

Supplemental Material to

Evaluation of surface mass balance records using geodetic data and physically-based modelling, Place and Peyto glaciers, western Canada

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Table S2: Glaciological and modelled mass balance series of Place and Peyto glaciers.



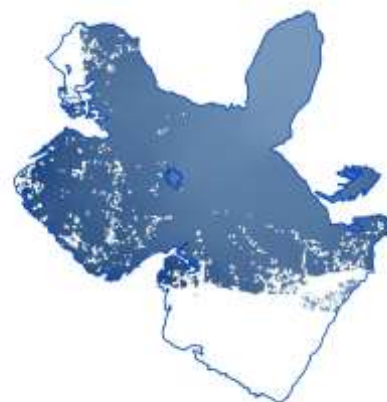
a) Peyto DEM 1982



b) Peyto DEM 1986



b) Peyto DEM 1991



b) Peyto DEM 1997



b) Peyto DEM 2001



f) Place DEM 1981



g) Place DEM 1987



h) Place DEM 1993



i) Place DEM 1997

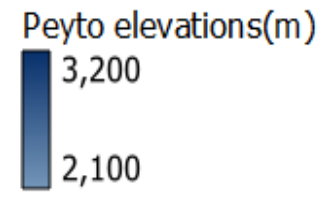
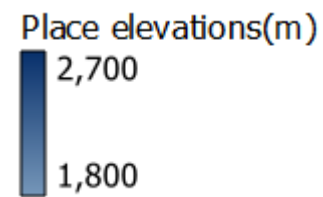


Figure S1: Coverages of DEMs generated using aerial photos

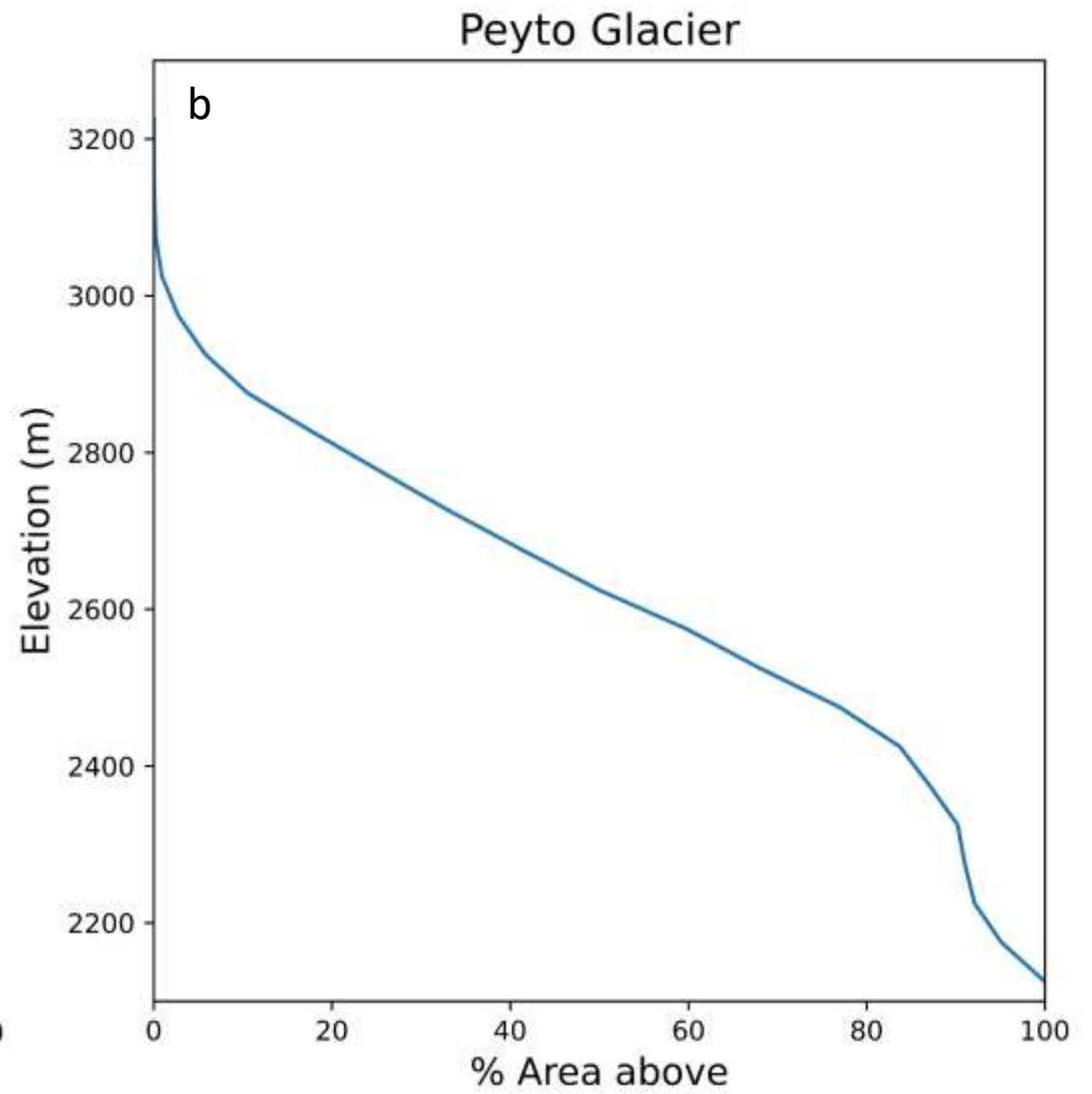
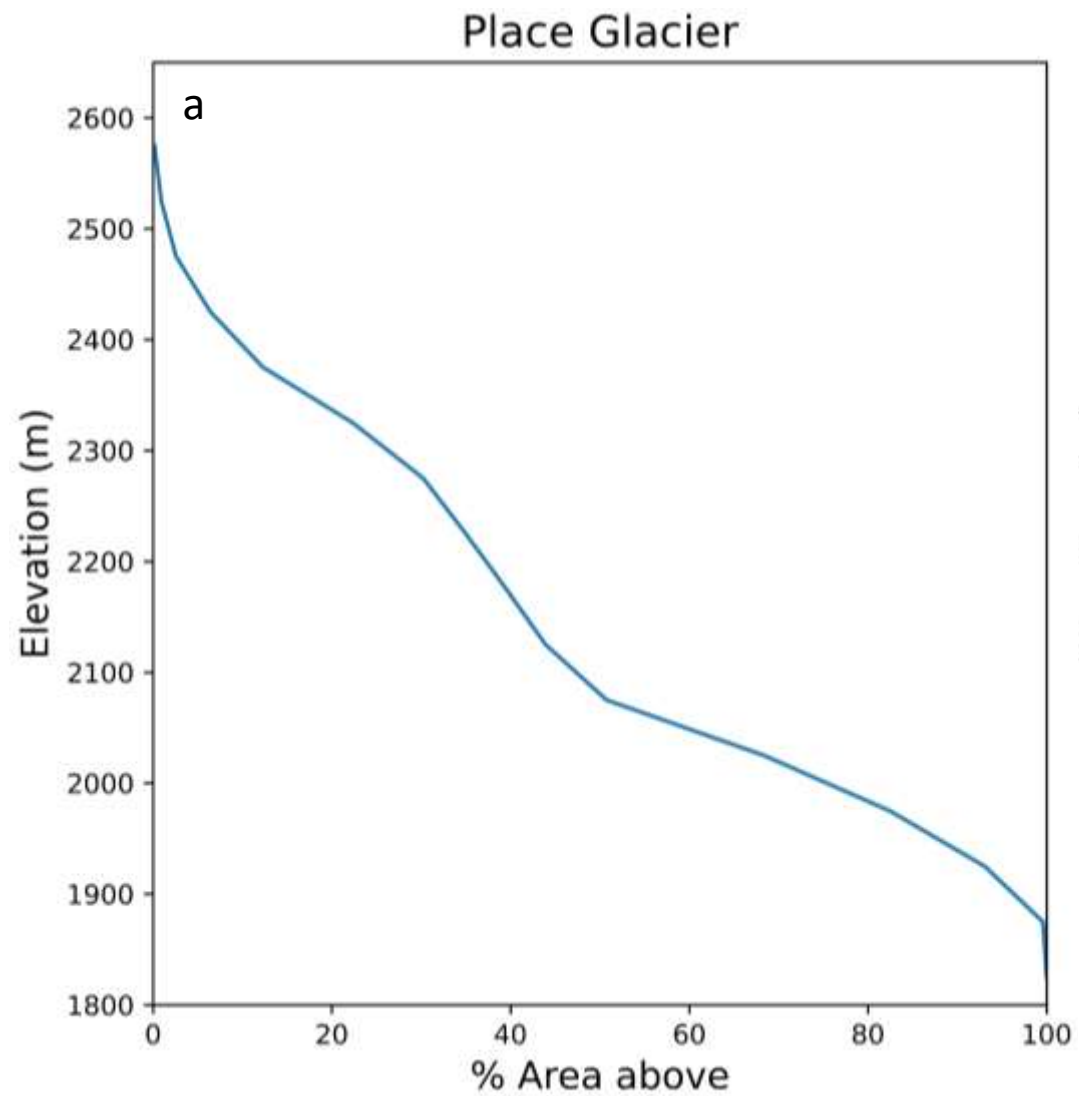


