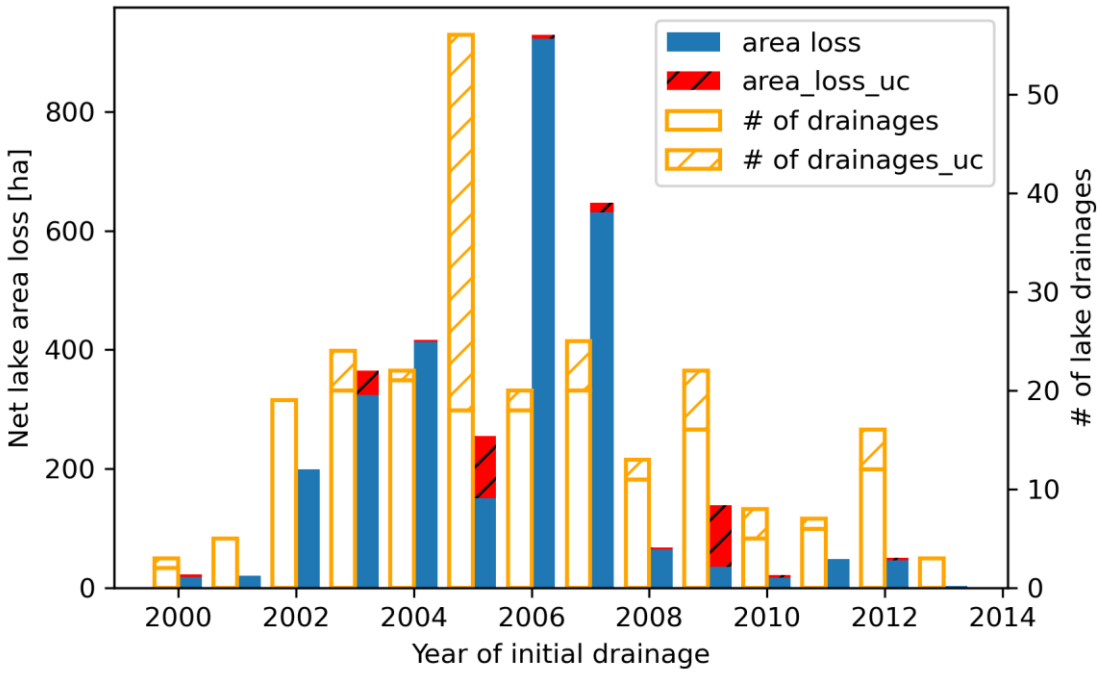
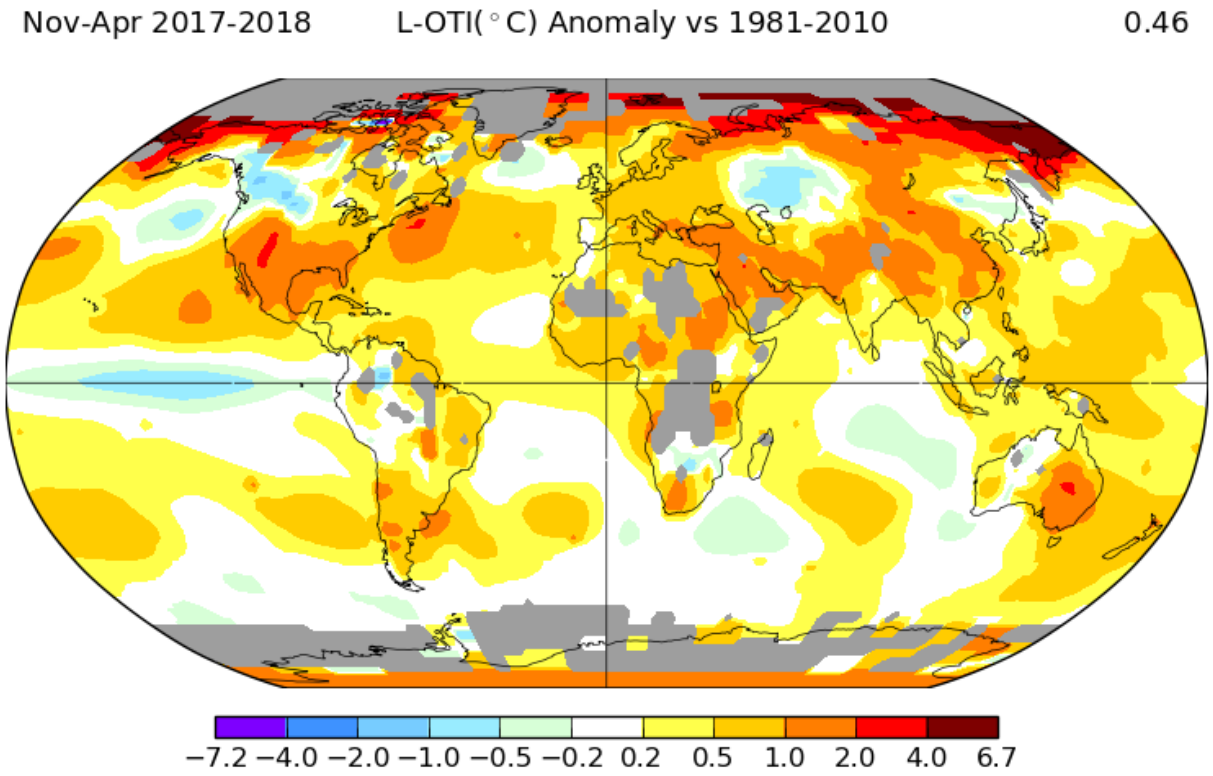
Supplementary file to:

