

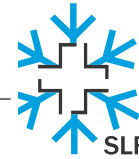
Focus Session 26

High Altitude Natural Laboratories

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Research history of the Murtèl-Corvatsch Rock Glacier: 50 years of scientific advances and long-standing observations in mountain permafrost

Amschwand, Dominik¹; Arenson, Lukas²; Bast, Alexander³; Beutel, Jan⁴; Bolch, Tobias⁵; Cicoira, Alessandro⁶; Farinotti, Daniel⁷; Fiddes, Joel³; Frauenfelder, Regula⁸; Frehner, Marcel⁹; Gärtner-Roer, Isabelle⁶; Gruber, Stephan¹⁰; Gubler, Hansueli¹¹; Häberli, Wilfried⁶; Hauck, Christian¹; Hilbich, Christin¹; Hoelzle, Martin¹; Jenk, Theo¹²; Käab, Andreas¹³; Leysinger Vieli, Gwendolyn⁶; Mollaret, Coline¹; Junghardt, Johann¹⁴; Noetzli, Jeannette³; Pellet, Cécile¹; Salzmann, Nadine^{3,15}; Scherler, Martin¹¹; Springman, Sarah¹⁶; Vieli, Andreas⁶; Vonder Mühll, Daniel¹⁷; Wicky, Jonas¹



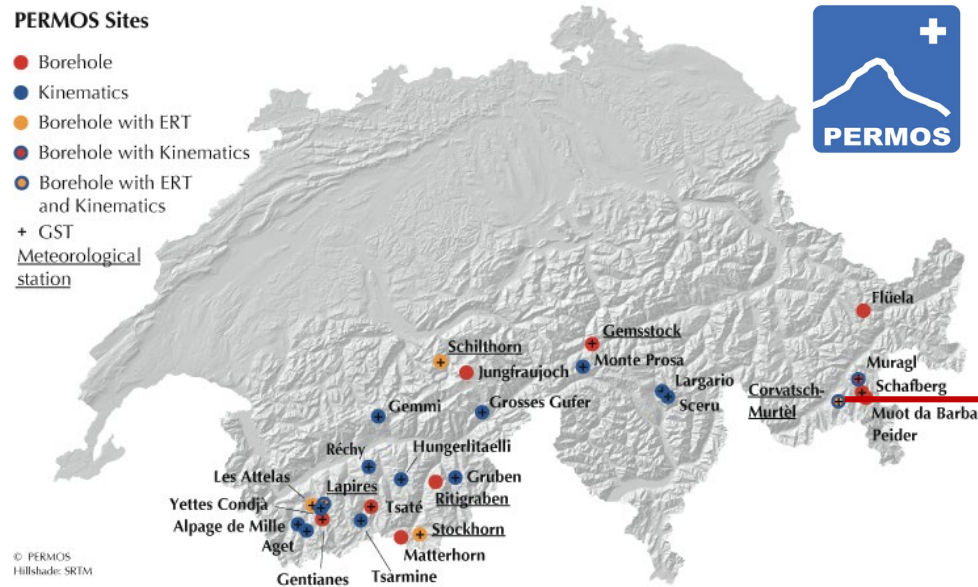
and many more!

Murtèl-Corvatsch rock glacier

- Upper Engadine, eastern Swiss Alps: cradle of Swiss rock glacier research
- Research since ~1970s (Dietrich Barsch, later Wilfried Haeberli)
- Site of the Swiss Permafrost Monitoring Network (PERMOS)

PERMOS Sites

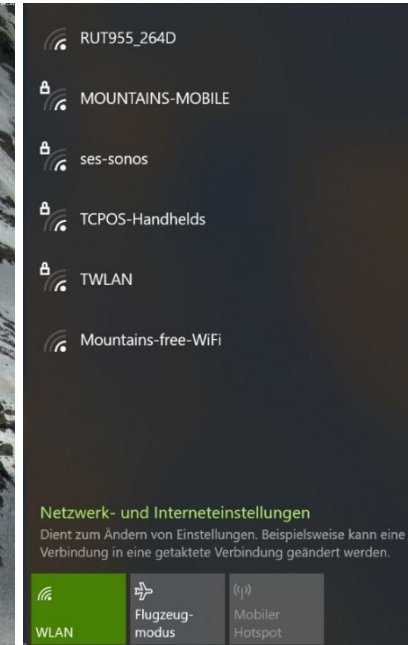
- Borehole
- Kinematics
- Borehole with ERT
- Borehole with Kinematics
- Borehole with ERT and Kinematics
- + GST
- Meteorological station



