

Supplementary Material

1. Pointes du Bricola rockfall



Figure S1: Ice in rockfall scar at Pointes du Bricola after a large rockfall of $\sim 40\,000\text{ m}^3$, October 2023 (Photo: A. Vogel).

2. GPR survey access techniques on the hanging glacier

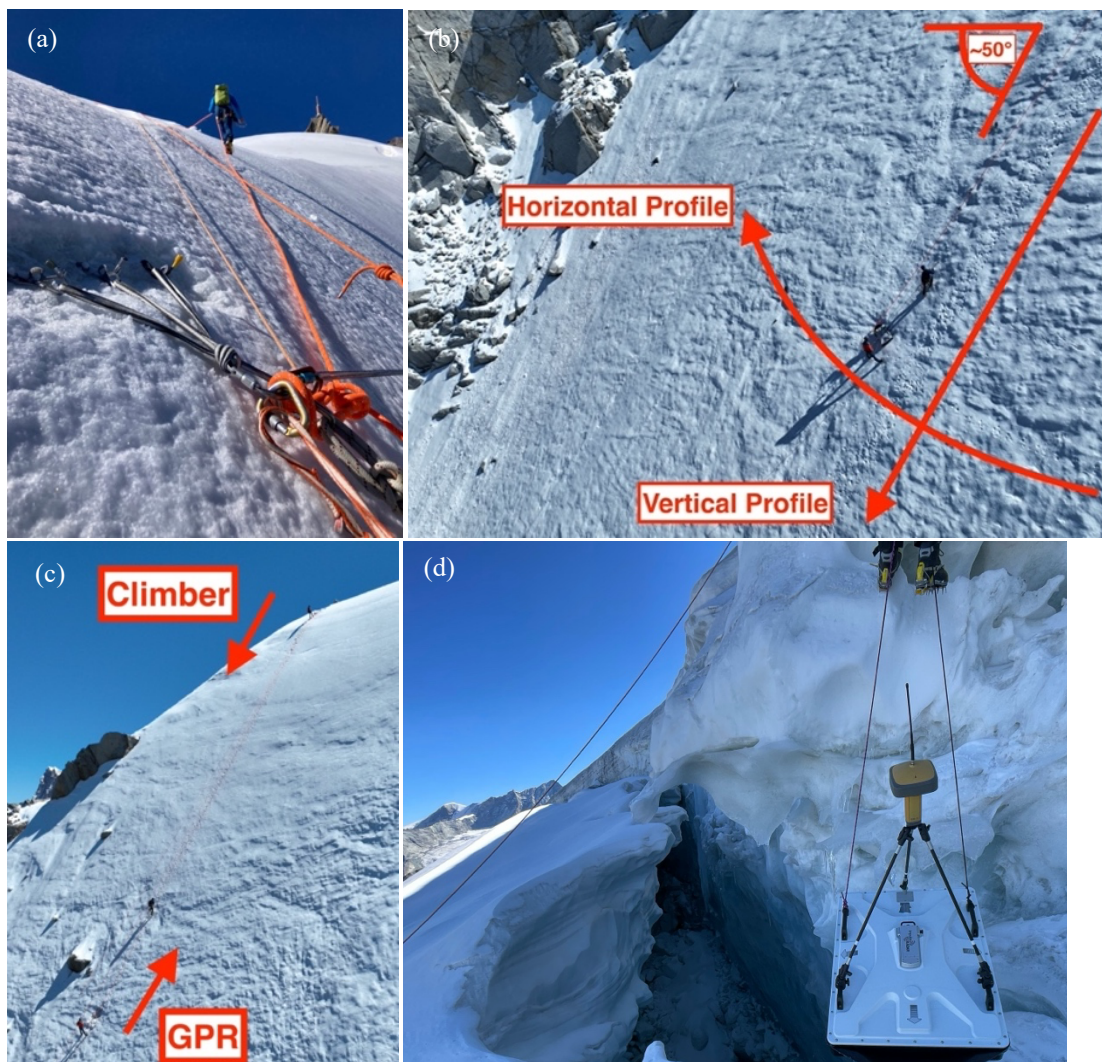


Figure S2: HG access techniques. (a) Ice screw anchor & rigging at an intermediate anchor point. (b) GPR profiles configuration of fall line “vertical” descents, and quasi-horizontal cross-profiles. (c) Counterweight technique to hoist the GPR/dGPS equipment back to the top of the slope. (d) Difficulties crossing the large bergschrund at Pointes du Mourti. Crevasse walls are vertical.

