



## *Supplement of*

# **SPASS – new gridded climatological snow datasets for Switzerland: potential and limitations**

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## Additional Tables

665

**Table S1: List of stations and corresponding altitude used for comparison in each elevation band. Station with a number at the beginning or end of the listed station indicatives are maintained by SLF and stations without any number are maintained by MeteoSwiss.**

| 250 – 750 m |      | 751-1250 m |      | 1251-1750 m |      | 1751-2250 m |      | 2251-2750 m |      |
|-------------|------|------------|------|-------------|------|-------------|------|-------------|------|
| Stat        | Alti | Stat       | Alti | Stat        | Alti | Stat        | Alti | Stat        | Alti |
| BAS         | 316  | LAG        | 755  | 5SI         | 1273 | 7SD         | 1751 | TUJ2        | 2262 |
| OTL         | 366  | 1LB        | 800  | 2ST         | 1280 | 7SN         | 1752 | BOG2        | 2299 |
| GVE         | 410  | 7BR        | 800  | 1WE         | 1280 | 2TR         | 1780 | CMA2        | 2325 |
| DEM         | 416  | STG        | 802  | 1LS         | 1300 | 4SF         | 1790 | NAS2        | 2350 |
| SNS         | 439  | 5KU        | 815  | 3BR         | 1310 | 6RI         | 1800 | JUL2        | 2426 |
| ALT         | 449  | EIN        | 910  | 3FB         | 1310 | SIA         | 1801 | GOM3        | 2427 |
| KOP         | 483  | ELM        | 965  | 1MI         | 1320 | 7MA         | 1810 | PMA2        | 2429 |
| NEU         | 483  | CHD        | 985  | 2ME         | 1320 | 1HB         | 1825 | EGH2        | 2500 |
| SIO         | 485  | 7PV        | 1015 | 1AD         | 1325 | 5AR         | 1845 | 5WJ         | 2536 |
| LAN         | 538  | 2EN        | 1023 | 3UI         | 1340 | 7MZ         | 1850 | ATT2        | 2550 |
| BER         | 548  | GTT        | 1055 | 4UL         | 1345 | 1GH         | 1970 | DIA2        | 2569 |
| CHU         | 572  | 2OG        | 1060 | 1LC         | 1360 | 4SH         | 2000 | ANV3        | 2589 |
| MER         | 592  | ROB        | 1078 | 7ST         | 1387 | 7DI         | 2090 | VIN2        | 2729 |
| SMA         | 604  | AIR        | 1139 | 1SM         | 1390 | 7AG         | 2090 | LAG2        | 2730 |
| VIS         | 662  | 2SO        | 1150 | 4MS         | 1430 |             |      |             |      |
| MAS         | 718  | D1S        | 1190 | 2AN         | 1440 |             |      |             |      |
|             |      | 1GS        | 1190 | 4WI         | 1450 |             |      |             |      |
|             |      | 1GA        | 1190 | 5SP         | 1457 |             |      |             |      |
|             |      | 5KK        | 1190 | 5IN         | 1460 |             |      |             |      |
|             |      | 3MG        | 1190 | 5SA         | 1510 |             |      |             |      |
|             |      | 6CB        | 1215 | 6BG         | 1525 |             |      |             |      |
|             |      |            |      | 5DF         | 1560 |             |      |             |      |
|             |      |            |      | 4GR         | 1560 |             |      |             |      |
|             |      |            |      | 1GB         | 1565 |             |      |             |      |
|             |      |            |      | 4MO         | 1590 |             |      |             |      |
|             |      |            |      | 4ZE         | 1600 |             |      |             |      |
|             |      |            |      | 6SB         | 1640 |             |      |             |      |
|             |      |            |      | 1MR         | 1650 |             |      |             |      |
|             |      |            |      | 4BP         | 1670 |             |      |             |      |
|             |      |            |      | 7CA         | 1690 |             |      |             |      |
|             |      |            |      | 7ZU         | 1710 |             |      |             |      |
|             |      |            |      | 7FA         | 1710 |             |      |             |      |
|             |      |            |      | 7LD         | 1710 |             |      |             |      |
|             |      |            |      | 5ZV         | 1735 |             |      |             |      |