PERMOS, 2019



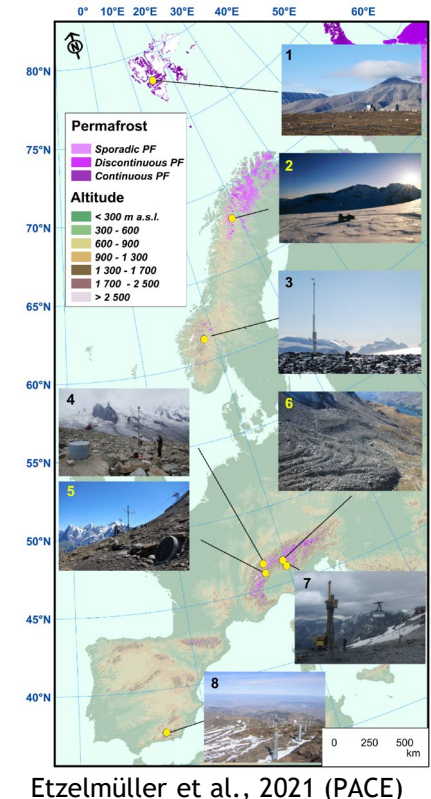
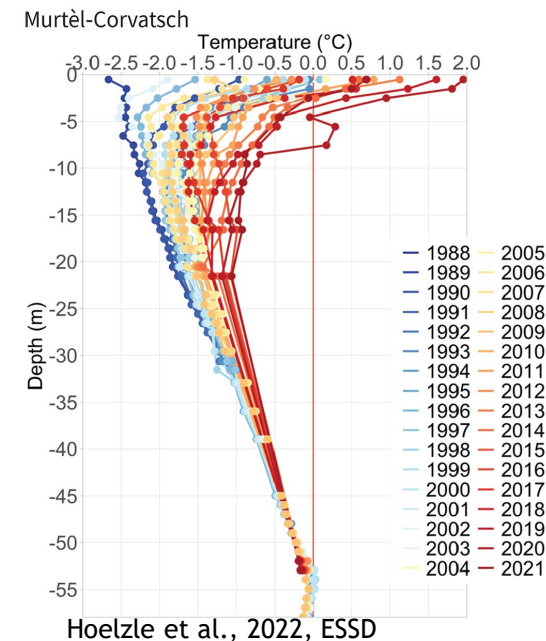
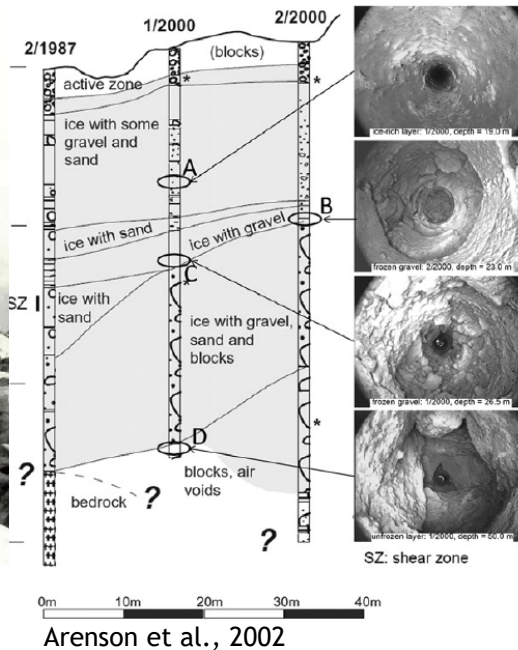
D. Amschwand



D. Amschwand

Drilling & borehole observations

- Pilot, sampling and monitoring boreholes (1975, 1987, 2000, 2015)
- Drilling experiences shared worldwide (e.g., PACE project)
- Rising permafrost temperatures attributed to anthropogenic warming