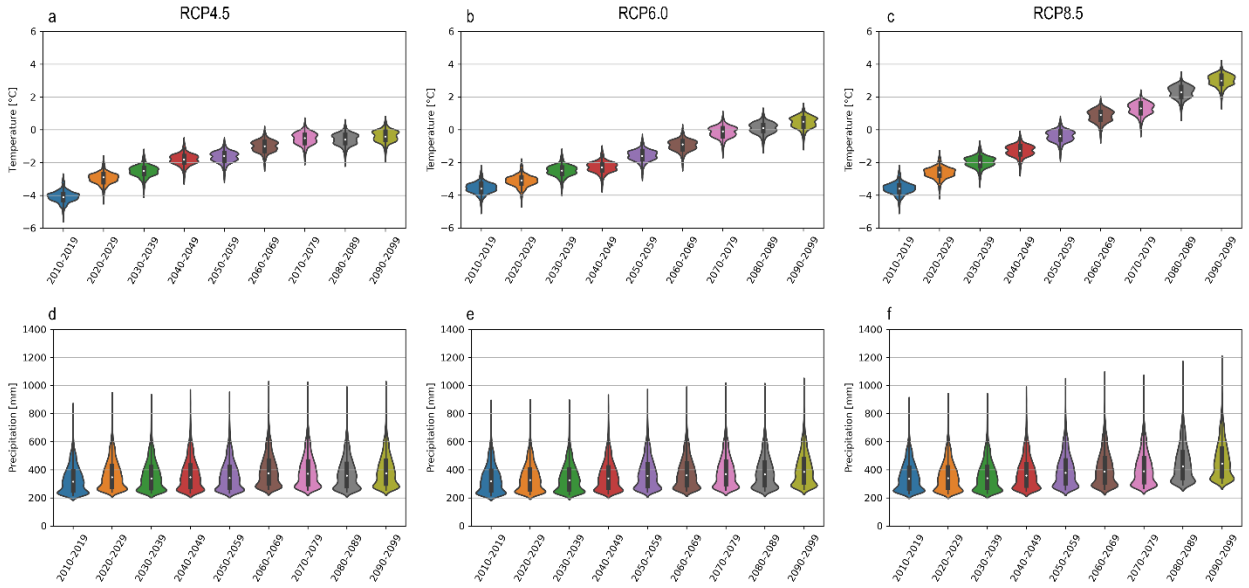
Nitze et al.: The catastrophic thermokarst lake drainage events of 2018 in northwestern Alaska: Fast-forward into the future



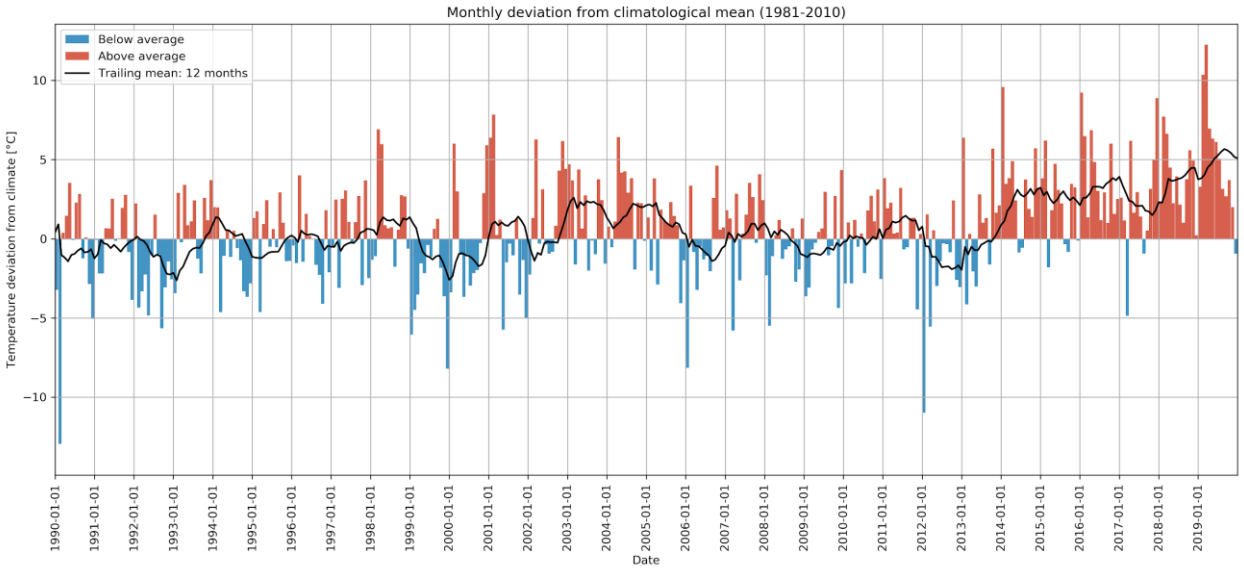
Supplementary Figure 1: Identified drained lakes and area between 2000 and 2014. Uncertainties of number of lakes and drained lake area due to missing data or cloud cover in preceding years indicated.



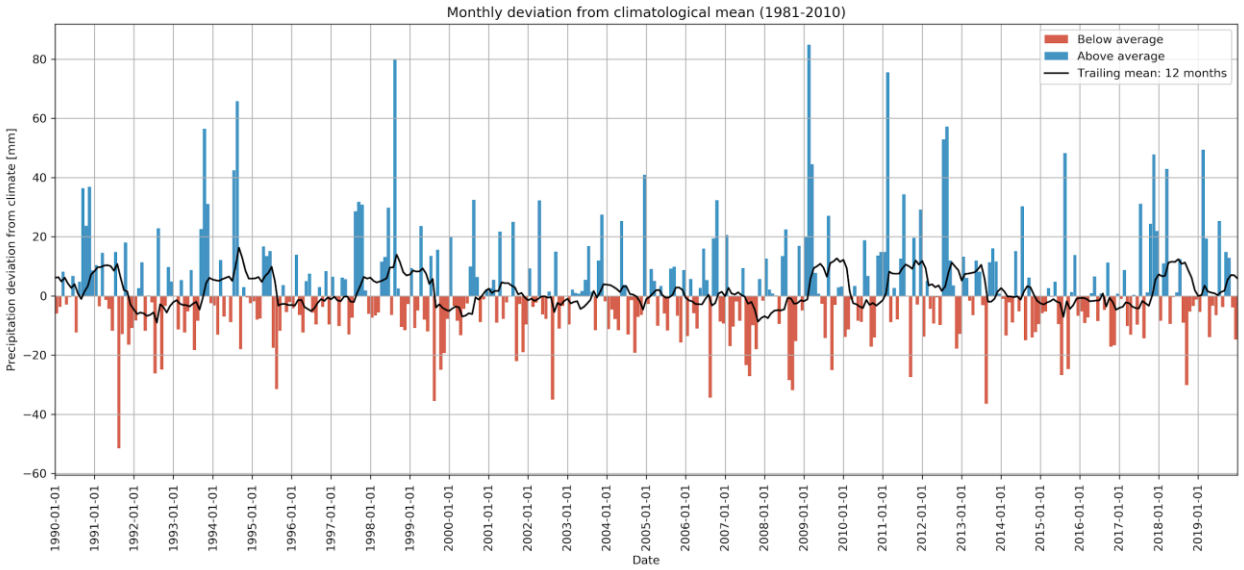
Supplementary Figure 2: GHCNv4 re-analysis temperature anomaly November 2017 through April 2018 (GISTEMP Team, 2019).



