

Supplementary information:

Comparison of Geodetic and Glaciological Mass Budgets for White Glacier, Axel Heiberg Island, Canada

Laura I. Thomson, Michael Zemp, Luke Copland, J. Graham Cogley, and Miles A. Ecclestone

The following provides supporting hypsometry data used in the calculation of surface mass balance at White Glacier using:

SI Table I: A reference topographic surface (1960 hypsometry with an update to elevations below 400 m a.s.l. in 2003); or

SI Table II: A conventional surface, which is modeled using a linear fit between the 1960 and 2014 topography.

Header value indicates upper limit of elevation band; units in km².

Hypsometry applied prior to 2014 geodetic survey (used for previously published WGMS results)

Year	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
1960	0.033	0.798	1.335	1.132	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1961	0.032	0.791	1.325	1.132	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1962	0.032	0.784	1.315	1.131	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1963	0.031	0.777	1.305	1.13	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1964	0.031	0.771	1.296	1.129	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1965	0.031	0.764	1.285	1.128	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1966	0.03	0.757	1.276	1.127	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1967	0.03	0.751	1.266	1.126	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1968	0.029	0.744	1.256	1.126	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1969	0.029	0.737	1.246	1.125	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1970	0.029	0.73	1.236	1.124	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1971	0.028	0.723	1.226	1.123	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1972	0.028	0.717	1.216	1.122	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1973	0.028	0.71	1.206	1.121	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1974	0.027	0.703	1.197	1.121	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1975	0.027	0.697	1.187	1.12	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1976	0.026	0.69	1.177	1.119	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1977	0.026	0.683	1.167	1.118	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1978	0.026	0.677	1.157	1.117	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1979	0.025	0.67	1.147	1.116	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	0.024	0.643	1.107	1.113	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1984	0.023	0.636	1.098	1.112	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1985	0.023	0.629	1.088	1.111	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1986	0.023	0.623	1.078	1.11	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1987	0.022	0.616	1.068	1.11	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1988	0.022	0.609	1.058	1.109	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1989	0.021	0.603	1.048	1.108	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1990	0.021	0.596	1.038	1.107	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1991	0.021	0.589	1.028	1.106	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1992	0.02	0.582	1.018	1.105	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1993	0.02	0.576	1.008	1.104	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1994	0.019	0.569	0.998	1.104	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1995	0.019	0.562	0.989	1.103	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1996	0.019	0.556	0.979	1.102	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1997	0.018	0.549	0.969	1.101	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1998	0.018	0.542	0.959	1.1	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
1999	0.018	0.535	0.949	1.099	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2000	0.017	0.529	0.939	1.098	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2001	0.017	0.522	0.929	1.098	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2002	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2003	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2004	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2005	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2006	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2007	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2008	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2009	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2010	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2011	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2012	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
2013	0.016	0.515	0.919	1.097	0.8	0.98	1.485	1.408	2.025	2.658	3.59	5.163	5.853	6.255	4.25	1.757	0.463	0.148
dS (1960 to 2003)	-0.017	-0.283	-0.416	-0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SI Table I. White Glacier hypsometry matrix in 100 m elevation bands used to calculate mass balance prior to this reanalysis study. An updated topographic surface below 400 m a.s.l. was produced in 2003.