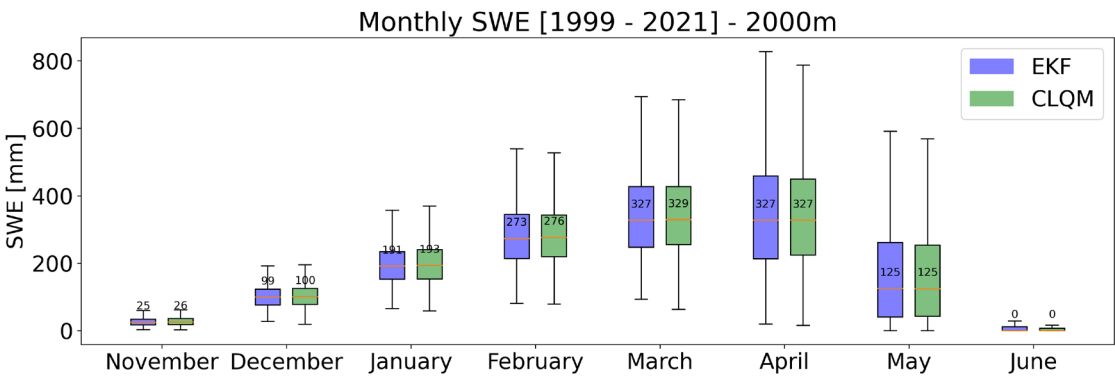
670

**Table S2: Number of available stations in the two different comparison periods, as well as the number of grid points in absolute and relative terms per elevation band.**

| Label    | Elevation band | # of stations<br>1999-2023 | # of stations<br>1962-2023 | # of grid<br>points | % of grid<br>points |
|----------|----------------|----------------------------|----------------------------|---------------------|---------------------|
| < 250 m  |                |                            |                            | 72                  | 0.2                 |
| 500 m    | 250-750 m      | 16                         | 16                         | 13405               | 34                  |
| 1000 m   | 751-1250 m     | 21                         | 21                         | 8056                | 20                  |
| 1500 m   | 1251-1750 m    | 34                         | 34                         | 5880                | 15                  |
| 2000 m   | 1751-2250 m    | 16                         | 16                         | 5592                | 14                  |
| 2500 m   | 2251-2750 m    | 16                         | 1                          | 4731                | 12                  |
| > 2750 m |                |                            |                            | 2105                | 5                   |

