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Macroseismic investigation of the 2008-2010 low magnitude seismic swarm in the Brabant Massif, Belgium. The link between macroseismic intensity and geomorphology

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Between July 2008 and January 2010 a seismic swarm took place in a region 20 km south of Brussels, Belgium. The sequence started on the 12th of July 2008 with a M_L = 2.2 event and was followed the day after by the largest event in the sequence (M_L = 3.2). Thanks to a locally installed temporary seismic monitoring system more than 300 low magnitude events, with events as low as M_L = -0.7, have been detected. Results of the relocations of the different hypocenters and analysis of the focal mechanisms show that the majority of these earthquakes took place at several km's depth (3 to 6 km) along a (possibly blind) 1.5 km long NW-SE fault (zone) situated in the Cambrian basement rocks of the Brabant Massif. Remarkably, 60 events ($0.6 \leq M_L \leq 3.2$) were felt, or heard only sometimes, by the local population. This was detected by the "Did you feel it?" macroseismic inquiries on the ROB seismology website (www.seismology.be). For each event a classical macroseismic intensity map has been constructed based on the average macroseismic intensity of each community. Within a single community, however, the reported macroseismic intensities locally often vary ranging between non-damaging intensities of I and IV (on the EMS-98 scale). Using the average macroseismic intensity of a community therefore often oversimplificates the local intensity, especially in hilly areas in which local site effects could have influenced the impact of the earthquakes at the surface.

In this presentation we investigate if the perception of the people of how they experienced the small events (sound, vibrations) was influenced by local geomorphological site effects. First, based on available borehole and outcrop data a sediment thickness map of the Cenozoic and Quaternary cover above the basement rocks of the Brabant Massif is constructed in a 200 km^2 area around the different epicenters. Second, several electrical resistivity tomography (ERT) profiles are conducted in order to locally improve the sediment thickness map and to determine if any fault trace can be localized. Finally, the relationship between the variation in macroseismic intensity and the local sediment thickness above the Cambrian basement is investigated in function of the distance to the epicenter.

This methodology allows deducing if macroseismic intensities are higher on the eroded hill slopes and in the incised valleys, at which the sediment and alluvial cover is the thinnest ($<$10 m), than compared to those intensities reported by people living on hill tops, at which the sediment cover is the thickest ($>$30 m), and if thus macroseismic intensity can be related to geomorphology.