Supplementary material

ERT settings
for TERRAMETER LS

NEW TASK

	Hauptstollen	**Seitenstollen**
spread	2X21S	2X21S
protocol	WEN32SX	WEN32SX ScNachWe
min. el. spacing X	4.6	1.53
min. el. spacing Y	1	1
min. el. spacing Z	1	1

RECEIVER SETTINGS

measure mode	RES
min. stacks	2
max. stacks	4
error limit	1 %
delay time	0.2 s
acq. time	0.2 s
full Wave Form	Yes
power line frequency	50 Hz

TRANSMITTER SETTINGS

min. current	0.5 mA
max. current	50 mA
max. power	250 W
max. output volt	600 V
electrode test	Focus One
bad electrode	600 kΩm
fail electrode	600 kΩm
electrode test current	1 mA

Figure S1. ERT settings.

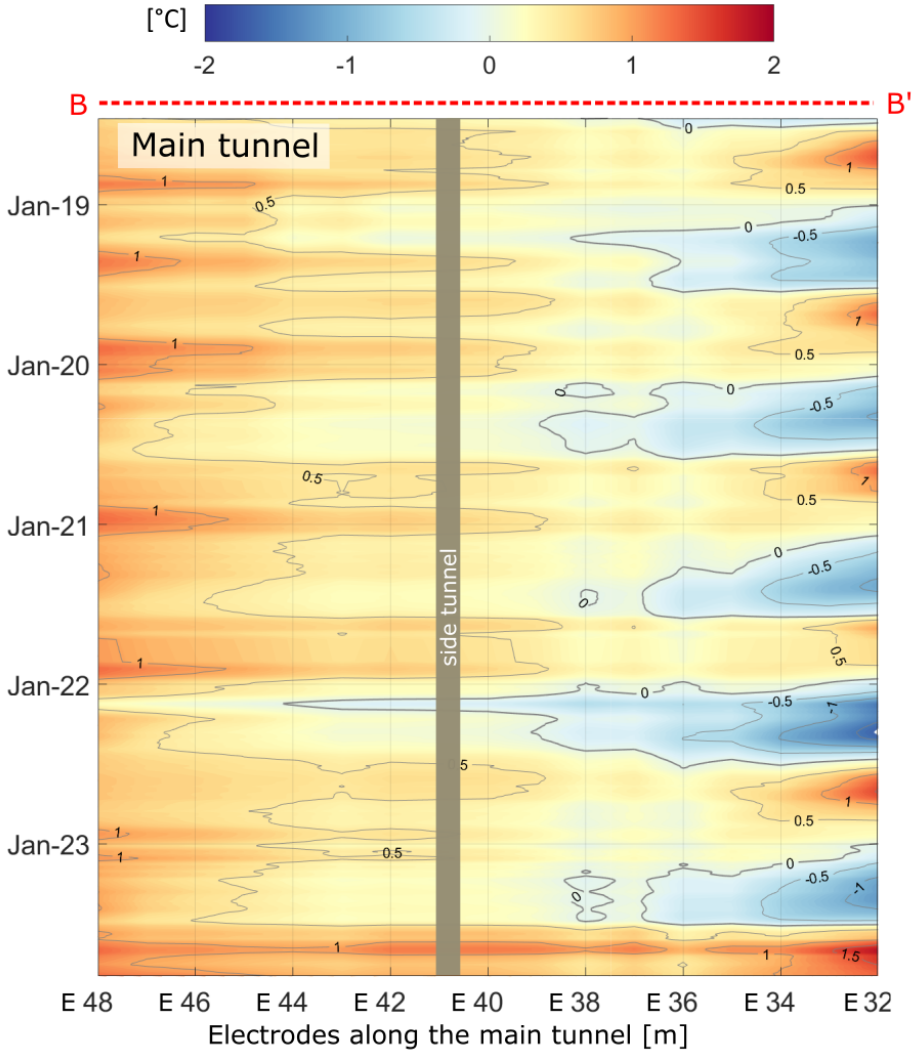


Figure S2. Temperature profiles B-B' in the side tunnel. The location of the transect is visible in Fig. 1b.

