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New insights in modeling coupled surface-subsurface flow in glacial and periglacial catchments

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A challenge in modeling the hydrological response of a glacial and periglacial catchment is represented by a properly land surface scheme (Walvoord, 2016).
In this abstract, we focus on the interaction between the surface and ground water flow. The infiltration rate through the ground surface is driven by the meteorological forcing and the soil hydraulic conductivity of the uppermost layer of the soil. The latter, in turn is significantly reduced by the presence of the permafrost and seasonally frozen soil (Bogaart, 2003). This affects the runoff production, and the energy balance of the ground since water flow carries a significant amount of heat. This for its part has a positive feedback on the ice thawing and hence on the soil hydraulic conductivity.

Thus, for these reasons the equation for freezing soil mass budget (called generalized Richards equation) based on the freezing equals drying hypothesis (Miller, 1965) has to be extended to couple the surface and subsurface flow. This can be achieved by using the new coupled surface-subsurface model presented in (Casulli, 2017). Finally there is the application of new techniques based on the double nested Newton algorithm (Casulli, 2010) to integrate the coupled equations of water and energy budgets.

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