Micrometeorology & energy balance modelling

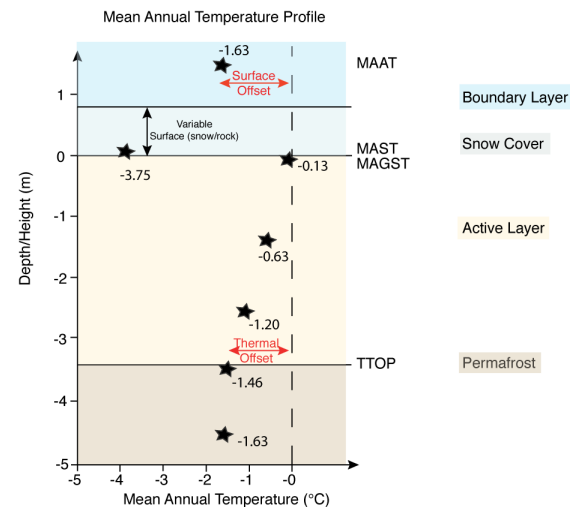
- Meteostation since 1997 (PACE→PERMOS): climate monitoring & data basis for process-oriented research
- Micro-meteorological measurements above and below ground
- Porous debris mantle leads to ground ‘undercooling’



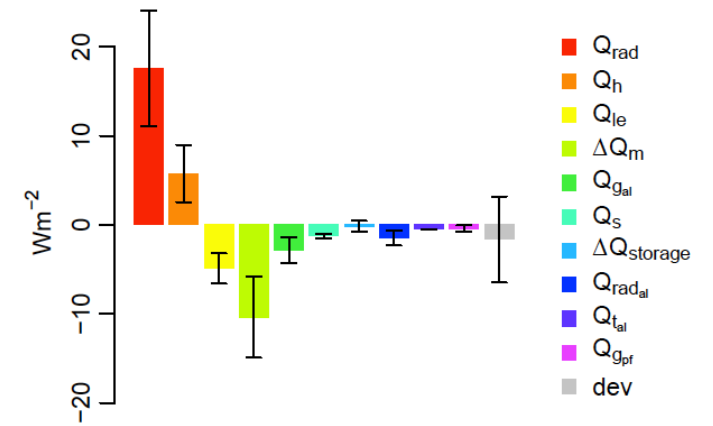
C. Stocker-Mittaz



D. Amschwand, ongoing PhD Uni Fribourg



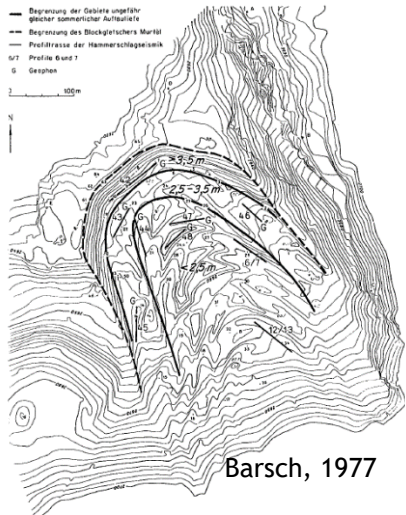
Hoelzle & Gruber, 2008



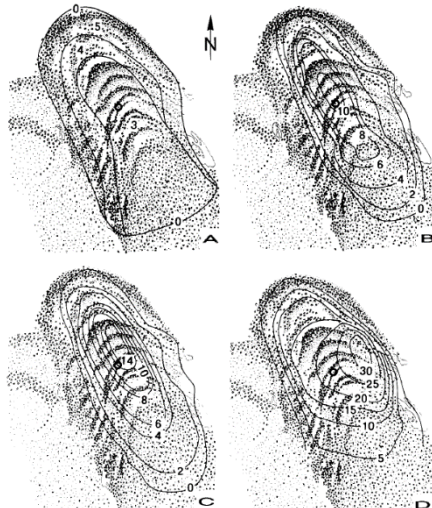
Scherler et al., 2014

Geophysics: Ongoing monitoring and new research

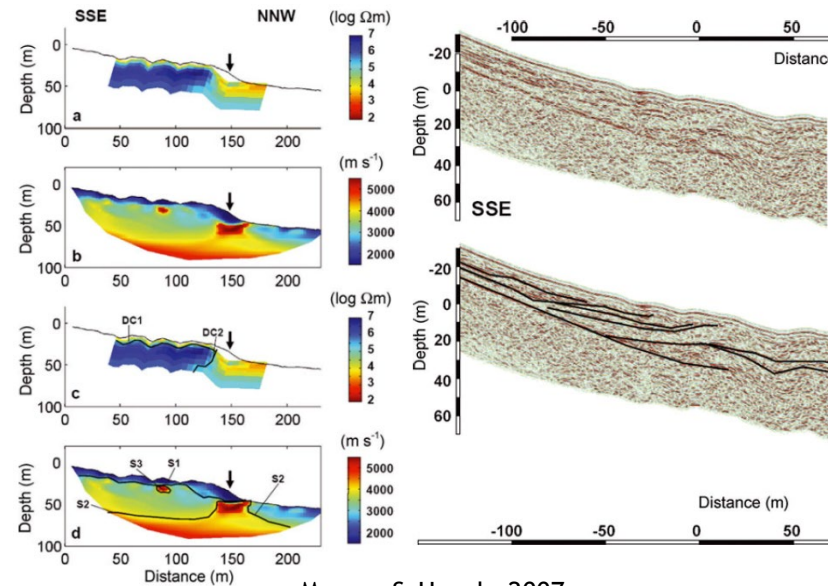
