

Supplement of "Long-term firn and mass balance modelling for Abramov glacier, Pamir Alay"

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S1 Supplementary tables

Table S1. Parameters measured at the original Abramov weather station from October 1967 until summer 1999 (data available until December 1998). The installation height and the sensor types are given for each parameter. Data were either recorded automatically or manually read. The recording frequency as well as the temporal resolution of data available for this study are indicated.

Variable	height	sensor (recording)	frequency	preserved data
Air temperature	2 m	bimetallic strip (recording)	$8 \times \text{day}^{-1}$	daily averages
		mercury thermometer (manual observation)		
Air temperature max	2 m	mercury maximum thermometer	$1 \times \text{day}^{-1}$	daily max
Air temperature min	2 m	alcohol-in-glass minimum thermometer	$1 \times \text{day}^{-1}$	daily min
Air pressure	2 m	aneroid barograph (recording)	$8 \times \text{day}^{-1}$	daily averages
		mercury barometer (manual observation)		
Relative humidity	2 m	hair hygrometer (recording)	$8 \times \text{day}^{-1}$	daily averages
		psychrometer - coupled wet-and-dry-bulb		
		mercury thermometers (manual observation)		
Wind speed	10 m	anemometer	$8 \times \text{day}^{-1}$	daily averages
Wind direction	10 m	anemometer	$8 \times \text{day}^{-1}$	not available
Precipitation	2 m	cylindric zinc bucket ($200 \text{ cm}^2 \times 2 \text{ m}$)	$2 \times \text{day}^{-1}$	daily sums
Cloud cover	-	visual observations	$8 \times \text{day}^{-1}$	daily averages and minimums

Table S2. Mean modelled energy fluxes, mean duration of melt period (p_{melt}) and mean annual precipitation (solid P_s and liquid P_l) per decade for three grid points. The melt period is defined as the amount of days for which the modelled melt amount is >0.002 m.w.e. d^{-1} . One point is located in the ablation area at ~ 3850 m.a.s.l. and two points are located in the accumulation area at site 1 at ~ 4250 m.a.s.l. and site 2 ~ 4400 m.a.s.l. The periods are hydrological years (e.g. 1968-1978 refers to 1 October 1968 - 30 September 1978). The locations are indicated in Figure 1b of the main manuscript

point m a.s.l.	decade	SW_{in} $W m^{-2}$	SW_{out} $W m^{-2}$	LW_{in} $W m^{-2}$	LW_{out} $W m^{-2}$	R_{net} $W m^{-2}$	Q_{sens} $W m^{-2}$	Q_{lat} $W m^{-2}$	Q_{sub} $W m^{-2}$	Q_{melt} $W m^{-2}$	P_{melt} days	P_s m w.e. a^{-1}	P_l m w.e. a^{-1}
3850	1968-1978	217.95	140.57	224.89	274.65	27.62	18.38	-3.61	3.77	46.16	202	1.08	0.19
3850	1978-1988	213.8	143.46	227.61	275.93	22.01	18.04	-1.75	3.62	41.91	191	1.25	0.19
3850	1988-1998	209.84	137.32	231.04	277.47	26.08	17.04	-0.87	3.41	45.65	198	1.22	0.23
3850	1998-2008	201.15	128.05	228.54	276.68	24.96	19.86	-1.18	2.96	46.6	191	1.1	0.27
3850	2008-2018	199.38	127.74	229.27	277.13	23.78	20.01	-1.3	3.07	45.56	196	1.18	0.27
3850	1968-2020	208.29	135.15	228.19	276.39	24.94	18.73	-1.72	3.36	45.3	195	1.16	0.23
4250	1968-1978	215.28	161.23	218.13	268.55	3.63	16.61	-2.7	4.69	22.23	186	1.69	0.15
4250	1978-1988	211.97	160.52	220.48	269.73	2.2	16.24	-1.13	4.31	21.61	181	1.99	0.15
4250	1988-1998	209.09	158.36	223.6	271.11	3.21	15.18	-0.41	4.32	22.29	181	1.97	0.2
4250	1998-2008	202.75	151.74	221.02	270.64	1.4	17.55	-0.6	4.28	22.63	173	1.84	0.25
4250	2008-2018	202.91	149.66	221.56	270.98	3.83	17.58	-0.69	3.98	24.7	180	2	0.24
4250	1968-2020	208.42	156.19	220.86	270.21	2.88	16.68	-1.08	4.29	22.77	180	1.89	0.2
4400	1968-1978	233.22	176.74	215.58	267.99	4.07	15.12	-2.63	4.87	21.44	192	1.93	0.13
4400	1978-1988	230.3	176.06	217.84	269.17	2.91	14.71	-1.22	4.33	20.72	187	2.27	0.13
4400	1988-1998	227.51	173.46	220.88	270.56	4.38	13.65	-0.58	4.3	21.74	184	2.26	0.18
4400	1998-2008	220.36	167.94	218.31	269.68	1.06	16.29	-0.51	4.16	21.01	180	2.12	0.23
4400	2008-2018	220.32	166.94	218.82	270	2.2	16.27	-0.59	4.09	21.97	183	2.31	0.21
4400	1968-2020	226.4	172.21	218.18	269.47	2.9	15.26	-1.08	4.34	21.42	185	2.17	0.17

