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Heat transfer through snow: Model reproducing measurements

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Accurate modeling of the energy balance of a snow cover cannot be possible without the understanding of the interplay of the components of heat transfer in snow (conduction, convection, latent heat release/gain) and effect of the temporally changing internal geometry of snow on the heat and mass transfer process. None of the available descriptions of the heat transfer in snow allow an estimation of the relative weight of the components in the overall heat transfer or provide a possible scenario of the intra-seasonal evolution of the thermophysical properties of a snow cover in dependence on environmental conditions. A newly developed model of the effective heat conductivity of anisotropic porous media with solid–gas phase transition as component of heat transfer reproduces satisfactory the experimentally observed temporal change of the effective heat conductivity of snow caused by snow recrystallization (metamorphism). For now, the input parameter for the model, in addition to the weighed snow density and measured temperature, is the internal geometry of snow as provided by computed micro-tomography—changing in time Structure Model Index, Mean Intersect Length anisotropy and Specific Surface Area. The model suggests high (up to 20–30%) weight of the alternating latent heat release/gain mechanism in the overall effective heat conductivity of snow and shows regulation of the heat transfer process in snow by snow micro and macrostructure. Relation of the internal geometry of snow cover to field/remotely observed snow cover characteristics would be the next step in the model development.