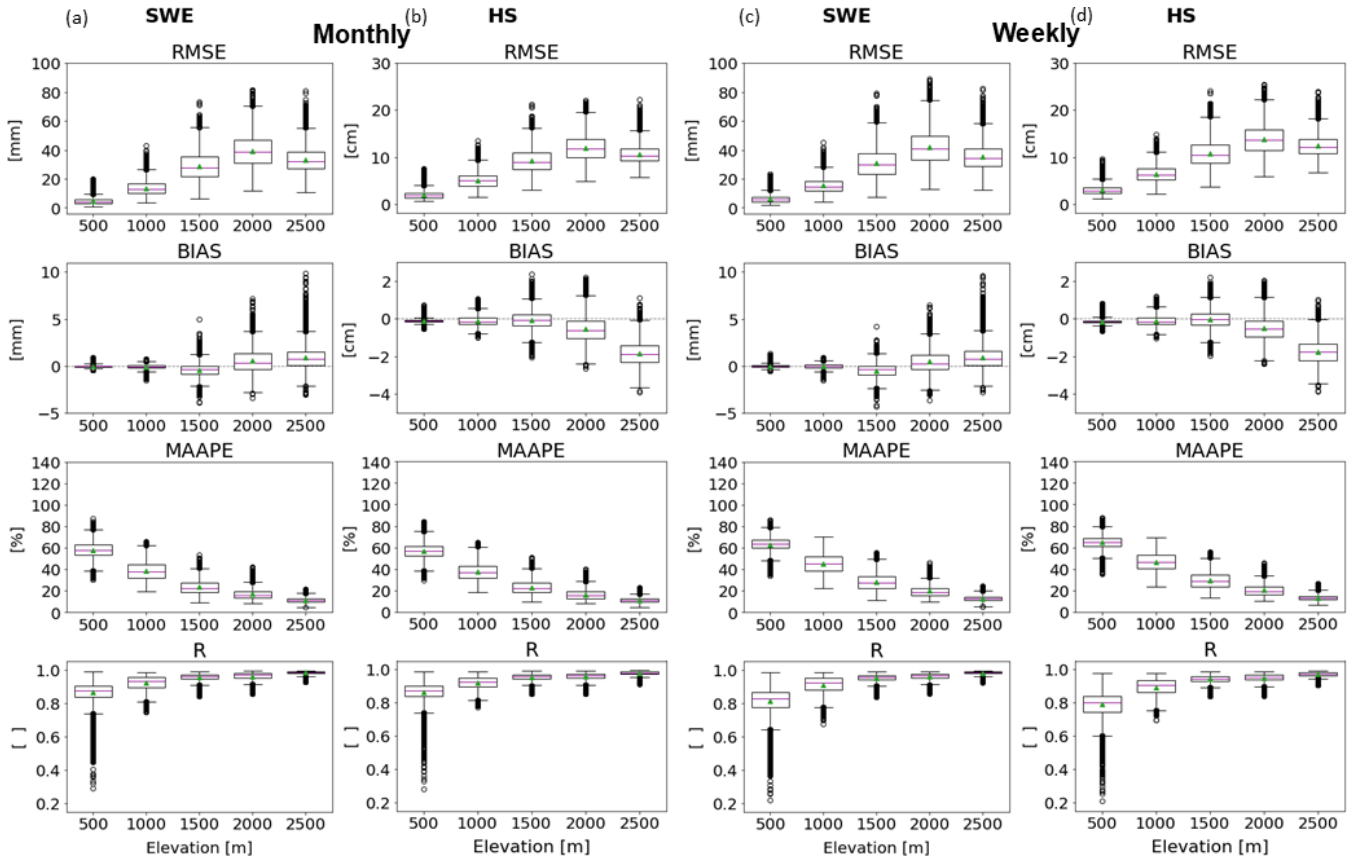
675

Additional Figures



680

**Figure S1: Climatology of monthly SWE values of OSHD-EKF and OSHD-CLQM in the 2000 m elevation band between the common period 1999- 2001. Numbers is the boxplots indicate monthly median values.**



**Figure S2: Score comparison between models CLQM and EKF ('reference') on a monthly (a,b) and weekly (c,d) resolution at respective elevation bands for SWE (a,c) and HS (b,d). Median value is illustrated as purple line and mean value as green triangle.**