Supplementary Figure 3: Decadal Regional SNAP Ensemble Climate Model Projections (2 km CMIP/AR5) of Scenarios RCP4.5 (a, d) , RCP6.0 (b, e) , and RCP8.5 (c, f) for Temperatures (a-c) and Precipitation (d-f).



Supplementary Figure 4: Anomaly of monthly temperatures from climatic mean (1981-2010) with 12 month trailing mean.



Supplementary Figure 5: Anomaly of monthly precipitation from climatic mean (1981-2020) with 12 month trailing mean.

Supplementary Table 1: Full List of Drained Lakes 2018 with Size rank of all lakes, LakeID, net change area from 2017 in ha and % as well as area in 2017 and 2018, respectively. Table sorted by net area loss from 2017 to 2018.

	Lake area rank 2017	LakeID	Net change 2017-2018 [ha]	Net change 2017-2018 [%]	Area 2017 [ha]	Area 2018 [ha]
1	12	99368	-332.04	-91.24	363.92	31.88
2	6	69152	-258.8	-34.307	754.36	495.56
3	32	99230	-185.12	-99.698	185.68	0.56
4	39	64656	-164.6	-99.83	164.88	0.28
5	51	99492	-132.12	-100	132.12	0
6	205	100218	-28.48	-78.242	36.4	7.92
7	105	101659	-27.56	-41.531	66.36	38.8
8	269	99545	-26.12	-97.317	26.84	0.72
9	281	102499	-25.72	-100	25.72	0
10	305	100470	-23.2	-100	23.2	0
11	362	99557	-19.48	-100	19.48	0
12	373	99550	-18.84	-98.95	19.04	0.2
13	395	69287	-18.24	-100	18.24	0
14	287	99756	-17.24	-68.413	25.2	7.96
15	353	99505	-12.16	-60.558	20.08	7.92
16	466	64659	-11.8	-76.425	15.44	3.64
17	591	99465	-11.64	-97.651	11.92	0.28
18	617	101224	-11.36	-100	11.36	0
19	433	68965	-9.4	-57.457	16.36	6.96
20	225	69482	-8.64	-26.024	33.2	24.56
21	334	99205	-7.68	-35.622	21.56	13.88
22	665	101680	-7.64	-73.745	10.36	2.72
23	722	101909	-7.56	-81.116	9.32	1.76
24	893	99516	-7.4	-100	7.4	0
25	478	99257	-7.28	-47.895	15.2	7.92
26	969	99519	-6.68	-100	6.68	0
27	1047	100378	-6.04	-100	6.04	0
28	842	99108	-5.76	-73.469	7.84	2.08
29	1139	69248	-5.48	-100	5.48	0
30	361	100347	-5.36	-27.515	19.48	14.12
31	1090	64520	-5.2	-89.655	5.8	0.6
32	913	68788	-5.2	-72.222	7.2	2
33	989	102024	-5.12	-78.528	6.52	1.4
34	374	101693	-4.96	-26.105	19	14.04
35	1211	99506	-4.4	-86.614	5.08	0.68
36	1179	69590	-4.32	-81.818	5.28	0.96
37	1135	101453	-3.96	-71.739	5.52	1.56
38	825	100234	-3.92	-48.515	8.08	4.16
39	1463	100268	-3.92	-100	3.92	0
40	1505	101887	-3.76	-100	3.76	0
41	950	99883	-3.44	-50	6.88	3.44
42	1444	99224	-3.32	-83	4	0.68
43	671	99179	-3.28	-32.031	10.24	6.96
44	1666	101125	-3.2	-100	3.2	0
45	1734	99421	-3.04	-100	3.04	0
46	1700	101591	-3	-96.154	3.12	0.12

47	737	69589	-2.92	-32.301	9.04	6.12
48	892	71080	-2.88	-38.71	7.44	4.56
49	1785	70973	-2.88	-100	2.88	0
50	1667	70014	-2.84	-88.75	3.2	0.36
51	1668	101752	-2.48	-77.5	3.2	0.72
52	912	63924	-2.48	-34.444	7.2	4.72
53	986	69414	-2.44	-37.195	6.56	4.12
54	2005	100177	-2.44	-100	2.44	0
55	2033	71258	-2.4	-100	2.4	0
56	2049	99198	-2.28	-96.61	2.36	0.08
57	864	99403	-2.28	-29.687	7.68	5.4
58	845	100528	-2.28	-29.082	7.84	5.56
59	2058	99376	-2.28	-98.276	2.32	0.04
60	1130	101246	-2.2	-39.568	5.56	3.36
61	925	99568	-2.2	-31.25	7.04	4.84
62	1374	99509	-2.16	-50.467	4.28	2.12
63	1278	101618	-2.08	-43.697	4.76	2.68
64	1964	70354	-1.96	-79.032	2.48	0.52
65	1429	99583	-1.92	-47.525	4.04	2.12
66	1851	101672	-1.88	-69.118	2.72	0.84
67	1206	100034	-1.84	-35.938	5.12	3.28
68	1386	100593	-1.84	-43.81	4.2	2.36
69	1969	101135	-1.76	-70.968	2.48	0.72
70	1832	69550	-1.72	-62.319	2.76	1.04
71	991	69553	-1.72	-26.38	6.52	4.8
72	1157	69526	-1.68	-31.111	5.4	3.72
73	2143	102480	-1.68	-77.778	2.16	0.48
74	2249	100562	-1.64	-83.673	1.96	0.32
75	1905	100519	-1.56	-60	2.6	1.04
76	1437	99153	-1.52	-38	4	2.48
77	1379	69567	-1.52	-35.849	4.24	2.72
78	1991	99200	-1.48	-60.656	2.44	0.96
79	1150	99928	-1.44	-26.471	5.44	4
80	2480	101396	-1.4	-83.333	1.68	0.28
81	1664	100588	-1.4	-43.75	3.2	1.8
82	1882	102605	-1.36	-50.746	2.68	1.32
83	2521	99381	-1.36	-85	1.6	0.24
84	1204	102098	-1.32	-25.781	5.12	3.8
85	1684	100886	-1.28	-40.506	3.16	1.88
86	2819	69037	-1.28	-100	1.28	0
87	1507	99055	-1.24	-32.979	3.76	2.52
88	2662	100644	-1.24	-83.784	1.48	0.24
89	1820	99434	-1.2	-42.857	2.8	1.6
90	1670	69677	-1.16	-36.25	3.2	2.04
91	2917	99429	-1.16	-96.667	1.2	0.04
92	1420	72236	-1.16	-28.431	4.08	2.92
93	2791	99380	-1.12	-84.848	1.32	0.2

