



HAL
open science

Assessing the sensitivity of steep rock slope permafrost to water infiltration under various fracture geometries: a numerical approach

Josué Bock, Florence Magnin, Jean-Yves Josnin, Matan Ben-Asher

► To cite this version:

Josué Bock, Florence Magnin, Jean-Yves Josnin, Matan Ben-Asher. Assessing the sensitivity of steep rock slope permafrost to water infiltration under various fracture geometries: a numerical approach. International Mountain Conference, Sep 2022, Innsbruck, Austria. , 2021. hal-04032881

HAL Id: hal-04032881

<https://hal.science/hal-04032881v1>

Submitted on 30 Mar 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

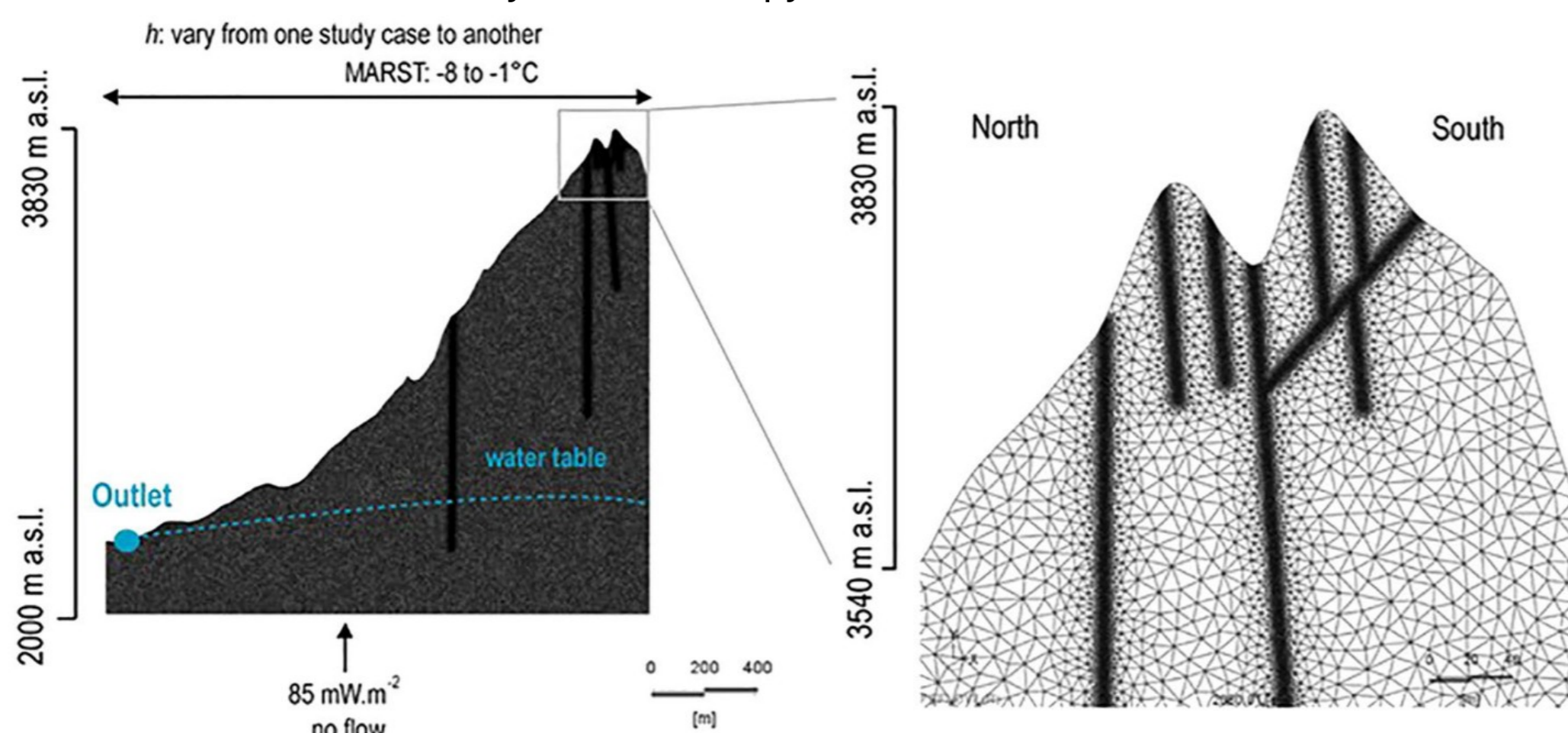


Distributed under a Creative Commons Attribution 4.0 International License

Assessing the sensitivity of steep rock slope permafrost to water infiltration under various fracture geometries: a numerical approach

