



Supplement of

Strong acceleration of glacier area loss in the Greater Caucasus between 2000 and 2020

Levan G. Tielidze et al.

Correspondence to: Levan G. Tielidze (tielidzelevan@gmail.com)

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Supplemental Tables

Table S1. Satellite images and digital elevation models used in this study. Figure 1 shows where the scenes are located.

Satellite	Path-Row or Tile	Date	UTM zone	Sub-Region	Resolution
Landsat 5 TM	169-031	20/08/1999	38N	Eastern	30 m
Landsat 5 TM	173-030	01/09/1999	37N	Western	30 m
Landsat 7 ETM+	170-030	28/07/2000	38N	Eastern	15/30 m
Landsat 5 TM	171-030	12/08/2000	38N	Central	30 m
Landsat 7 ETM+	171-030	05/09/2000	38N	Central	15/30 m
Landsat 7 ETM+	172-030	12/09/2000	37-38N	Western and Central	15/30 m
Landsat 5 TM	173-030	05/08/2001	37N	Western	30 m
Landsat 5 TM	168-031	06/09/2002	38-39N	Eastern	30 m
Sentinel 2B	38TNN (2 scenes)	15/08/2019	38N	Eastern	10 m
Sentinel 2B	39TTF	22/08/2019	38-39N	Eastern	10 m
Sentinel 2B	38TMN	23/08/2019	38N	Central and Eastern	10 m
Sentinel 2B	38TPL (2 scenes)	05/09/2020	38N	Eastern	10 m
Sentinel 2B	38TQL	05/09/2020	38-39N	Eastern	10 m
Sentinel 2B	37TEJ (3 scenes)	04/09/2020	37N	Western	10 m
Sentinel 2B	37TEJ (2 scenes)	04/09/2020	37-38N	Western and Central	10 m
Sentinel 2B	38TLN	11/09/2020	38N	Central	10 m
Sentinel 2B	38TMN	11/09/2020	38N	Central and Eastern	10 m
SPOT-7	00035202	29/07/2019	38N	Central	1.5 m
SPOT-6	00035543	30/07/2019	38N	Central	1.5 m
SPOT-6	00035203	30/07/2019	38N	Central	1.5 m
SPOT-6	00035365	30/07/2019	38N	Central	1.5 m
SPOT-6	00035200	13/08/2019	38N	Eastern	1.5 m
Google Earth	-	14/09/2019	38N	Eastern	<1 m
ASTER GDEM	N43E041/E040	17/11/2011	37N	Western	30 m
ASTER GDEM	N43E042/E043	17/11/2011	38N	Central	30 m
ASTER GDEM	N42E045/E046	17/11/2011	38N	Eastern	30 m

Table S2. The Greater Caucasus glacier count and area change in 2000–2020 by individual river basins.

