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

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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.

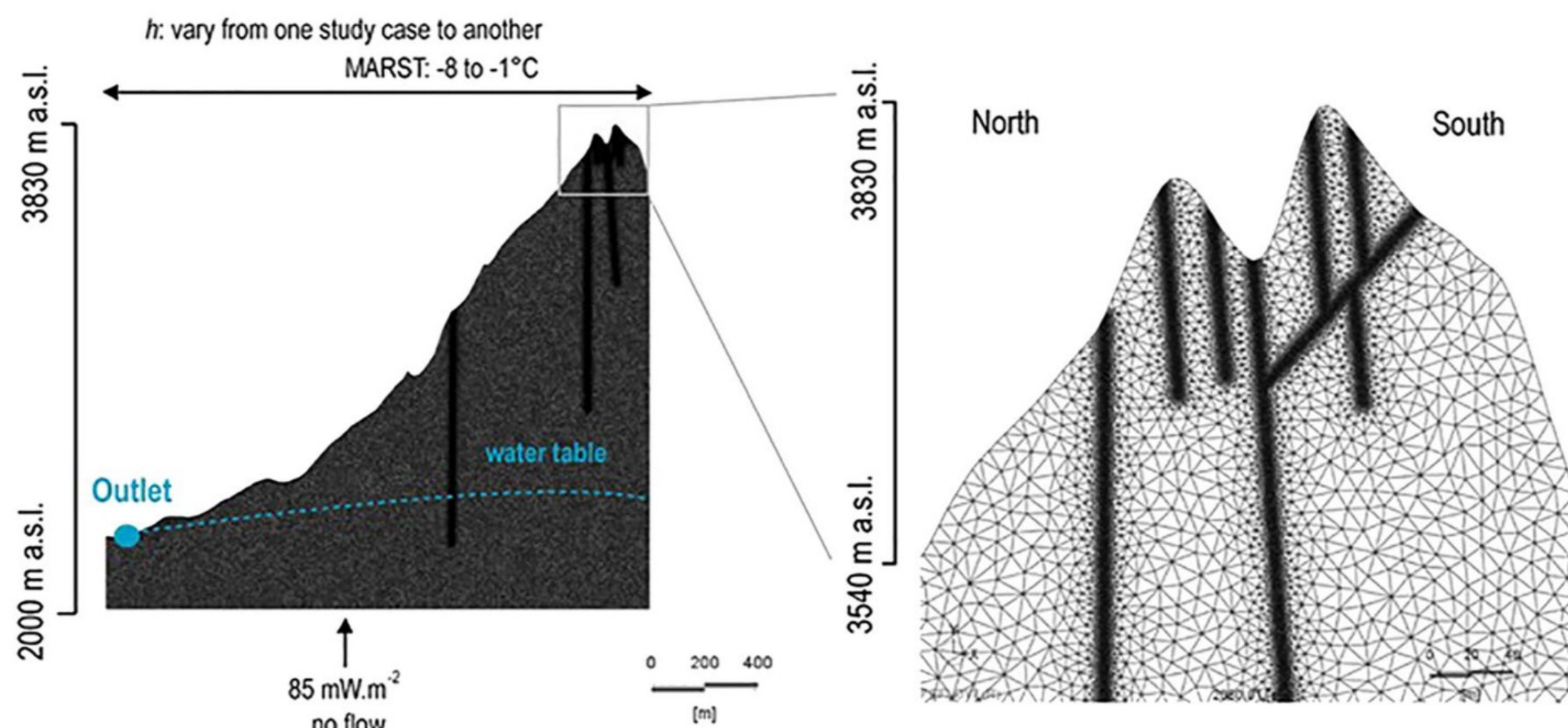