Josué Bock¹, Florence Magnin¹, Jean-Yves Josnin¹, Matan Ben-Asher¹
¹Laboratoire EDYTEM, Université Savoie Mont-Blanc, CNRS, 73376 Chambéry, France

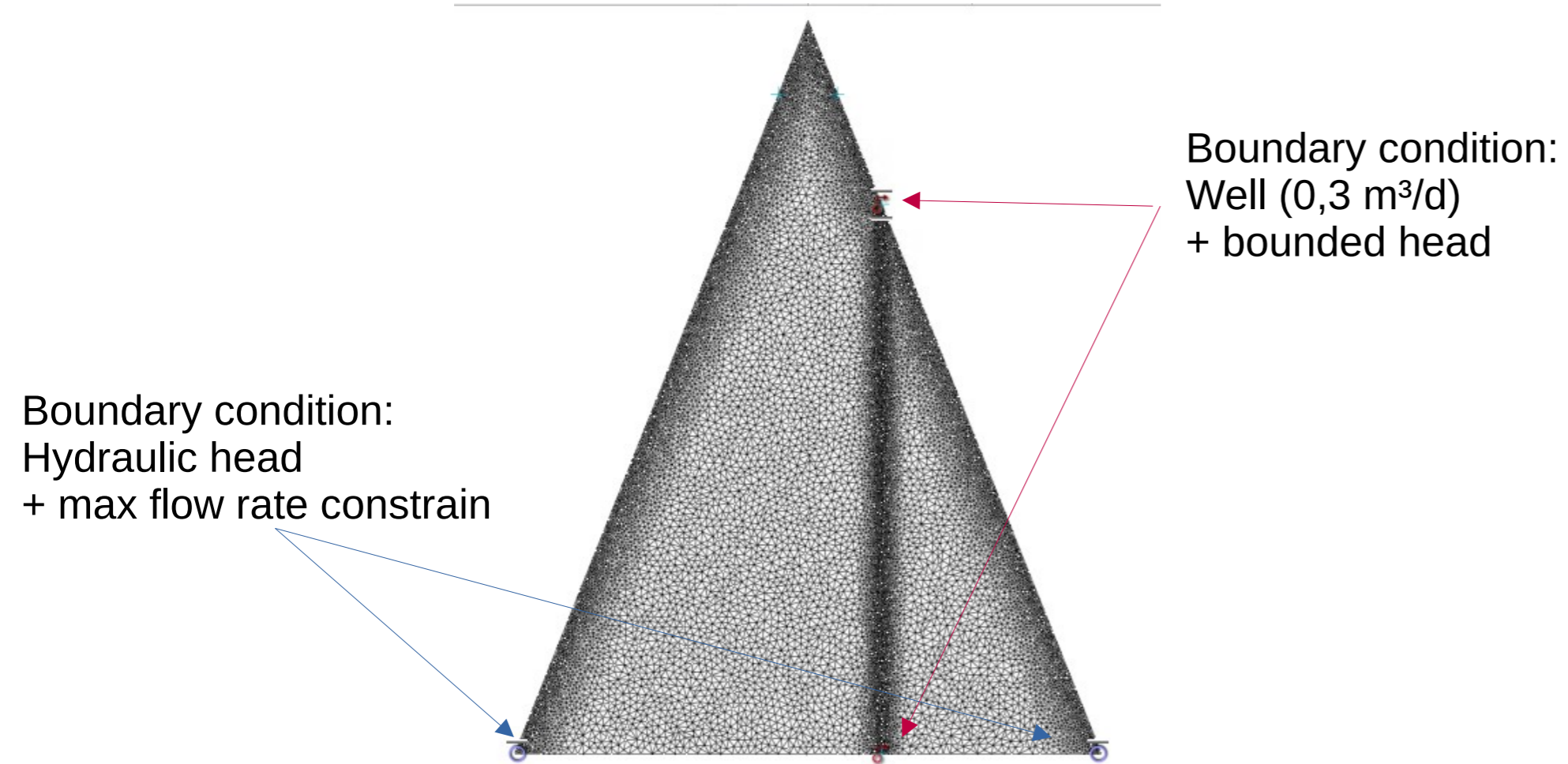
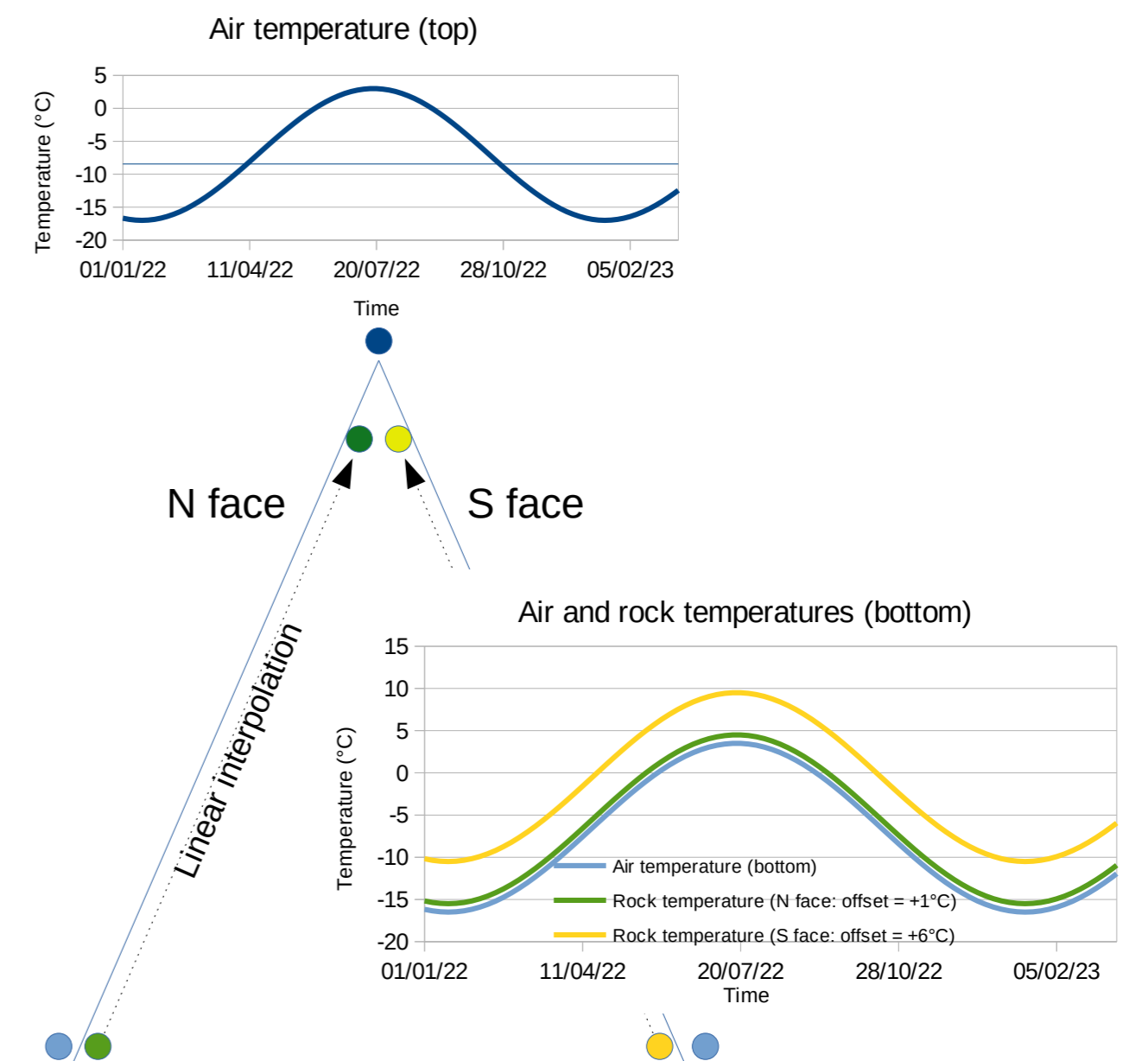
Water infiltration and circulation in frozen bedrock fractures may enhance heat transport from the surface to the permafrost body and play a role in rock slope failure. However, such processes occurring in steep rock slope permafrost are difficult to investigate because of their non-linearity and anisotropy.