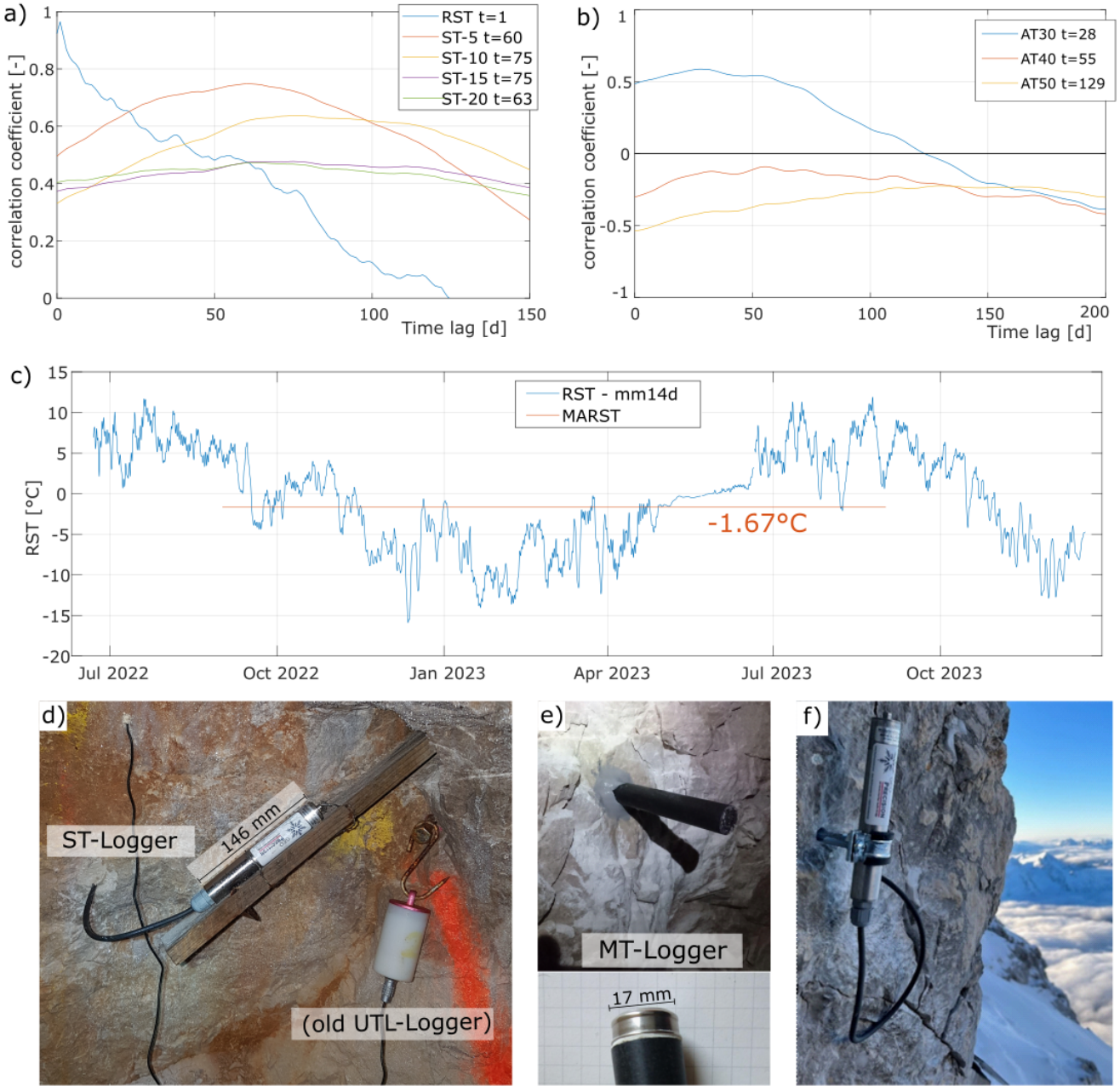


Figure S3. Extra analysis of tunnel temperatures. a) Correlation between rock temperatures and the external air temperature, measured at the DWD station. b) Correlation between AT loggers and the DWD air temperature. c) In blue is presented the 2-week moving mean of RST (image d), in red is the mean annual rock surface temperature. d) Photo of the new ST-loggers and the old UTL-loggers. All sensors are located at a depth of 40 cm. The old loggers were replaced in 2019, with a one-year overlapping period. e) Photos of the MT-loggers. All sensors are located at a depth of 40 cm. f) Photo of the RST logger installed on the north face, close to Electrode E30, at 10 cm depth.

