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Monitoring spatio-temporal infiltration pattern and its interaction with permafrost thaw using electrical resistivity and self-potential measurements at Schilthorn, Swiss Alps

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The permafrost evolution and ground ice conditions have been investigated in detail at the long-term monitoring station Schilthorn, Northern Swiss Alps, over the past 20 years. Results show warm permafrost conditions close to the freezing point over at least 100 metres depth, a high interannual variability of the active layer depth, but a clear increasing trend of active layer thickness reaching almost 10m in recent years.

In addition to borehole temperature measurements, an energy balance station, distributed soil moisture and ground temperature sensors, geophysical monitoring installations are used to monitor the spatio-temporal variability of ground ice conditions and provide ground truth data for hydro-thermal model simulations. Geophysical monitoring techniques include autonomous electrical resistivity tomography (ERT) measurements, yearly refraction seismic measurements and recently installed continuous self potential (SP) measurements to monitor the permafrost hydrology (Hilbich et al. 2008, 2011, Kemna et al. 2016).

Numerical model simulations consistent with borehole data showed the occurrence of deep infiltration processes within the active layer, but also within the permafrost, suggesting low and/or heterogeneous ice contents within the permafrost (Scherler et al. 2010). In this contribution, we will use the combination of geophysical data (ERT, SP) with the distributed soil moisture data to analyse spatio-temporal infiltration patterns and address the question of its potential impact on active layer deepening and permafrost thaw. In addition, the relative frequency of infiltration events due to summer precipitation, snow melt and upslope processes detected by the different methods will be compared and analysed over several years.

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