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Climatic and thermal controls on rockglacier kinematics in the Swiss Alps

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The Swiss National Fond SINERGIA project "The evolution of mountain permafrost in Switzerland" (TEMPS) aims to improve the understanding of the complex interaction of permafrost conditions and dynamics in the Swiss Alps and is to a large part based on the extensive data set obtained within the Swiss permafrost monitoring network (PERMOS). One aspect of this permafrost assessment is the analysis of rockglacier kinematics resulting from permafrost creep: Those mechanisms are driven and influenced by the ground thermal regime, the composition, structure and momentum of the subsurface material and the morphology of the bedrock on the local scale as well as the characteristics and temporal variations of the climatic conditions on the regional scale. The PERMOS initiative generates comprehensive datasets on key variables influencing the characteristics of permafrost creep such as ground surface temperature (GST), ice content and subsurface conditions derived from borehole data and geophysical measurements. These primary datasets are extended and used by TEMPS to derive further information such as the onset and duration of snow cover, which strongly influences permafrost kinematics by insulation effects and/or the intrusion of melt water. The monitoring of rockglacier kinematics is deducted from remote sensing data and annual and seasonal terrestrial surveys on numerous sites in the Valais and Engadine region representing a west-east transect through the Swiss Alps.

Changes in rockglacier creep due to variations in climate and extraordinary "weather events" such as warm/cold summers, warm/cold winters and/or early/late development and melt of a permanent snow cover provide insights into the coupling between atmospheric signals and the ground thermal regime (controlling geotechnical properties and rockglacier rheology). Thus, this study analyses how selected rockglaciers distributed all over the Swiss Alps react to large scale variations in climate and according changes in (sub)surface (hydro-)thermal regimes. Therefore, comprehensive data on rockglacier kinematics throughout the Swiss Alps from the PERMOS database is analyzed in relation to relevant climatic factors and temperature data: the influence of air temperature and precipitation, surface and subsurface temperatures and snow cover related parameters (timing and duration of the snow-melt) on rockglacier kinematics are presented and discussed. This large scale assessment of rockglacier kinematics in relation to variations in climate leads to a better understanding of the climate – (sub)surface conditions – rockglacier coupling and help to develop a more thorough understanding of rockglacier dynamics.