3. RST Sensor Installation Positions

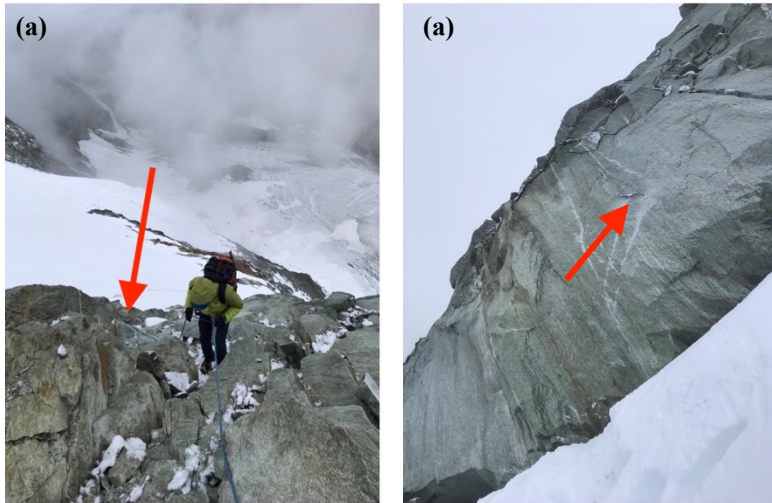


Figure S3a: RST sensor PM_N1



Figure S3b: RST sensor PM_E2



Figure S3c: RST sensor PM_E3



Figure S3d: Position of sensors PM_E2 and PM_E3.
View from East.



Figure S3e: RST sensor PM_SW1



Figure S3f: Air temperature sensor at the summit

4. ERT profile positions



Figure S4: (a) Main summit of PdM, view of the hanging glacier on its north face, and the west face with 120 m long ERT 1 profile, SW branch, marked in red. (b) Profile ERT 1, SW branch, view from PdM summit.



Figure S5: (a) Main summit of PdM, east face from a helicopter, with 120 m long ERT 1 profile, NE branch marked in red. The hanging glacier on the right is on the north face. (b) View down-slope of ERT 1, NE branch.



Figure S6: (a) View south from the main summit of PdM, ERT 1 profile straddles this ridge, NE branch on the left, SW branch on the right. (b) View NW from the main summit of PdM, looking at the south face of the west PdM summit. The summit of the north facing hanging glacier is visible on the right of the image.

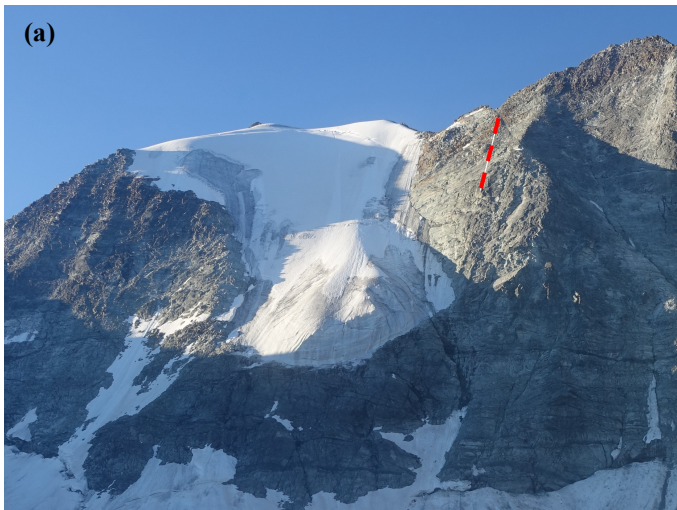


Figure S7: (a) North face of PdM with the hanging glacier. Position of ERT 2 marked in red. PdM east summit is on the right of the image.

