Supplementary material for:

A long-term mass-balance reconstruction (1974-2021) and a decadal in-situ mass-balance record (2011-2021) of Rikha Samba Glacier, central Himalaya

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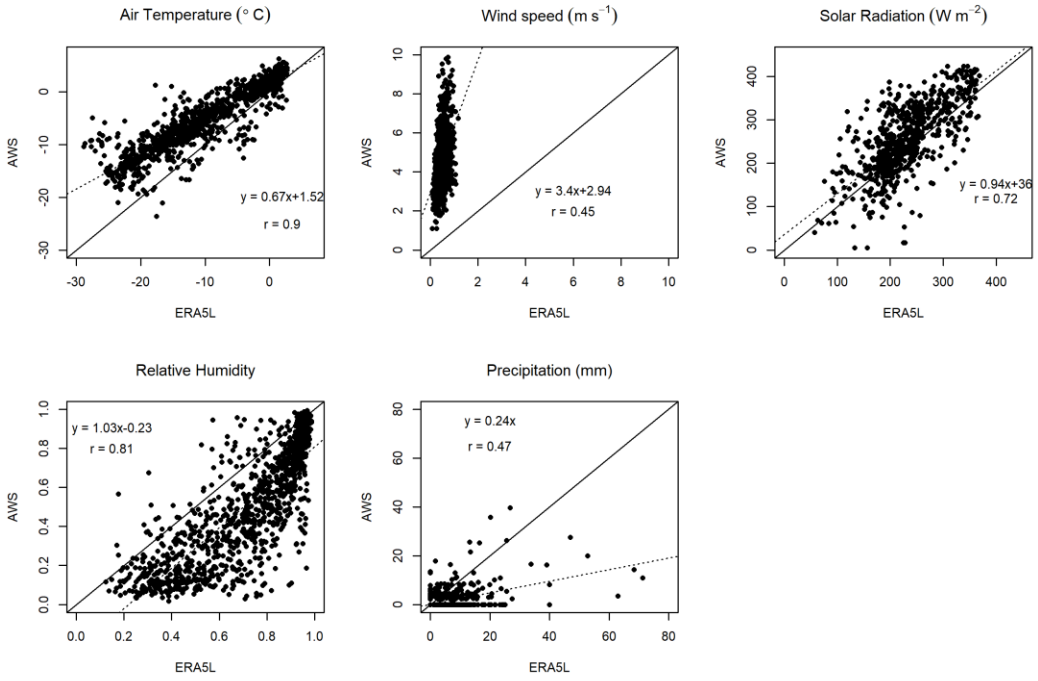

Figure S1*. Scatter plots comparing the Automatic Weather Station (AWS) and ERA5L data for air temperature, wind speed, solar radiation, relative humidity, and precipitation. Each graphic also includes the regression equation and correlation coefficients listed in Table 2. The 1:1 and best-fit lines are shown as solid and dashed lines, respectively.*

***Table S1**: Parameters used to adjust the daily meteorological variables at the Rikha Samba Glacier AWS location. Linear regression (y = mx + c) was used to adjust the variables from the ERA5/ ERA5L data (x). Also listed are the correlation coefficients (r). The regression equation for precipitation was obtained by the assuming a zero intercept (c=0) to avoid persistent precipitation. Regression equations and correlation coefficients are calculated on a daily (single equation), monthly, 4 season and 2 season scale between the ERA5/ERAL and AWS data.*

