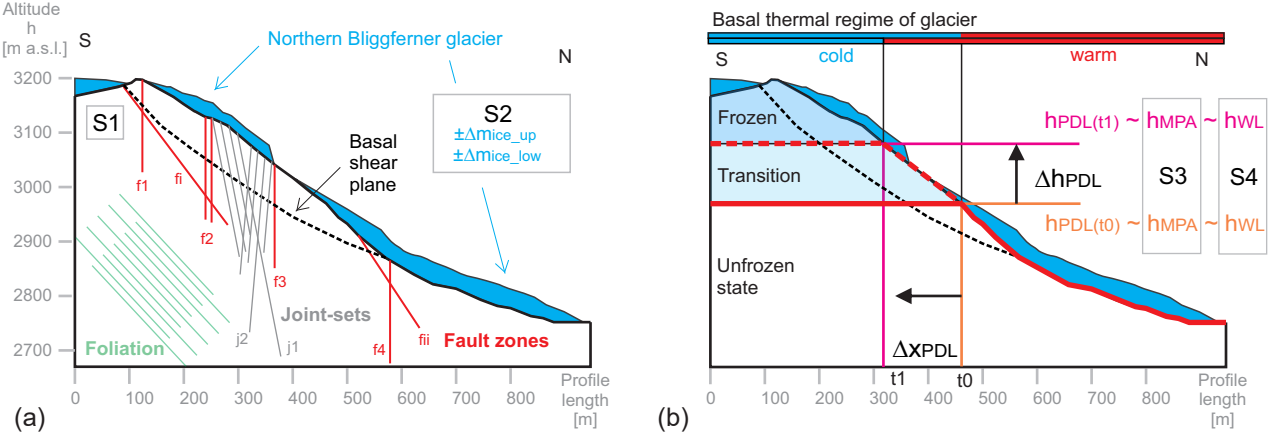

Model setup and characterization of individual scenarios

Rock mechanical analysis

different model geometries according to varying levels of detail of geological features (A-F)

S1 Structural predisposition

Rock mass: Linear-elastic block model

Rock mass parameters estimated via Hoek and Brown (2019), Parameters are fixed:
ρ_m = 2.600 kg/m³
GSI = 35
K_m = 6 GPa,
G_m = 1.5 GPa

Discontinuities: Mohr-Coulomb shear model

Sensitivity tests on varying shear parameters
φ = 40 - 25°
c = 0.5 - 0.01 MPa
K_n = K_s = const
K_n = 10 GPa/m

Results of S1 as basis for subsequent scenarios

Cryospheric forcings

S2 Glacier unloading

Glacier: Elasto-plastic block model

Initial state:
ρ_{ice} = 917 kg/m³
K_{ice} = 1 GPa,
G_{ice} = 1 Gpa
φ = 30°
c = 0.1 MPa

Simulation of impact of glacier mass loss: stages → Δm_{ice}

Sensitivity tests applying different densities to upper and lower glacier to simulate varying glacier mass

S3 Permafrost distribution

Simulation of PDL dynamics: stages → Δh_{PDL}

Different shear param. for frozen/unfrozen discont.

Above PDL → Frozen
a) Δφ= +5°
b) Δφ= +5°, Δc = + 0.02 MPa

Below PDL → Unfrozen
→ defined by results of S1

S4 Peak ground water level

Assign hydrostatic pressure

PDL & slope topography define distribution of peak ground water level
→ only discontuinities are permeable

(c)