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The influence of natural and anthropogenic noise to seismic detection capacities of events Ml < 0.0

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Applying the method Nanoseismic Monitoring to the unstable Heumoes slope, Austria, a permanent seismic network consisting of three seismic small-arrays was superficially installed in July 2009 in order to determine the spatio-temporal occurrence of varying slope dynamics. One seismic small-array consists of one 3-component central station and three 1-component outer stations, all of them with an eigenfrequency of 1 Hz and a preset sampling rate of 400 Hz. In the time-period of ∼16 months, we observed more than 70 fracture processes with magnitudes varying between -0.5 < Ml < -2.5 caused by initial stress relief during the slope's movement. Beside the determination of the spatio-temporal occurrence of these fracture processes, one major focus of the study marks the analysis of their frequency-magnitude distribution.

Using the crucial Gutenberg-Richter (1956) relationship (log (N>MC) = a-bM; N = amount of earthquakes above the magnitude of completeness (MC), a = tectonic parameter, b = b-value), we determined a b-value of b = 1.03 +/- 0.1 for the observed fracture processes at the Heumoes slope. The frequency-magnitude distribution generally follows the Gutenberg-Richter relationship, but is enormously depending on the detection threshold of the seismic network, which is influenced by varying noise-conditions at the slope. The comprehensive analysis of natural (wind speed, rain events, snow cover) as well as anthropogenic influences to the detection capacities of seismic events Ml < 0.0 is presented in this study.

We figured out, that wind gusts of ∼14 m/s increases the ambient noise about ∼10 dB at those stations located close to forests, while stations installed in unwooded areas are not affected. Strong rain-events with more than 15 mm/h cause an increase of 5-10 dB up to ∼10 Hz and 10-20 dB above 10 Hz at all stations. The cover of snow generally attenuates the coupling of sound signals to soil and decreases the ambient noise about ∼20 dB at all stations influenced by anthropogenic sound noise over the entire frequency-range. The worst noise conditions were observed at days where human construction works were going on. Depending on the source distance, the ambient noise increased between 20 dB and 40 dB at the seismometer stations.

Natural influences, which can be barely avoided, can result in a temporary decrease of the detection thresholds between 0.5 and 1.0 order of magnitude, while anthropogenic noise causes a temporary decrease of the detection threshold up to 2 orders of magnitudes for the fracture processes we want to observe. The entire noise-analysis as well as its influence to b-value calculation will be presented.