Figure S2: Hypsometry of a)Place (1993 DEM) and b) Peyto glaciers (1991 DEM)

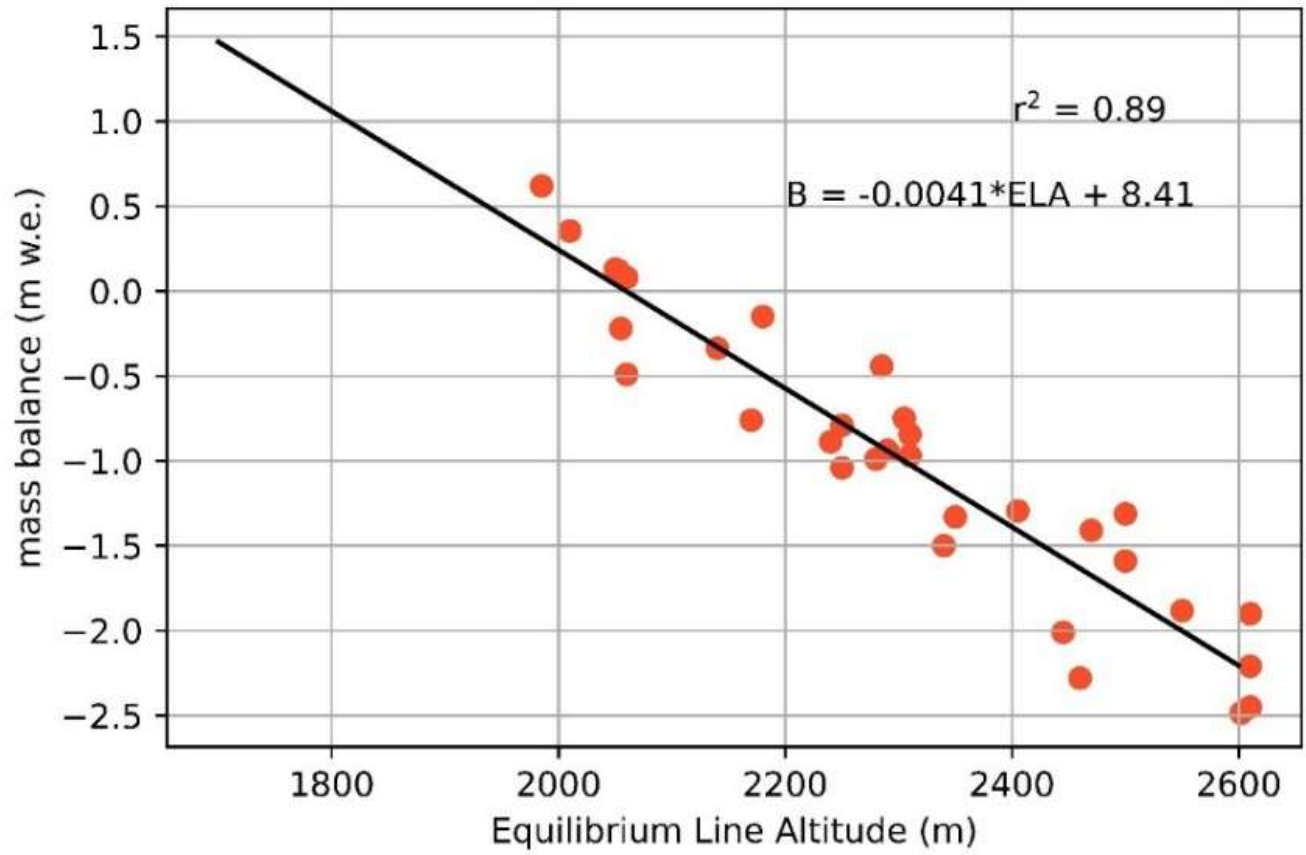


Figure S3: Mass balance (B) vs. Equilibrium Line Altitude (ELA) for Place Glacier using WGMS records