(b) View down profile ERT 2 from above.

(c) View of the south face of PdM west summit from the col separating the two summits. ERT profile 1 on the north face is marked in red.

5. GPR radargram profile H-4

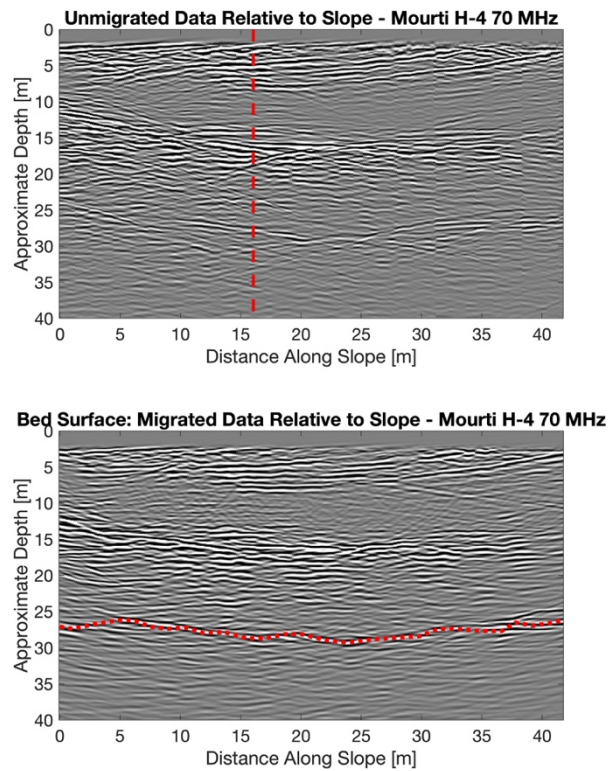


Figure S8: Radargram for GPR profile H-4. Intersection with profile V-1b is denoted by vertical dashed red line on the unmigrated data (upper radargram). Picked bedrock surface is superimposed onto the migrated data (lower radargram, dotted red line). Both images show a distinctive double reflection at 10 -15 m, caused by the proximity to a vertically orientated crevasse.