ERA5											
Time		Temperature		Precipitation		Radiation		RH		Wind	
		r	mx+c	r	mx+c	r	mx+c	r	mx+c	r	mx+c
Daily		0.9	0.7x-3.16	0.75	0.32x	0.7	0.93x+44.44	0.77	1.11x-0.3	0.45	5.81x+1.11
Monthly	January	0.23	0.21x-8.39	0.92	0.441x	0.66	1.11x-42.55	0.36	0.36x+0.03	0.05	0.6x+4.79
	February	-0.15	-0.22x-18.43	0.9	0.336x	0.83	1.98x-246.72	0.58	0.61x+0.03	0.11	1.58x+4.28
	March	0.69	0.61x-5.86	0.72	0.381x	0.61	1.63x-183.48	0.56	0.63x+0.03	0.07	0.9x+4.32
	April	0.1	0.2x-7.16	0.65	0.353x	0.43	1.14x-47.52	0.16	0.24x+0.23	0.54	9.36x-0.67
	May	0.31	0.37x-4.38	0.4	0.284x	0.57	1.38x-97.1	0.29	0.78x-0.11	0.37	6.39x+1.43
	June	0.55	0.68x-3.09	0.78	0.38x	0.67	0.69x+135.71	0.3	1.6x-0.78	0.66	9.45x-1.12
	July	0.35	0.56x-1.63	0.34	0.224x	0.67	0.92x+77.5	0.2	1.28x-0.34	0.15	1.2x+2.58
	August	0.6	0.66x-2.18	0.23	0.139x	0.37	0.66x+130.03	0.42	1.46x-0.47	0.29	2.75x+2.01
	September	0.73	0.8x-3.5	0.14	0.068x	0.64	1.09x+23.49	0.24	1.16x-0.3	0.26	3.25x+2.03
	October	0.84	0.79x-2.72	0.97	0.378x	0.71	0.9x+50.91	0.52	1x-0.19	0.25	3.97x+1.45
	November	0.7	0.61x-4.12	0.76	0.321x	0.23	0.4x+135.83	0.48	0.53x-0.06	0.19	3.48x+2.92
	December	0.69	0.65x-2.68	0.84	0.487x	0.65	0.99x+0.13	0.54	0.43x-0.04	0.11	1.44x+4.81
4 Season	Spring	0.73	0.7x-4.39	0.51	0.315x	0.65	1.44x-127.36	0.45	0.51x+0.08	0.24	2.33x+2.86
	Monsoon	0.69	0.76x-3.22	0.62	0.276x	0.64	0.79x+105.91	0.28	1.62x-0.69	0.5	3.73x+0.6
	Autumn	0.9	0.74x-3.15	0.85	0.305x	0.67	1.05x+17.65	0.71	1.17x-0.35	0.34	3.73x+0.93
	Winter	0.58	0.56x-4.2	0.9	0.399x	0.64	1.03x-17.37	0.5	0.5x-0.03	0.07	0.53x+4.89
2 Season	Summer	0.87	0.79x-3.51	0.59	0.259x	0.68	0.75x+108.09	0.56	1.87x-0.94	0.63	8.87-0.72
	Winter	0.78	0.65x-3.56	0.92	0.391x	0.73	1.07x-9.62	0.62	0.8x-0.15	0.22	3x+3.07

ERA5L											
Time		Temperature		Precipitation		Radiation		RH		Wind	
		r	mx+c	r	mx+c	r	mx+c	r	mx+c	r	mx+c
Daily		0.9	0.67x+1.52	0.47	0.24x	0.72	0.94x+35.98	0.81	1.03x-0.23	0.45	3.4x+2.94
Monthly	January	0.24	0.2x-7.1	0.49	0.239x	0.66	1.14x-52.53	0.35	0.35x+0.05	0.09	0.71x+4.72
	February	-0.15	-0.21x-19.96	0.69	0.27x	0.83	2.03x-264.49	0.59	0.63x+0.03	0.16	1.6x+4.29
	March	0.69	0.61x-1.02	0.33	0.178x	0.64	1.75x-230.48	0.59	0.64x+0.05	0.13	0.88x+4.39
	April	0	0x-8.31	0.33	0.225x	0.46	1.31x-112.84	0.14	0.19x+0.28	0.48	5.13x+2.63
	May	0.23	0.25x-2.7	0.07	0.184x	0.61	1.67x-206.18	0.35	0.75x-0.05	0.5	6.85x+2.5
	June	0.52	0.59x+1.12	0.57	0.339x	0.68	0.72x+121.94	0.48	1.81x-0.96	0.11	1.16x+3.47
	July	0.23	0.42x+2.16	0.38	0.271x	0.66	0.91x+73.74	0.4	2.6x-1.64	0.1	0.41x+3.01
	August	0.66	0.82x+2.07	0.07	0.138x	0.36	0.66x+125.24	0.61	2.3x-1.31	0.24	1.32x+2.88
	September	0.8	0.88x+2.2	0.02	0.059x	0.65	1.16x-0.69	0.47	1.93x-1.01	0.05	0.42x+3.6
	October	0.84	0.73x+2.63	0.26	0.123x	0.73	0.97x+29.77	0.53	0.9x-0.08	0.29	2.44x+2.84
	November	0.71	0.54x-0.48	0.52	0.223x	0.26	0.47x+119.87	0.55	0.6x-0.06	0.32	2.54x+3.75
	December	0.68	0.61x+1.3	0.71	0.407x	0.67	1.05x-13.59	0.6	0.48x-0.03	0.18	1.57x+4.82
4 Season	Spring	0.71	0.63x-0.01	0.2	0.2x	0.67	1.52x-165.74	0.48	0.52x+0.09	0.18	1.38x+4.39
	Monsoon	0.67	0.73x+1.76	0.48	0.278x	0.65	0.79x+99.04	0.58	2.49x-1.53	0.11	0.83x+3.14
	Autumn	0.9	0.69x+1.84	0.25	0.114x	0.7	1.12x-2.82	0.76	1.05x-0.23	0.46	3.64x+2.76
	Winter	0.59	0.54x-0.59	0.58	0.263x	0.65	1.07x-26.74	0.53	0.53x-0.02	0.1	0.85x+4.89
2 Season	Summer	0.86	0.72x+1.67	0.45	0.257x	0.68	0.76x+101.12	0.7	1.58x-0.7	0.36	3.51x+2.7
	Winter	0.79	0.63x+0.98	0.49	0.22x	0.75	1.09x-18.55	0.65	0.82x-0.12	0.34	2.61x+3.53