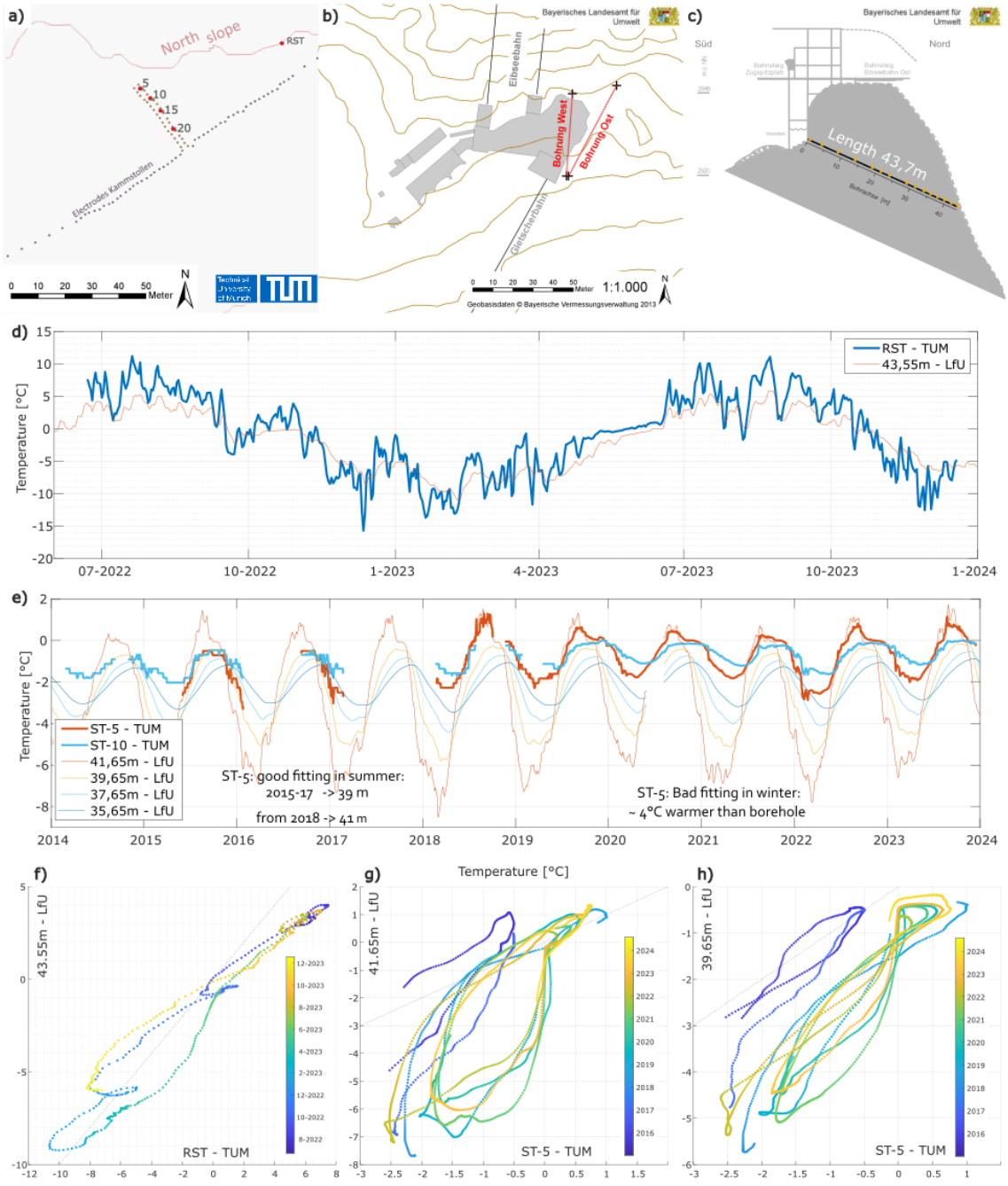


Figure S4. Comparison of tunnel temperatures with those from the LfU borehole under the summit station. a) Location of the tunnel loggers. Please note that the numbering starts from the north wall ($X_{north} = 0m$). b)-c) Location of the LfU borehole (modified from Gallemann et al. (2017)). Please note that here the numbering starts from the south wall ($X_{north} = 43.7m$). d)-f) Comparison of the TUM RST logger and the LfU-43m logger. e)-g)-h) Comparison of TUM ST-5/ST-10 logger and LfU-41m/39m logger.