6. Historical Images

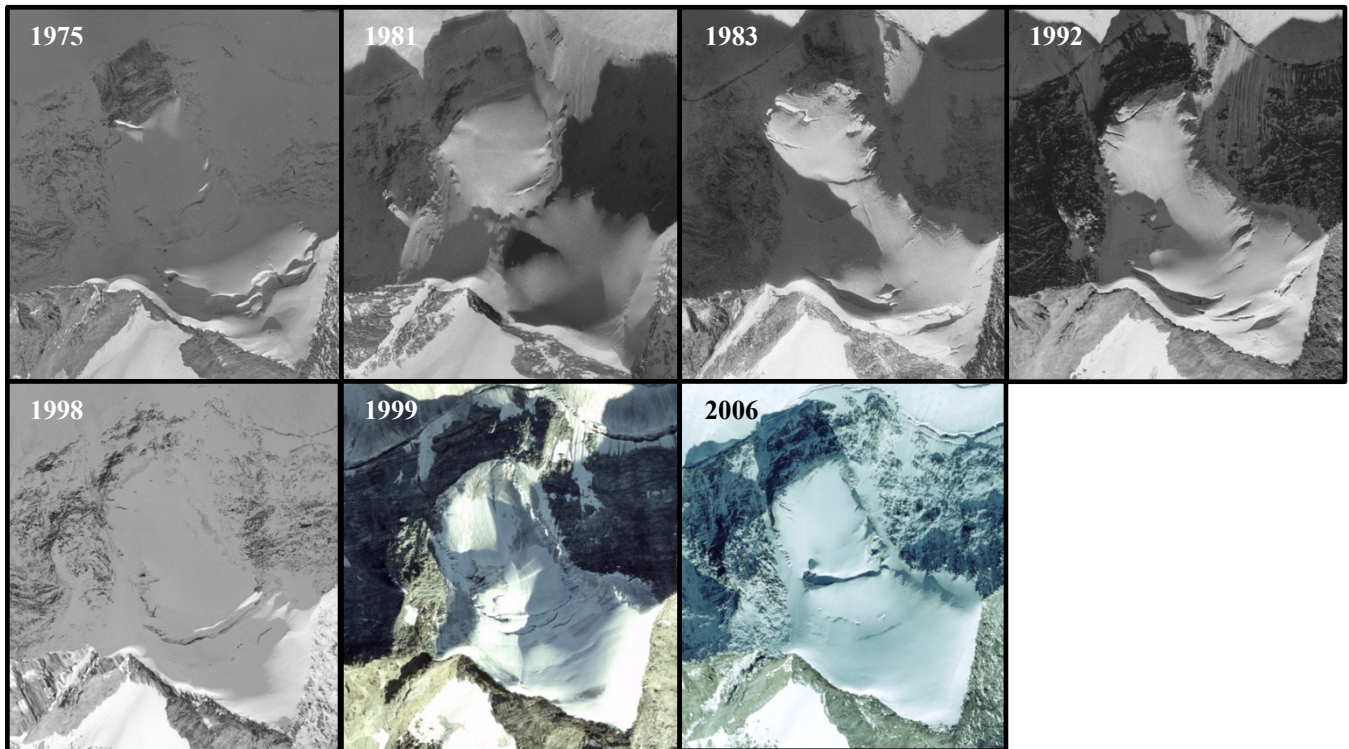


Figure S9: Historical images showing the evolution of the HG since 1975. Only one ice avalanche from the glacier terminus was observed from satellite images, in 1975 (Orthoimages: map.geoadmin.ch)

7. Mean annual rock surface and air temperatures

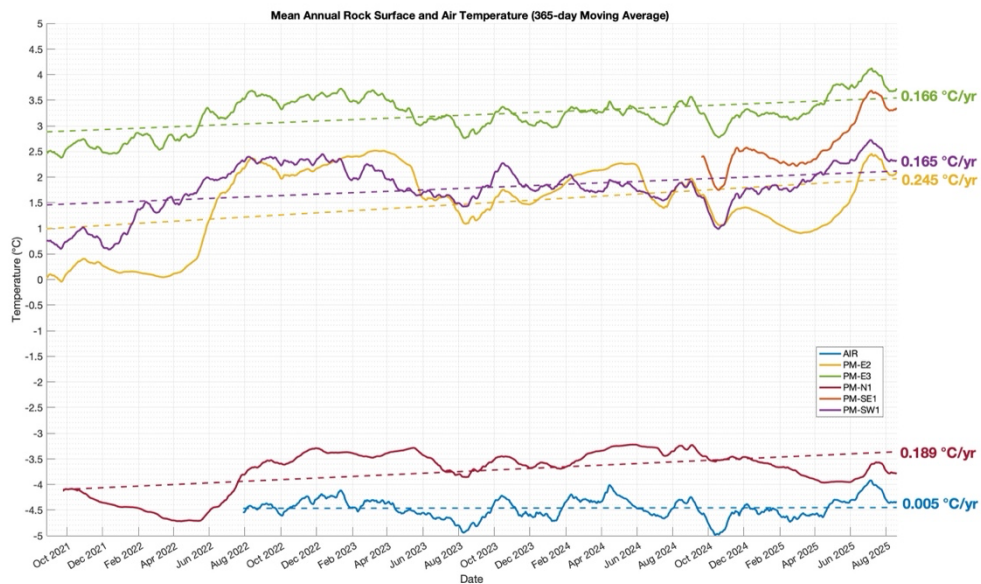


Figure S10: 12-month mean annual air temperature (MAAT) and mean annual rock surface temperatures (MARST) with linear regression trend. Temperatures increased at all sensors, at a faster rate than the air temperature, which itself remained stable.