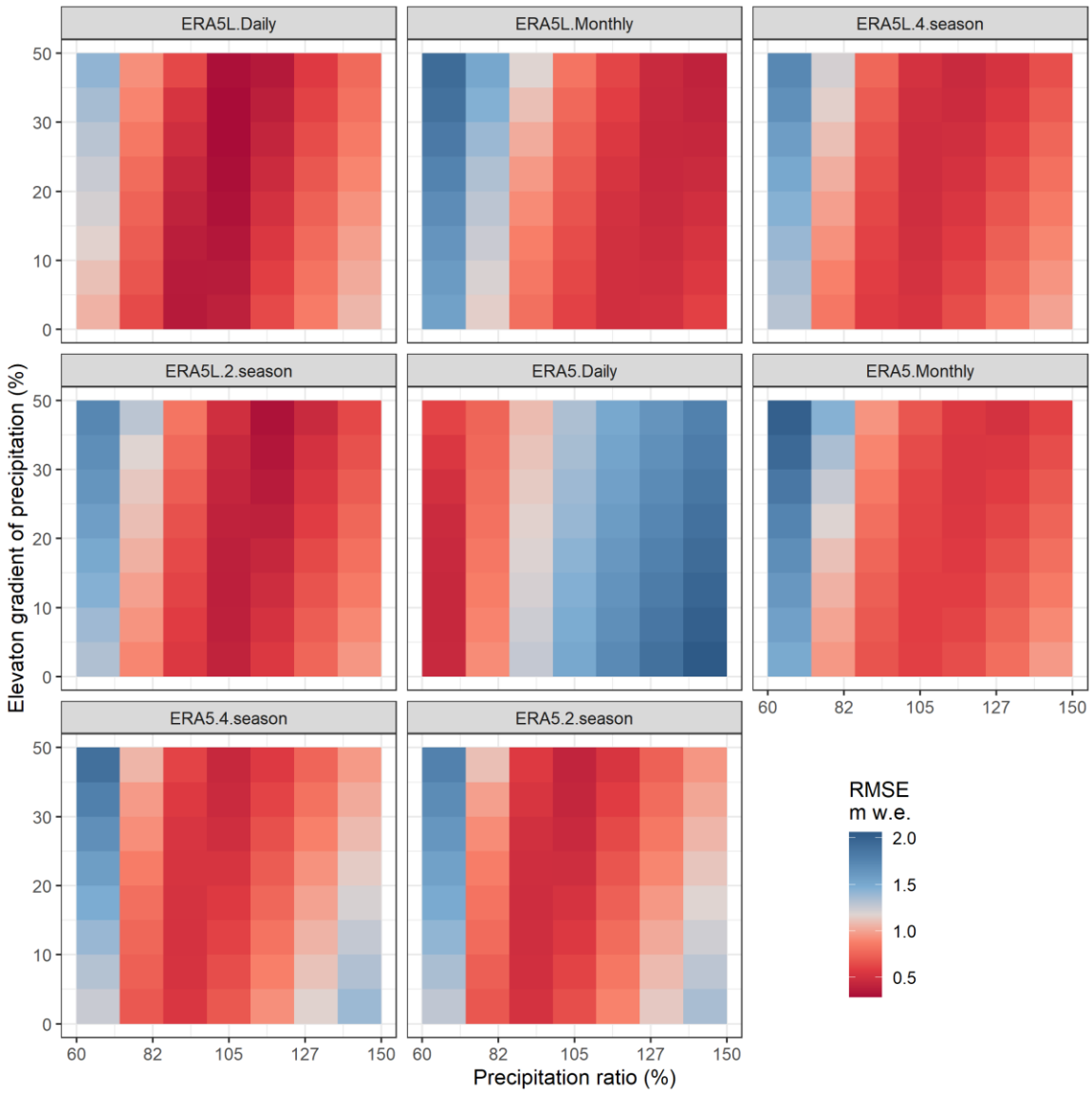

Figure S2*. Root mean square error (RMSE) of the model performance for Rikha Samba Glacier. RMSE was calculated between the observed mass balance profiles of 1998/99, 2012/13, 2015/16, 2016/17, 2017/18 and 2018/19, and the modeled mass balance profile as a function of precipitation ratio (horizontal axis) against the estimated precipitation at AWS location and elevation gradient of precipitation (vertical axis) for the same period. The modeled mass balance was computed by forcing the bias-corrected daily input variable offered by the different S2 regression equations of the ERA5 and ERA5L data for a different time. The bias-corrected data with ERA5L on a daily scale have the lowest RMSE, so this combination was used to calculate the mass balance of Rikha Samba Glacier.*

***Table S2**: Energy balance components of the whole glacier (summing up energy balance of all 23-elevation intervals) prior to 2000 and after 2000.*

Flux (W m^{-2})	Prior to 2000	After 2000
SW net	2204	2248
LW net	-1694	-1692
HL	-543	-563
HS	140	109
Q	107	102

Table S3: *Sensitivities of glacier mass balance to air temperature (T_a), precipitation (P), solar radiation (S_{in}), and relative humidity (RH). Variable sensitivity was calculated as the ratio of the change in mass balance relative to the change in each parameter as a percentage except for air temperature (T_a).*

