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First results from the analysis of seismic noise on the dynamic response of two slopes failed during the 2004 Niigata earthquake (Japan)

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In 2004 an earthquake of magnitude 6.8 hit the central part of the Niigata Prefecture in Japan, causing high damage and thousands of landslides. Two among the most catastrophic of these landslides occurred at the localities of Terano and Higashi Takezawa, causing damming of the Imo river and severe flooding. In both cases the estimated volume of the displaced material exceeded one million cubic meters. The lithologies involved in failures were sandy silt, silty sand, sandstone, siltstone and mudstones. Following recent studies on phenomena of directional resonance characterising the dynamic response of some slopes prone to landsliding, in situ recordings of seismic noise were carried out at several sites on the slopes of the two landslides to detect possible presence of site amplification effects that may have favoured the earthquake triggering of these failures. The subsequent analysis was conducted following two procedures: i) the standard Nakamura (or HVNR) technique, based on the examination of azimuthal variations of ratios between spectra of horizontal and vertical components of noise recording; ii) a new technique that estimates the rate of recurrence, in noise recording, of signals showing coherent preferential directivity and calculates H/V spectral ratio average restricting it to peaks satisfying purposely defined significance requirements. The results of these analyses showed that, whereas the employment of the standard method provided uncertain outcomes in terms of the presence or absence of site response directivity, the new technique proved to be effective in revealing directional resonance properties. In particular, apart from an ubiquitous low frequency signal with a strong directional character, possibly related to sea wave influence, evidences of directional amplification with orientation consistent with landsliding directions (approx. west) were found on both slopes. Nevertheless, a considerable variability of resonance frequency and amplification factors was also observed, being likely related to local differences in measurement site conditions (geology and topography).