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The ATMOperm – project: Atmosphere - permafrost relationship in the Austrian Alps - extreme atmospheric events and their relevance for the mean state of the active layer

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Permafrost is a forming element of the high mountain landscape, subject to considerable degradation due to global climate change. In the Alps infrastructure facilities such as roads, routes or buildings are affected by the changes of permafrost, where modification often cause enormous costs. However, the understanding of the permafrost changes inducing processes is still insufficient. In particular, the energy exchange with the atmosphere in the interplay with processes in the soil, is weakly recognized and understood. This is especially true for the influence of extreme atmospheric events such as a summer heat wave (e.g. 2003), early-winter cold wave or events relating to the snow thickness. This scientific deficit is not only due to the complexity of permafrost processes, but also because of the relatively short period of establishment of alpine permafrost research (especially in Austria).

The geophysical method of geoelectrics (Electrical Resistivity Tomography ERT) is a innovative approach for the detection of thermal structures in the subsurface. ATMOperm has the goal of further exploring the method of geoelectrics for estimation of thawing layer thickness (Active Layer Thickness) for mountain permafrost and to optimize it for long time monitoring. It is clearly necessary to further optimize the transformation of ERT data to thermal structures in the ground - a significant innovation of ATMOperm. The measurement of the thawing layer by the geoelectric method is complemented by measurements of the energy fluxes between the atmosphere and soil. This allows to investigate the effects of energy exchange between the atmsosphere and the ground on the thickness and the thermal structure of the thawing layer in an ideal way. The use of an energy and mass transfer model of the soil (Coupling Model) allows to simulate exchange processes between the atmosphere and the ground and so to understand the effect of atmospheric energy fluxes on the temperature distribution in the soil.

The ATMOperm monitoring will be developed for the Sonnblick mountain(Austrian Central Alps). This is mainly for the fact that for Sonnblick an extensive permafrost monitoring already exists and that the atmospheric monitoring network is highly developed there. In addition to Sonnblick the data from the already existing monitoring locations Schilthorn (Bernese Alps , Switzerland) and Kitzsteinhorn (Austrian Central Alps) will also be used, as these sites offer longer geoelectric measurement time series essential for model improvements.