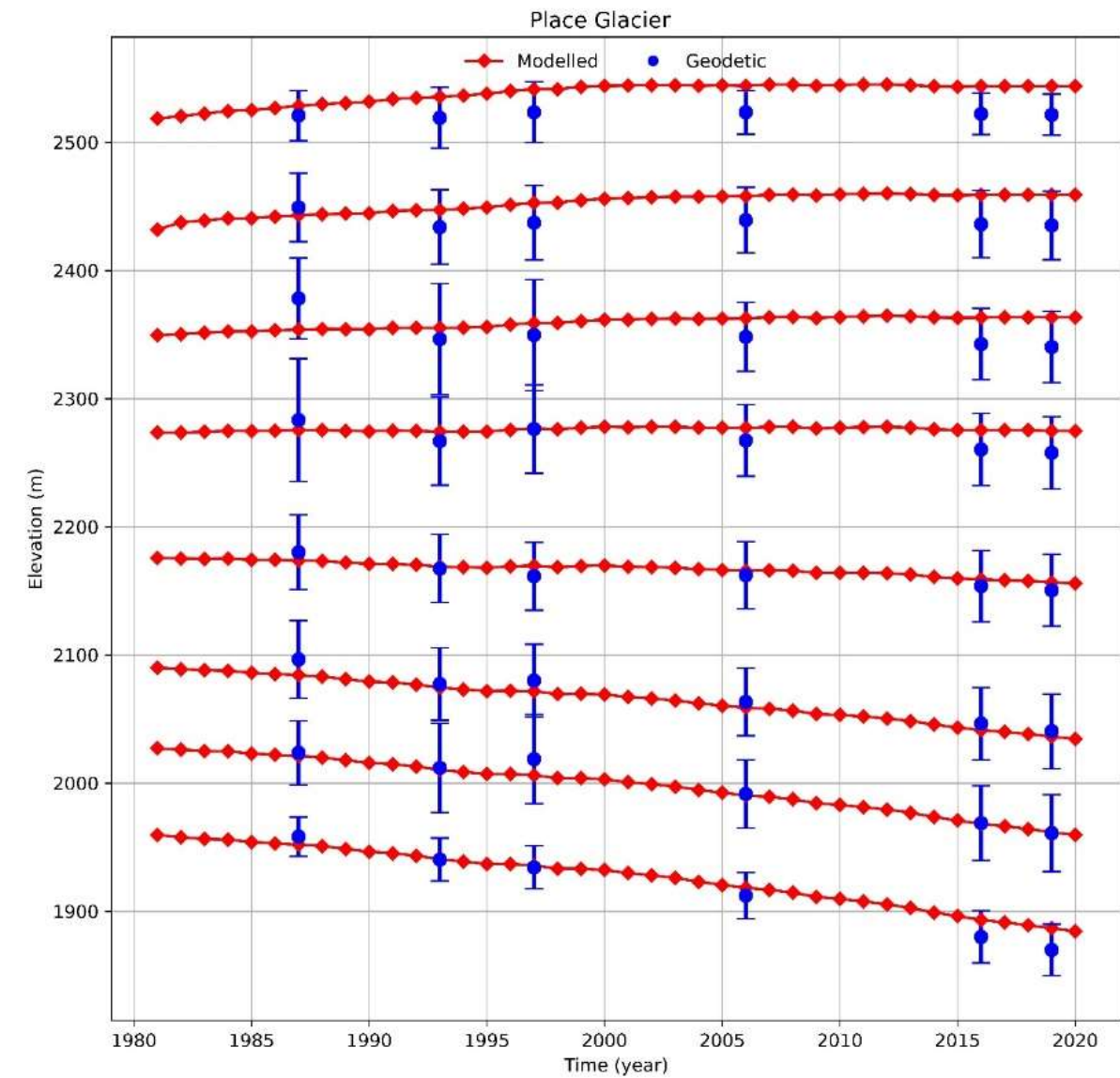


Figure S4: Comparison of modelled vs. geodetic elevations for Place Glacier

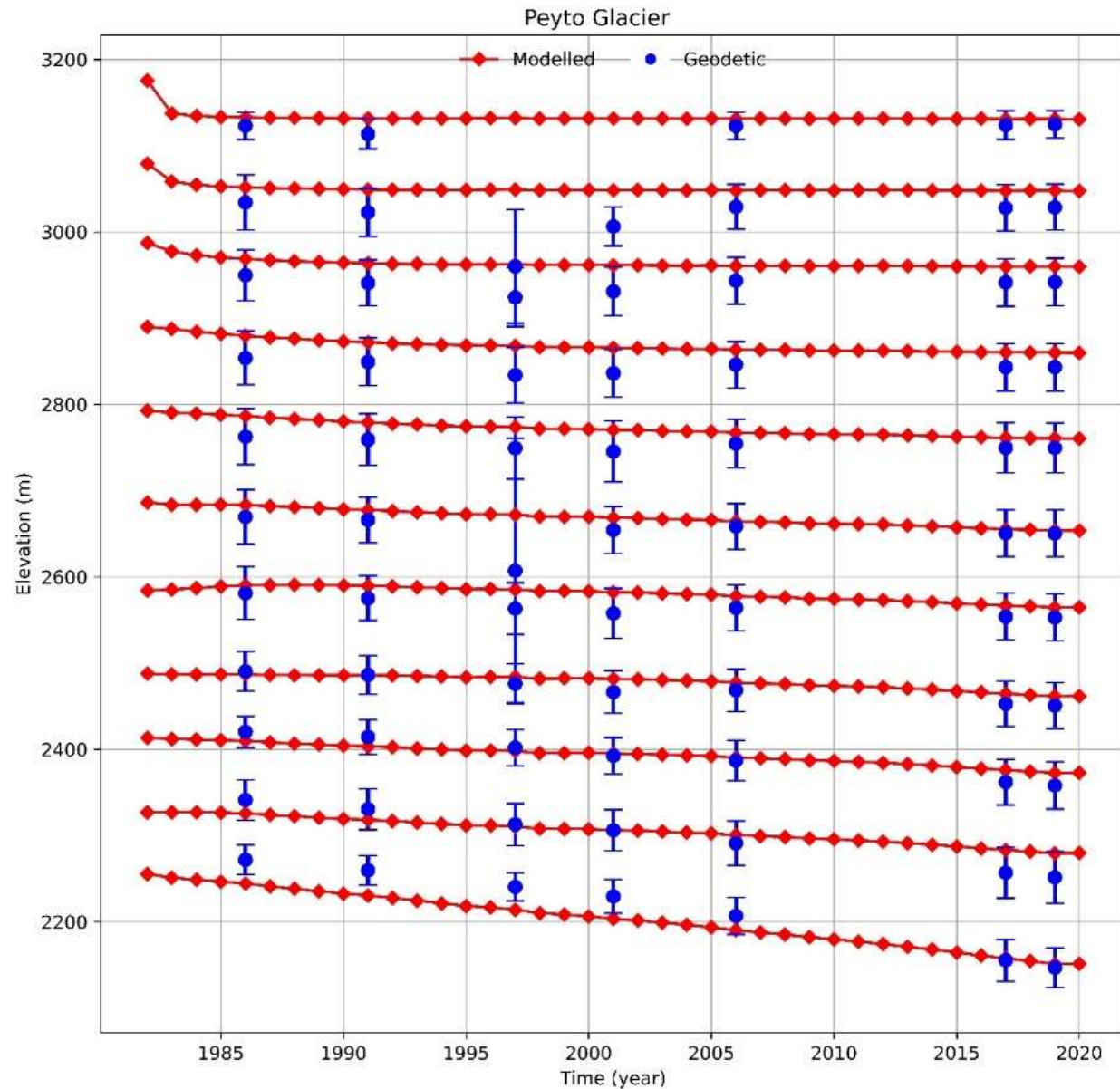


Figure S5: Comparison of modelled vs. geodetic elevations for Peyto Glacier

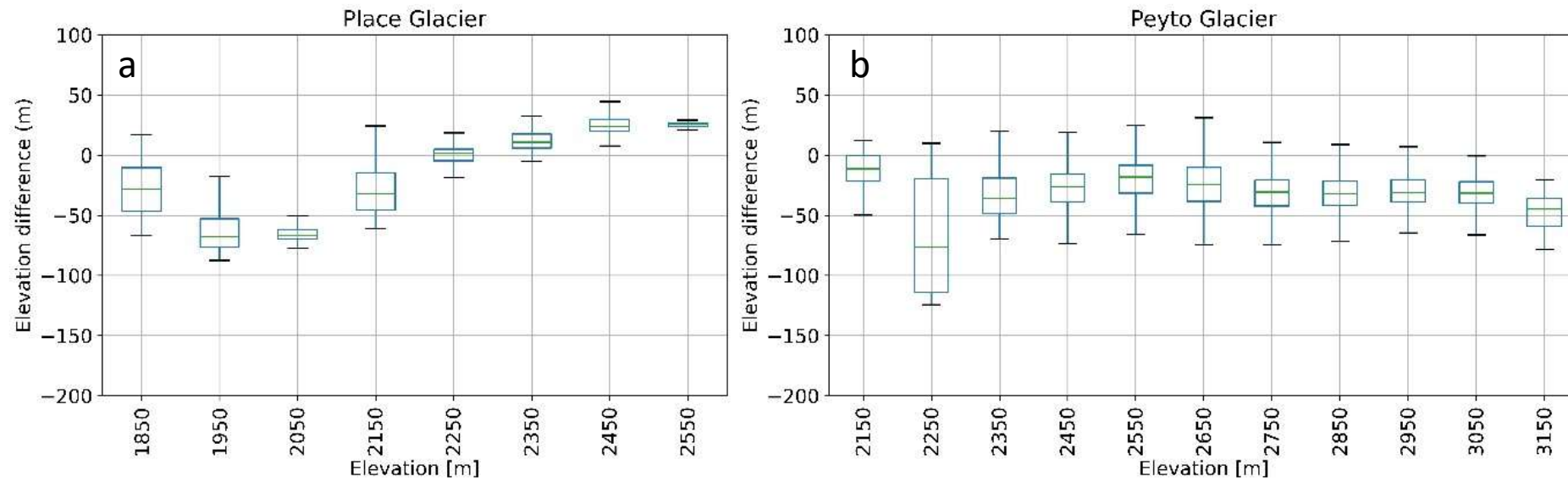


