



## **A model including compressible firn applied to crater glacier flow simulation**

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Large parts of cold glaciers may consist of firn rather than pure ice. As the shear fluidity as well as compressibility of firn show a strong dependency on the ice volume fraction, this altered rheology should be taken into account. We present a fully three-dimensional, thermo-mechanical model for glacier dynamics accounting for firn and its transition to ice. The numerical implementation is based on the Finite Element package Elmer and solves simultaneously the compressible Stokes-flow problem with non-Newtonian isotropic rheology, the heat transfer equation and – if applied prognostically – the evolution of the ice volume fraction. Additionally, a three-dimensional model for the dating of firn/ice is applied. Due to the hyperbolic (advection dominated) nature of the latter two problems, a discontinuous Galerkin method has been adopted for their numerical solution.

The model is applied to the Gorshkov crater glacier at Ushkovsky volcano, Kamchatka; the only crater glacier for which the bedrock topography has been determined so far. As a large part of the glacier's volume consists of firn, comparison of profiles for the temperature distribution as well as the age/depth relation between an incompressible and the presented model shall demonstrate the impact of the altered rheology. The results will also be compared to measured values from boreholes.