S1. Glacier data integration and evaluation of global glacier model

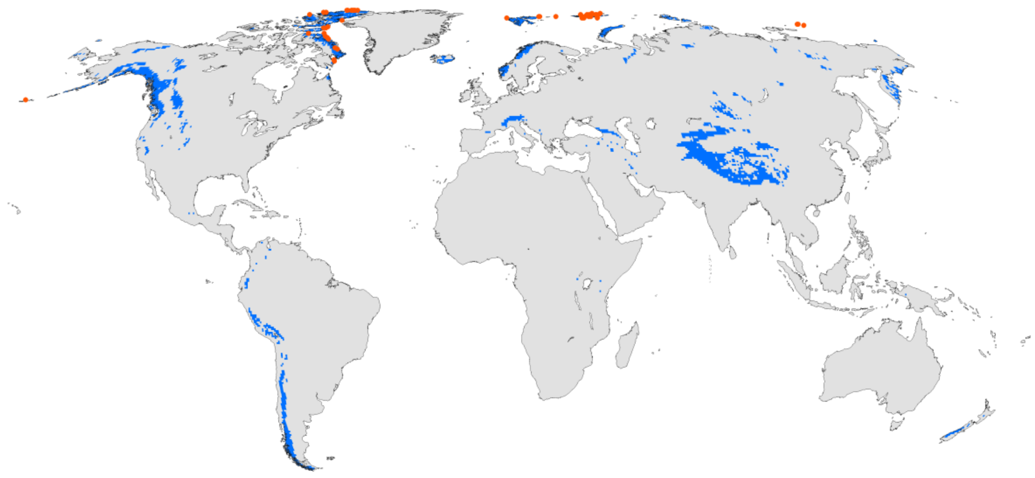

Figure S1: Location of glacierized grid cells (from GGM gridded data) within (blue cells) and outside (orange dots) of the boundaries of the WATCH-CRU land-sea mask (used by WaterGAP).

Table S1: List of individual glaciers considered for the comparison between observed and simulated glacier seasonal mass change. Observational data was obtained from the World Glacier Monitoring Service (2017). Modelled data was obtained with the global glacier model of Marzeion et al. (2012). NSE; Nash–Sutcliffe efficiency, r; correlation coefficient.

Glacier name (RGI region)	Number of years with obs.	Area (km², 1950)	r	NSE	Glacier name (RGI region)	Number of years with obs.	Area (km², 1950)	r	NSE
Gulkana (Alaska)	49	17.57	0.97	0.23	Storglaciaeren (Scandinavia)	71	3.16	0.94	0.68
Wolverine (Alaska)	49	0.03	0.97	0.86	Engabreen (Scandinavia)	46	42.95	0.98	0.93
Melville South Ice Cap (Western Canada and US)	39	1.24	0.9	0.77	Aalfotbreen (Scandinavia)	53	4.86	0.99	0.97
Helm (Western Canada and US)	13	0.98	0.99	0.91	Vodopadniy (North Asia)	28	0.76	0.9	0.8
Place (Western Canada and US)	24	3.02	0.99	0.98	Maliy Aktru (North Asia)	44	2.62	0.89	0.57
Peyto (Western Canada and US)	27	9.7	0.97	0.72	Leviy Aktru (North Asia)	23	5.67	0.95	0.68
South Cascade (Western Canada and US)	51	3.55	0.99	0.97	Careser (Central Europe)	16	2.84	0.97	0.91
Devon Ice Cap NW (Arctic Canada North)	54	765.44	0.94	-0.68	Gries (Central Europe)	55	5.29	0.98	0.84
Meighen Ice Cap (Arctic Canada North)	49	92.93	0.88	0.73	Sarennes (Central Europe)	68	0.44	0.96	0.85
Midtre Lovenbreen (Svalbard)	38	5.21	0.96	0.9	Vernagtferner (Central Europe)	50	8.56	0.96	-1.23
Austre Broeggerbreen (Svalbard)	38	9.81	0.96	0.9	Silvretta (Central Europe)	57	2.88	0.97	0.92
Rembesdalskaaka (Scandinavia)	53	16.83	0.97	0.88	Hintereis F. (Central Europe)	6	8.04	0.99	0.94
Storbreen (Scandinavia)	67	5.21	0.98	0.97	Djankuat (Caucasus and Middle East)	47	1.76	0.99	0.85
Graasubreen (Scandinavia)	54	2	0.96	0.48	TS. Tuyuksuyskiy (Central Asia)	50	2.84	0.93	0.52
Hellstugubreen (Scandinavia)	54	3.28	0.98	0.94	Echaurren Norte (Southern Andes)	41	0.34	0.96	0.71
Nigardsbreen (Scandinavia)	54	38.1	0.97	0.91					