Main river basin	Tributary river basin	Landsat 5/7 1999-2002		Sentinel 2019–2020		Area decrease 2000–2020	
		Count	Area km ²	Count	Area km ²	%	% yr ⁻¹
Mzimta		13	2.3±0.2	12	1.6±0.1	30.4	1.52
Kuban	Belaya	52	8.6±0.6	52	6.2±0.4	27.9	1.40
	Malaya Laba	46	9.2±0.7	41	6.5±0.3	29.3	1.47
	Bolshaya Laba	31	5.8±0.4	31	3.5±0.2	39.7	1.99
	Bolshoy Zelenchuk	72	30.4±1.6	86	21.9±0.9	28.0	1.40
	Maliy Zelenchuk	42	27.8±1.1	50	21.6±0.7	22.3	1.12
	Teberda	103	59.6±2.6	115	44.8±1.4	24.8	1.24
	Daut	23	5.4±0.4	23	3.5±0.2	35.2	1.76
	Uchkulan	70	21.0±1.2	84	14.5±0.7	31.0	1.55
	Ullukam	96	47.1±2.2	103	34.2±1.3	27.4	1.37
Malka		10	55.7±0.9	13	49.1±0.6	11.8	0.59
Baksan		152	160.8±6.0	199	126.4±3.6	21.4	1.07
Chegem	Bashil-Auzusu	28	28.2±1.1	33	21.8±0.6	22.7	1.14
	Gara-Auzusu	20	28.1±1.1	25	22.0±0.7	21.7	1.09
	Bulungu	9	3.4±0.3	11	2.3±0.1	32.4	1.62
Cherek	Cherek-Bezingskiy	41	78.8±2.6	53	68.4±1.7	13.2	0.66
	Cherek-Balkarskiy	87	106.0±3.6	89	86.1±2.3	18.8	0.94
	Psigansy	11	14.3±0.6	14	11.9±0.4	16.8	0.84
Urukh	Khanzidon	12	7.1±0.3	13	5.4±0.6	23.9	1.20
	Biliagikom	4	1.6±0.04	5	0.7±0.1	56.3	2.82
	Urukh headwaters	36	28.2±1.2	46	21.4±0.8	24.1	1.21
	Karaugom	25	44.7±1.3	31	39.5±0.8	11.6	0.58
	Aigamuga	20	16.3±0.9	19	12.8±0.5	21.5	1.08
Ardon	Tseyadon	19	18.2±0.7	20	15.7±0.4	13.7	0.69
	Sidan	1	0.05±0.005	1	0.02±0.001	60.0	3.00
	Vilsa	5	1.0±0.05	4	0.8±0.04	20.0	1.00
	Adaikom	7	5.0±0.2	5	3.9±0.1	22.0	1.10
	Mamikhdon	15	4.4±0.3	16	2.9±0.5	34.1	1.71
	Nar	16	2.7±0.2	8	1.2±0.1	55.6	2.78
	Gilvan	1	0.05±0.006	0	0	-	-
	Kasaidon	2	0.2±0.07	2	0.2±0.004	0	0
	Labagkomdon	1	0.09±0.005	1	0.08±0.004	11.1	0.56
	Baddon	8	3.3±0.2	8	2.0±0.4	39.4	1.97
	Arkhondon	4	3.8±0.2	5	3.3±0.1	13.2	0.66
Fiagdon		31	7.8±0.5	19	4.8±0.3	38.5	1.93
Gizeldon		25	28.8±1.0	23	22.2±0.7	22.9	1.15
Tergi (Terek) headwaters		106	52.1±1.3	92	41.3±1.1	20.7	1.04
Sunja right tributaries	Assa	15	3.1±0.2	12	1.9±0.1	38.7	1.94
	Arghuni	25	6.7±0.5	20	4.7±0.3	29.9	1.50
	Sharo Argun	35	19.5±0.9	35	14.3±0.6	26.7	1.34
Sulak	Andiyskoye Koysu	50	16.3±1.0	42	9.7±0.5	40.5	2.03
	Avarskoye Koysu	75	14.5±1.1	34	4.8±0.3	66.9	3.35
Samur		52	8.9±0.6	12	2.0±0.1	77.5	3.88
Agrichai	Shinchai	1	0.03±0.002	0	0	-	-
Kusarchai		17	2.6±0.3	11	0.5±0.003	80.8	4.04
Bzipi		27	5.9±0.4	33	3.0±0.2	49.2	2.46
Kelasuri		2	1.1±0.4	2	0.8±0.03	27.3	1.37

Kodori		190	54.9±3.3	198	36.2±1.8	34.1	1.71
Enguri		303	265.9±11.1	315	209.6±5.9	21.2	1.06
Khobistkali		12	0.7±0.01	11	0.5±0.01	28.6	1.43
Rioni		126	59.9±3.0	133	46.4±1.7	22.5	1.13
Liakhvi		11	2.4±0.2	12	1.7±0.1	29.2	1.46
Aragvi		1	0.6±0.005	1	0.4±0.002	33.3	1.67
Total, Greater Caucasus		2186	1381.5±58.2	2223	1060.9±33.6	23.2	1.16

Table S3. Characteristics of glaciers used for measuring length change. The average error terms are ±15 m.

Name	Country	Area 2000 (km ²)	Area 2020 (km ²)	Annual decrease in 2000–2020 (% yr ⁻¹)	Glacier retreat in 2000–2020 (m)	Annual retreat in 2000–2020 (m yr ⁻¹)
Glaciers with >10 km² area						
Bezingi	Rus	39.4±0.9	34.8±0.9	0.6	292	14.6
Dykhsu	Rus	33.6±0.9	28.9±0.9*	0.7	556	27.8
Lekhzi	Geo	32.8±0.9	28.2±0.8*	0.7	1395	69.8
Karaugom	Rus	28.8±0.8	26.9±0.7*	0.3	771	38.6
Tsaneri Southern	Geo	13.9±0.5	12.7±0.5	0.4	491	24.6
Tsaneri Northern	Geo	12.5±0.5	11.5±0.5	0.4	582	29.1
Glaciers with 5-10 km² area						
Shkhelda	Rus	12.1±0.5	9.9±0.4*	0.9	624	31.2
Adishi	Geo	10.2±0.4	9.6±0.4	0.3	415	20.8
Khalde	Geo	10.2±0.4	9.2±0.4	0.5	328	16.4
Bashil	Rus	7.7±0.3	6.9±0.3	0.5	555	27.8
Dolra	Geo	6.1±0.2	5.0±0.2	0.9	178	8.9
Glaciers with 1-5 km² area						
Kirtisho	Geo	4.8±0.2	4.1±0.2	0.7	366	18.3
Boko	Geo	4.7±0.2	4.5±0.2	0.2	424	21.2
Leadast Northern	Geo	3.9±0.1	3.3±0.1	0.8	228	11.4
Kashkatash	Rus	3.2±0.1	2.8±0.1	0.6	407	20.4
Marukh Northern	Rus	3.1±0.1	2.7±0.1*	0.6	363	18.2

