Supplementary

Table 1. Selected aimag WMO stations used to extract satellite Tb and snow cover retrievals, and evaluate estimated melt events and SCD.

Aimag	Station	Lat [dd]	Lon [dd]	Elev [m]	Start [YYYYMMDD]	End [YYYYMMDD]
Arkhangai	TSETSERLEG	47.5	101.5	1691	19560803	20171230
Bayankhongor	GALUUT	46.7	100.1	2126	19570725	20171230
Bayan-Ulgi	ULGI	48.9	89.9	1715	19590101	20171230
Bulgan	BULGAN	48.8	103.6	1208	19560805	20171230
Dornod	KHALKH-GOL	47.6	118.6	688	19831011	20171230
Dornogovi	UNKNOWN MNG	43.2	109.2	213	19730102	20171230
Dundgovi	CHOIR	46.5	108.2	1286	19560802	20171230
Govi-Altai	ALTAI	46.4	96.3	2181	19560802	20171230
Khentii	BAYAN-OVOO	47.8	112.1	926	19690101	20171230
Khovd	HOVD	48.0	91.6	1405	19561016	20171230
Khovsgol	TARIALAN	49.6	102.0	1235	19830112	20171230
Omnogovi	TSOGT-OVOO	44.4	105.3	1298	19690101	20171230
Ovorkhangai	BAT OLDZIY BUND	47.0	103.8	1358	19730103	20171230
Selenge	BARUUNHARAA	48.9	106.1	807	19560802	20171230
Sukhbaatar	ERDENETSAGAAN	45.9	115.4	1076	19730101	20171230
Tov	MAANTI	47.3	107.5	1430	19560821	20171230
Ulaanbaatar	CHINGGIS KHAAN INT	47.8	106.8	1330.1	19560802	20171230
Uvs	ULAANGOM	49.8	92.1	939	19570701	20171230
Zavkhan	URGAMAL	48.5	94.3	1263	19750109	20171230

The PM derived SCD was evaluated against local snow depth measurements from available WMO weather stations across Mongolia. We calculated a bias of -26 (days) which indicate that WMO station measurements are likely an underestimation of SCD. We also found good overall agreement between the in situ SCD observations and PM based estimates with a correlation of 0.52 (S3).

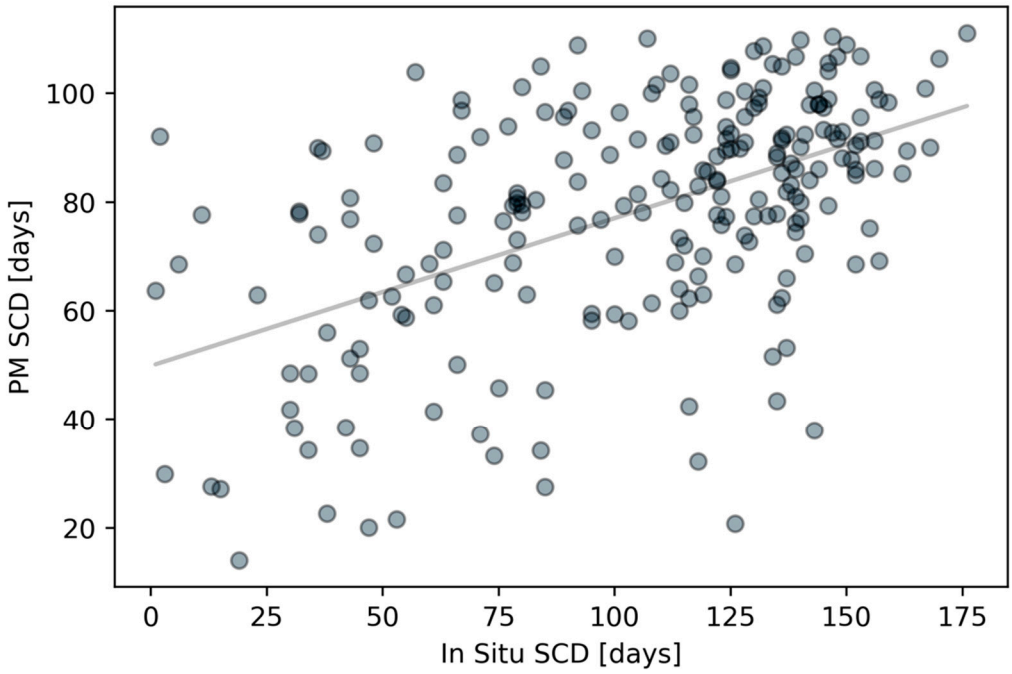

Figure 1. Comparison of PM calculated SCD and in situ SCD.

Table 2. (a-c) GLM model outputs for the fall (a), winter (b), and spring (c) models. Each table includes the p-value and the proportion of variance each predictor explains (SS).