Modelled hypsometry for calculation of *conventional* surface mass balance

Year	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
1960	0.029	0.779	1.33	1.14	0.805	0.97	1.483	1.391	2.155	2.839	4.032	5.411	5.942	6.313	4.121	1.686	0.506	0.142
1961	0.028	0.777	1.321	1.138	0.805	0.974	1.485	1.385	2.155	2.836	4.027	5.404	5.936	6.302	4.116	1.689	0.507	0.142
1962	0.028	0.774	1.313	1.136	0.805	0.978	1.487	1.379	2.155	2.833	4.021	5.396	5.929	6.292	4.112	1.691	0.508	0.143
1963	0.028	0.771	1.304	1.135	0.806	0.982	1.489	1.373	2.156	2.83	4.016	5.389	5.923	6.281	4.107	1.694	0.509	0.144
1964	0.028	0.768	1.295	1.133	0.806	0.986	1.49	1.367	2.156	2.826	4.011	5.381	5.916	6.271	4.102	1.697	0.51	0.145
1965	0.027	0.766	1.286	1.131	0.806	0.99	1.492	1.361	2.156	2.823	4.005	5.374	5.91	6.26	4.097	1.699	0.511	0.145
1966	0.027	0.763	1.277	1.129	0.807	0.993	1.494	1.355	2.156	2.82	4	5.366	5.903	6.25	4.092	1.702	0.512	0.146
1967	0.027	0.76	1.268	1.127	0.807	0.997	1.496	1.349	2.156	2.817	3.994	5.359	5.897	6.239	4.087	1.705	0.513	0.147
1968	0.027	0.758	1.259	1.125	0.808	1.001	1.498	1.342	2.157	2.814	3.989	5.352	5.89	6.229	4.082	1.708	0.514	0.147
1969	0.026	0.755	1.25	1.124	0.808	1.005	1.5	1.336	2.157	2.811	3.984	5.344	5.884	6.218	4.077	1.71	0.515	0.148
1970	0.026	0.752	1.242	1.122	0.808	1.009	1.502	1.33	2.157	2.808	3.978	5.337	5.877	6.207	4.072	1.713	0.516	0.149
1971	0.026	0.749	1.233	1.12	0.809	1.013	1.504	1.324	2.157	2.805	3.973	5.329	5.871	6.197	4.067	1.716	0.517	0.15
1972	0.026	0.747	1.224	1.118	0.809	1.017	1.506	1.318	2.158	2.802	3.967	5.322	5.864	6.186	4.062	1.718	0.518	0.15
1973	0.025	0.744	1.215	1.116	0.809	1.021	1.508	1.312	2.158	2.799	3.962	5.314	5.858	6.176	4.057	1.721	0.519	0.151
1974	0.025	0.741	1.206	1.114	0.81	1.025	1.51	1.306	2.158	2.795	3.957	5.307	5.851	6.165	4.052	1.724	0.52	0.152
1975	0.025	0.738	1.197	1.113	0.81	1.028	1.512	1.3	2.158	2.792	3.951	5.299	5.845	6.155	4.047	1.726	0.521	0.153
1976	0.025	0.736	1.188	1.111	0.811	1.032	1.514	1.294	2.158	2.789	3.946	5.292	5.838	6.144	4.042	1.729	0.522	0.153
1977	0.024	0.733	1.179	1.109	0.811	1.036	1.516	1.288	2.159	2.786	3.941	5.284	5.832	6.134	4.037	1.732	0.523	0.154
1978	0.024	0.73	1.171	1.107	0.811	1.04	1.518	1.281	2.159	2.783	3.935	5.277	5.825	6.123	4.033	1.734	0.524	0.155
1979	0.024	0.728	1.162	1.105	0.812	1.044	1.52	1.275	2.159	2.78	3.93	5.269	5.818	6.112	4.028	1.737	0.525	0.156
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	0.023	0.717	1.126	1.098	0.813	1.06	1.528	1.251	2.16	2.768	3.908	5.24	5.792	6.07	4.008	1.748	0.529	0.158
1984	0.023	0.714	1.117	1.096	0.814	1.064	1.53	1.245	2.16	2.764	3.903	5.232	5.786	6.06	4.003	1.75	0.53	0.159
1985	0.023	0.711	1.108	1.094	0.814	1.067	1.531	1.239	2.16	2.761	3.897	5.225	5.779	6.049	3.998	1.753	0.531	0.16
1986	0.022	0.709	1.1	1.092	0.814	1.071	1.533	1.233	2.16	2.758	3.892	5.217	5.773	6.038	3.993	1.756	0.532	0.161
1987	0.022	0.706	1.091	1.091	0.815	1.075	1.535	1.227	2.161	2.755	3.887	5.21	5.766	6.028	3.988	1.758	0.533	0.161
1988	0.022	0.703	1.082	1.089	0.815	1.079	1.537	1.221	2.161	2.752	3.881	5.202	5.76	6.017	3.983	1.761	0.534	0.162
1989	0.022	0.7	1.073	1.087	0.816	1.083	1.539	1.214	2.161	2.749	3.876	5.195	5.753	6.007	3.978	1.764	0.535	0.163
