10 Supplement

 ## 10.1 Additional Tables

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				

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 1999-2023	# of stations 1962-2023	# of grid points	% of grid 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

590

10.2 Additional Figures

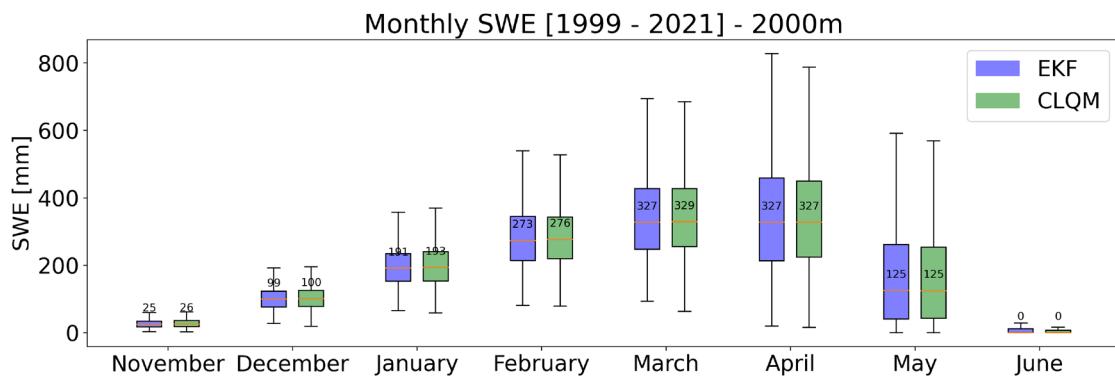



Figure S1: Climatology of monthly SWE values of OSHD-EKF and OSHD-CLQM in the 2000 m elevation band between the common period 1999- 2001. Numbers is the boxplots indicate monthly median values.

