Periodic ReMi-MASW surveys on active landslides in the Emilia Romagna region (Northern Apennines)

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From January 2014 to December 2016, several combined ReMi-MASW seismic surveys (Refraction Microtremor-Multi Channel Analysis of Surface Waves) were conducted on active landslides. All the landslides are located in the Emilia Romagna region (Northern Apennines), and were classified as: 1) flows and 2) slides. For the seismic campaigns, we used eight vertical polarized geophones at 4.5 Hz, placed at intervals of 2 m each, and a total array length in the range of 10-14 m. As suggested by Louie (2001), we used a single geophone sensor at each channel, with the geophones connected to a SoilSpy Rosina acquisition system (Micromed spa). The first 5 minutes of each acquisition were performed in the passive mode, just acquiring the ambient seismic noise, and the last minute was in the active mode. For the active source, we used the jump of an operator at $\sim$5 m from the first geophone. The MASW approach relies on mid-to-high frequency artificial sources and usually provides better results in the high frequency domain (i.e. low depth). The ReMi analysis relies on ambient noise, which is ubiquitous and spans a wider frequency range, potentially working better in the mid-to low frequency domain (i.e. mid-to-high depths). The surveys were interpreted with Grilla (Micromed Software) with a manual procedure. ReMi-MASW lines were done both inside and outside the landslide area to compare the shear wave velocity (Vs) of the displaced soil with that of the source material. Often, the first campaign survey was performed in the range of 15 days from the reactivation of the landslide, than, where it was possible, we conducted periodic ReMi-MASW acquisitions, in order to evaluate the Vs variation over time. Analyzing all the data, it is clear that the Vs detected in the flow types landslide are lower than the ones detected in the slide types. It is also interesting to observe the increase of shear wave velocity over time, due to the consolidation of the material and the decrease of void index.