94	1375	99744	-1.12	-26.168	4.28	3.16
95	1709	100036	-1.08	-35.065	3.08	2
96	1607	69938	-1.08	-31.765	3.4	2.32
97	2266	99473	-1.04	-53.061	1.96	0.92
98	2906	69649	-1.04	-86.667	1.2	0.16
99	1486	102248	-1	-26.316	3.8	2.8
100	1499	101422	-1	-26.596	3.76	2.76
101	1671	69301	-0.96	-30	3.2	2.24
102	1497	99418	-0.96	-25.532	3.76	2.8
103	1566	99209	-0.96	-26.966	3.56	2.6
104	2928	99571	-0.92	-76.667	1.2	0.28
105	2474	72420	-0.92	-54.762	1.68	0.76
106	2629	99208	-0.92	-62.162	1.48	0.56
107	1773	68937	-0.92	-31.507	2.92	2
108	1970	102593	-0.88	-35.484	2.48	1.6
109	1743	99147	-0.88	-29.333	3	2.12
110	1901	99235	-0.84	-32.308	2.6	1.76
111	2154	101165	-0.84	-39.623	2.12	1.28
112	2361	69614	-0.84	-45.652	1.84	1
113	1728	100105	-0.8	-26.316	3.04	2.24
114	2924	64366	-0.8	-66.667	1.2	0.4
115	2074	99032	-0.8	-35.088	2.28	1.48
116	2893	102777	-0.8	-66.667	1.2	0.4
117	2879	99127	-0.76	-61.29	1.24	0.48
118	1816	65563	-0.76	-27.143	2.8	2.04
119	1749	100231	-0.76	-25.333	3	2.24
120	2625	101086	-0.76	-51.351	1.48	0.72
121	2362	70331	-0.76	-41.304	1.84	1.08
122	2518	101460	-0.76	-47.5	1.6	0.84
123	1845	69634	-0.76	-27.941	2.72	1.96
124	1811	99389	-0.72	-25.714	2.8	2.08
125	2071	99058	-0.72	-31.579	2.28	1.56
126	2231	69407	-0.72	-36	2	1.28
127	2162	101614	-0.68	-32.075	2.12	1.44
128	2524	99145	-0.68	-42.5	1.6	0.92
129	2270	101234	-0.68	-34.694	1.96	1.28
130	2657	69609	-0.68	-45.946	1.48	0.8
131	2892	71776	-0.68	-56.667	1.2	0.52
132	2015	68768	-0.68	-28.333	2.4	1.72
133	2867	71246	-0.64	-51.613	1.24	0.6
134	3129	99104	-0.64	-64	1	0.36
135	2467	101650	-0.64	-38.095	1.68	1.04
136	2011	100913	-0.64	-26.667	2.4	1.76
137	2650	99367	-0.6	-40.541	1.48	0.88
138	2175	100645	-0.6	-28.846	2.08	1.48
139	2235	99532	-0.6	-30	2	1.4
140	2324	100157	-0.6	-31.915	1.88	1.28

141	2647	72042	-0.6	-40.541	1.48	0.88
142	2240	101652	-0.56	-28	2	1.44
143	2197	100327	-0.56	-27.451	2.04	1.48
144	2913	99363	-0.56	-46.667	1.2	0.64
145	2441	69803	-0.56	-32.558	1.72	1.16
146	2593	99062	-0.56	-36.842	1.52	0.96
147	2322	102732	-0.56	-29.787	1.88	1.32
148	2400	99146	-0.56	-31.818	1.76	1.2
149	2886	99800	-0.52	-41.935	1.24	0.72
150	2911	99668	-0.52	-43.333	1.2	0.68
151	2957	100705	-0.52	-44.828	1.16	0.64
152	2719	99374	-0.52	-37.143	1.4	0.88
153	3148	101915	-0.48	-48	1	0.52
154	3084	100836	-0.48	-46.154	1.04	0.56
155	2552	72962	-0.48	-30.769	1.56	1.08
156	2705	101210	-0.48	-34.286	1.4	0.92
157	2652	71238	-0.48	-32.432	1.48	1
158	2706	73001	-0.48	-34.286	1.4	0.92
159	2416	99551	-0.48	-27.273	1.76	1.28
160	2454	99214	-0.48	-27.907	1.72	1.24
161	2804	71574	-0.48	-36.364	1.32	0.84
162	2309	100926	-0.48	-25.532	1.88	1.4
163	2499	102724	-0.48	-29.268	1.64	1.16
164	2679	101555	-0.48	-33.333	1.44	0.96
165	2585	100619	-0.44	-28.947	1.52	1.08
166	2721	101530	-0.44	-31.429	1.4	0.96
167	2813	71516	-0.44	-33.333	1.32	0.88
168	2856	72309	-0.44	-35.484	1.24	0.8
169	3034	102279	-0.44	-40.741	1.08	0.64
170	2634	99143	-0.44	-29.73	1.48	1.04
171	2735	69040	-0.44	-31.429	1.4	0.96
172	2643	99355	-0.4	-27.027	1.48	1.08
173	2693	100512	-0.4	-27.778	1.44	1.04
174	2680	71213	-0.4	-27.778	1.44	1.04
175	2687	71095	-0.4	-27.778	1.44	1.04
176	2846	99082	-0.4	-31.25	1.28	0.88
177	2723	71207	-0.4	-28.571	1.4	1
178	2824	71673	-0.4	-31.25	1.28	0.88
179	2743	99266	-0.4	-29.412	1.36	0.96
180	2798	100184	-0.4	-30.303	1.32	0.92
181	2646	100838	-0.4	-27.027	1.48	1.08
182	2836	70968	-0.4	-31.25	1.28	0.88
183	2591	64067	-0.4	-26.316	1.52	1.12
184	3010	99503	-0.4	-35.714	1.12	0.72
185	2968	99162	-0.36	-31.034	1.16	0.8
186	2925	100752	-0.36	-30	1.2	0.84
187	2964	70333	-0.36	-31.034	1.16	0.8