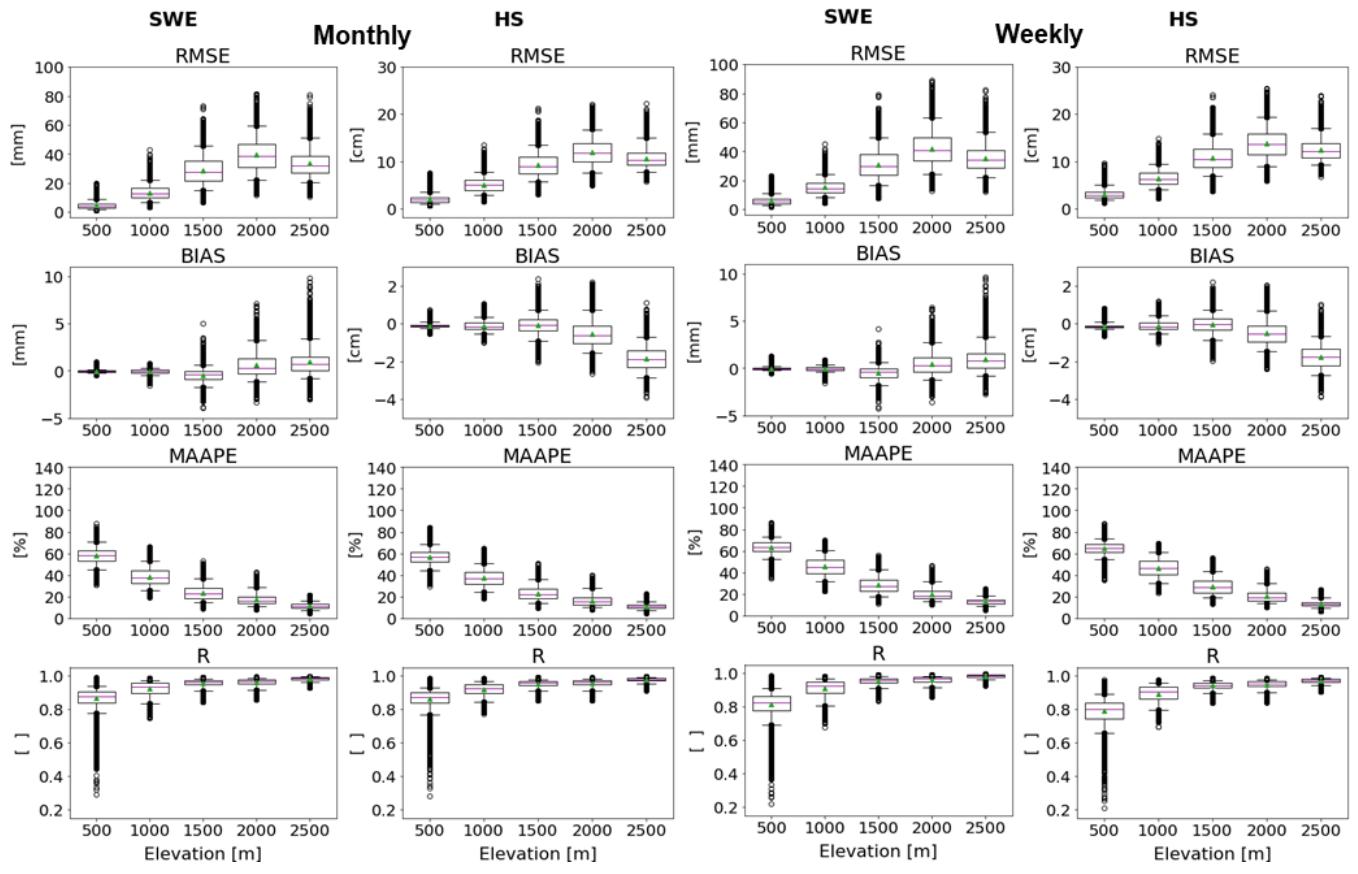
595

600

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.

605

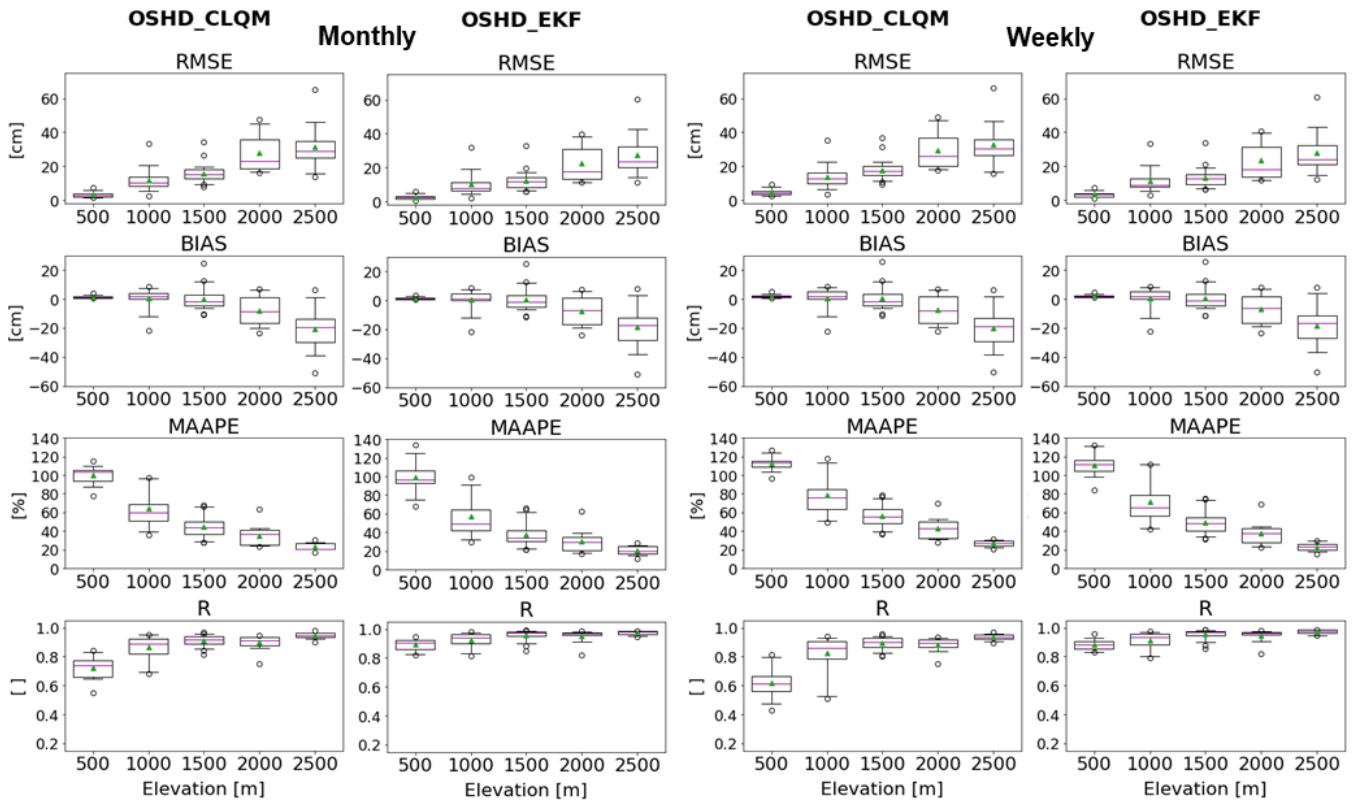



Figure S3: Score comparison between stations data and OSHD-CLQM (a,c) as well as OSHD-EKF (b,d) for monthly (a,b) and weekly (c,d) snow depth values in the respective elevation bands. Median value is illustrated as purple line and mean value as green triangle.

