Geophysical Research Abstracts
Vol. 21, EGU2019-10311, 2019
EGU General Assembly 2019

A high-resolution coupled permafrost - ice sheet model

Thomas Zwinger (1), Juha Hartikainen (2), and Denis Cohen (3)

(1) CSC - IT Center for Science Ltd., High Performance Computing, Espoo, Finland (thomas.zwinger@csc.fi), (2) University of Tampere, Tampere, Finland, (3) New Mexico Tech, Socorro, NM, USA

We present a recently developed high-resolution permafrost model. Based on continuum thermodynamics, the model consists of several sub-modules representing heat-transfer within ice, water and soil, saturated groundwater flow, salinity transport as well as deformation and stress-distributions of the solid constituents (i.e. ice, soil and bedrock). Within these sub-modules, we introduce important coupling mechanisms, such as effects of permafrost on glacier sliding and hydraulic conductivity of soil and bedrock, effects of solutes on the development of permafrost, and changes in hydrological conductivity by bedrock deformation. Implemented in the Finite Element code Elmer, this package provides the possibility to couple the permafrost to a high-resolution glacier or ice-sheet model (Elmer/Ice) that accounts for all stress components (full-Stokes). This makes it possible to study detailed processes at places that need high resolutions, such as ice-sheet margins where permafrost may play an important role in controlling the basal ice temperature, or geologically strongly varying bedrocks where permeability changes as a result of permafrost formation or degradation can significantly alter groundwater flow paths. The model is tested on benchmark problems for sub-module coupling as well as problems in combination with either advancing or retreating glaciation.