S2 Supplementary figures

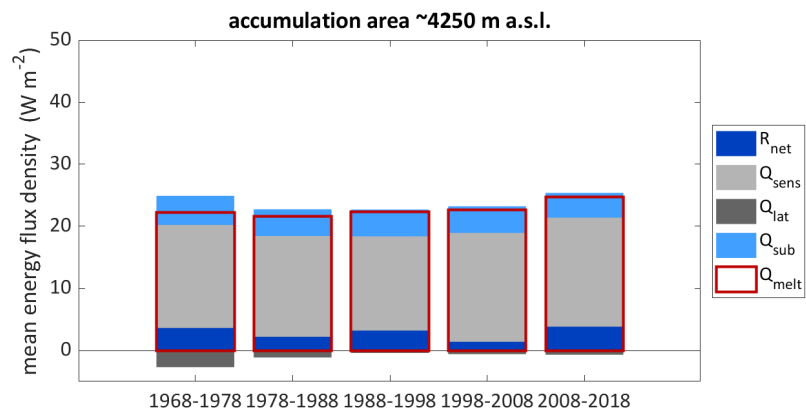


Figure S1. Mean modelled energy fluxes per decade for site 1 located in the accumulation area at ~ 4250 m a.s.l. R_{net} is the net radiation, Q_{sens} the sensible and Q_{lat} the latent heat flux, Q_{sub} the heat flux from/into the subsurface and Q_{melt} the total energy available for melt. The periods are hydrological years (e.g. 1968-1978 refers to 1 October 1968 - 30 September 1978). The point location is indicated in Fig. 1b of the main manuscript

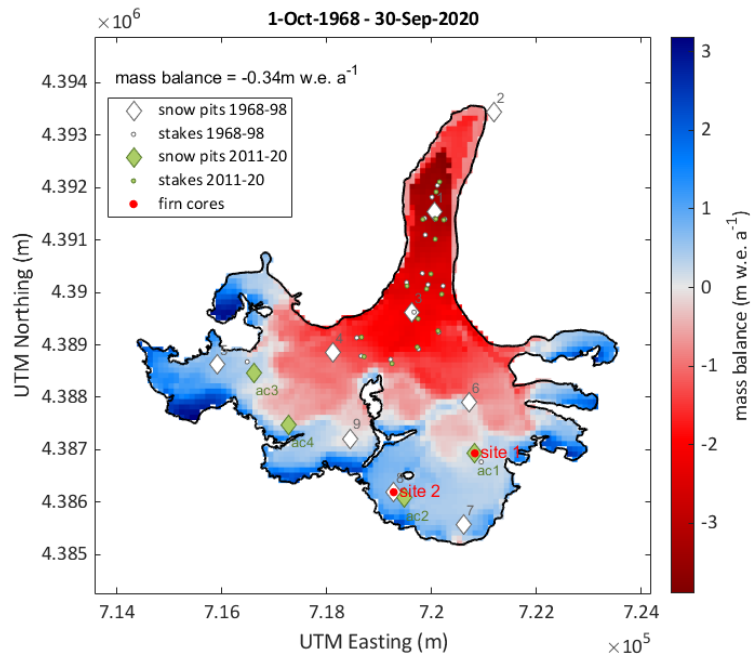


Figure S2. Result of the alternative model run. Modelled mean annual distributed mass balance for updated glacier extents for the period from 1 October 1968 to 30 September 2020. Note, that the mean annual mass balance for the entire period and updated glacier surfaces is shown. Values are thus reduced on the glacier tongue, where the glacier area reduced over time. Furthermore, the location of point observations used for calibration and validation are indicated with symbols, further details are shown in the legend.

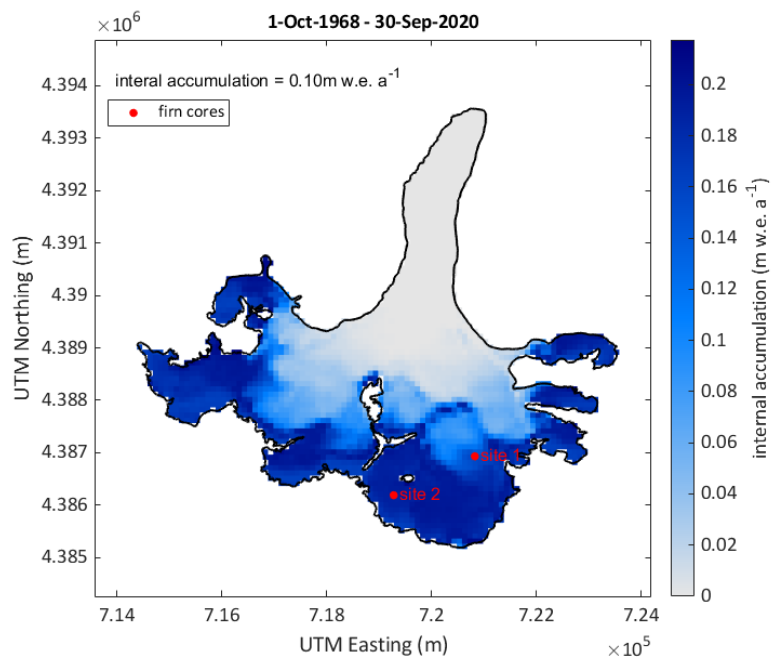


Figure S3. Result of the alternative model run. Map of mean annual internal accumulation for the mass balance years 1968/1969-2019/2020. Location of firn core drill sites used for validation are indicated with red dots.