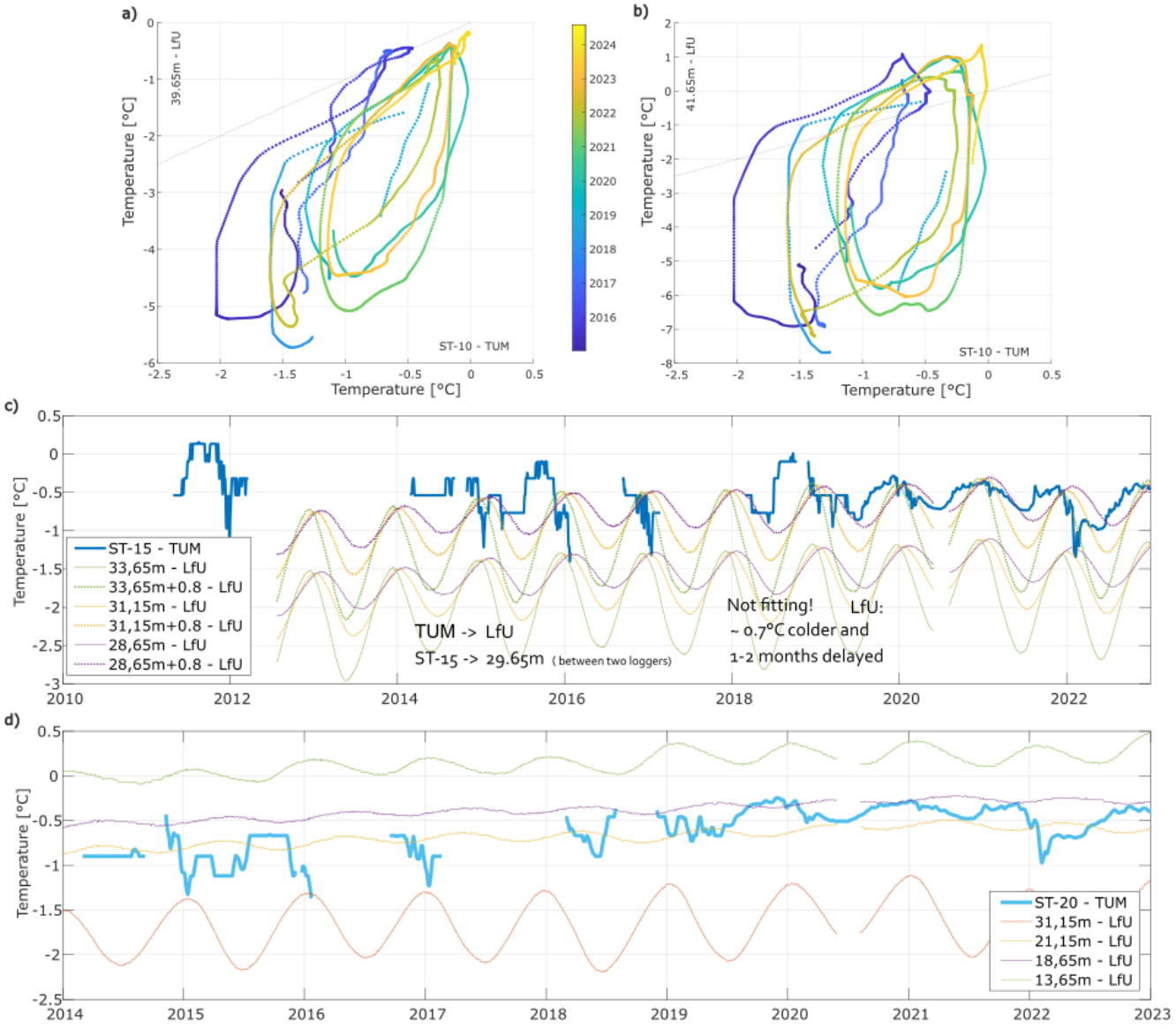


Figure S5. Comparison of tunnel temperatures with those from the LfU borehole under the summit station, second part. a)-b) Comparison of ST-10 TUM-logger and LfU-9/41m logger. c) Comparison of TUM ST-15 logger and multiple LfU loggers. d) Comparison of TUM ST-20 logger and multiple LfU loggers.

