 stations. In the frequency range studied (0.5 – 20 Hz), we found a site-to-reference ratio up to 3 to 8. However, these values present a large variability, depending on the earthquake recordings. This may indicate that the observed amplification from one station to the other depends not only from the local site effect but also from the source.
We then used the same earthquake recordings as Empirical Green's Functions (EGF) in order to simulate the ground motions generated by a virtual earthquake. For this simulation, we have used a stochastic EGF summation method. We have worked on the simulation of a magnitude Mw=6.8 using successively 2 smaller events that occurred on the Leogane fault as EGF. The results obtained using the two events are surprisingly very different. Using the first EGF, we obtained almost the same ground motion values at each station in Port au Prince, whereas with the second EGF, the results highlight large differences.
The large variability obtained in the results indicates that a particular combination of site and source effects may be responsible of large ground motions, especially at some given sites.