

CHARACTERISING EARTHQUAKE MONITORING STATIONS USING MASW, MICROTREMOR ARRAY, SCPT AND CROSS-HOLE TOMOGRAPHY

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In this work, we present a comparative study of different methods to characterize V_s , using the following techniques: Multichannel Analysis of Surface Waves (MASW), microtremor array method, cross-hole tomography and Seismic Cone Penetration Tests (SCPT).

A network of 18 surface stations in the Netherlands monitor induced earthquakes due to the extraction of the Groningen gas field. The subsurface at the stations consists of unconsolidated and heterogeneous sediments, because of several generations of incised and infilled channel structures.

These techniques used represent a range of sampling volumes and spatial resolutions. For example, the SCPT is a high resolution technique, but the sampling volume is quite small, while The MASW samples much larger soil volumes and has a lower spatial resolution. We applied several adjustments to the techniques both in acquisition as in the processing phase. For example, the MASW data were analysed using classic shot gathers, but also Common Mid-Point cross-correlation gathers to obtain information about the heterogeneity of the subsurface. For the SCPTS, not only zero-offset shots were performed, but also offsets of 5, 10, 15 and 20 m to obtain a tomographic VS image based on SCPT. It was possible to determine the representative VS profile at each station location using the various techniques.

Heterogeneity was visualised by the cross-hole tomography, offset SCPT and CMP-cc of MASW.

Based on the expected resolution of each method and the site characteristics, we propose a joint use of several methods to balance the strengths of each method in various depths. For instance, the low signal quality of SCPT in the top meters was balanced by the high MASW VS quality in that depth range, resulting in a reliable VS depth profile