New insights in permafrost modelling

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Simulating freezing soil has ignored for long time in mainstream surface hydrology. However, it has indubitably a large influence on soil infiltrability and an even larger influence on the soil energy budget, and, over large spatial scales, a considerable feedback on climate. The topic is difficult because it involves concepts of disequilibrium Thermodynamics and also because, once solved the theoretical problem, integration of the resulting partial differential equations in a robust manner, is not trivial at all.

In this abstract, we are presenting a new algorithm to estimate the water and energy budget in freezing soils. The first step is a derivation of a new equation for freezing soil mass budget (called generalized Richards equation) based on the freezing equals drying hypothesis (Miller 1965). The second step is the re-derivation of the energy budget. Finally there is the application of new techniques based on the double nested Newton algorithm (Casulli and Zanolli, 2010) to integrate the coupled equations. Some examples of the freezing dynamics and comparison with the Dall'Amico et al. (2011) algorithm are also shown.

References

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