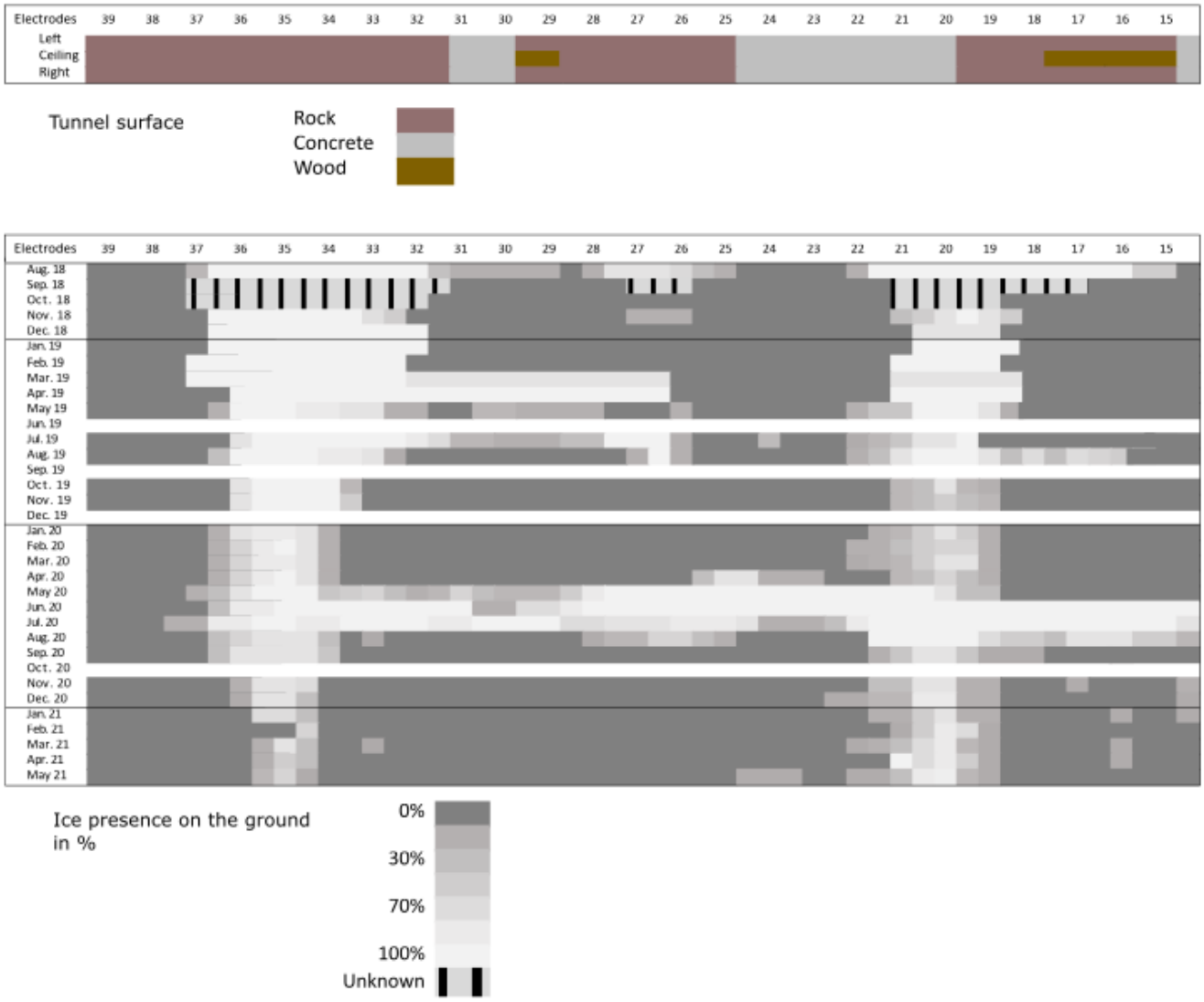


Figure S6. Mapping of surface ice in the tunnel. Upper graph: Surface coverage of the tunnel. Lower graph: Percentage of the ground covered by ice.