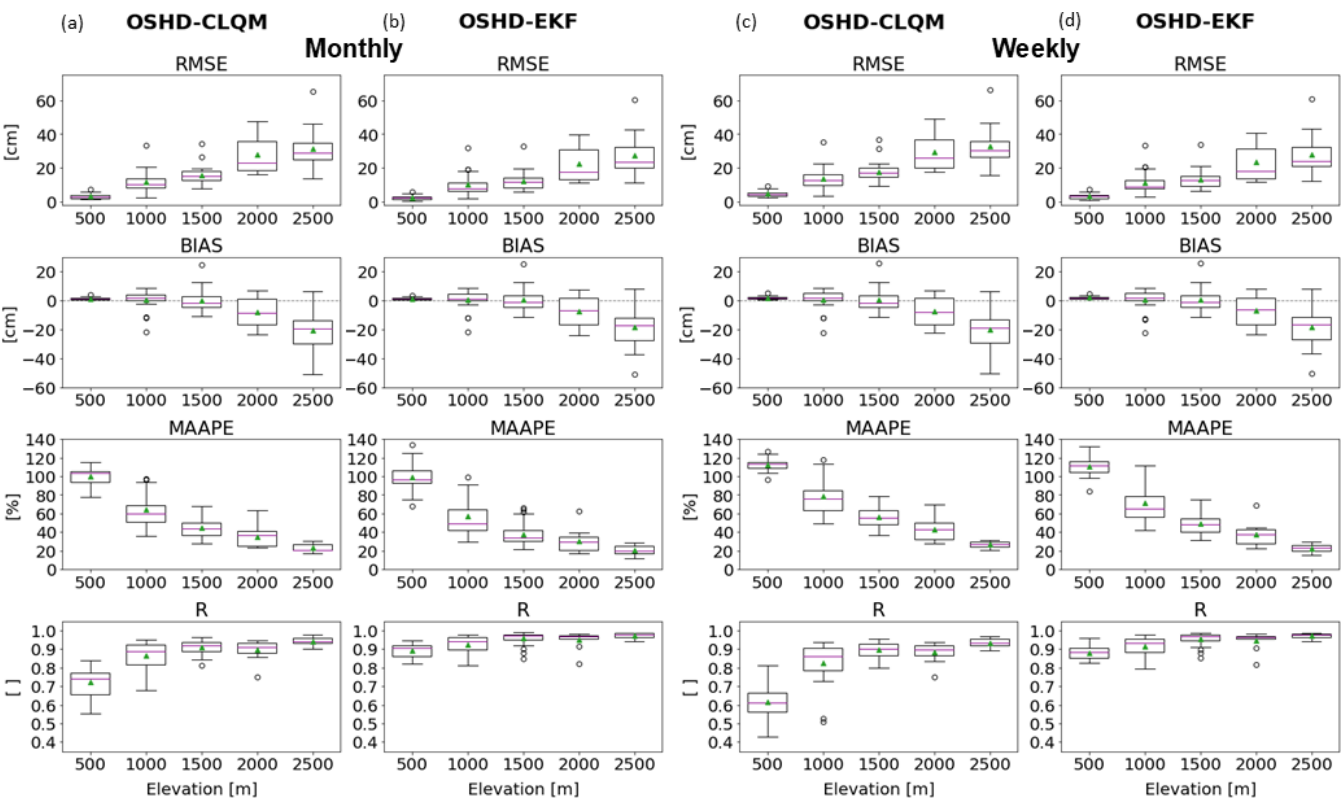


Figure S3: Score comparison between stations data and OSHD-CLQM (a,c) as well as OSHD-EKF (b,d) for monthly (a,b) and weekly (c,d) snow depth values in the respective elevation bands. Median value is illustrated as purple line and mean value as green triangle.

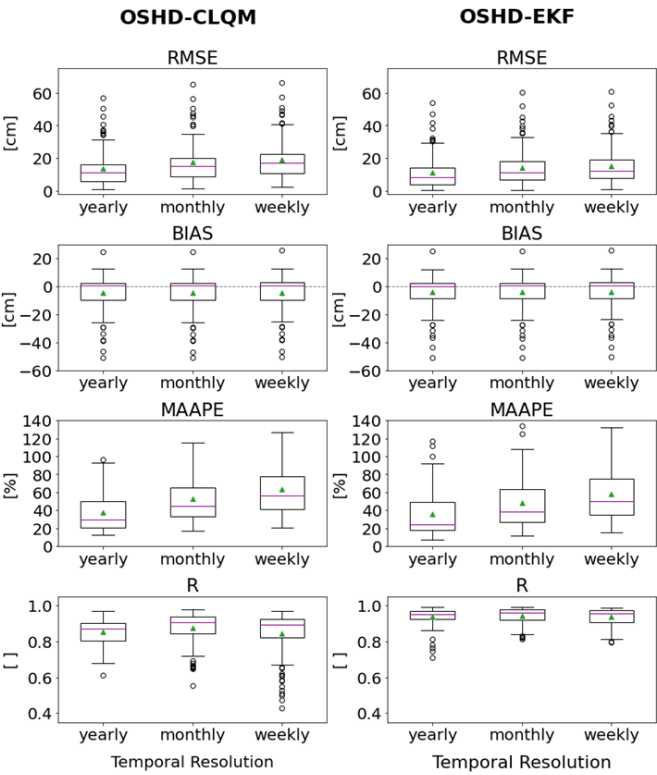


Figure S4: Score comparison between all stations and the respective model gridpoints of OSHD-CLQM (left) and OSHD-EKF (right) for yearly, monthly and weekly snow depth values. Median value is illustrated as purple line and mean value as green triangle.