610

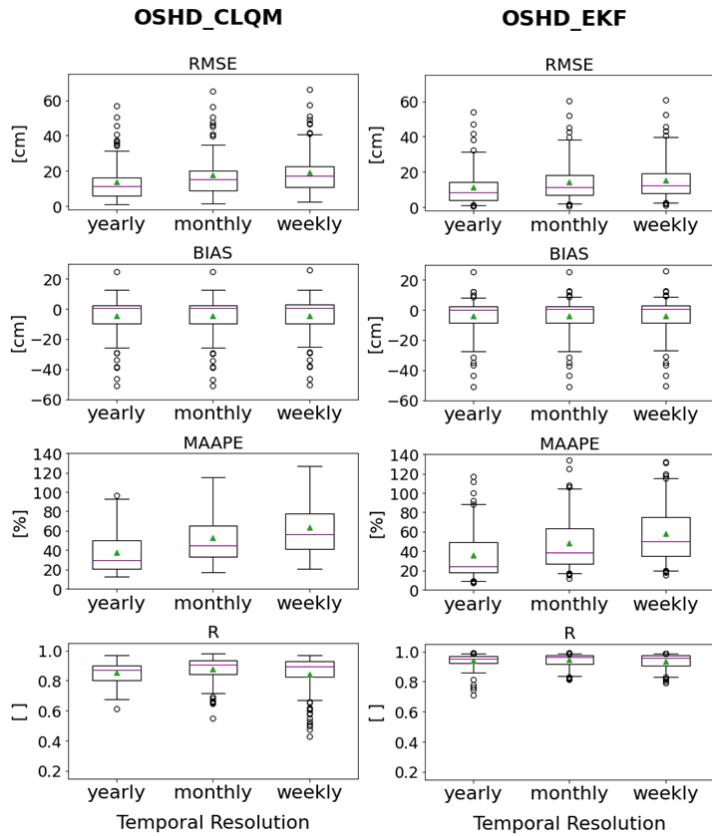



Figure S4: Score comparison between all stations and the respective model gridpoints of OSHD-CLQM (left) and OSHD-EKF (right) for yearly, monthly and weekly snow depth values. Median value is illustrated as purple line and mean value as green triangle.

615

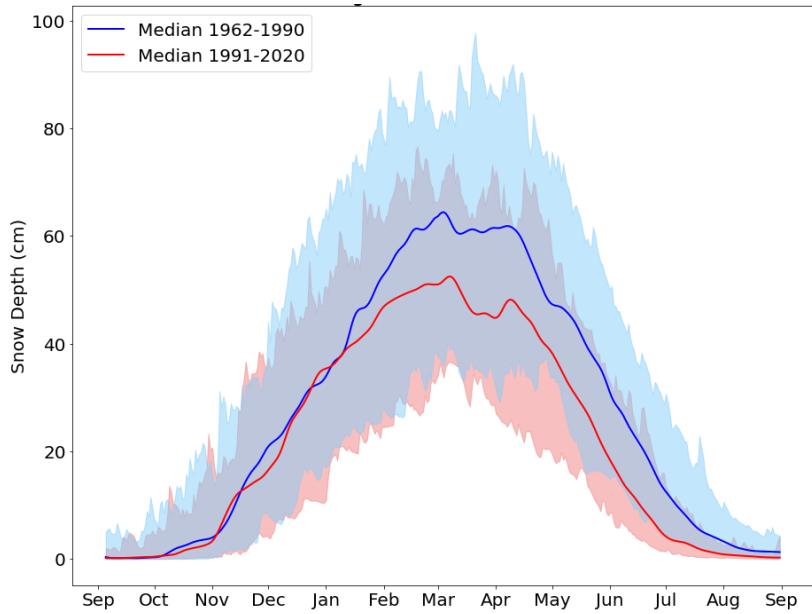



Figure S5: Annual evolution of snow depth from the OSHD_CLQM model for the two 30-year reference periods 1962-1990 (blue) and 1991-2020 (red). The daily values are calculated based on all grid points between 0 and 3000 m in Switzerland.

620

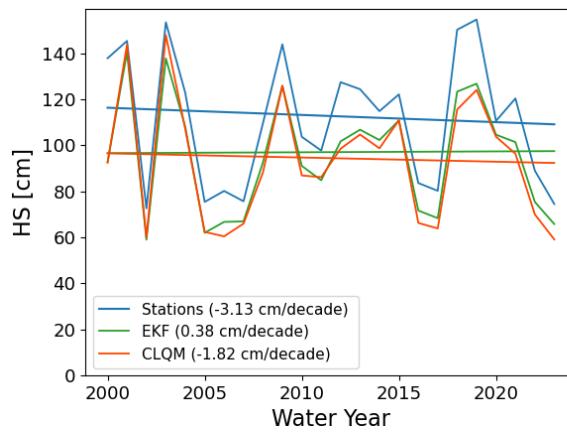



Figure S6: Trends of yearly snow depth [cm / decade] calculated using Thiel-Sen slopes for the OSHD-CLQM and the OSHD_EKF, as well as for station measurements (mean of 16 stations) for the highest elevation band (2500 m). Possible significance is indicated with * p < 0.05; ** p < 0.01; *** p < 0.001.

