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# Air Convection in Coarse Blocky Permafrost: A Numerical Modelling Approach to Improve the Understanding of the Ground Thermal Regime

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This thesis describes a consistent approach to model air convection in porous ground and its influence on permafrost temperatures. Although air convection in the ground has been observed and described for quite a long time, its representation in a numerical model on a real two-dimensional field-scale, applying measured data as boundary and afterwards as validation, is novel. The approach confirms most of the field observations, but it allows for an extended qualitative description of the air convection in the ground as well as for attempts of an absolute quantification of the influence of air convection on permafrost temperatures.

The model solves for heat transfer through conduction and convection with air flow described by Darcy's law and adopting a Boussinesq-approximation to account for the buoyancy induced free convection effects. The Rayleigh number is shown to be a good dimensionless number to characterize the convection regime of the coarse blocky permafrost substratum. The most important parameters governing the Rayleigh number are the temperature gradient within the ground and the permeability of the ground. The temperature gradient can be measured (or modelled), the permeability is subject to greater uncertainty. It has been shown that permeability values in the range of 1 - 3 * $10^{-6}$ $m^2$ enable a consistent representation of ground convection in coarse blocky permafrost.

For all modelled landforms, ground convection has a cooling effect on ground temperatures. Colder temperatures are modelled when accounting not only for conduction but also for convection. Air convection in the coarse blocky ground is thus a crucial process to remodel the measured temperatures in boreholes. A conduction-dominated model approach yields warmer than measured temperatures.

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