- Development and testing of new methods at a well-investigated site
- Mutual validation of different methods (geoelectrics, electromagnetic methods, GPR, refraction seismics tomography, gravimetry)
- Geophysical monitoring by PERMOS: ERT



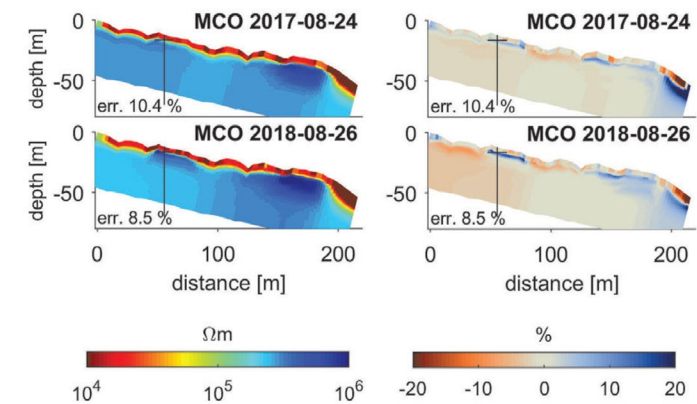
Barsch, 1977



Vonder Mühl & Klingelé, 1994



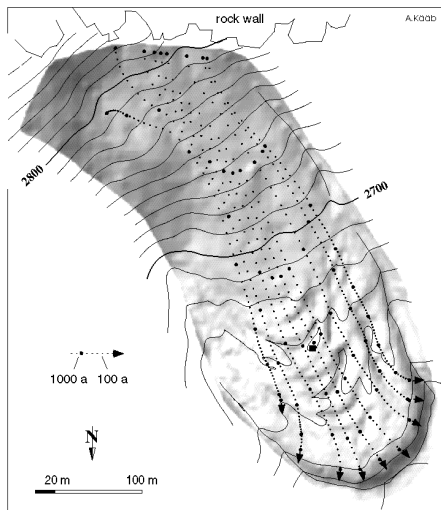
Maurer & Hauck, 2007



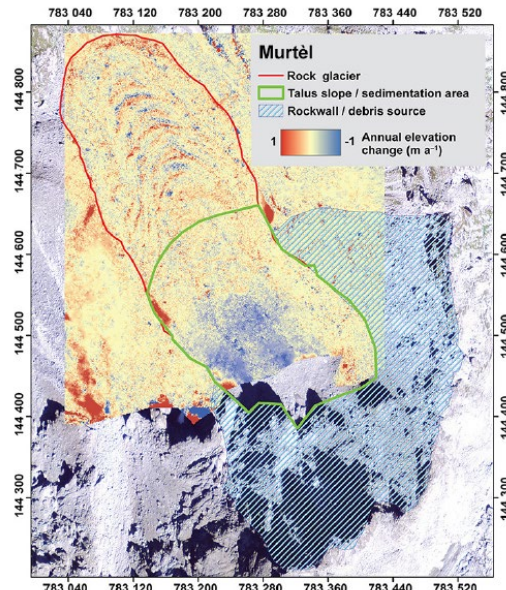
PERMOS, 2019

Close-range and remote sensing & surface kinematics

- Kinematic studies since 1971 (Barsch & Hell, 1975): geodetic surveys, photogrammetry, lidar scanning, GNSS, thermal infrared imagery
- Kinematic monitoring by PERMOS