1990	0.021	0.698	1.064	1.085	0.816	1.087	1.541	1.208	2.161	2.746	3.871	5.187	5.747	5.996	3.973	1.766	0.536	0.164
1991	0.021	0.695	1.055	1.083	0.816	1.091	1.543	1.202	2.161	2.743	3.865	5.18	5.74	5.986	3.968	1.769	0.537	0.164
1992	0.021	0.692	1.046	1.081	0.817	1.095	1.545	1.196	2.162	2.74	3.86	5.173	5.734	5.975	3.963	1.772	0.538	0.165
1993	0.021	0.689	1.037	1.08	0.817	1.099	1.547	1.19	2.162	2.737	3.854	5.165	5.727	5.965	3.958	1.774	0.539	0.166
1994	0.02	0.687	1.029	1.078	0.817	1.102	1.549	1.184	2.162	2.733	3.849	5.158	5.721	5.954	3.954	1.777	0.54	0.166
1995	0.02	0.684	1.02	1.076	0.818	1.106	1.551	1.178	2.162	2.73	3.844	5.15	5.714	5.943	3.949	1.78	0.541	0.167
1996	0.02	0.681	1.011	1.074	0.818	1.11	1.553	1.172	2.162	2.727	3.838	5.143	5.708	5.933	3.944	1.782	0.542	0.168
1997	0.02	0.679	1.002	1.072	0.819	1.114	1.555	1.166	2.163	2.724	3.833	5.135	5.701	5.922	3.939	1.785	0.543	0.169
1998	0.019	0.676	0.993	1.07	0.819	1.118	1.557	1.16	2.163	2.721	3.827	5.128	5.695	5.912	3.934	1.788	0.544	0.169
1999	0.019	0.673	0.984	1.069	0.819	1.122	1.559	1.154	2.163	2.718	3.822	5.12	5.688	5.901	3.929	1.79	0.545	0.17
2000	0.019	0.67	0.975	1.067	0.82	1.126	1.561	1.147	2.163	2.715	3.817	5.113	5.682	5.891	3.924	1.793	0.546	0.171
2001	0.019	0.668	0.966	1.065	0.82	1.13	1.563	1.141	2.163	2.712	3.811	5.105	5.675	5.88	3.919	1.796	0.547	0.172
2002	0.018	0.665	0.958	1.063	0.82	1.134	1.565	1.135	2.164	2.709	3.806	5.098	5.669	5.87	3.914	1.798	0.548	0.172
2003	0.018	0.662	0.949	1.061	0.821	1.137	1.567	1.129	2.164	2.706	3.801	5.09	5.662	5.859	3.909	1.801	0.549	0.173
2004	0.018	0.66	0.94	1.059	0.821	1.141	1.569	1.123	2.164	2.702	3.795	5.083	5.656	5.848	3.904	1.804	0.55	0.174
2005	0.018	0.657	0.931	1.058	0.822	1.145	1.57	1.117	2.164	2.699	3.79	5.076	5.649	5.838	3.899	1.806	0.551	0.175
2006	0.017	0.654	0.922	1.056	0.822	1.149	1.572	1.111	2.164	2.696	3.784	5.068	5.643	5.827	3.894	1.809	0.552	0.175
2007	0.017	0.651	0.913	1.054	0.822	1.153	1.574	1.105	2.165	2.693	3.779	5.061	5.636	5.817	3.889	1.812	0.553	0.176
2008	0.017	0.649	0.904	1.052	0.823	1.157	1.576	1.099	2.165	2.69	3.774	5.053	5.63	5.806	3.884	1.814	0.554	0.177
2009	0.017	0.646	0.895	1.05	0.823	1.161	1.578	1.093	2.165	2.687	3.768	5.046	5.623	5.796	3.879	1.817	0.555	0.177
2010	0.016	0.643	0.887	1.048	0.823	1.165	1.58	1.086	2.165	2.684	3.763	5.038	5.617	5.785	3.875	1.82	0.556	0.178
2011	0.016	0.64	0.878	1.047	0.824	1.169	1.582	1.08	2.165	2.681	3.757	5.031	5.61	5.775	3.87	1.822	0.557	0.179
2012	0.016	0.638	0.869	1.045	0.824	1.172	1.584	1.074	2.166	2.678	3.752	5.023	5.603	5.764	3.865	1.825	0.558	0.18
2013	0.016	0.635	0.86	1.043	0.825	1.176	1.586	1.068	2.166	2.675	3.747	5.016	5.597	5.753	3.86	1.828	0.559	0.18
2014	0.015	0.632	0.851	1.041	0.825	1.18	1.588	1.062	2.166	2.671	3.741	5.008	5.59	5.743	3.855	1.83	0.56	0.181
dS (1960 to 2014)	-0.014	-0.147	-0.479	-0.099	0.02	0.21	0.105	-0.329	0.011	-0.168	-0.291	-0.403	-0.352	-0.57	-0.266	0.144	0.054	0.039

SI Table 2. White Glacier hypsometry matrix in 100 m elevation bands used to calculate conventional mass balance (this study) from linear interpolation between 1960 and 2014 hypsometries.