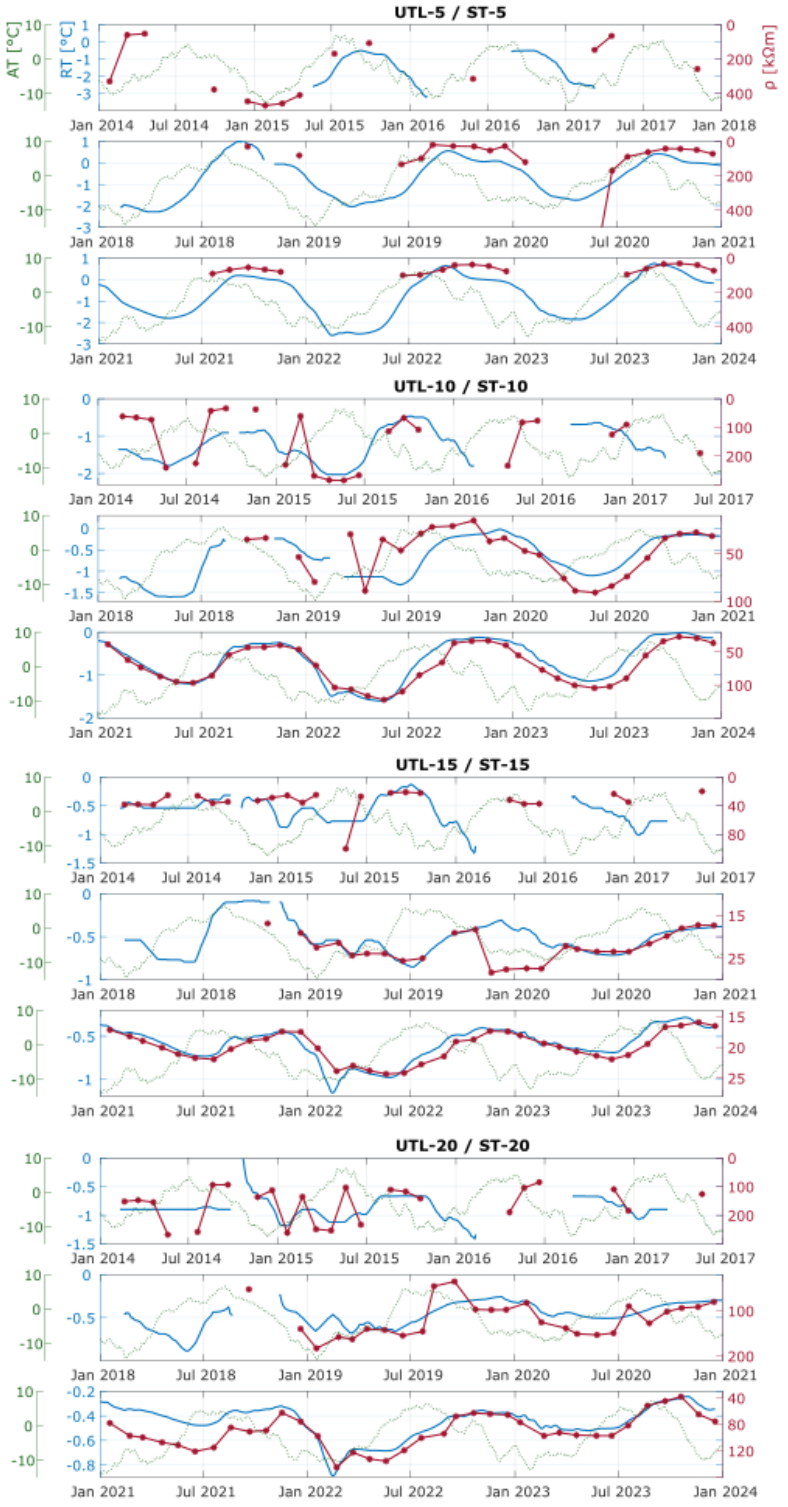


Figure S7. Comparison of temperatures and their closest apparent resistivities.