* in 2020 this glacier was already divided by several ice bodies

Supplemental Figure

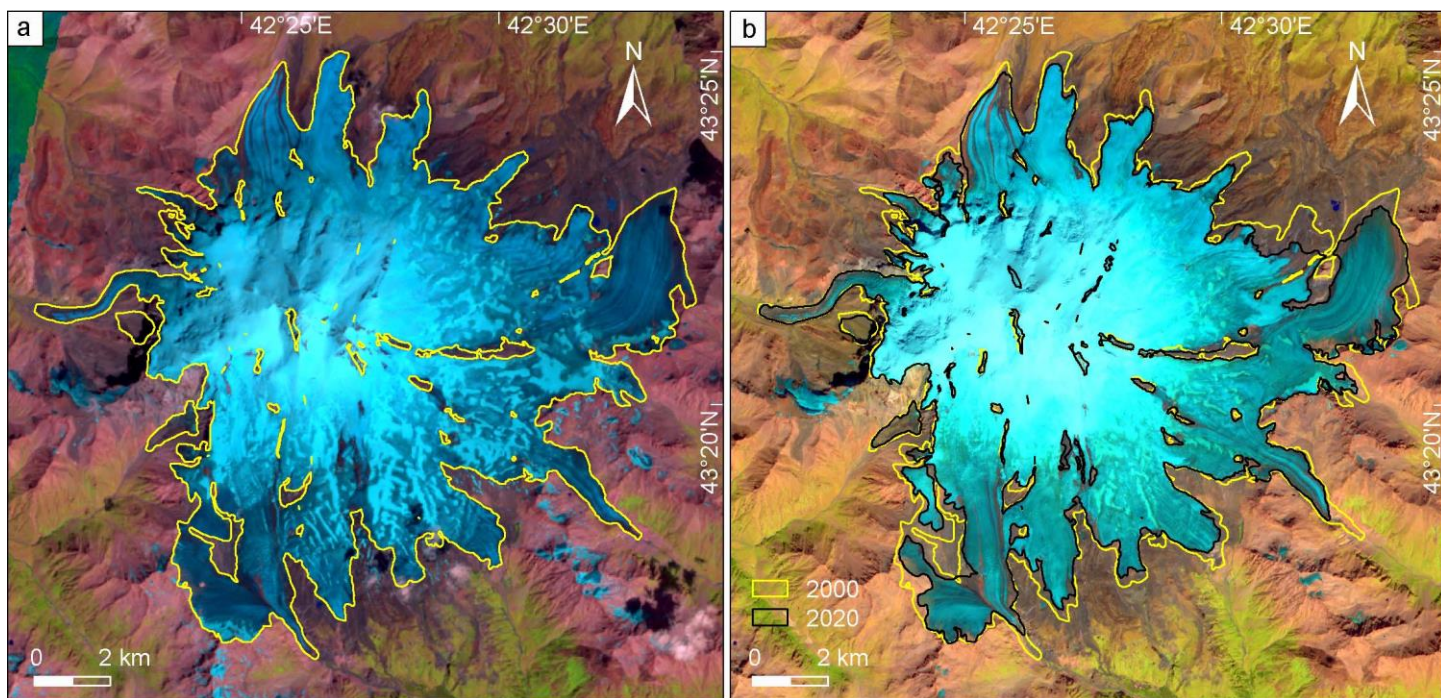


Figure S1. Changes in glacierized area of Elbrus in 2000-2020. (a) The 12 August 2000 Landsat 5 image is used as background. (b) The 4 September 2020 Sentinel 2 image is used as background.