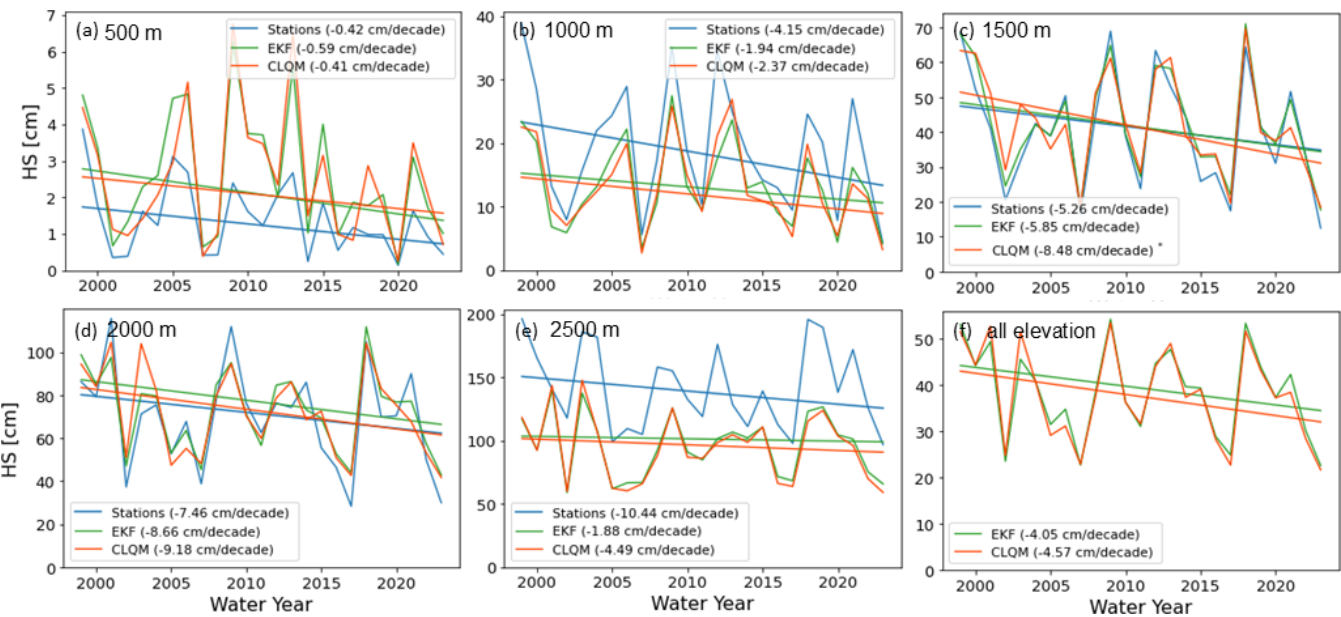


Figure S5: Same as Figure 7, but for 1999-2023. Trends of yearly snow depth[cm / decade] calculated using Theil-Sen slopes for the OSHD-CLQM and the combined model data series (OSHD-Comb), as well as for station measurements for the five elevation bands: (a) 500, (b) 1000, (c) 1500, (d) 2000, (e) 2500 m and (f) entire Switzerland (0-3000 m). Significance is indicated with \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

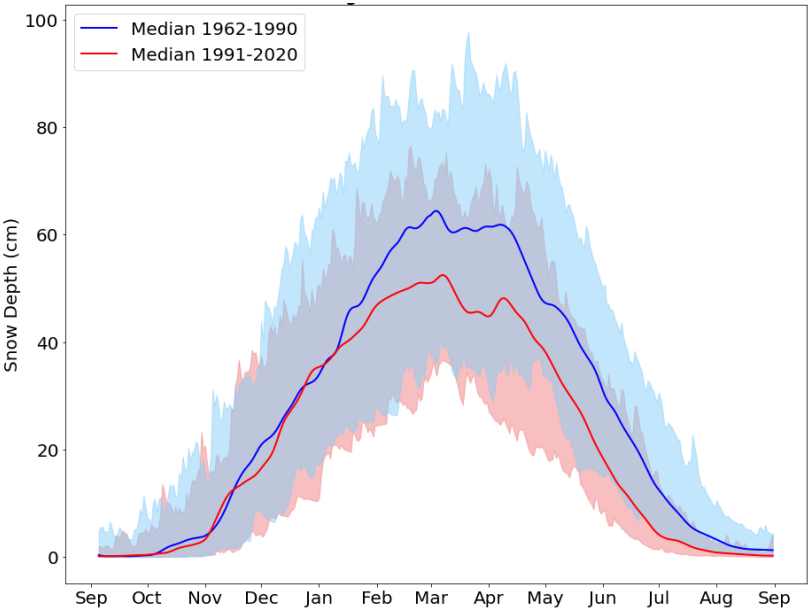
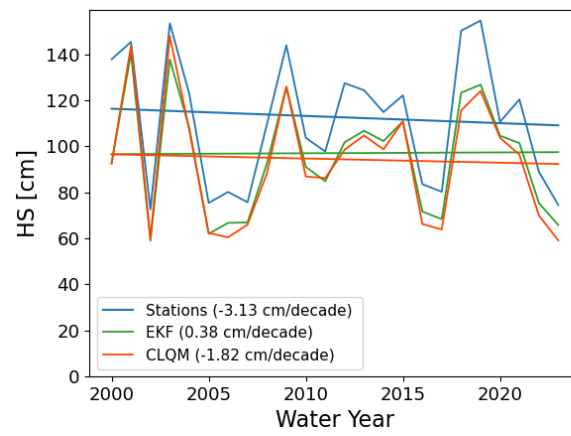