8. Rock surface temperature daily mean time series

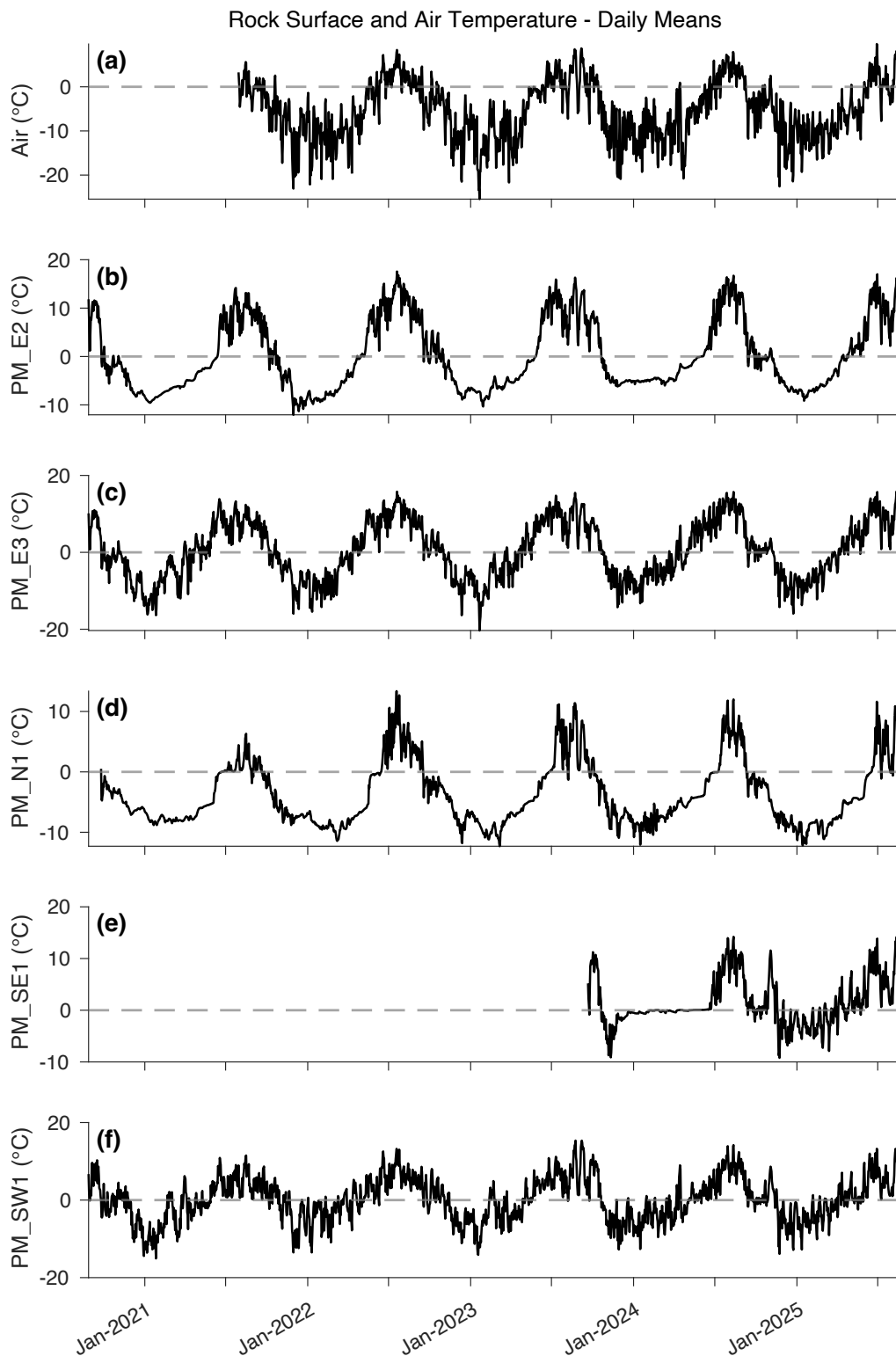


Figure S11: Rock surface temperatures 20.08.2020 – 18.08.2025 at 5 RST sensors. (a) PM_E2. Note the damped amplitude during winter months compared to PM_E3 and PM_SW1, indicating light presence of snow on the sensor during winter. (b) PM_E3. Day to day fluctuations are visible during all winter periods, indicating snow free conditions. (c) PM_N1. Note the smoother curve during winter months and a short “zero-curtain period” in spring compared to