188	2771	101998	-0.36	-27.273	1.32	0.96
189	2810	68981	-0.36	-27.273	1.32	0.96
190	3081	101908	-0.32	-30.769	1.04	0.72
191	3105	100114	-0.32	-32	1	0.68
192	2939	99797	-0.32	-27.586	1.16	0.84
193	3024	69362	-0.32	-29.63	1.08	0.76
194	3097	99362	-0.28	-26.923	1.04	0.76
195	3042	99652	-0.28	-25.926	1.08	0.8

Supplementary Table 2: Full List of Drained Lakes (>25% loss, >1ha size) 1999-2014 with Size rank of all lakes, LakeID, net change area from 1999to 2014 in ha and % as well as lake area in 1999 and 2014, respectively. Table sorted by net area loss from 1999 to 2014.

	LakeID	Net change 1999-2014 [ha]	Net change 1999-2014 [%]	Area 1999 [ha]	Area 2014 [ha]	Year Drained
1	101282	-568.92	-97.95	580.8	11.88	2007
2	99433	-373.29	-99.63	374.67	1.37	2006
3	99313	-299.98	-78.77	380.84	80.85	2006
4	100588	-208.53	-94.69	220.22	11.69	2004
5	99624	-113.43	-99.55	113.94	0.52	2006
6	101659	-79.32	-31.55	251.42	172.1	2009
7	99505	-76.16	-62.7	121.48	45.31	2003
8	100505	-74.27	-28.86	257.36	183.08	2003
9	101402	-65.62	-98.3	66.75	1.14	2003
10	101844	-56.5	-99.06	57.03	0.54	2004
11	101223	-45.54	-73.06	62.34	16.79	2002
12	100387	-41.26	-64.37	64.1	22.84	2006
13	101624	-40.72	-95.74	42.54	1.81	2002
14	100506	-40.55	-37.3	108.69	68.15	2005
15	101888	-38.56	-63.33	60.88	22.33	2003
16	102655	-34.86	-86.03	40.53	5.66	2006
17	102007	-34.32	-69.57	49.33	15.01	2003
18	102196	-32.29	-43.42	74.37	42.08	2004
19	69745	-28.41	-96.54	29.43	1.02	2002
20	101228	-27.6	-92.14	29.96	2.36	2002
21	100573	-26.71	-97.67	27.35	0.64	2004
22	102395	-26.69	-36.38	73.36	46.67	2012
23	102593	-25.91	-82.18	31.53	5.62	2003
24	102399	-24.18	-98.35	24.58	0.4	2002
25	99484	-22.78	-31.53	72.26	49.47	2005
26	101752	-19.94	-53.56	37.23	17.29	2009
27	100031	-18.33	-77.19	23.75	5.42	---
28	101374	-16.45	-31.54	52.14	35.7	2005
29	102098	-16.25	-57.56	28.23	11.98	2011
30	102803	-15.77	-98.05	16.09	0.31	2000
31	99896	-15.28	-93.46	16.35	1.07	2005
32	102476	-14.94	-47.36	31.55	16.61	2011
33	99914	-14.79	-99.09	14.92	0.14	2005

34	102358	-14.6	-87.77	16.63	2.03	2004
35	102775	-13.7	-96	14.27	0.57	2008
36	102759	-13.22	-99.58	13.28	0.06	2008
37	102284	-12.96	-66.87	19.38	6.42	2004
38	68981	-12.06	-86.72	13.91	1.85	2007
39	99588	-12.02	-97.95	12.27	0.25	2006
40	69026	-10.69	-99.58	10.74	0.05	2005
41	101520	-10.51	-87.16	12.06	1.55	2006
42	102767	-10.27	-99.03	10.37	0.1	2005
43	99210	-10.27	-25.1	40.91	30.64	2001
44	102335	-9.83	-42.34	23.21	13.38	2004
45	102409	-9.8	-57.05	17.17	7.38	2004
46	102491	-9.19	-99.36	9.24	0.06	2003
47	99461	-9.13	-93.44	9.77	0.64	2005
48	102454	-9.09	-54.88	16.57	7.48	2006
49	69195	-9.08	-95.77	9.48	0.4	2008
50	101809	-8.6	-99.64	8.63	0.03	2004
51	99360	-8.51	-86.96	9.78	1.28	2008
52	99617	-8.39	-52.15	16.09	7.7	2010
53	71375	-7.95	-99.29	8	0.06	2007
54	99369	-7.79	-71.78	10.86	3.06	2011
55	102768	-7.22	-97.14	7.44	0.21	2005
56	99997	-6.85	-31.99	21.4	14.56	---
57	69571	-6.83	-61.4	11.12	4.29	2002
58	102300	-6.46	-99.6	6.48	0.03	2004
59	72895	-6.27	-84.12	7.45	1.18	2005
60	100825	-6.2	-95.49	6.49	0.29	2005
61	101272	-6.07	-66.75	9.09	3.02	2007
62	101287	-5.94	-29.85	19.91	13.96	2003
63	101470	-5.91	-74.07	7.98	2.07	2004
64	100248	-5.88	-25.25	23.28	17.4	2011
65	71194	-5.63	-66.56	8.45	2.83	2012
66	99823	-5.61	-85.65	6.56	0.94	---
67	100790	-5.59	-28.75	19.44	13.85	2005
68	102227	-5.4	-69.25	7.8	2.4	2004
69	101964	-5.11	-77.59	6.59	1.48	2006
70	101969	-5.05	-86.09	5.87	0.82	2007
71	102451	-5.03	-84.31	5.96	0.94	2004
72	100450	-4.78	-58.97	8.11	3.33	2007
73	101773	-4.65	-45.04	10.33	5.68	2007
74	102623	-4.64	-60.49	7.67	3.03	2008
75	100551	-4.62	-83.15	5.56	0.94	2005
76	102746	-4.61	-84.46	5.46	0.85	2009
77	72334	-4.54	-96.87	4.68	0.15	2007
78	100663	-4.48	-32.85	13.64	9.16	2002
79	71290	-4.47	-96.71	4.63	0.15	2010
80	64366	-4.45	-30.45	14.61	10.16	2009

