The influence of radiative forcing on permafrost temperatures in Arctic rock walls

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Climate change has a strong impact on periglacial regions and intensifies the degradation of mountain permafrost. This can result in instabilities of steep rock walls as rock- and ice-mechanical properties are modified. Besides altitude and the related air temperature, latitude is a crucial factor, as solar radiation has a strong impact on the energy transfer processes from the atmosphere to the ground. It can differ significantly in intensity and time over latitudinal positions and exposures of frozen rock slopes.

In this project, we suggest improving the parametrization of short-wave and long-wave radiation in thermal models for permafrost degradation. To achieve this, we will analyze temperature data of surface temperature loggers from Southern Norway to Svalbard. In total, 37 loggers were installed between 2010 and 2017. The field sites display enormous latitudinal gradients as well as topographic settings. Furthermore, they provide hourly data, allowing us to set up short-stepped time series for examination of solar radiation angles at varying latitudes.

The data is used to set up a transient heat-flow model (CryoGrid) to simulate the local thermal regime. The model takes into account varying input of short-wave radiation due to aspect, slope angle and time as well as long-wave radiation under different sky-view factors. Finally, the influence of solar radiation on permafrost degradation in steep rock walls is investigated.