Figure S6: Annual evolution of snow depth from the OSHD-CLQM model for the two 30-year reference periods 1962-1990 (blue) and 1991-2020 (red). The daily values are calculated based on all grid points between 0 and 3000 m in Switzerland.



**Figure S7: Trends of yearly snow depth [cm / decade] calculated using Thiel-Sen slopes for the OSHD-CLQM and the OSHD-EKF, as well as for station measurements (mean of 16 stations) for the highest elevation band (2500 m). Possible significance is indicated with \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .**

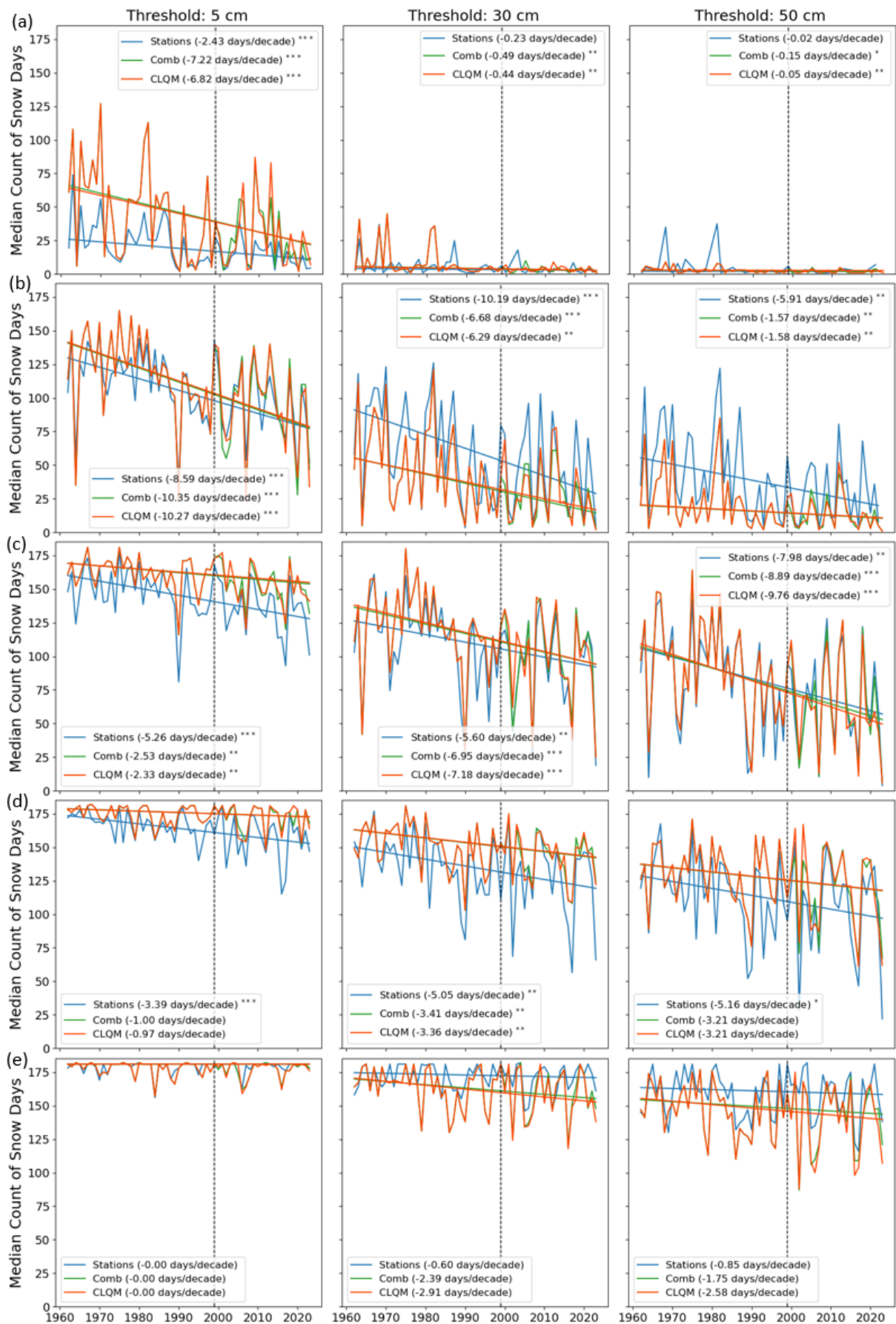
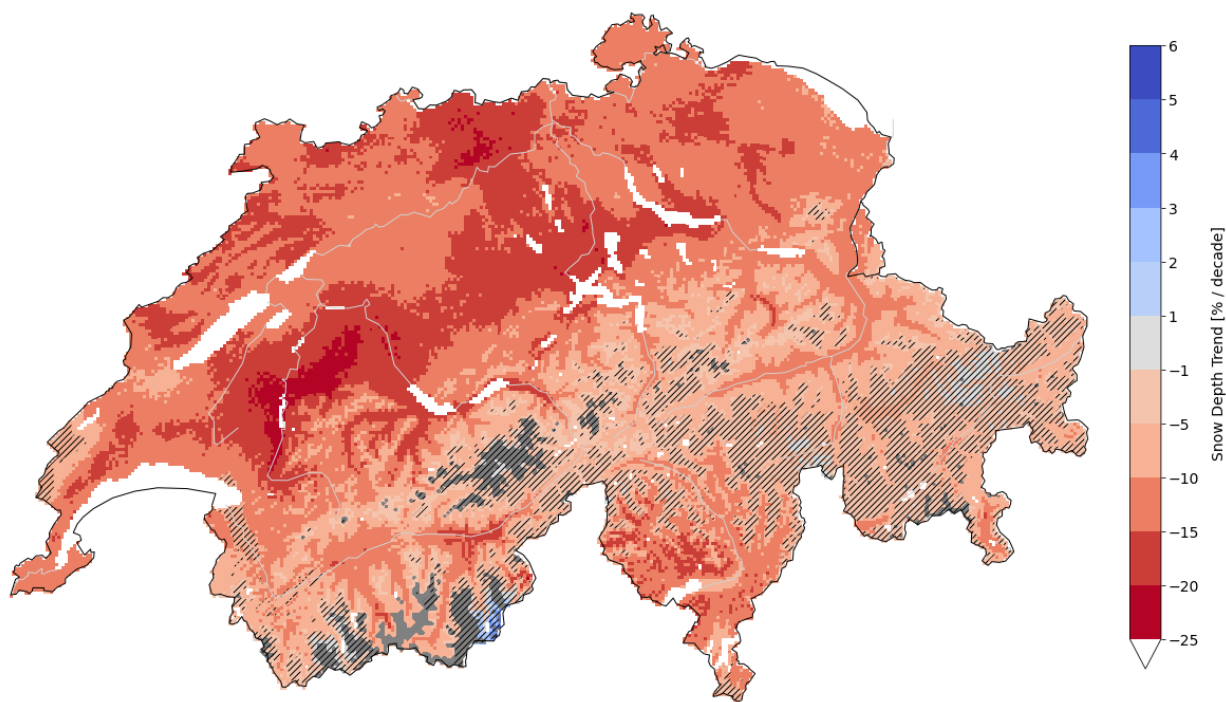


Figure S8: Trends of median snow days for three different thresholds (5,30, 50 cm) using Theil-Sen-slope regression for OSHD-CLQM and OSHD-comb, as well as stations across five elevation bands: (a) 500, (b) 1000, (c) 1500, (d) 2000, and (e) 2500 m. Significance is indicated with \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ . The dashed line indicates the year 1999, before which the yearly values of OSHD-CLQM and OSHD-comb are the same.



**Figure S9: Relative trends of yearly mean snow depth (%/decade) for the period 1962 - 2023 based on Theil-Sen slopes for each 1-km grid point of the OSHD-CLQM model in Switzerland. Water bodies appear white, elevations above 3000 m are colored in grey and non-hatched areas indicate significant trends at 95% confidence level,  $p < 0.05$ .**