625

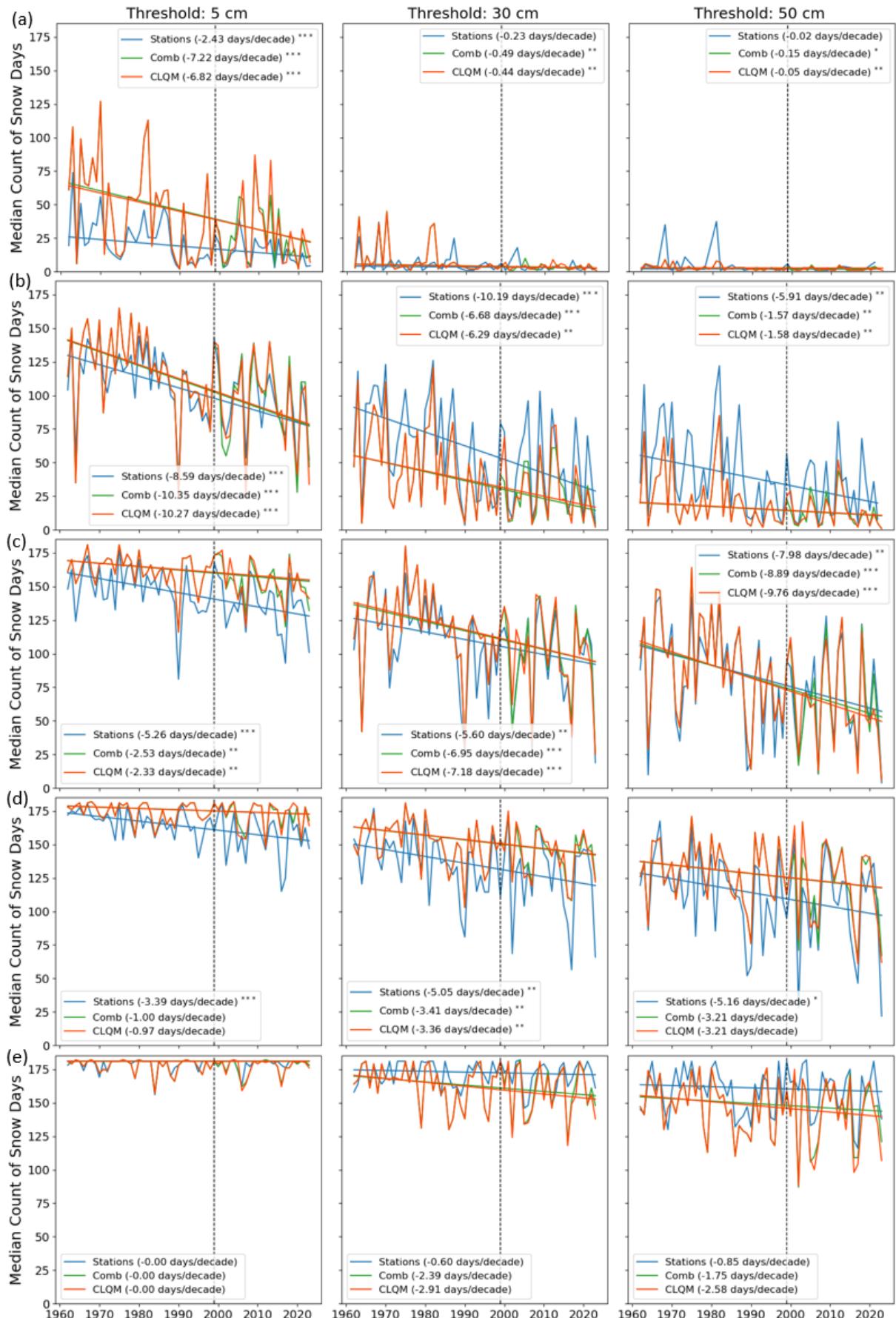



Figure S7: **Trends of median snow days for three different thresholds (5,30, 50 cm) using Theil-Sen-slope regression for OSHD-CLQM and OSHD-comb, as well as stations across five elevation bands: (a) 500, (b) 1000, (c) 1500, (d) 2000, and (e) 2500 m. Significance is indicated with * p < 0.05; ** p < 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.**