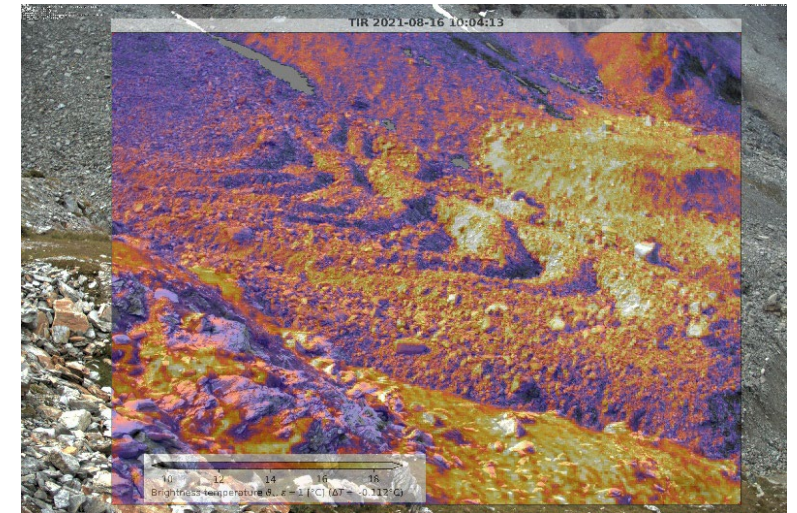
Kääb, 2005



Müller et al., 2016



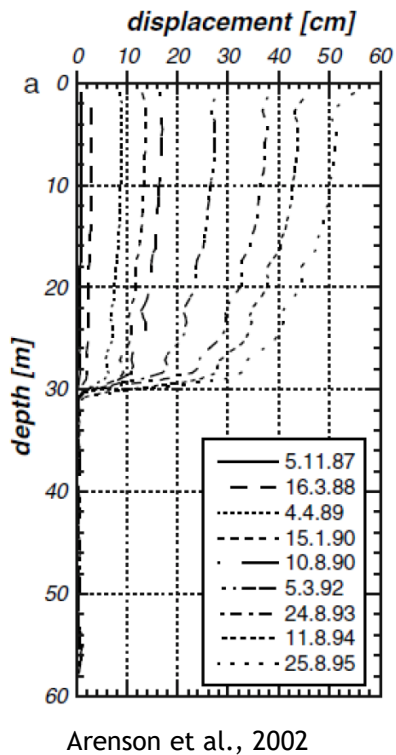
K. Naegeli, Remote Sensing Lab
Uni Zurich



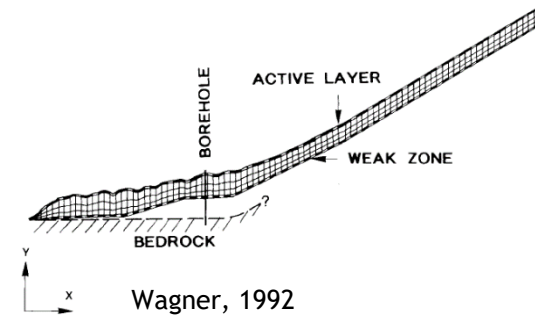
D. Amschwand, PhD Uni Fribourg

Numerical modelling

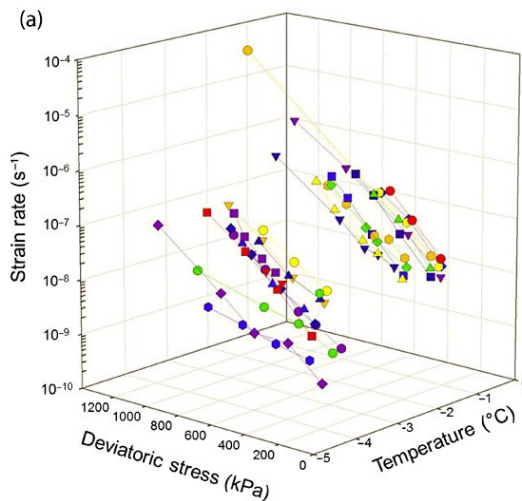
- Rock glacier creep, rheology of the debris-ice mixture, role of water
- Long-term landform evolution & future runoff from permafrost ice melt