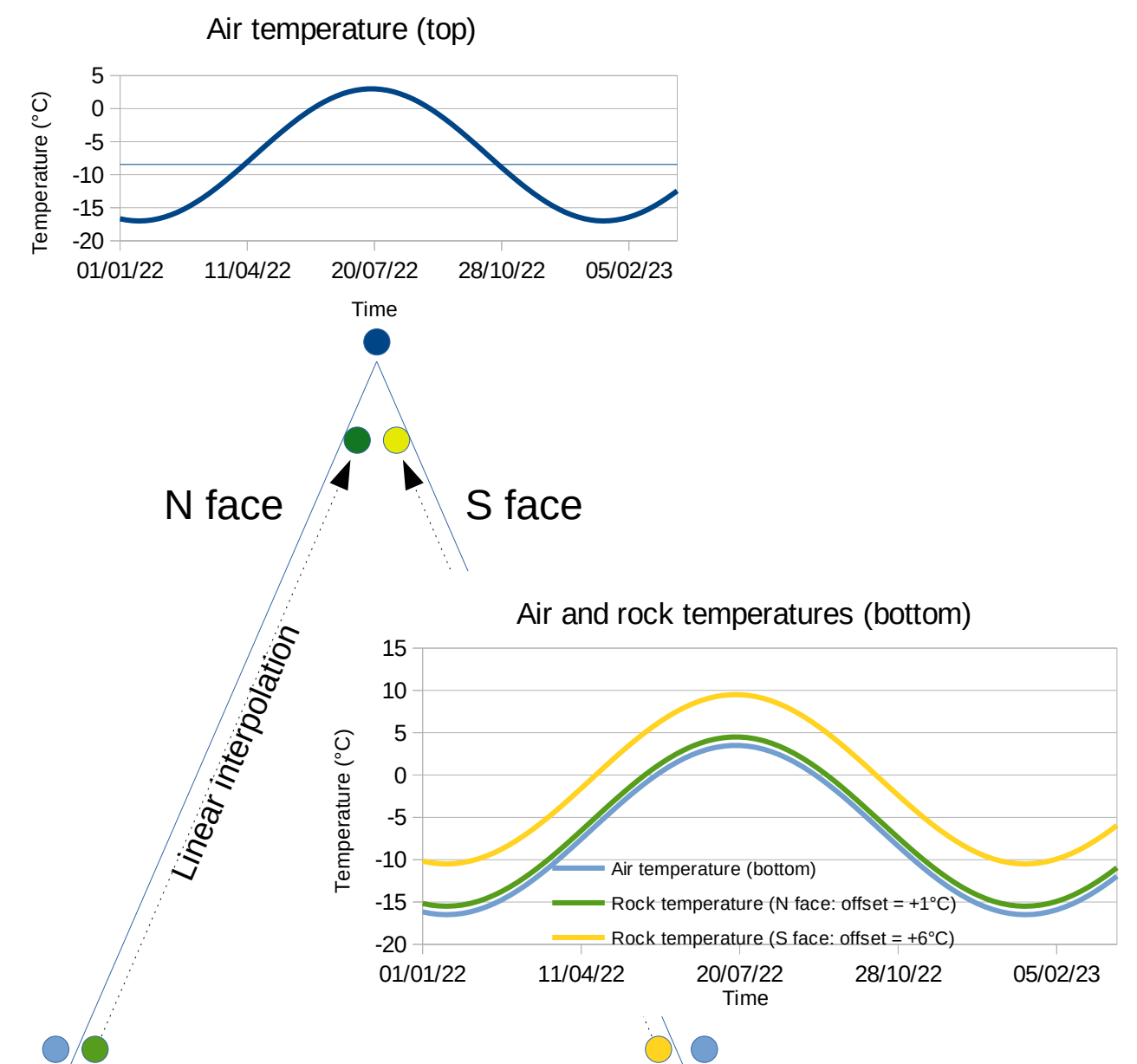


Figure from Magnin and Josnin, JGR 2021

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:

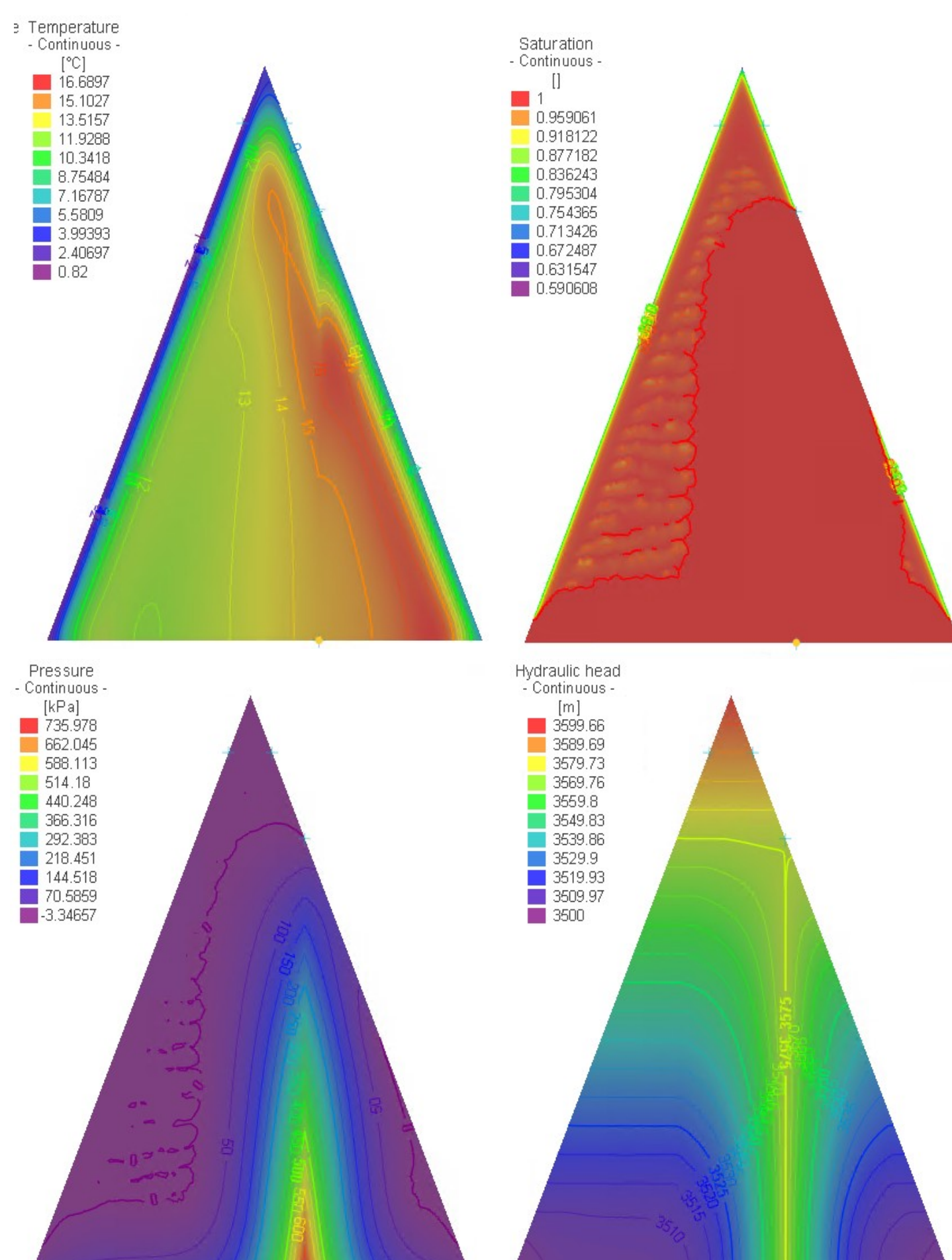
the FeFlow® (DHI-WASY, version 7.4) software is used to model and study the coupled heat and mass transfer in a simple alpine geometry that typically represents steep rock slope affected by permafrost and seasonal freeze and thaw cycles at c.a. 3500 m a.s.l.



