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Seismic monitoring of the Gugla rock glacier: observations and perspectives

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Coda-Wave Interferometry is commonly used to monitor various subsurface processes. Relative seismic velocity changes (dV/V) can be extracted from ambient noise correlations, in order to track tiny mechanical and structural changes within the surveyed medium (1). Since years 2000 such methodology has been applied on many different geological objects, among which volcanoes (2), landslides (3), glaciers and aquifers (4). Applying environmental seismology on rock glaciers as well is therefore promising, with the aim of a better understanding of its internal dynamics along with natural hazard forecasting.

Located in Wallis (Switzerland), the Gugla rock glacier is encountering a severe destabilization phase since the middle of the years 2000 (5). The site has been surveyed since October 2015 with a seismological network, with the aim of estimating seismic velocity changes and detecting micro-seismicity. Ambient noise correlations have been used to compute hourly and daily relative changes in surface waves velocity with respect to a stable reference period. At low frequencies (between 4 and 10 Hz), we clearly observe seasonal variations along the whole period of three years. Seismic velocities are higher in winter than in summer, likely due to the freezing of surface layers that increases the whole rigidity of the medium. During melting periods, we observe a sudden velocity decrease at high frequencies (around 12 Hz) and a decorrelation of the seismic responses. These results can be explained by density increase due to melting water percolation into the active layer. From these seismic data, we are also able to detect micro-seismicity and extract seismic activity (micro-quakes and rockfalls). Daily frequency of these events exhibits seasonal variations, with a maximum in spring and summer, correlated with an acceleration of the rock glacier. In addition, we also observe short bursts of micro-seismicity, which occur both during snowfalls and during rapid melting periods. These observations are likely to take part in future alert systems based on continuous seismic recordings, with the aim of predicting critical debris flows triggered by rock glacier destabilization (6).

References

(1) Larose E., C. S. (2015). Environmental seismology: What ca we learn on earth surface processes with ambient noise. Journal of Applied Geophysics, 116, 62-74.

(2) Sens-Schönfelder C., W. U. (2006). Passive image interferometry and seasonal variations of seismic velocities at Merapi Volcano, Indonesia. Geophysical Research Letters, 33.

(3) Mainsant, G., Larose, E., Brönnimann , C., Jongmans, D., Michoud, C., & Jaboyedoff, M. (2012). Ambient seismic noise monitoring of a clay landslide: Toward failure prediction. Journal of Geophysical Research: Earth Surface, 117.

(4) Voisin C., Garambois S., Massey C., Brossier R. (2016). Seismic noise monitoring of the water table in a deep-seated, slow-moving landslide, Interpretation, 4 (3), SJ67-SJ76.

(5) Delaloye R., M. S. (2012). Rapidly moving rock glaciers in Mattertal. Jahrestagung der Schweizerischen Geomorphologischen Gesellschaft, 21-31.

(6) Guillemot A., Baillet L., Helmstetter A., Larose E., Mayoraz R., (2019). Seismic monitoring of the Gugla rock glacier, in preparation.