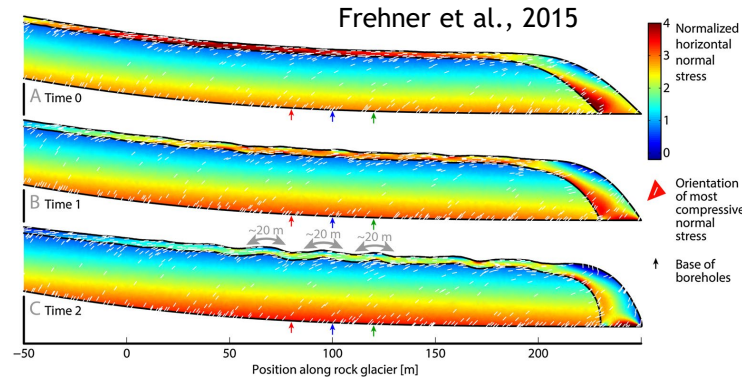
Arenson et al., 2002



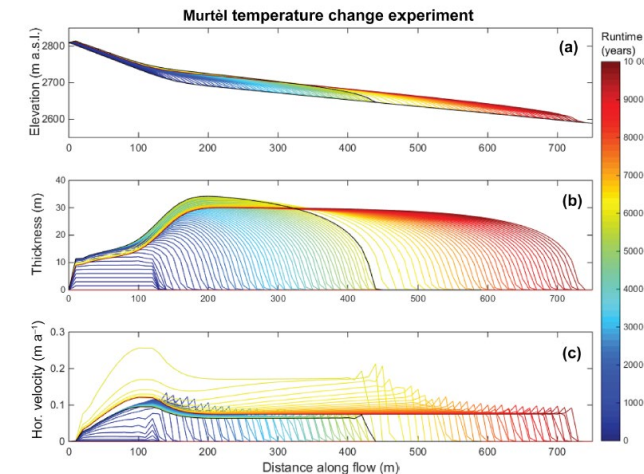
Wagner, 1992



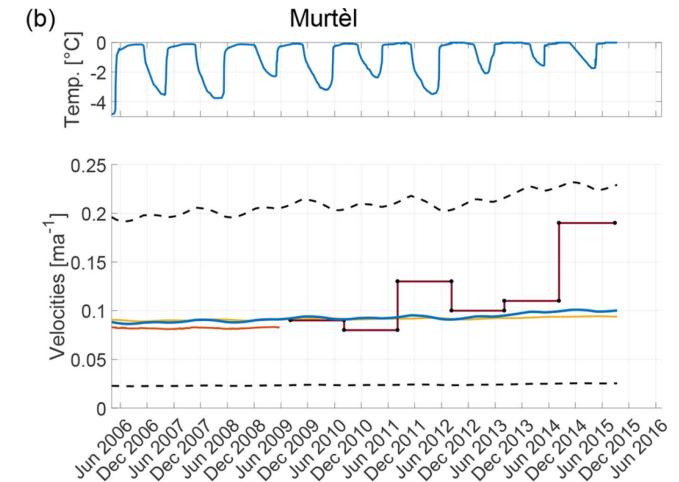
Springman, Arenson et al., 2012



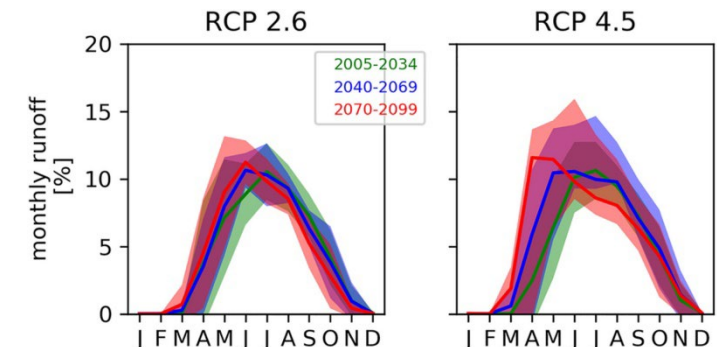
Frehner et al., 2015



Müller et al., 2015



Cicoira et al., 2019a

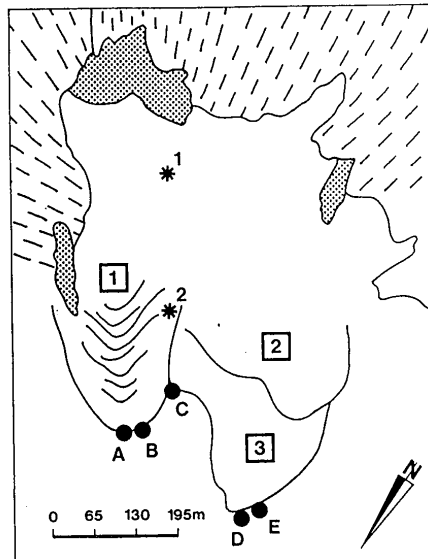


Pruessner et al., 2022

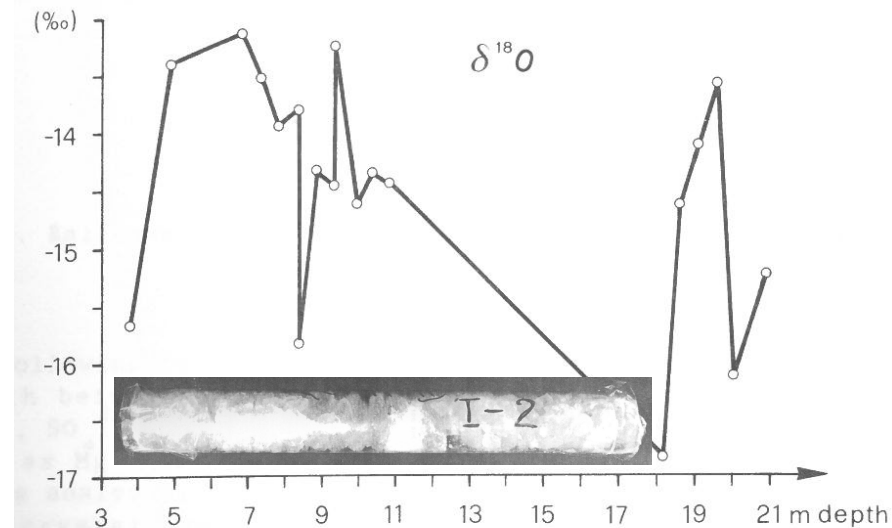
Hydrology & chemistry of drillcores

