# Auxiliary Material:

# Strong Alpine glacier melt in the 1940s
# due to enhanced solar radiation

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**Auxiliary Table AM 1.** Calibrated parameter values and units (see Eq. 1). The 94-year average ($avg$) and the standard deviation $\sigma_\mathrm{p}$ of the parameters over the entire time period is given. Proportionality factors between $f_\mathrm{M}$, $r_\mathrm{firn}$ and $r_\mathrm{snow}$ are assumed to be constant over time and are defined as $r_\mathrm{snow} = c_\mathrm{s} \cdot f_\mathrm{M}$ and $r_\mathrm{firn} = c_\mathrm{f} \cdot f_\mathrm{M}$, where $c_\mathrm{s}$=0.035 and $c_\mathrm{f}$=0.050 (both in $\mathrm{W^{-1}\,m^2}$) according to Huss and Bauder (2009). $c_\mathrm{prec}$ refers to the correction of measured precipitation at the MeteoSwiss stations of Elm (Clariden), Lauterbrunnen (Aletsch) and Davos/Klosters (Silvretta) to the glacier sites (see Fig. 1). The elevation of the study sites is given.

| Parameter | Units | $avg$ | $\sigma_\mathrm{p}$ | $avg$ | $\sigma_\mathrm{p}$ | $avg$ | $\sigma_\mathrm{p}$ | $avg$ | $\sigma_\mathrm{p}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | Clariden Upper | | Clariden Lower | | Aletsch | | Silvretta | |
| | | (2894 m a.s.l.) | | (2679 m a.s.l.) | | (3338 m a.s.l.) | | (2732 m a.s.l.) | |
| $f_\mathrm{M}$ | $10^{-3}\,\mathrm{m\,d^{-1}\,{}^\circ C^{-1}}$ | 0.49 | 0.11 | 0.52 | 0.11 | 0.50 | 0.12 | 0.43 | 0.09 |
| $r_\mathrm{firn}$ | $10^{-5}\,\mathrm{m^3\,W^{-1}\,d^{-1}\,{}^\circ C^{-1}}$ | 2.46 | 0.54 | 2.59 | 0.53 | 2.51 | 0.62 | 2.15 | 0.45 |
| $r_\mathrm{snow}$ | $10^{-5}\,\mathrm{m^3\,W^{-1}\,d^{-1}\,{}^\circ C^{-1}}$ | 1.72 | 0.38 | 1.81 | 0.37 | 1.75 | 0.43 | 1.51 | 0.32 |
| $c_\mathrm{prec}$ | − | 2.67 | 0.36 | 2.66 | 0.39 | 3.07 | 0.54 | 2.79 | 0.83 |

**Auxiliary Table AM 2.** Global radiation data available in Switzerland for the period 1981-2008. Mean global solar radiation in the summer months (June, July, August) $\overline{I_{gl,JJA}}$ is given for 14 stations located in the Swiss Alps (see Fig. 1), divided into three regions, each representative for one of the investigated glaciers. Averages are calculated for the entire length of the time series (1981-2008) and decadal periods.

| Region | Station | Elevation (m a.s.l.) | $\overline{I_{gl,JJA}}$ (1981-2008) (W m$^{-2}$) | $\overline{I_{gl,JJA}}$ (1981-1989) (W m$^{-2}$) | $\overline{I_{gl,JJA}}$ (1990-1999) (W m$^{-2}$) | $\overline{I_{gl,JJA}}$ (2000-2008) (W m$^{-2}$) |
|---|---|---|---|---|---|---|
| East | Davos | 1594 | 222 | 220 | 220 | 227 |
| (Silvretta) | Weissfluhjoch | 2690 | 216 | 221 | 214 | 213 |
| | Piz Corvatsch | 3315 | 241 | 249 | 236 | 239 |
| | Samedan | 1709 | 234 | 229 | 235 | 238 |
| Central | Altdorf | 438 | 197 | 197 | 194 | 202 |
| (Clariden) | Disentis | 1197 | 219 | 216 | 220 | 222 |
| | Glarus | 517 | 192 | 188 | 191 | 198 |
| | Säntis | 2502 | 211 | 214 | 202 | 217 |
| | Guetsch | 2287 | 235 | 234 | 234 | 237 |
| | Pilatus | 2106 | 182 | 181 | 178 | 187 |
| West | Interlaken | 577 | 212 | 210 | 210 | 215 |
| (Aletsch) | Jungfraujoch | 3580 | 253 | 254 | 246 | 260 |
| | Ulrichen | 1346 | 229 | 228 | 227 | 234 |
| | Visp | 639 | 244 | 248 | 240 | 245 |