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Topographic site effects: numerical studies and a possible application to the regional Newmark approach

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2D elasto-dynamic modelling of the seismic response was performed with the UDEC software (ver. 4.01, ITASCA). The numerical studies have been performed for six models constructed from real topographic settings of the landslide-prone slopes situated in the Mailuu-Suu River Valley, Southern Kyrgyzstan. The main focus of our studies was the development of proxies for a regional mapping of topographic site effects. The main parameter we studied was the Arias Intensity (Ia). This parameter is applied to the GIS-based Newmark method, which regionally maps the seismically-induced landslide susceptibility. This method performs a mapping of the Ia values via empirical attenuation laws, which mainly account for the regional geometric spreading. An input of site effects is generally not included in these laws. While total site effects normally integrate both geologic and topographic inputs, our paper focuses only on the pure topographic effects. The numerical studies showed that the amplification of the Arias Intensity depends on two main factors: the frequency content of the input signal and the site settings. The first parameter can be predicted for wide areas through attenuation laws. With respect to the impact of site settings on Ia amplification, our studies show that convex surface morphologies with a longer baseline induce amplification in the low frequency domain, while those with a shorter baseline amplify the seismic shaking in the higher frequency domain. The link between topographic site amplification and the size of a surface morphology is identified. Those developed proxies are adapted for application in conventional GIS software platforms.