Figure S6: Modelled thickness changes by elevation band, a) 1981-2020 (Place Glacier) and b) 1982-2020 (Peyto Glacier)

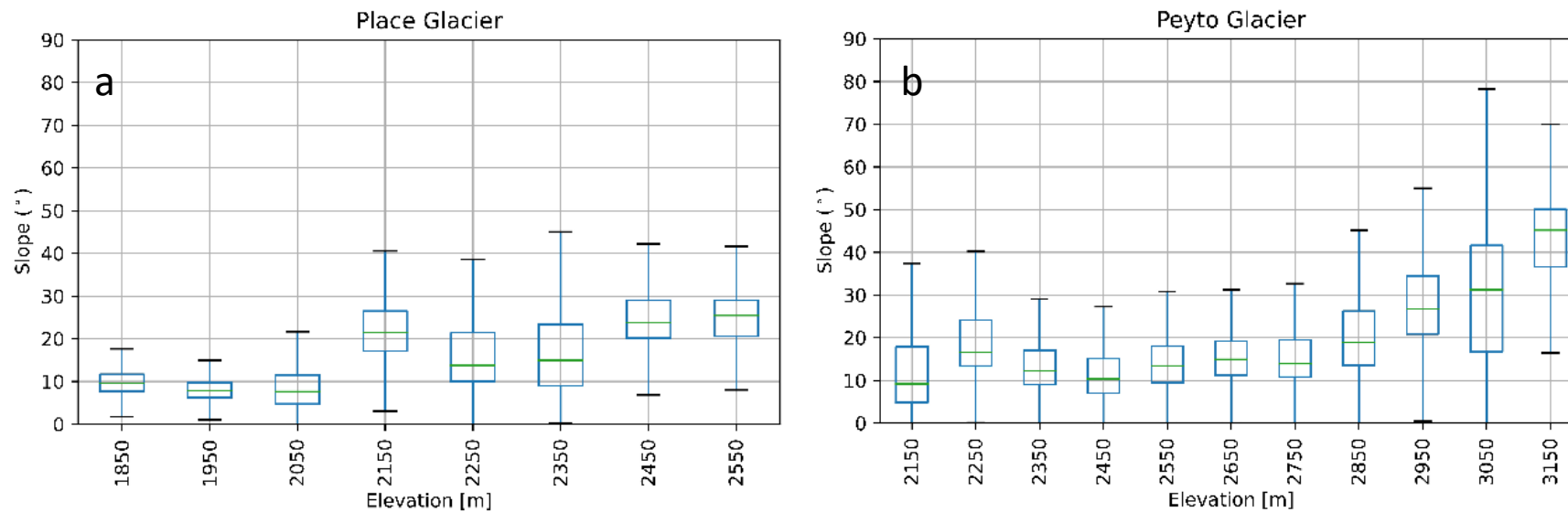


Figure S7: Boxplots of surface slope by elevation band. a) Place Glacier, b) Peyto Glacier

