Geophysical Research Abstracts
Vol. 13, EGU2011-13620, 2011
EGU General Assembly 2011

The GEOtop model as a tool to describe the energy and water balance in permafrost or seasonally-frozen soils

Stefano Endrizzi (1), Stephan Gruber (1), Matteo Dall'Amico (2), and Riccardo Rigon (3)

(1) University of Zurich, Department of Geography, Zurich, Switzerland , (2) Mountain-eering Srl, Consulting Company, Trento, Italy, (3) University of Trento, Department of Civil and Environmental Engineering, Trento, Italy

GEOtop is a grid-based model that fully couples the soil heat and water budgets, represents the energy exchange with the atmosphere considering the radiative and turbulent fluxes, and describes the subsurface water flow in its three-dimensional nature. In particular, the model reproduces the strong coupling between water and energy balance taking place in the soil freezing and thawing processes, and considers the high non-linear dependence of soil internal energy on soil temperature in proximity to the freezing temperature, respecting the energy conservation. In addition, it describes the water and energy budgets in the snow cover, and models the temporal evolution of the snow depth and its effect on soil temperature. Therefore, GEOtop is potentially a very useful tool in several applications that involve permafrost and seasonally-frozen soils, both in high altitude and latitude regions. The work is primarily a description of the characteristic of the model. Applications show that GEOtop is able to reasonably reproduce the temperature in a borehole, in particular characterized by long zero-curtain effect. Distributed applications can also be carried out to have information on the spatial distribution of the annual average of the surface temperature, its correlation with the active layer thickness and lateral deformation rates at a relatively small scale ($\sim$10-20 m), allowing the inclusion of the effect of the lateral water fluxes, which is normally neglected in permafrost models.