(a)

Aimag	Winter Temperature		Fall Melt		Summer NDVI	
	p	***SS%***	***p***	***SS%***	***p***	***SS%***
Arkhangai	0.11	22.43	0.49	3.73	0.72	0.96
Bayan-Ulgi	0.06	21.11	0.57	1.65	0.03	29.92
Bayankhongor	0.26	10.80	0.87	0.22	0.20	14.08
Bulgan	0.18	9.04	0.29	5.43	0.01	42.97
Dornod	0.03	32.50	0.14	13.02	0.45	3.17
Dornogovi	0.53	2.23	0.27	7.29	0.03	36.90
Dundgovi	0.03	36.67	0.27	7.67	0.97	0.01
Govi-Altai	0.29	8.30	0.31	7.66	0.13	17.96
Khentii	0.21	11.22	0.14	16.21	0.26	8.99
Khovd	0.04	33.62	0.44	3.86	0.44	3.76
Khovsgol	0.11	23.90	0.99	0.00	0.95	0.03
Omnogovi	0.09	22.63	0.63	1.61	0.23	10.70
Ovorkhangai	0.08	25.86	0.43	4.56	0.61	1.92
Selenge	0.26	5.82	0.03	27.22	0.03	26.39
Sukhbaatar	0.77	0.59	0.29	8.20	0.07	26.22
Tov	0.05	25.11	0.12	14.66	0.21	9.09
Ulaanbaatar	0.11	22.53	0.60	2.24	0.85	0.27
Uvs	0.07	21.04	0.09	17.88	0.19	10.11
Zavkhan	0.19	11.82	0.82	0.33	0.05	28.88

(b)

Aimag	Winter Temperature		Winter Melt		Summer NDVI	
	p	***SS%***	***p***	***SS%***	***p***	***SS%***
Arkhangai	0.10	22.43	0.41	5.25	0.55	2.68
Bayan-Ulgi	0.06	21.11	0.20	8.99	0.05	23.12
Bayankhongor	0.27	10.80	0.81	0.46	0.29	9.99
Bulgan	0.17	9.04	0.22	6.94	0.01	43.55
Dornod	0.04	32.50	0.36	5.65	0.65	1.35
Dornogovi	0.58	2.23	0.67	1.32	0.06	29.81
Dundgovi	0.03	36.67	0.31	6.46	0.60	1.62
Govi-Altai	0.27	8.30	0.59	1.86	0.05	29.56
Khentii	0.21	11.22	0.11	19.17	0.33	6.53
Khovd	0.04	33.62	0.77	0.56	0.50	3.01
Khovsgol	0.09	23.90	0.35	6.60	0.88	0.16
Omnogovi	0.10	22.63	0.31	7.94	0.67	1.34
Ovorkhangai	0.09	25.86	0.60	2.08	0.73	0.90
Selenge	0.29	5.82	0.57	1.57	0.01	45.75
Sukhbaatar	0.77	0.59	0.08	23.34	0.18	12.91
Tov	0.05	25.11	0.25	7.14	0.07	19.43
Ulaanbaatar	0.12	22.53	0.75	0.81	0.75	0.78
Uvs	0.07	21.04	0.22	8.71	0.08	19.48
Zavkhan	0.14	11.82	0.19	9.26	0.03	32.01

(c)

Aimag	Winter Temperature		Spring Melt		Summer NDVI	
	p	***SS%***	***p***	***SS%***	***p***	***SS%***
Arkhangai	0.08	22.43	0.14	15.90	0.65	1.35
Bayan-Ulgi	0.04	21.11	0.28	5.19	0.02	33.82
Bayankhongor	0.22	10.80	0.42	4.51	0.10	21.32
Bulgan	0.17	9.04	0.04	22.28	0.03	28.02
Dornod	0.04	32.50	0.22	9.88	0.70	0.91
Dornogovi	0.59	2.23	0.57	2.60	0.12	21.31
Dundgovi	0.01	36.67	0.13	10.04	0.05	17.12
Govi-Altai	0.21	8.30	0.08	17.11	0.03	28.95
Khentii	0.16	11.22	0.07	19.82	0.06	21.29
Khovd	0.02	33.62	0.22	8.39	0.19	9.75
Khovsgol	0.10	23.90	0.42	5.10	0.96	0.02
Omnogovi	0.11	22.63	0.66	1.52	0.60	2.21
Ovorkhangai	0.03	25.86	0.04	24.33	0.22	7.24
Selenge	0.29	5.82	0.80	0.30	0.01	47.38
Sukhbaatar	0.76	0.59	0.24	9.14	0.04	31.62
Tov	0.05	25.11	0.64	1.15	0.06	23.01
Ulaanbaatar	0.12	22.53	0.88	0.18	0.79	0.57
Uvs	0.09	21.04	0.80	0.39	0.09	20.34
Zavkhan	0.13	11.82	0.93	0.03	0.01	43.54