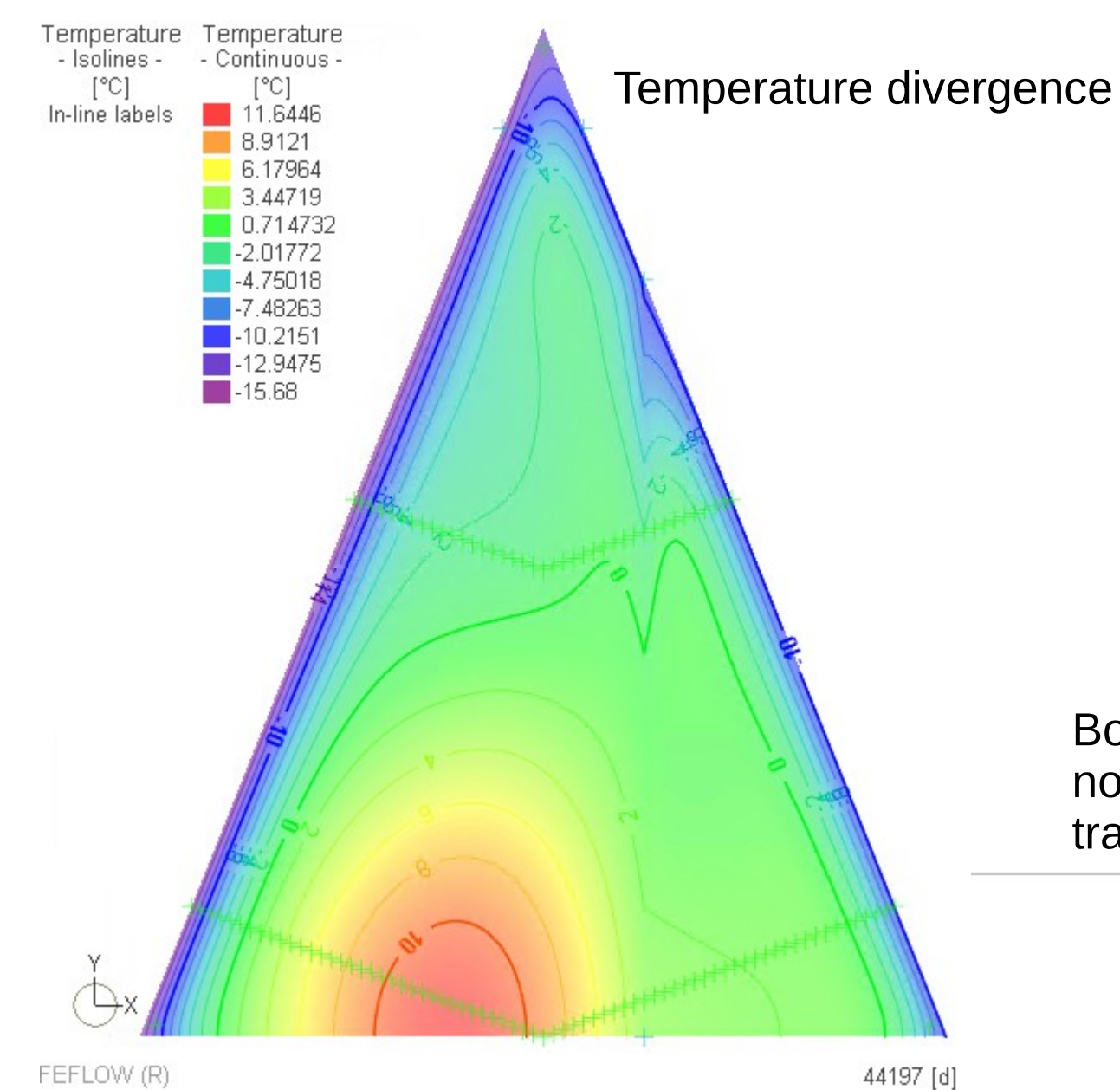
Boundary conditions: synthetic annual cycles for N and S faces surface temperature:  
- mean air temperature (-7 °C) consistent with elevation (3600 m a.s.l.)  