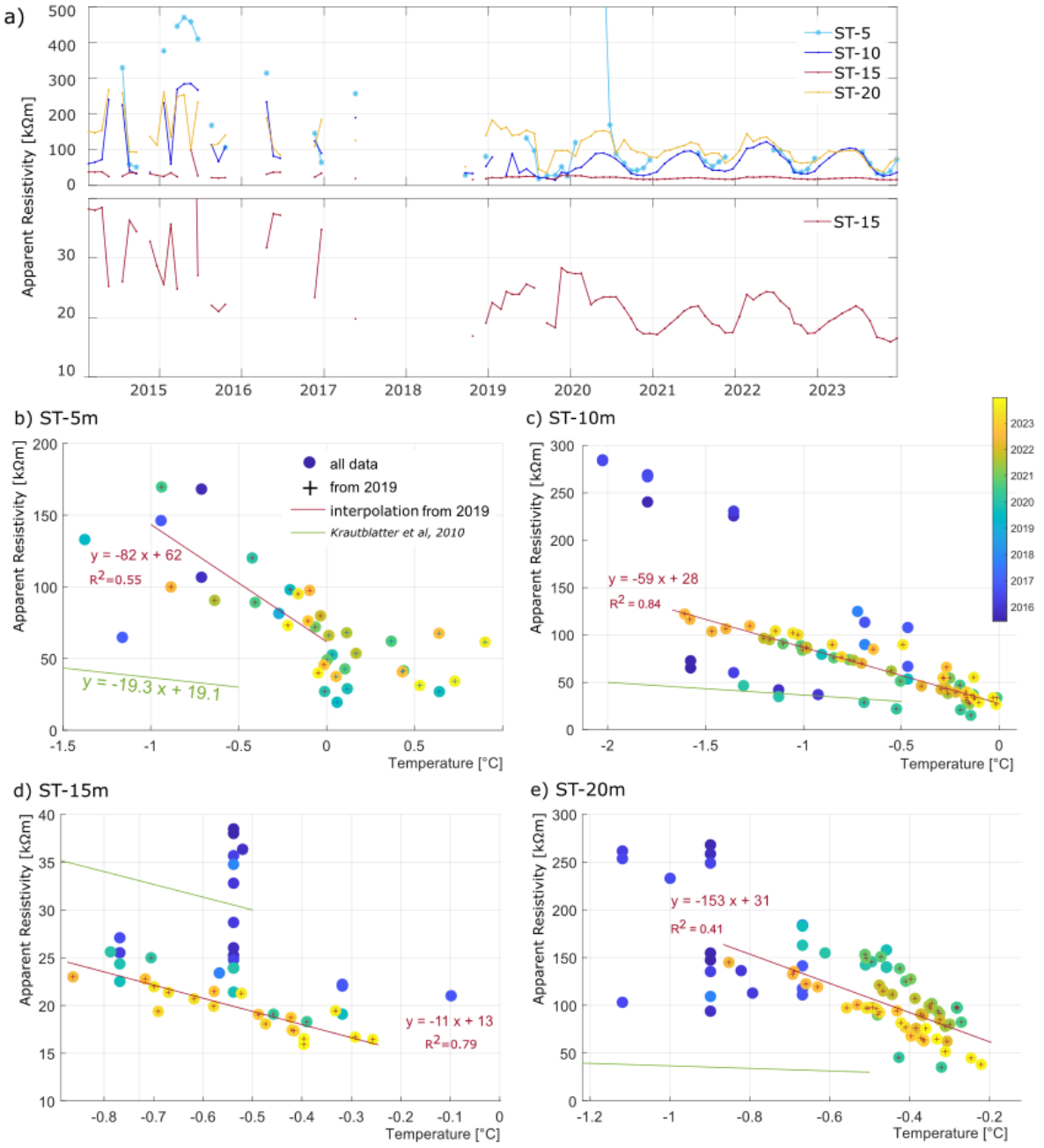
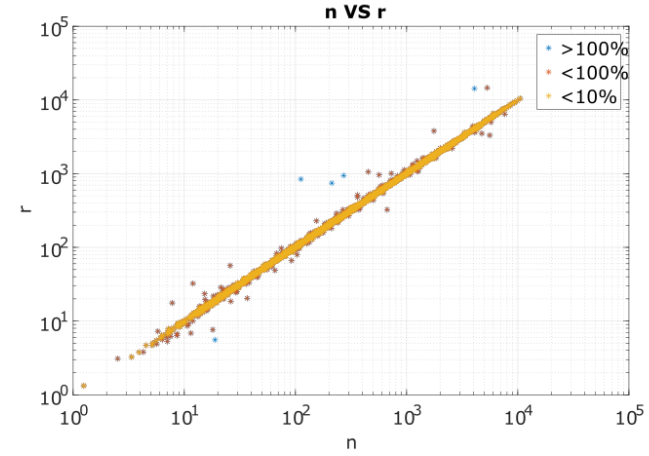
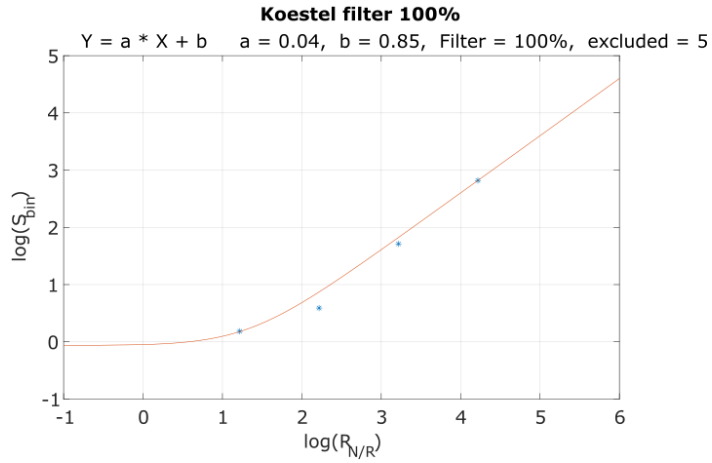


Figure S8. Field calibration. a) Apparent resistivity measured at the closest point to the respective ST-Logger. b-e) Correlation between ST-loggers and apparent resistivity. Only measurements from 2019 are included in the interpolation because new temperature loggers have a higher resolution. In red: resulting interpolation line with respective equation and R^2 value. In green, line after the calibration of Krautblatter et al. (2010).





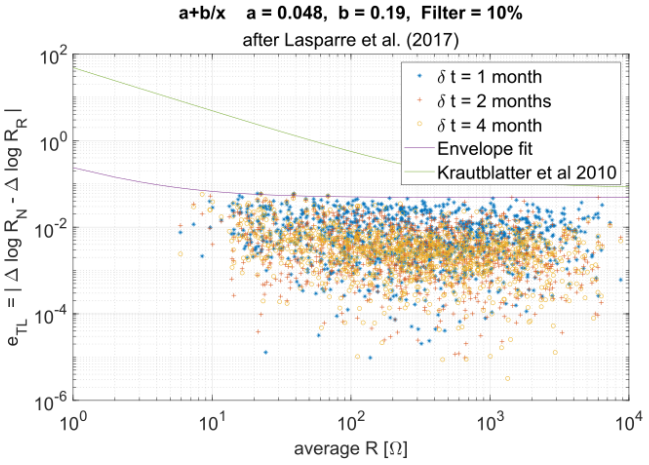


Figure S9. Other Error models. Upper Figure: Normal vs reciprocal measurements. Middle Figure: Error modeling according to Koestel et al. (2008). Lower Figure: Error modeling after Lesparre et al. (2017).