Perturbation	Change in terms of mean daily value	Change in mass balance		Sensitivity
		m w.e.	%	
T_a	-1.5K	0.731	132.68	-0.488 m w.e. K^{-1}
T_a	-1K	0.542	98.37	-0.542 m w.e. K^{-1}
T_a	-0.5K	0.296	53.77	-0.593 m w.e. K^{-1}
T_a	+0.5K	-0.334	-60.63	-0.668 m w.e. K^{-1}
T_a	+1K	-0.698	-126.56	-0.698 m w.e. K^{-1}
T_a	+1.5K	-1.070	-194.18	-0.714 m w.e. K^{-1}
P	-30%	-0.732	-132.79	0.024 m w.e.$\%^{-1}$
P	-20%	-0.441	-80.04	0.022 m w.e.$\%^{-1}$
P	-10%	-0.191	-34.71	0.019 m w.e.$\%^{-1}$
P	+10%	0.198	35.85	0.020 m w.e.$\%^{-1}$
P	+20%	0.358	64.88	0.018 m w.e.$\%^{-1}$
P	+30%	0.519	94.11	0.017 m w.e.$\%^{-1}$
S_{in}	+20%	-0.448	81.23	-0.022 m w.e.$\%^{-1}$
S_{in}	-20%	0.347	62.88	-0.017 m w.e.$\%^{-1}$
RH	+20%	-0.227	-41.14	-0.011 m w.e.$\%^{-1}$
RH	-20%	0.186	33.71	-0.009 m w.e.$\%^{-1}$

***Table S4**: Sensitivities of glacier mass balance to critical temperature (CT_a) and albedo (α).*

Perturbation	Change from the reference model run value	Change in mass balance		Sensitivity
		m w.e.	%	
CT_a	-2°C	-0.020	3.69	-0.020 m w.e. $°C^{-1}$
CT_a	-1°C	-0.042	-7.68	-0.021 m w.e. $°C^{-1}$
CT_a	+1°C	0.035	6.29	0.009 m w.e. $°C^{-1}$
CT_a	+2°C	0.056	10.16	0.011 m w.e. $°C^{-1}$
α (0.0)	-100%	0.346	62.82	0.003 m w.e. $\%^{-1}$
α (0.1)	-50%	0.169	30.67	0.003 m w.e. $\%^{-1}$
α (0.3)	+50%	-0.161	-29.29	-0.003 m w.e. $\%^{-1}$
α (0.4)	+100%	-0.315	-57.13	-0.003 m w.e. $\%^{-1}$