- offset between air and rock surface temperature: +1 °C for N face, +6 °C for S face

Boundary condition:  
Hydraulic head  
+ max flow rate constrain

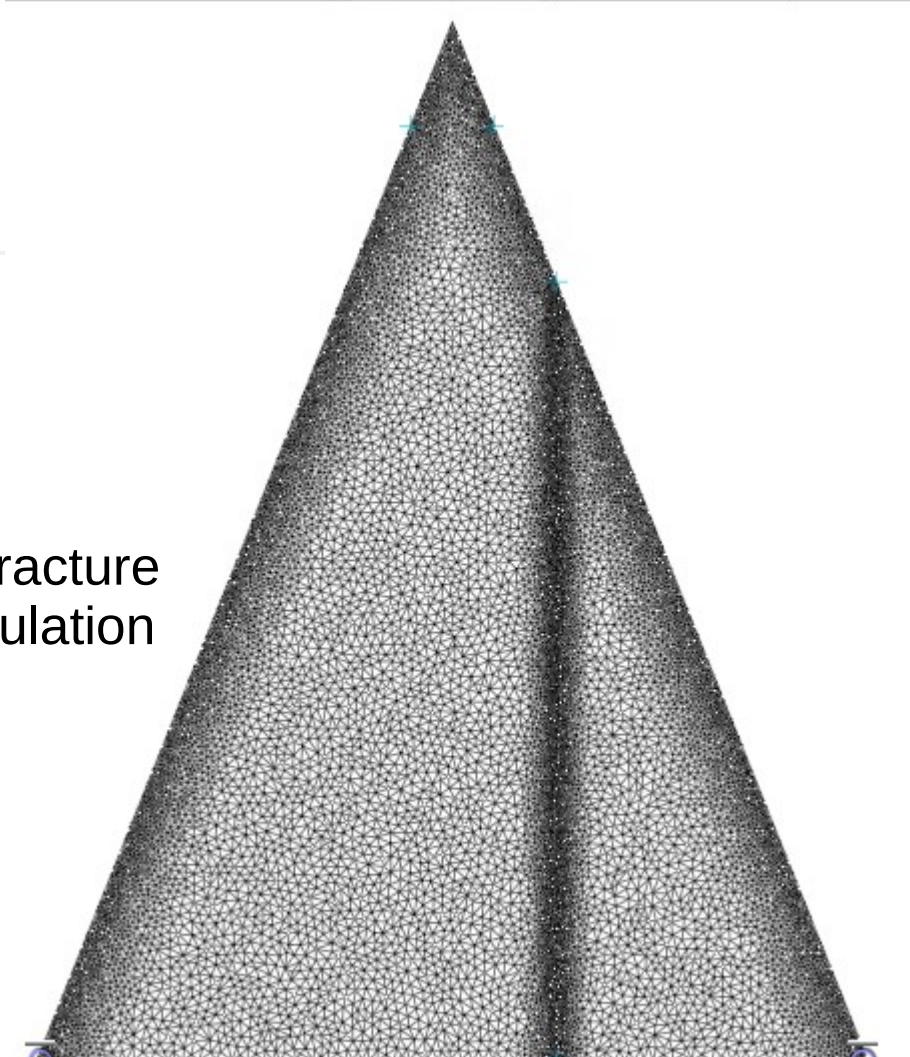
