Geophysical Research Abstracts
Vol. 21, EGU2019-4274, 2019
EGU General Assembly 2019

Air Convection Within the Active Layer of an Alpine Rock Glacier: A Numerical Modelling Approach

Jonas Wicky and Christian Hauck

Alpine Cryosphere and Geomorphology Group, Dep. of Geosciences, University of Fribourg, Fribourg, Switzerland (jonas.wicky@unifr.ch)

In an Alpine setting coarse blocky surface material with underlying permafrost is widespread. The interconnected voids allow for air convection. This influences the thermal regime of the underlying permafrost. Rock glaciers are one of the main permafrost landforms, also often covered with coarse blocky material, and thus influenced by air convection. Previous 1D-modelling approaches were able to reproduce this effect using sink- or source terms or other parametrizations. We switch to a 2D domain to explicitly model and solve the governing equations for air convection within the ground. The model solves for heat conduction coupled with air flow described as a Darcian flow with the Boussinesq approximation to account for natural convection. We use a simplified geometry of a rock glacier to solve the equations in transient model runs. Long-term monitoring data from the Swiss Permafrost Monitoring Network PERMOS serves for model forcing and validation. Our results show that convection has a great influence on ground temperatures in the active layer and the underlying permafrost. Seasonal patterns develop. During wintertime, when the thermal gradient between the active layer and air temperature is negative, the air stratification within the active layer is thermally unstable. The onset of vertical convection cells can be observed and the ground cools very efficiently. Whereas during summer, air circulation is weak and mainly driven by gravity. Summer heat transfer is thus mainly conductive. The modelling results fit quite well to the measured borehole data. During winter, the intense ground cooling, which cannot be explained by conduction only, is well represented. In the context of a changing climate and degrading permafrost in the Alps, a thorough understanding of these processes is important. Our modelling results show that landforms covered with coarse blocks react differently to changing atmospheric conditions. This is of great importance to understand and predict the development and extent of Alpine permafrost in future.