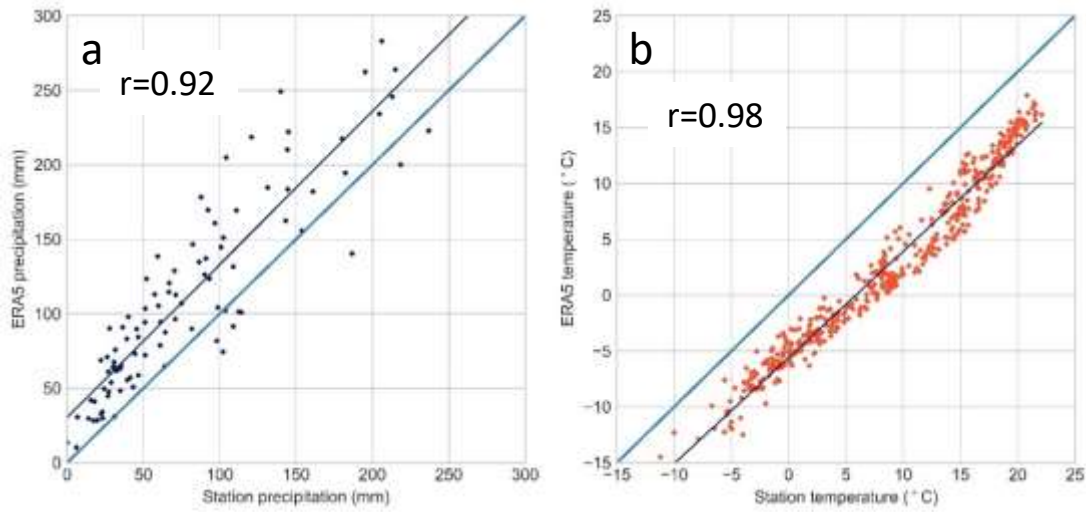


Figure S8: Comparison of monthly homogenized a) precipitation (mm) and b) temperature (°C) of Pemberton station data with ERA5 Land data for Place Glacier

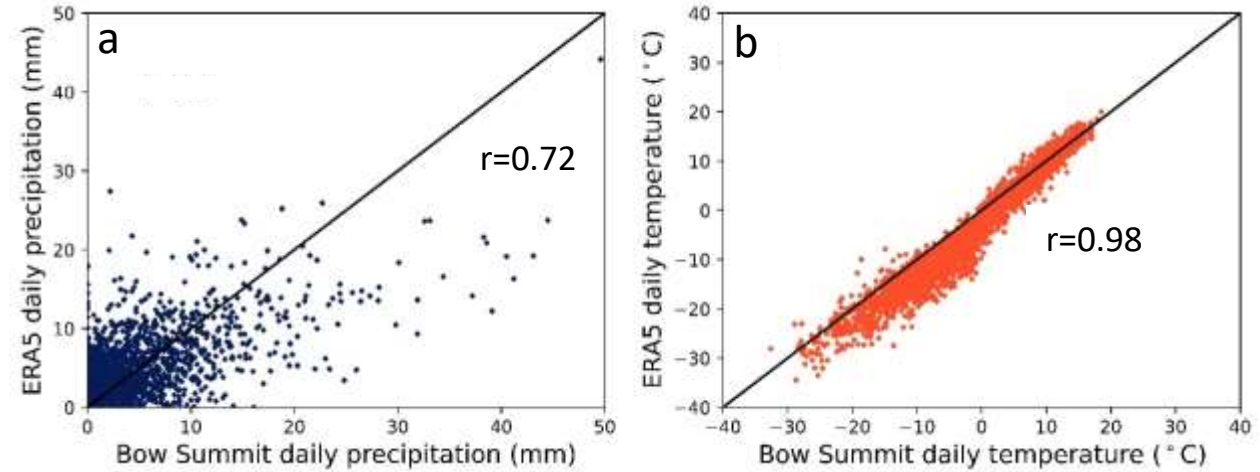


Figure S9: Comparison of a) daily total precipitation (mm) and b) daily average temperature (°C) of Bow Summit with ERA5 Land data for Peyto Glacier

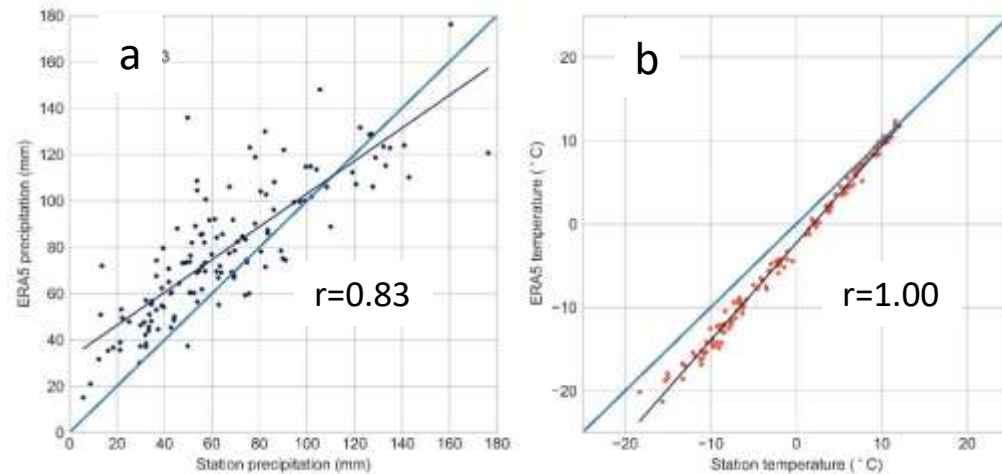


Figure S10: Comparison of a) monthly total precipitation (mm) and b) monthly average temperature (°C) of Bow Summit with ERA5 Land for Peyto Glacier

