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TITLE: Using H/V Spectral Ratio Analysis to Map Sediment Thickness and to Explain Macroseismic Intensity Variation of a Low-Magnitude Seismic Swarm in Central Belgium

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ABSTRACT BODY: Between 2008 and 2010, the Royal Observatory of Belgium received numerous 'Did You Feel It'-reports related to a 2-year lasting earthquake swarm at Court-Saint-Etienne, a small town in a hilly area 20 km SE of Brussels, Belgium. These small-magnitude events ($-0.7 \leq M_L \leq 3.2$, n = *c.* 300 events) were recorded both by the permanent seismometer network in Belgium and by a locally installed temporary seismic network deployed in the epicentral area. Relocation of the hypocenters revealed that the seismic swarm can be related to the reactivation of a NW-SE strike-slip fault at 3 to 6 km depth in the basement rocks of the Lower Palaeozoic London-Brabant Massif. This sequence caused a lot of emotion in the region because more than 60 events were felt by the local population. Given the small magnitudes of the seismic swarm, most events were more often heard than felt by the respondents, which is indicative of a local high-frequency earthquake source. At places where the bedrock is at the surface or where it is covered by thin alluvial sediments (<10 m), such as in incised river valleys and on hill slopes, reported macroseismic intensities are higher than those on hill tops where respondents live on a thicker Quaternary and Cenozoic sedimentary cover (> 30 m). In those river valleys that have a considerable alluvial sedimentary cover, macroseismic intensities are again lower.

To explain this variation in macroseismic intensity we present a macroseismic analysis of all DYFI-reports related to the 2008-2010 seismic swarm and a pervasive H/V spectral ratio (HVSR) analysis of ambient noise measurements to model the thickness of sediments covering the London-Brabant Massif. The HVSR method is a very powerful tool to map the basement morphology, particularly in regions of unknown subsurface structure. By calculating the soil's fundamental frequency above boreholes, we calibrated the power-law relationship between the fundamental frequency, shear wave velocity and the thickness of sediments. This relationship is useful for places where the sediment thickness is unknown and where the fundamental frequency can be calculated by H/V spectral ratio analysis of ambient noise. In a subsequent research step macroseismic intensity of the different felt events is compared to sediment thickness in order to investigate if the people's perception of earthquake strong ground motions relates to the local sediment column above bedrock.

We discovered that the decrease in macroseismic intensity of the felt/heard events on the hill tops can be explained by the absorption of high frequency seismic energy due the thickness of the local sediment column. Our results illustrate that it is fundamental to study regional soil properties to understand the effects of earthquake strong ground motions in an intraplate tectonic setting.

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KEYWORDS:
7212 SEISMOLOGY Earthquake ground motions and engineering seismology,
7215 SEISMOLOGY Earthquake source observations,
7299 SEISMOLOGY General or miscellaneous.

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