EGU21-8082
https://doi.org/10.5194/egusphere-egu21-8082
EGU General Assembly 2021

Drivers of reversible and irreversible slope deformations in a paraglacial environment

Nicolas Oestreicher[1], Clément Roques[2], Marc Hugentobler[1], Jordan Aaron[1], and Simon Loew[1]
[1]ETH Zurich, Zürich, Switzerland
[2]Univ Rennes, CNRS, Géosciences Rennes - UMR 6118, F-35000 Rennes, France

Retreating glaciers around the world lead to rapid and profound changes in the surrounding landscapes. In the Alps, many glaciers are rapidly retreating and downwasting, substantially modifying stresses and hydro-thermal boundary conditions on the adjacent slopes. There is an increase in observations of bedrock responses and the formation of large-scale instabilities in paraglacial environments, but still a little knowledge about the underlying preparatory factors and drivers. This presentation is linked to the one from Hugentobler et al. in the same session. Both studies take place in the same catchment and address the same questions at different spatial scales, with other techniques and datasets.

We analyse surface deformation data monitored in a crystalline bedrock catchment, on the recently deglaciated slopes of the Great Aletsch Glacier (Valais, Switzerland). Our monitoring system has been in operation for six years and comprises 93 reflectors, 2 robotic TPS, and 4 cGPS stations distributed on both sides of the glacier tongue. This unique dataset allows studying the main processes involved at relevant spatial and temporal scales. The response of potential drivers for reversible and irreversible deformation is evaluated through combined multivariate (vbICA) and cross-correlation statistical analysis. We found that the variability in deformation near the glacier tongue is primarily controlled by glacier unloading through melting and seasonal groundwater fluctuations. At the catchment scale, the later effect is poroelastic and hence reversible, but we argue that it could also induce hydromechanical fatigue. By investigating the deformation's spatial pattern, we observed that the reversible deformation is mostly controlled by discrete structures such as hectometer-scale brittle-ductile shear zones striking subparallel to the valley axes and the main Alpine foliation. Field mapping and pressure monitoring during borehole drilling suggest that infiltration into the fractured rockmass is very heterogeneous and mainly controlled by the presence of interconnected tensile fractures.