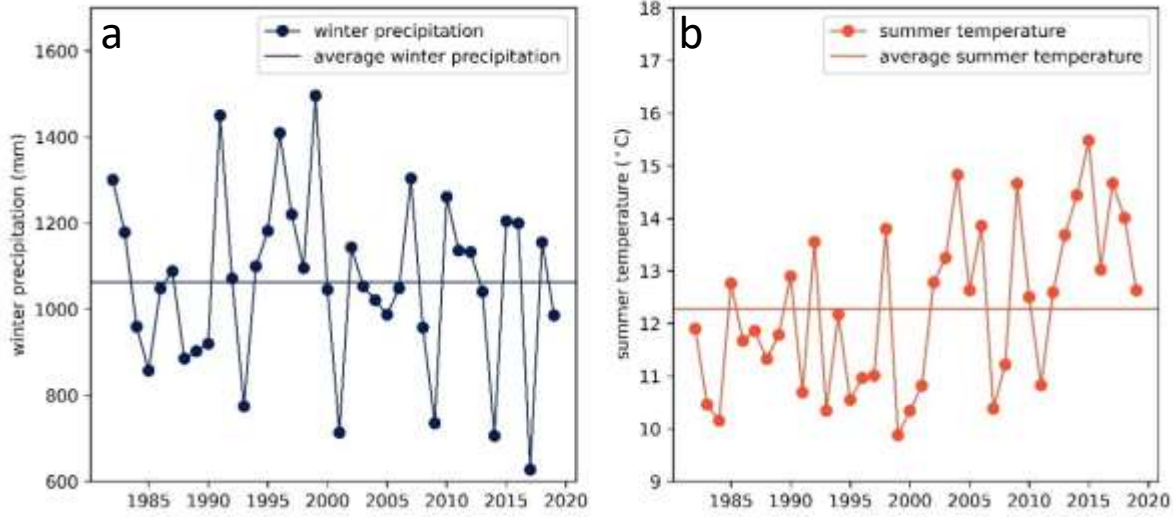


Figure S11: a) Winter precipitation, and b) summer temperature using ERA5 Land data for Place Glacier

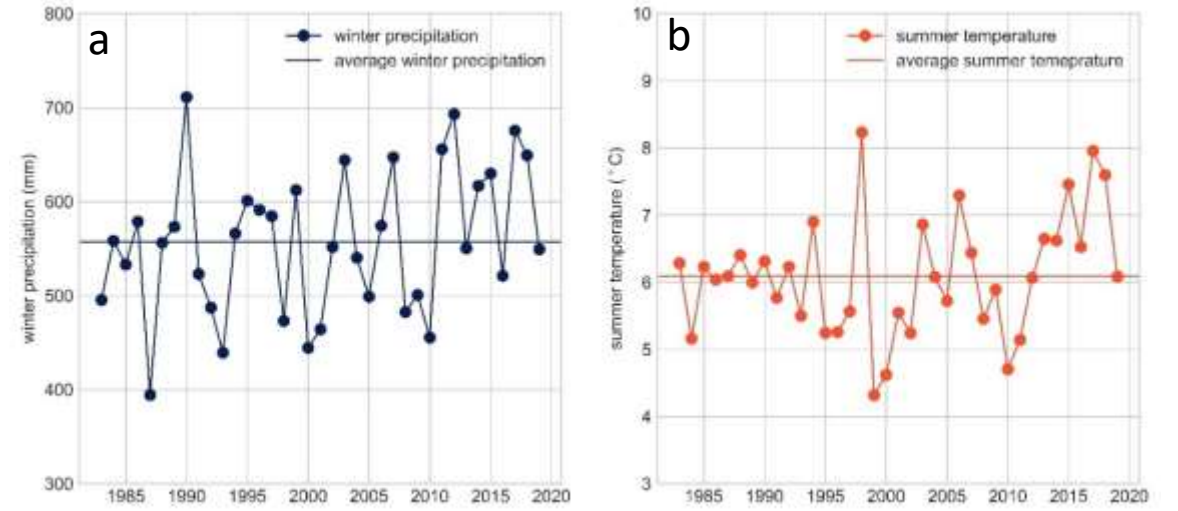


Figure S12: a) Winter precipitation, and b) summer temperature using ERA5 Land data for Peyto Glacier

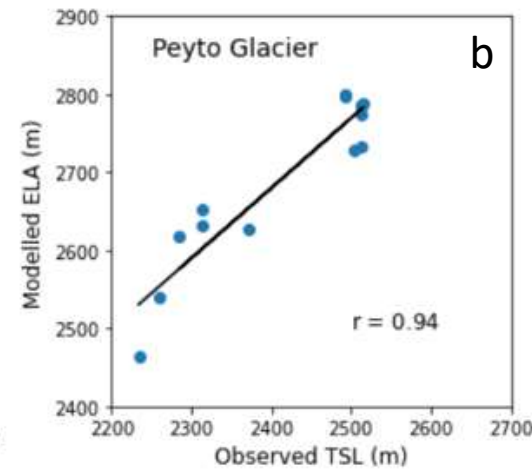
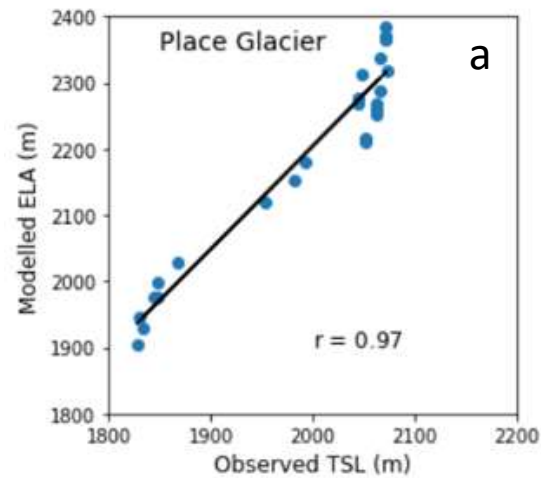