81	102729	-4.42	-25.52	17.34	12.91	2009
82	102717	-4.28	-96.92	4.42	0.14	2006
83	101961	-4.22	-39.48	10.68	6.46	2006
84	102537	-4.22	-48.72	8.67	4.45	2000
85	100737	-4.15	-90.56	4.58	0.43	2005
86	65014	-4	-70.71	5.66	1.66	2007
87	102222	-3.93	-97.45	4.03	0.1	2005
88	102523	-3.91	-74.02	5.28	1.37	2004
89	72926	-3.86	-98.82	3.9	0.05	2005
90	99804	-3.76	-35.27	10.66	6.9	2014
91	100584	-3.73	-78.61	4.74	1.01	2006
92	101178	-3.56	-33.45	10.66	7.09	2001
93	100797	-3.55	-73.29	4.85	1.3	2003
94	102494	-3.52	-93.16	3.78	0.26	2003
95	102178	-3.51	-82.03	4.28	0.77	2007
96	99850	-3.5	-95.97	3.65	0.15	---
97	102616	-3.42	-98.23	3.48	0.06	2007
98	100861	-3.41	-41.5	8.21	4.8	2003
99	69275	-3.37	-78.12	4.31	0.94	2009
100	101313	-3.33	-71.22	4.68	1.35	2005
101	99374	-3.32	-63.2	5.26	1.94	2008
102	102773	-3.31	-92.18	3.59	0.28	2005
103	100800	-3.19	-98.95	3.22	0.03	2005
104	100988	-3.18	-86.93	3.66	0.48	2005
105	102091	-3.16	-80.44	3.93	0.77	2001
106	100261	-3.13	-84.93	3.68	0.55	2007
107	102243	-3.08	-48.8	6.32	3.23	2005
108	102440	-3.08	-80.58	3.82	0.74	2007
109	100727	-3.07	-51.52	5.96	2.89	2002
110	102612	-3.06	-95.21	3.21	0.15	2008
111	101166	-3.05	-93.06	3.28	0.23	2002
112	102149	-3.05	-99.46	3.07	0.02	2005
113	102489	-2.96	-82.74	3.58	0.62	2003
114	102670	-2.95	-94.28	3.13	0.18	2010
115	69720	-2.95	-99.5	2.96	0.01	2005
116	101072	-2.92	-96.03	3.04	0.12	2005
117	99329	-2.9	-98.61	2.94	0.04	2003
118	69849	-2.9	-56.16	5.16	2.26	2008
119	102774	-2.88	-60.84	4.73	1.85	2006
120	101184	-2.83	-96.5	2.94	0.1	2008
121	101439	-2.82	-49.33	5.72	2.9	2008
122	100827	-2.81	-35.25	7.97	5.16	2002
123	101290	-2.8	-98.9	2.83	0.03	2003
124	101967	-2.79	-57.45	4.85	2.07	2012
125	102723	-2.75	-99.59	2.76	0.01	2006
126	99732	-2.73	-97.56	2.8	0.07	2000
127	69195	-2.69	-99.42	2.71	0.02	---

128	99181	-2.65	-99.41	2.67	0.02	2001
129	99764	-2.62	-78.31	3.35	0.73	2006
130	69280	-2.54	-25.9	9.81	7.27	---
131	102304	-2.53	-97.74	2.59	0.06	2006
132	71625	-2.43	-98.07	2.47	0.05	2005
133	100417	-2.43	-63.55	3.83	1.4	2009
134	102481	-2.38	-98.77	2.41	0.03	2004
135	101233	-2.36	-76.85	3.07	0.71	2003
136	101590	-2.35	-45.22	5.19	2.84	2002
137	72808	-2.3	-99.24	2.32	0.02	2005
138	101191	-2.24	-74.7	2.99	0.76	2005
139	102602	-2.23	-84.87	2.62	0.4	2004
140	102547	-2.23	-31.23	7.15	4.92	2007
141	99530	-2.21	-35.48	6.23	4.02	2012
142	69271	-2.18	-96.15	2.27	0.09	---
143	102144	-2.13	-56.53	3.76	1.64	2010
144	100932	-2.1	-98.28	2.14	0.04	2005
145	101768	-2.09	-39.72	5.27	3.17	2003
146	100972	-2.08	-53.67	3.88	1.8	2006
147	69816	-2.06	-87.27	2.36	0.3	2008
148	102674	-2.05	-91.03	2.25	0.2	2005
149	71799	-2.04	-36.76	5.54	3.5	2012
150	99294	-2.03	-88.19	2.3	0.27	2007
151	71492	-1.98	-91.41	2.16	0.19	2003
152	99248	-1.96	-95.45	2.06	0.09	2005
153	71374	-1.94	-46.84	4.13	2.2	2005
154	101769	-1.94	-30.68	6.31	4.38	2003
155	99383	-1.93	-29.15	6.61	4.68	2011
156	102744	-1.93	-76.4	2.52	0.59	2009
157	99988	-1.92	-65.43	2.93	1.01	2005
158	103028	-1.91	-99.79	1.91	---	2005
159	69670	-1.89	-98.8	1.91	0.02	2009
160	99415	-1.89	-38.7	4.88	2.99	2009
161	100540	-1.88	-93.22	2.01	0.14	2005
162	102590	-1.85	-29.61	6.23	4.39	2009
163	99872	-1.83	-86.58	2.11	0.28	2005
164	102135	-1.83	-93.95	1.94	0.12	2009
165	101394	-1.82	-48.51	3.76	1.93	2010
166	101145	-1.8	-99.01	1.82	0.02	2003
167	99385	-1.79	-95.89	1.86	0.08	2002
168	102319	-1.78	-35.86	4.97	3.19	2007
169	101628	-1.78	-50.53	3.52	1.74	2009
170	71602	-1.75	-31.76	5.52	3.77	---
171	99895	-1.72	-68.34	2.52	0.8	2005
172	101675	-1.7	-98.62	1.73	0.02	2002
173	102389	-1.69	-91.46	1.84	0.16	2012
174	102548	-1.69	-94.39	1.79	0.1	2005