Using a fully coupled hydrological and thermal model applied to rock wall permafrost, Magnin and Josnin shown that water flows have major effects on the aggradation and degradation of alpine rock wall permafrost, resulting in a deeper permafrost body than under heat conduction only.

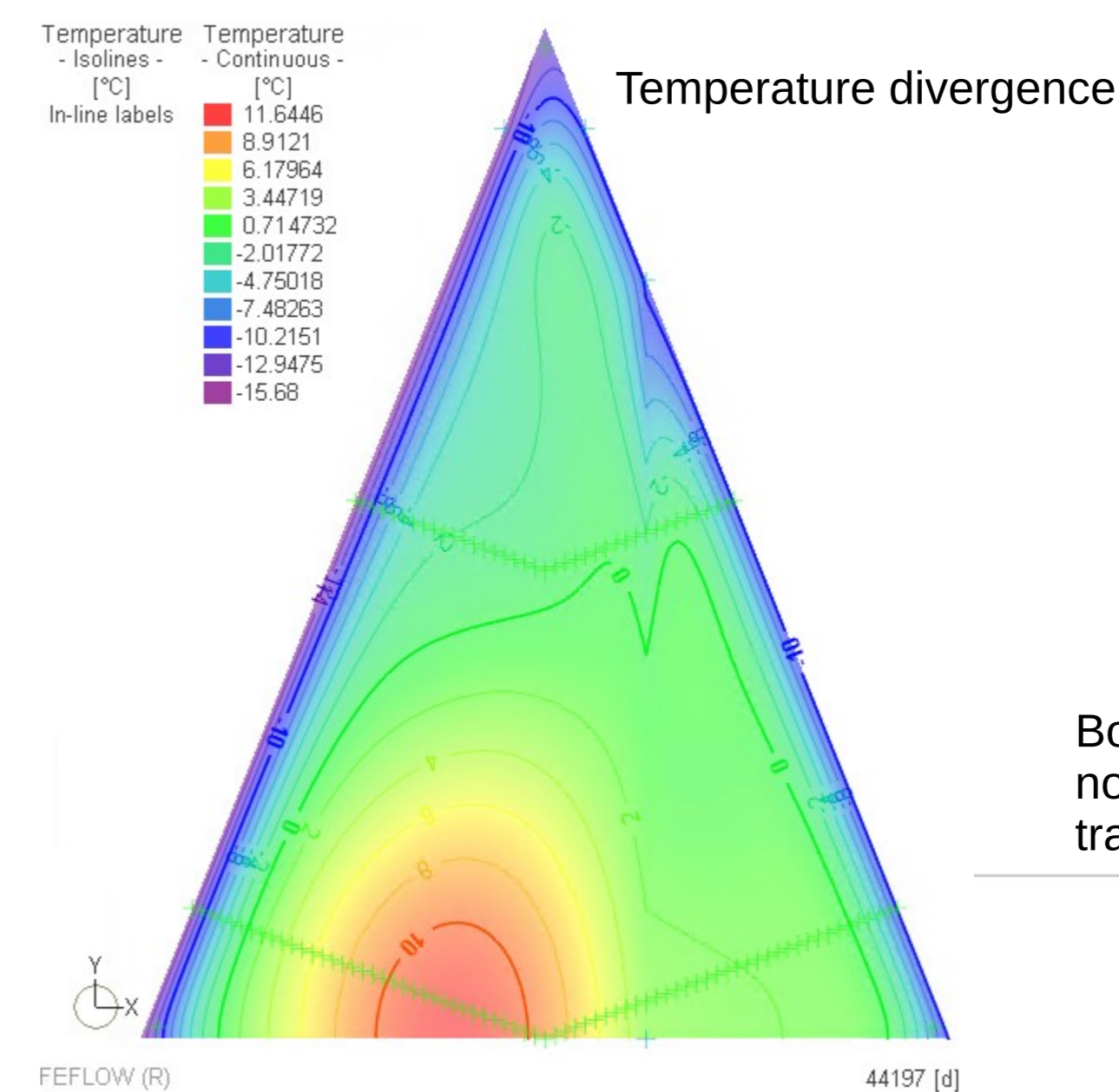