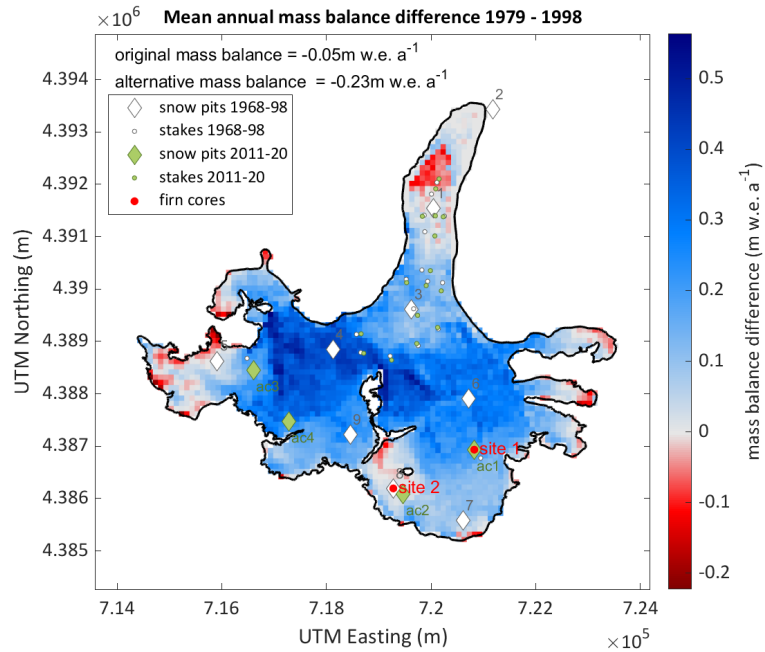


Figure S4. Comparison of original and alternative model run results. Difference of mean annual distributed mass balance for updated glacier extents for the period from 1 October 1968 to 30 September 2020. Note, that the mean annual mass balance for the entire period and updated glacier surfaces is shown. Furthermore, the location of point observations used for calibration and validation are indicated with symbols, further details are shown in the legend.

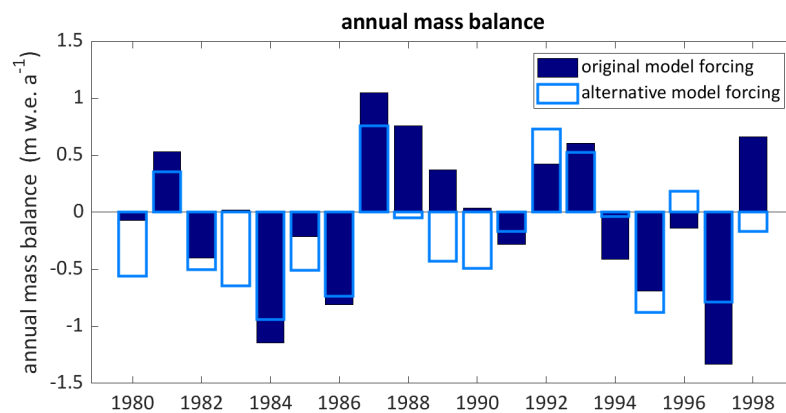


Figure S5. Comparison of mean annual mass balances of the original model run and the alternative model run.

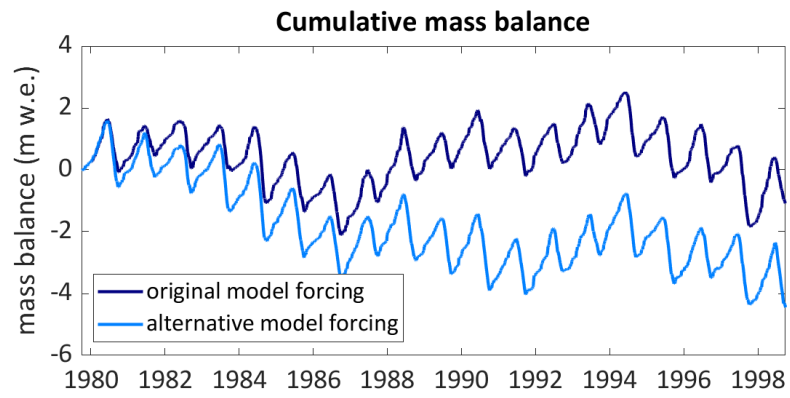


Figure S6. Comparison of cumulative mass balances of the original model run and the alternative model run.