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The effect of temporal variability of soil moisture on mountain permafrost: a combined model and monitoring approach

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Soil moisture is a key factor controlling the energy and mass exchange processes at the soil-atmosphere interface. In permanently frozen ground it strongly affects the thermal behaviour of the ground by influencing its physical properties such as ice content, thermal conductivity and heat capacity. It also influences other processes like evaporation, infiltration, refreezing rate and runoff and modifies the electrical and electromagnetic properties such as electrical conductivity and permittivity that are used in indirect geophysical and remote sensing methods.

In a first attempt to quantify the role of water content, a soil moisture network along an altitudinal gradient in middle and high mountain areas in Switzerland has been initiated, and first results confirm the importance of different water related processes that are dominant at different elevation bands.

At very high elevations, in permafrost regions, these processes have not yet been analysed in detail, and current state-of-the-art climate and climate impact simulations are neither calibrated nor validated regarding water content in the subsurface, mostly due to missing data. Using the data from the new soil moisture network in combination with measured in-situ ground temperatures and meteorological parameters (air temperature, global radiation, and wind speed), we calibrated the one dimensional heat and mass transfer model COUP (Jansson, 2012) at all locations. This model was then used to analyse the water balance and more precisely the specific repartition of precipitations into runoff, evaporation and change in moisture content. Finally, we analysed the relations between infiltrating water from the snow cover, phase changes and latent heat release and its influence on subsurface temperature in frozen terrains.

REFERENCES

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