175	101444	-1.68	-45.93	3.65	1.97	2007
176	72794	-1.67	-72.55	2.3	0.63	2006
177	70815	-1.64	-99.13	1.65	0.01	2005
178	71104	-1.59	-36.52	4.36	2.77	2013
179	99198	-1.56	-30.79	5.06	3.5	2009
180	102613	-1.54	-98.65	1.56	0.02	2004
181	100010	-1.52	-98.08	1.55	0.03	2002
182	73099	-1.52	-97.14	1.56	0.04	2012
183	102372	-1.49	-97.81	1.52	0.03	2003
184	102694	-1.43	-99.65	1.43	---	2005
185	102134	-1.42	-74.54	1.91	0.49	2003
186	99249	-1.4	-93.97	1.48	0.09	2005
187	102376	-1.4	-47.21	2.96	1.56	2007
188	100200	-1.38	-36.28	3.8	2.42	2005
189	100541	-1.35	-92.47	1.46	0.11	2005
190	72678	-1.34	-37.31	3.59	2.25	2012
191	100502	-1.32	-91.81	1.44	0.12	2005
192	102468	-1.31	-96.25	1.36	0.05	2009
193	73410	-1.28	-99.44	1.29	0.01	2007
194	101400	-1.27	-88.08	1.44	0.17	---
195	102471	-1.27	-70.03	1.81	0.54	2003
196	100020	-1.25	-95.4	1.31	0.06	2002
197	71292	-1.24	-68.3	1.81	0.57	2012
198	101635	-1.24	-96.81	1.28	0.04	2005
199	101397	-1.23	-59.96	2.05	0.82	2008
200	102704	-1.22	-32.19	3.8	2.58	2006
201	99863	-1.22	-75.24	1.62	0.4	---
202	102002	-1.19	-59.86	1.98	0.8	2005
203	101101	-1.19	-33.97	3.49	2.31	2005
204	101289	-1.19	-96.15	1.24	0.05	2002
205	100826	-1.18	-33.08	3.56	2.38	2012
206	102609	-1.17	-93.77	1.25	0.08	2004
207	99852	-1.15	-49.23	2.34	1.19	2005
208	72079	-1.15	-56.77	2.03	0.88	2013
209	101292	-1.14	-34.15	3.33	2.19	2012
210	99276	-1.14	-93.83	1.21	0.07	2005
211	99941	-1.13	-66.02	1.72	0.58	2007
212	102192	-1.12	-33.85	3.3	2.18	2011
213	103151	-1.11	-86.65	1.28	0.17	2010
214	101701	-1.11	-30.89	3.6	2.49	2006
215	99886	-1.1	-89.27	1.24	0.13	2005
216	100806	-1.09	-92.9	1.18	0.08	2009
217	102347	-1.07	-33.18	3.22	2.15	2009
218	101829	-1.06	-27.03	3.91	2.85	2009
219	99207	-1.05	-27.11	3.88	2.83	2002
220	71535	-1.05	-95.97	1.1	0.04	2005
221	101322	-1.04	-62.17	1.67	0.63	2002

222	71732	-1.02	-51.24	1.99	0.97	2013
223	99371	-1.01	-60.32	1.68	0.67	2012
224	99332	-1.01	-54.86	1.83	0.83	2005
225	71606	-0.99	-58.59	1.68	0.7	2009
226	100229	-0.99	-35	2.82	1.83	---
227	99268	-0.98	-36.25	2.71	1.73	2005
228	99306	-0.97	-93.03	1.04	0.07	2005
229	71094	-0.96	-67.5	1.43	0.46	---
230	102014	-0.95	-42.74	2.23	1.28	2002
231	102553	-0.95	-93.21	1.02	0.07	2005
232	101925	-0.94	-55.64	1.68	0.75	2009
233	102085	-0.93	-44.75	2.07	1.14	2005
234	101864	-0.91	-86.91	1.05	0.14	2007
235	99669	-0.91	-27.06	3.38	2.46	---
236	99668	-0.89	-26.68	3.34	2.45	---
237	101890	-0.89	-27.89	3.2	2.31	2003
238	102488	-0.88	-47.74	1.84	0.96	2003
239	102401	-0.86	-61.39	1.41	0.54	---
240	102272	-0.85	-36.92	2.31	1.46	---
241	102459	-0.84	-78.31	1.07	0.23	2004
242	73433	-0.84	-56.32	1.49	0.65	2007
243	102572	-0.84	-68.53	1.22	0.38	2004
244	72867	-0.82	-69.15	1.19	0.37	2012
245	99697	-0.82	-50.81	1.62	0.8	2007
246	65855	-0.79	-36.69	2.16	1.37	2004
247	101777	-0.77	-51.69	1.48	0.72	2008
248	102292	-0.72	-59.27	1.21	0.49	2009
249	100078	-0.68	-32.73	2.08	1.4	---
250	102460	-0.68	-43.58	1.57	0.88	---
251	101107	-0.66	-40.41	1.64	0.98	2007
252	99870	-0.65	-55.29	1.17	0.52	2004
253	102749	-0.64	-53.49	1.2	0.56	2012
254	101528	-0.63	-27.31	2.3	1.68	2001
255	72279	-0.6	-30.57	1.96	1.36	2007
256	101775	-0.59	-39.21	1.51	0.92	2011
257	69671	-0.59	-35.78	1.66	1.07	---
258	101513	-0.55	-36.93	1.49	0.94	---
259	99643	-0.52	-43.77	1.19	0.67	---
260	69207	-0.52	-28.2	1.85	1.33	2005
261	102157	-0.48	-27.72	1.75	1.26	---
262	99311	-0.47	-44.75	1.05	0.58	2010
263	101759	-0.46	-27.98	1.64	1.18	2012
264	100322	-0.46	-36.04	1.29	0.82	2014
265	100910	-0.43	-27.79	1.54	1.11	---
266	72940	-0.4	-25.3	1.58	1.18	2010
267	101630	-0.32	-25.38	1.28	0.95	---
268	101850	-0.3	-26.08	1.16	0.86	---

Supplementary Table 3: Annually aggregated observations of mean air temperature, accumulated precipitation, accumulated snowfall, accumulated freezing degree days, and freezing days per winter year (July 1st until June 30th) for climate station Kotzebue, sorted by year.