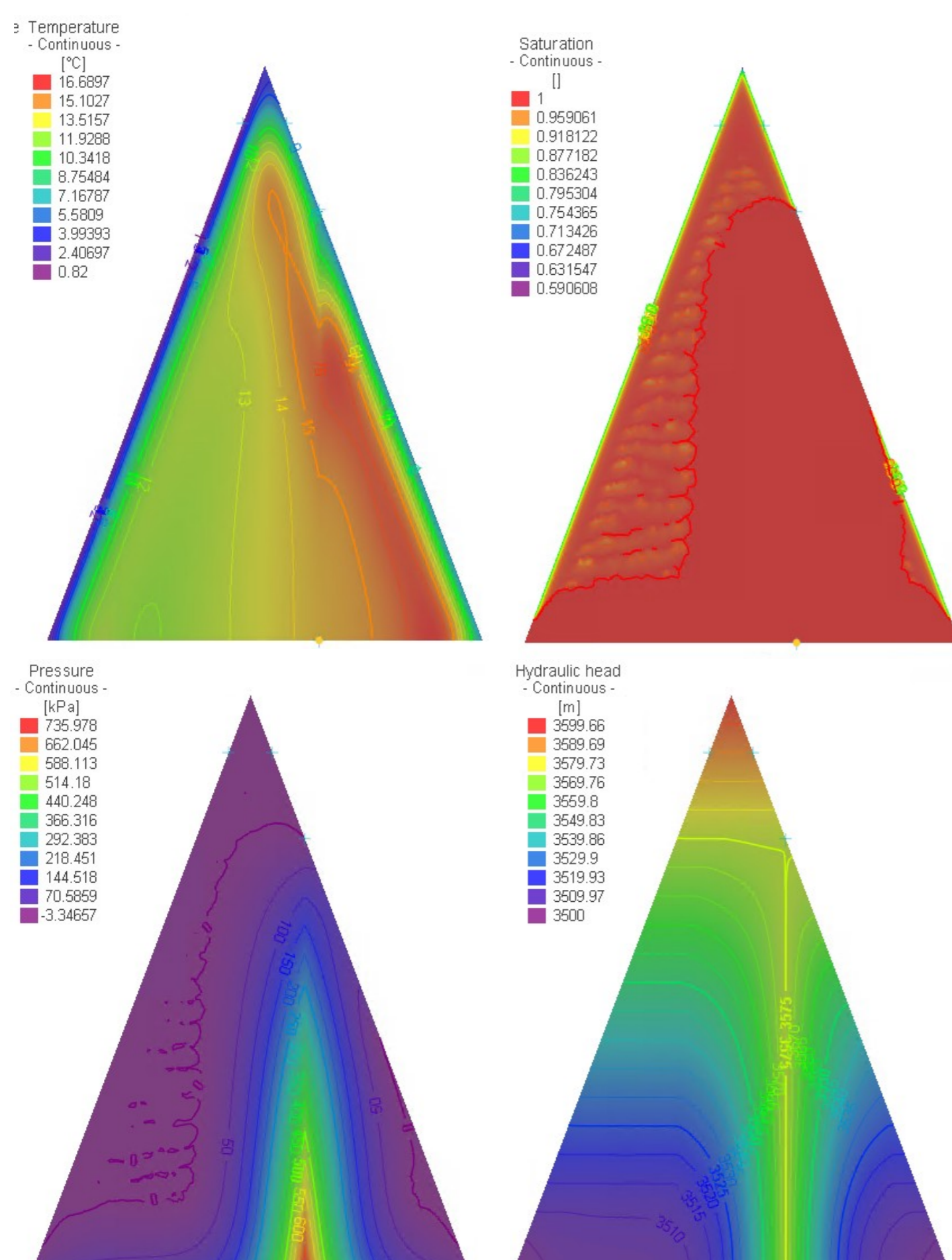
in the frame of the WISPER project ("Water and Ice related thermo-mechanical processes in the fractures of Steep alpine bedrock Permafrost", funded by the French National Agency for Research), the sensitivity of steep rock slope permafrost is further investigated:

the FeFlow® (DHI-WASY, version 7.4) software is used to model and study the coupled heat and mass transfer in a simple alpine geometry that typically represents steep rock slope affected by permafrost and seasonal freeze and thaw cycles at c.a.3500 m a.s.l.

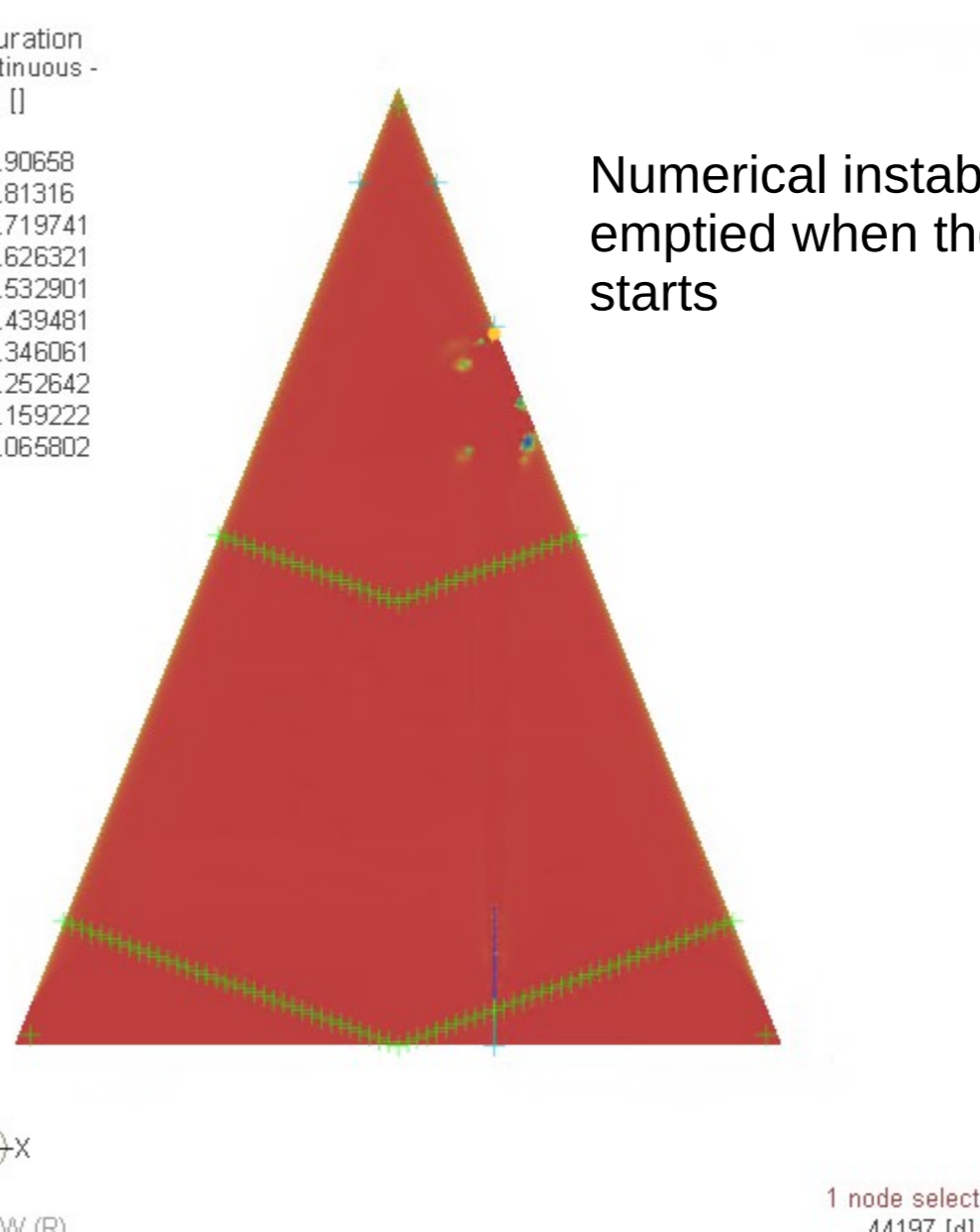


Boundary conditions: synthetic annual cycles for N and S faces surface temperature:
 - mean air temperature (-7 °C) consistent with elevation (3600 m a.s.l.)