PM_E3 and PM_SW1, indicating light presence of snow on the sensor during winter. (d) PM_SE1. Winter 2023/2024 temperatures are maintained close to 0 °C, indicating a thick snow cover. Strong temperature variations show that winter 2024/2025 was snow free at this location. (e) PM_SW1. Day to day fluctuations are visible during all winter periods, indicating snow free conditions.

9. Evolution of modelled temperatures

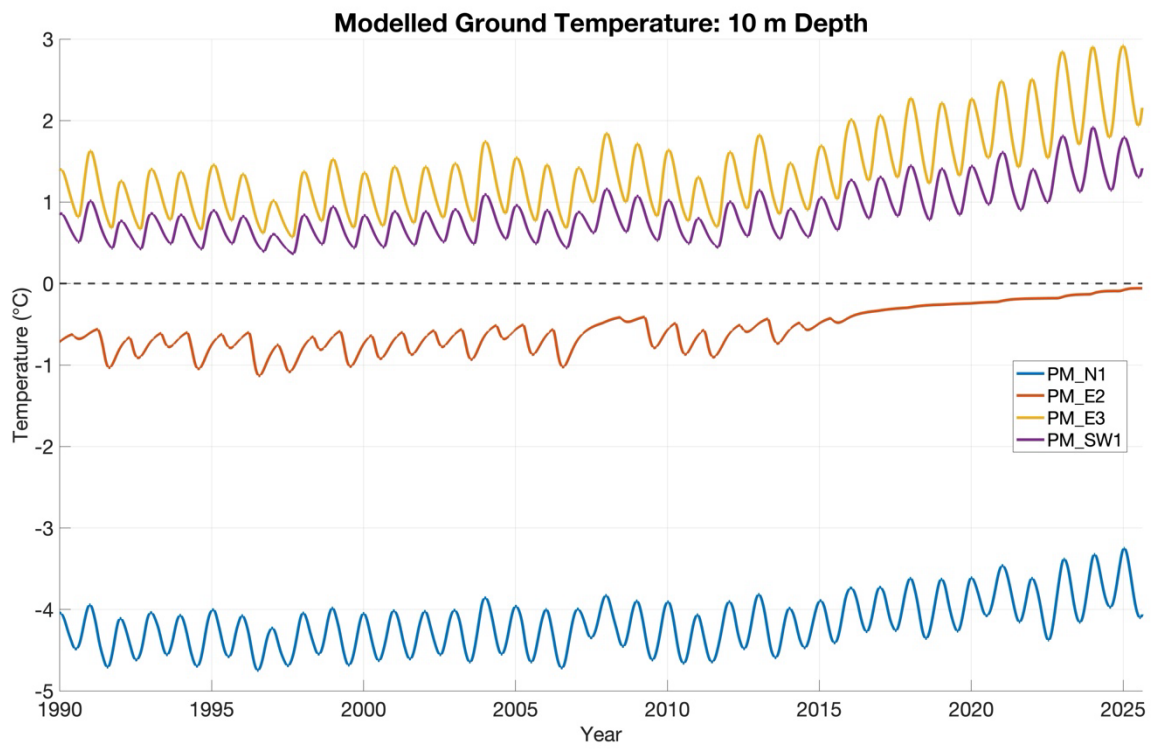


Figure S12: Modelled temperatures with CryoGrid2 at 10 m depth from 1990 to 2025