S2. Comparison of observed and simulated global TWSA during the period January 2003 to August 2016

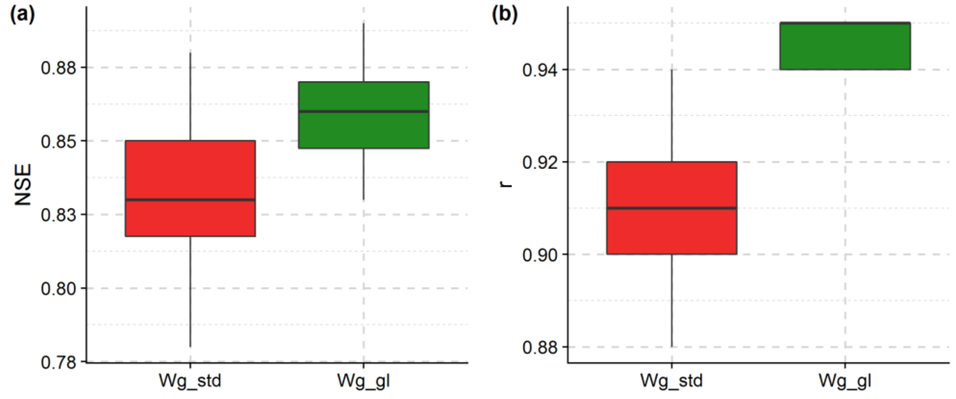

Figure S2: Nash-Sutcliffe efficiency NSE (a) and correlation coefficient r (b) obtained by comparing global monthly TWSA from GRACE observations and from two versions of WaterGAP2.2d, January 2003 to August 2016. Four GRACE-based TWSA time series were compared to four TWSA time series computed by standard WaterGAP (Wg_std) in anthropogenic mode (Wg_std_ant_CRU_irr100, Wg_std_ant_CRU_irr70, Wg_std_ant_GPCC_irr100 and Wg_std_ant_GPCC_irr70 in Table 1) and to four TWSA time series computed by integrated WaterGAP (Wg_gl) in anthropogenic mode (Wg_gl_ant_CRU_irr100, Wg_gl_ant_CRU_irr70, Wg_gl_ant_GPCC_irr100 and Wg_gl_ant_GPCC_irr70 in Table 1).

S3. Global water transfer from continents to oceans over the period 1948-2016

Table S2: Linear trends of contribution of TWSA to OMC over three periods (1948-1975, 1976-2002 and 2003-2016). Estimates were obtained with four variants of integrated WaterGAP (same variants as in Figure 5a). Trends were calculated according to the least squares regression method. Positive trends translate to ocean mass gain, whereas negative trends translate to ocean mass loss. Millimetres of sea level equivalent (mm SLE) are relative to the global ocean area ($361.0 \cdot 10^6$ km^2).

Model variant		**Linear trend mm SLE yr^{-1}**	
	1948-1975	**1976-2002**	**2003-2016**
Wg_gl_GPCC_irr70	0.18	0.57	1.06
Wg_gl_GPCC_irr100	0.23	0.66	1.19
Wg_gl_CRU_irr70	0.13	0.49	1.18
Wg_gl_CRU_irr100	0.17	0.58	1.30

References

Marzeion, B.; Jarosch, A. H.; Hofer, M. (2012): Past and future sea-level change from the surface mass balance of glaciers. In *The Cryosphere* 6 (6), pp. 1295–1322. DOI: 10.5194/tc-6-1295-2012.

World Glacier Monitoring Service (2017): Fluctuations of Glaciers Database.