Figure S13: Observed TSL vs. modelled ELA of a) Place and b) Peyto glaciers

Table S1: Statistics for for modelled vs. glaciological mass balance for Place and Peyto glaciers

Place			Peyto		
Period	R ²	RMSE (m w.e.)	Period	R ²	RMSE (m w.e.)
1981-1987	0.59	0.35	1982-1986	0.69	0.49
1987-1993	0.29	0.50	1986-1991	0.65	0.48
1993-1997	0.93	0.82	1991-1997	0.50	0.40
1997-2006	0.75	0.60	1997-2001	0.78	0.58
2006-2016	0.69	0.76	2001-2006	0.85	0.19
2016-2019	0.81	0.29	2006-2017	0.61	0.36
1981-2020	0.45	0.60	1982-2018	0.41	0.46

Table S2: Glaciological and modelled mass balance series of Place and Peyto glaciers.

SMID on implies mass balance using SnowModel coupled with icy dynamics model. SMID off implies mass balance using only SnowModel and the first available glacier extent (1981 for Place, 1982 for Peyto). Fraction is the ratio of mass loss using SMID on in the glacier area vacated due to marginal retreat, and the mass balance using SMID on for the next year.

Year	Place Glacier			Fraction	Peyto Glacier			Fraction
	Mass balance (m w.e. a ⁻¹)				Mass balance (m w.e. a ⁻¹)			
	WGMS	ID off	ID on		WGMS	ID off	ID on	
1982	-0.75	-1.01	-1.01	5.09%				
1983	-0.44	-0.89	-0.83	1.33%	-0.39	-1.27	-1.27	2.77%
1984	-0.34	-0.32	-0.28	2.23%	-0.58	-0.87	-0.74	2.21%
1985	-1.88	-1.58	-1.47	0.18%	-0.81	-0.64	-0.50	2.03%
1986	-1.31	-0.79	-0.73	1.71%	-0.47	-0.89	-0.72	1.58%
1987	-0.84	-0.91	-0.83	1.38%	-0.62	-1.65	-1.41	1.80%
1988	-0.97	-0.92	-0.80	0.96%	-0.99	-1.17	-0.95	3.93%
1989	-1.04	-1.96	-1.76	0.69%	-0.59	-1.31	-1.05	1.58%
1990	-0.94	-1.73	-1.55	1.66%	-0.74	-1.35	-1.10	0.56%
1991	-0.99	-0.83	-0.72	1.67%	-1.22	-1.00	-0.79	0.34%
1992	-0.79	-1.57	-1.38	0.79%		-1.30	-1.07	0.20%
1993	-2.28	-2.16	-1.91	1.45%	-1.22	-1.32	-1.06	0.20%
1994	-2.01	-1.31	-1.16	2.15%	-1.30	-1.41	-1.17	0.40%
1995	-2.49	-1.35	-1.18	1.04%	-0.30	-1.37	-1.13	0.46%
1996	-0.22	0.17	0.18	2.56%	0.13	-0.20	-0.09	3.18%
1997	-0.89	-0.63	-0.54	0.31%	-0.82	-0.86	-0.66	0.27%
1998	-2.45	-1.92	-1.63	0.94%	-2.21	-2.31	-1.99	0.45%
1999	0.62	0.19	0.21	1.10%	-0.32	-0.20	-0.10	4.16%
2000	0.13	-0.62	-0.50	0.70%	0.81	-0.45	-0.32	1.18%
2001	-0.76	-1.83	-1.53	0.81%	-0.92	-1.20	-0.98	0.39%
2002	-0.12	-1.17	-0.96	2.56%	-0.50	-0.62	-0.48	0.71%
2003	-0.99	-1.56	-1.28	1.53%	-1.37	-1.23	-1.05	0.50%
2004	-2.21	-2.13	-1.76	1.77%	-0.55	-0.94	-0.78	0.93%
2005	-1.29	-1.78	-1.45	2.80%	-0.81	-0.85	-0.66	0.85%
2006	-1.90	-1.61	-1.30	2.49%	-1.65	-1.82	-1.61	0.53%
2007	-0.15	-0.82	-0.63	1.92%	-1.85	-0.74	-0.57	0.88%
2008	-0.49	-1.48	-1.15	1.49%	-0.23	-0.82	-0.65	0.81%
2009	-1.50	-2.60	-2.04	1.34%	-1.02	-1.54	-1.33	0.36%
2010	0.08	-0.89	-0.71	4.16%	-0.34	-0.67	-0.53	1.48%
2011	0.35	-1.27	-0.96	1.30%	-0.95	-0.74	-0.57	1.05%
2012	0.12	-1.39	-1.04	2.21%	-0.36	-0.82	-0.65	0.82%
2013	-2.30	-2.12	-1.59	1.81%	-0.91	-1.37	-1.15	0.43%
2014		-2.84	-2.09	2.25%	-1.63	-1.38	-1.16	0.70%
2015	-1.59	-2.20	-1.63	3.53%	-1.54	-1.52	-1.28	0.70%
2016	-1.33	-2.13	-1.52	3.43%	-1.84	-1.36	-1.19	0.88%
2017	-1.17	-1.43	-0.99	3.24%	-1.61	-1.40	-1.24	0.98%
2018	-1.56	-1.69	-1.14	2.07%	-1.02	-1.08	-0.90	1.02%
2019	-1.73	-2.18	-1.50	1.69%		-1.17	-0.99	1.25%
2020	-1.65	-1.56	-1.06	3.80%		-1.07	-0.84	1.37%