Boundary condition:  
Well (0,3 m³/d)  
+ bounded head



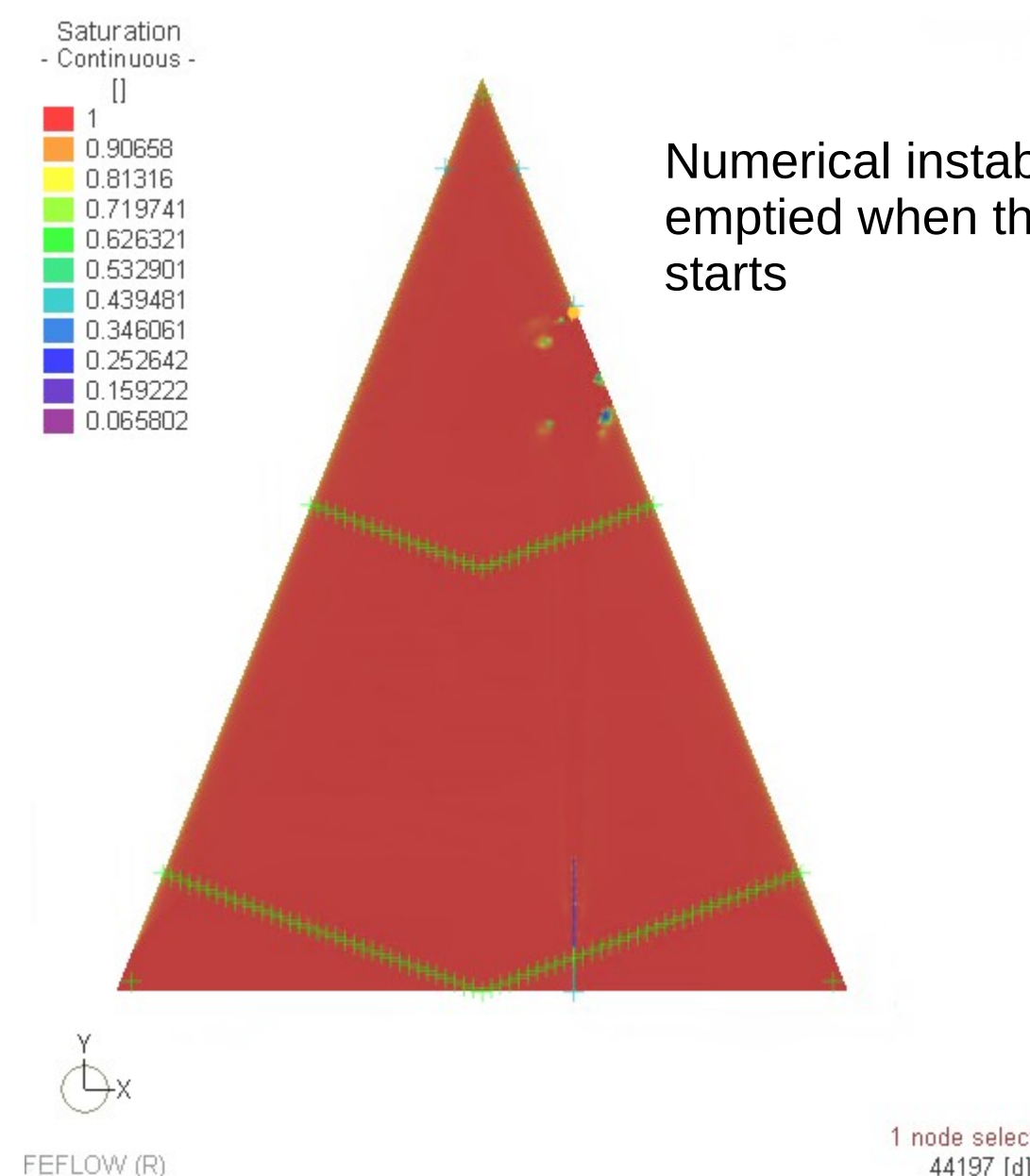
A range of numerical issues, still unresolved as for now:



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