# New multi-phase thermo-geophysical model: Validate ERT-monitoring & assess permafrost evolution in alpine rock walls (Zugspitze, German/Austrian Alps)

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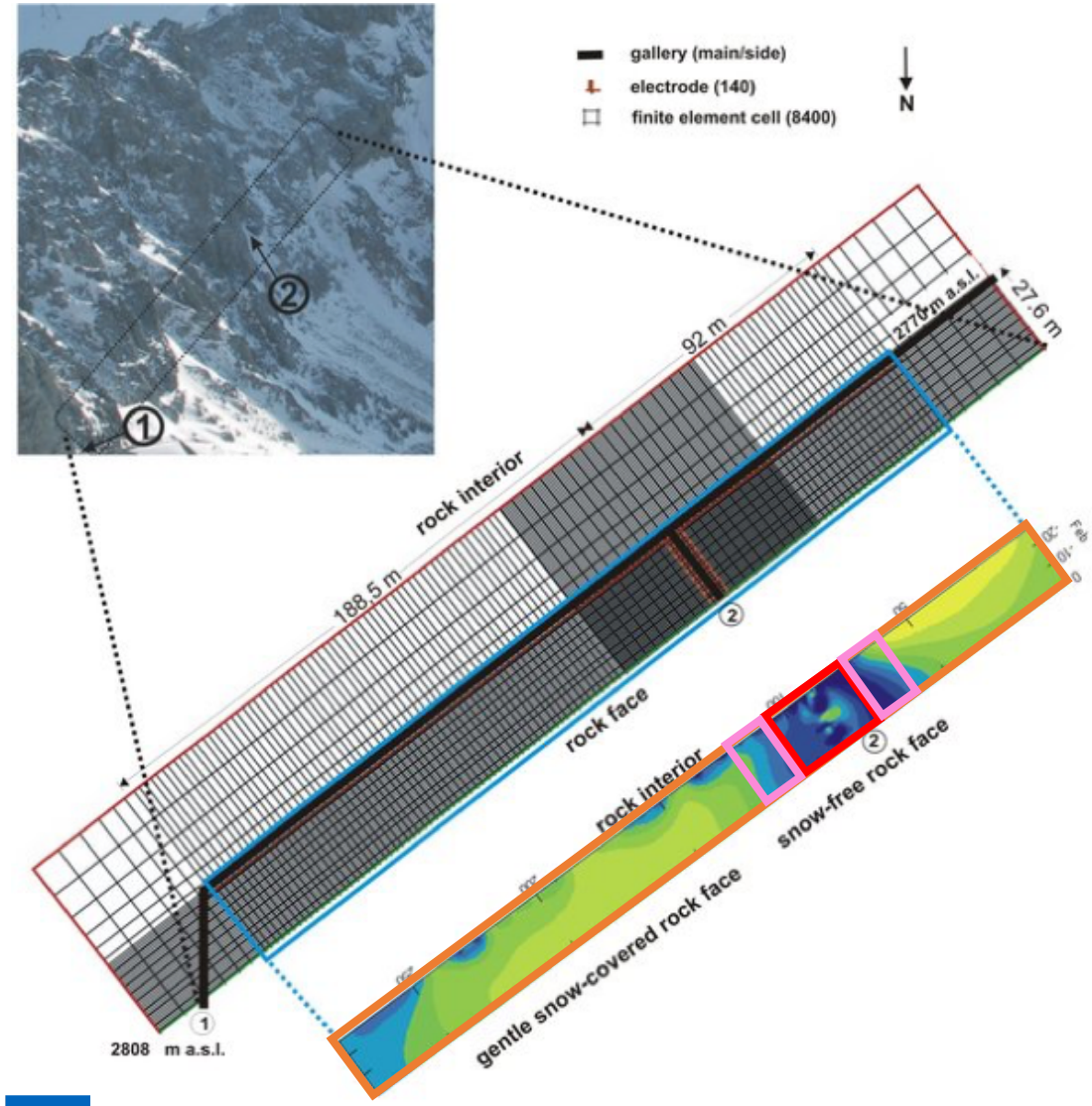
# ERT setup to monitor permafrost change




Krautblatter et al., 2010

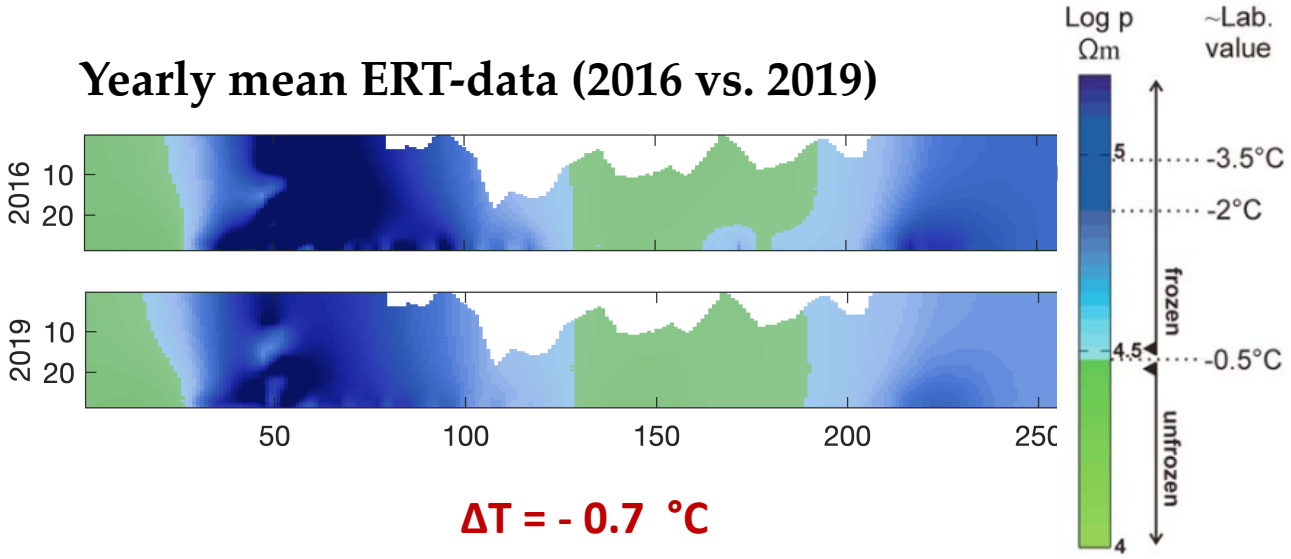
**Study-site:** Zugspitze (German/Austrian Alps)