 - offset between air and rock surface temperature: +1 °C for N face, +6 °C for S face

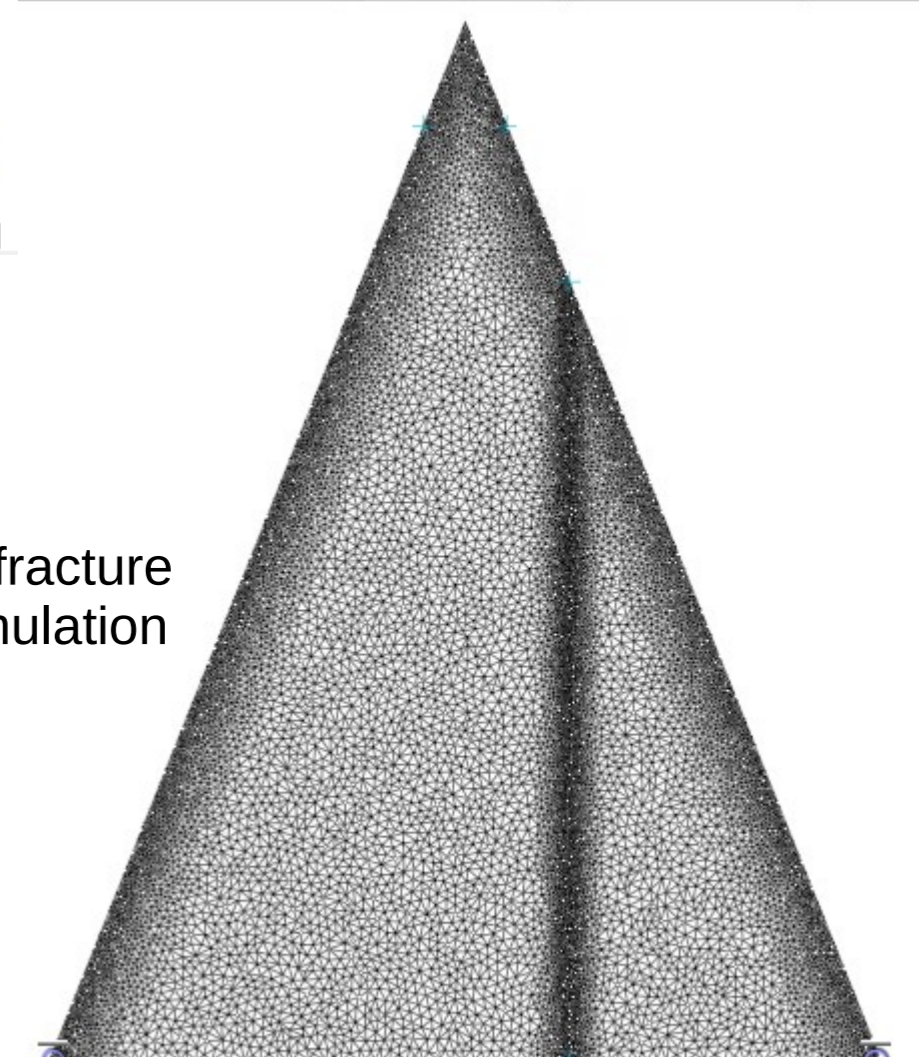
A range of numerical issues, still unresolved as for now:



Boundary conditions which are not honoured (deleted or transformed)



Numerical instability, fracture emptied when the simulation starts



Perspective: limit the sensitivity study to a saturated case