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Resolving the influence of temperature and liquid water forcing on rockglacier dynamics: a numerical modelling approach

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In the past decades, observations have highlighted seasonal and inter-annual variability in rockglacier flow (e.g. Haeberli, 1985; Arenson, 2002). Temperature forcing and liquid water have been proposed as key processes to explain these variations in kinematics (among others: Ikeda, 2008; Wirz et al., 2016). Numerical modelling studies exist to investigate rockglacier flow (e.g. Kääb et al., 2007; Müller et al., 2016; Monnier and Kinnard, 2016). However, the relative influence of the identified climatic forcings on rockglacier dynamics has not yet been quantitatively assessed against real-world data.

We investigate rockglacier flow variability by designing 1-dimensional numerical models that couple heat conduction to different creep relations, including variations in pore water pressure. We compare the modelling with borehole temperatures and surface velocity measurements from several sites of the PERMOS and PermaSense monitoring networks.

We find that velocity variations cannot be explained from the influence of temperature forcing on rockglacier rheology alone. Coupling variations in water input to a water pressure dependent creep relation, we are able to reproduce velocity variations both in magnitude and temporal pattern over time scales from several months to several years.