- Borehole observations: water flow during drilling, advective heat transfer attributed to water flow
- Tracer tests, chemical analyses of drillcores, isotope & EC measurements

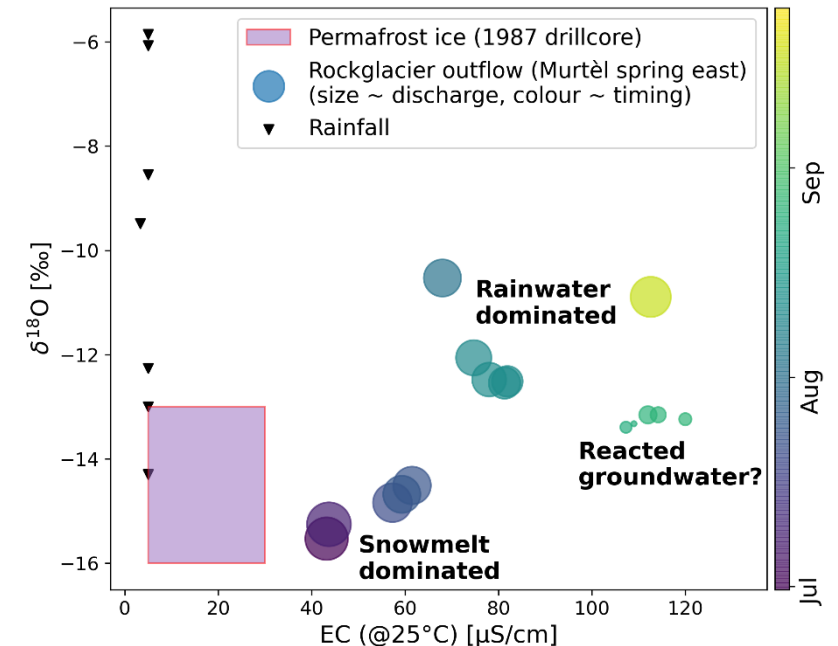
Tracer Experiments: Murtel Rock Glaciers
11.08.89-14.08.89



Tenthorey & Gerber, 1991



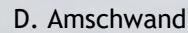
Haerberli et al., 1990 (VAW workshop report)



Amschwand et al., submitted to the
Swiss Geoscience Meeting 2022

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