**Here, multi-year (2007-today) monthly field data-set to evaluate:**

(i) How well the **ERT record** in steep permafrost rock walls be matched with a **thermal model**?

(ii) How is permafrost **affected by environmental factors** in natural rock walls?

**Yearly mean ERT-data (2016 vs. 2019)**




**ΔT = - 0.7 °C**

Schroeder et al., in prep.

Schroeder et al. 2020, EGU2020-19984

# Strategy to model thermal regime

(1)
- Meteorological data
- Topographic data

(2)
- Astronomical & meteorological parameters

(3)
- Solar radiation (short- & longwave)

(4)
- (Non-)Turbulent heat fluxes

(5)
- Ground surface temperature
- Heat conduction + local influences

Input

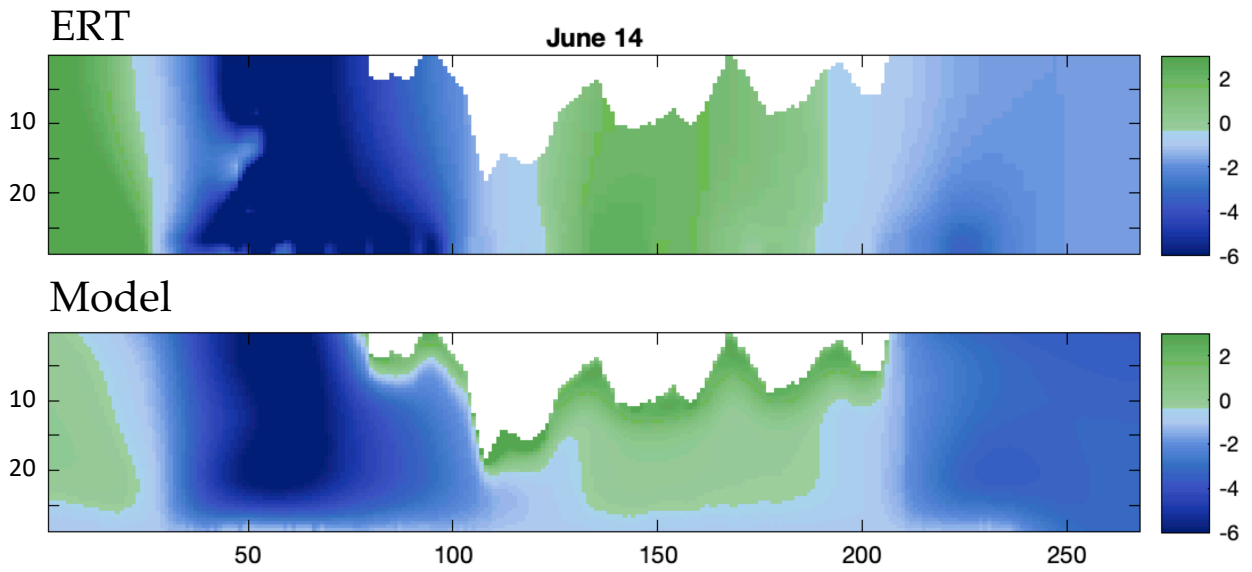
Calculations

**Spatial-temporal thermal permafrost regime**

**Coupled thermo-geophysical model for conductive heat transfer** in steep rock-wall permafrost/frozen rock, affected by seasonality & long-term climate change

**Preliminary model results**

Excerpt of main ERT-area




Schroeder et al. 2020, EGU2020-19984

Schroeder et al., in prep.

$\Delta T_{(ERT\ vs\ Model)} = 0.3\ °C$

# Thermal-spatial permafrost change can be acquired via ERT & reproduced by model

- We can **reproduce natural rock temperatures** in steep bedrock permafrost with **ERT derived temperatures**!
- We prove the applicability of the laboratory derived resistivity-temperature relationship for natural rock walls!
- We can **validate ERT-measurements via a local high-resolution thermal heat flux model** in steep bedrock permafrost!

Schroeder et al. 2020, EGU2020-19984

# References

Krautblatter, M., Verleysdonk, S., Flores-Orozco, A., & Kemna, A. (2010). Temperature-calibrated imaging of seasonal changes in permafrost rock walls by quantitative electrical resistivity tomography (Zugspitze, German/Austrian Alps). *Journal of Geophysical Research: Earth Surface*, *115*(F2).

Schroeder, T., Scandroglio, R., Wittmann, M., Stammberger, V., Koerner, C., Eppinger, S., & Krautblatter, M. (in prep.). A high-resolution multi-phase thermo-geophysical model to verify long-term electrical resistivity tomography monitoring in alpine permafrost rock walls (Zugspitze, German/Austrian Alps).