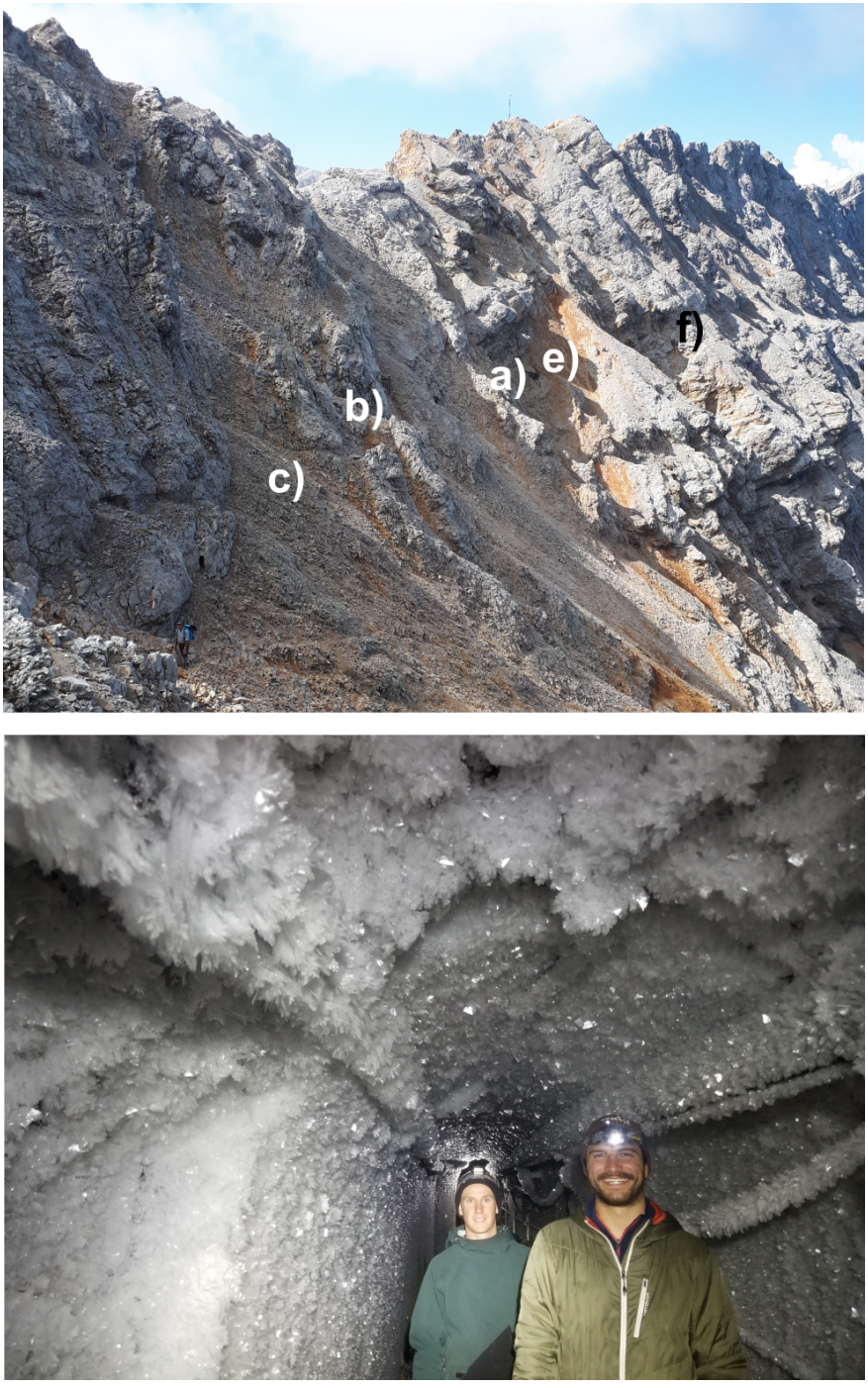


Figure S10. Upper image: External view of the area outside the tunnel. The letters represent the features shown in Figure 8a. Lower image: Internal view of the temporary frozen area (b).