Why rock glacier deformation velocities correlate with both ground temperatures and water supply at multiple temporal scales

Robert Kenner¹, Luisa Pruessner², Jan Beutel³, Philippe Limpach⁴, and Marcia Phillips¹

¹WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland
²Laboratory of Hydraulics, Hydrology and Glaciology, ETH Zürich, Switzerland
³Computer Engineering and Networks Laboratory, ETH Zürich, Switzerland
⁴BSF Swissphoto AG, Regensdorf, Switzerland

Recent studies have highlighted water supply as a driving factor for rock glacier deformation velocities. In parallel, numerous observations of correlating mean annual air- or ground temperatures and rock glacier velocities have been reported. We investigated the connection between rock glacier temperatures and –hydrology and found that there is no contradiction between both hypotheses. We observed that water supply to the shear horizon of rock glaciers is highly correlated to their mean annual temperatures and – even more pronounced – to their temperatures during early winter. The rock glacier temperatures influence the amount of water supplied to the shear horizon to a lesser extent, but strongly determine the duration of the water supply. The main external influencing factor on rock glacier dynamics found next to atmospheric warming was early winter snow cover. Our results are based on deformation- and borehole temperature measurements of four Swiss rock glaciers.