Winter Year	Mean Air Temperature [°C]	Cumulative Precipitation [mm]	Cumulative Snowfall [cm]	Cumulative FDD	Freezing Days	Rank Temperature	Rank Precipitation	Rank Snowfall
2019	0.12	278.6	155.1	-1775.5	181	1	21	28
2018	-1.33	424.5	274.2	-1904.8	196	2	1	2
2017	-3.01	225.0	136.7	-2631.1	194	7	43	36
2016	-1.84	258.1	151.6	-2142.9	200	3	31	30
2015	-2.34	247.8	63.6	-2428.8	208	5	36	68
2014	-2.27	260.5	82.8	-2136.8	178	4	30	62
2013	-5.41	402.0	95.3	-3207.3	223	38	2	57
2012	-6.93	295.8	219.1	-3662.4	222	61	17	8
2011	-3.76	387.4	263.9	-2772.6	216	11	6	4
2010	-5.03	226.5	108.4	-3098.2	223	29	42	52
2009	-5.93	390.0	271.9	-3341.0	220	45	5	3
2008	-4.66	221.0	221.4	-3109.2	218	20	44	7
2007	-4.83	272.7	168.8	-2946.2	213	26	23	20
2006	-5.98	263.3	158.7	-3468.6	216	47	27	24
2005	-4.00	268.3	304.7	-2873.6	213	15	26	1
2004	-3.64	313.5	229.7	-2698.2	181	10	13	6
2003	-2.73	244.0	172.6	-2262.9	195	6	37	16
2002	-5.27	269.0	187.7	-3174.1	217	32	25	10
2001	-4.31	327.6	175.2	-2442.7	245	17	9	12
2000	-6.23	205.4	85.9	-3426.1	229	52	59	61
1999	-6.22	324.3	188.6	-3415.2	224	51	10	9
1998	-3.94	390.4	126.9	-2809.2	208	14	4	38
1997	-5.35	252.7	147.0	-3110.3	216	34	33	32
1996	-4.80	214.5	158.4	-3090.8	209	24	46	25
1995	-5.92	393.7	113.4	-3334.5	210	44	3	47
1994	-4.74	336.6	173.2	-2878.6	208	23	8	15
1993	-5.74	243.8	148.1	-3259.1	237	43	38	31
1992	-6.24	208.6	112.2	-3477.4	222	53	53	48
1991	-5.44	377.8	230.3	-3376.2	210	40	7	5
1990	-5.94	323.5	126.6	-3552.6	207	46	11	39
1989	-5.37	277.9	184.5	-3078.5	224	36	22	11
1988	-4.56	211.1	121.4	-2871.3	198	19	50	43
1987	-4.96	271.2	103.5	-2968.0	226	27	24	55
1986	-5.28	238.4	95.2	-3060.9	227	33	39	58
1985	-6.10	284.3	124.2	-3206.1	219	50	19	41
1984	-6.77	284.3	115.0	-3443.6	236	59	20	46
1983	-4.06	231.5	98.5	-2756.5	211	16	41	56
1982	-5.42	262.5	106.0	-3098.9	233	39	29	53
1981	-3.84	169.5	105.4	-2602.5	211	12	66	54
1980	-3.91	290.1	111.2	-2818.7	196	13	18	49

1979	-3.29	207.5	64.3	-2648.8	221	8	55	67
1978	-3.52	210.9	40.7	-2795.1	206	9	51	70
1977	-5.47	157.8	128.4	-3173.8	216	41	68	37
1976	-8.25	199.7	124.5	-3923.1	239	69	62	40
1975	-7.17	214.0	109.3	-3768.4	236	65	48	51
1974	-7.05	256.3	122.8	-3497.1	238	63	32	42
1973	-5.35	209.2	170.3	-3209.6	214	35	52	18
1972	-6.97	207.2	174.4	-3658.1	227	62	56	14
1971	-7.96	160.3	109.6	-3975.5	237	68	67	50
1970	-5.39	104.9	75.6	-3074.4	205	37	70	65
1969	-4.50	146.9	88.2	-3064.8	217	18	69	59
1968	-6.49	201.8	155.9	-3414.4	223	56	61	27
1967	-4.68	179.6	164.7	-2886.5	219	22	65	22
1966	-7.48	262.7	169.0	-3642.3	240	66	28	19
1965	-6.55	193.0	174.7	-3507.8	210	57	64	13
1964	-8.76	300.6	154.0	-4130.0	227	70	15	29
1963	-5.07	248.2	146.9	-3043.6	217	30	35	33
1962	-5.99	202.5	166.3	-3273.7	222	48	60	21
1961	-5.53	300.4	137.7	-3103.4	221	42	16	35
1960	-6.68	213.1	74.7	-3420.9	220	58	49	66
1959	-6.27	237.4	81.3	-3461.0	220	54	40	63
1958	-4.80	207.0	142.6	-3037.2	215	25	57	34
1957	-6.44	196.0	163.3	-3520.9	224	55	63	23
1956	-7.11	216.8	158.0	-3712.5	212	64	45	26
1955	-7.48	305.9	120.4	-3711.7	225	67	14	45
1954	-5.99	206.9	120.7	-3285.1	214	49	58	44
1953	-5.17	214.3	62.6	-2982.6	213	31	47	69
1952	-6.85	322.7	171.6	-3485.5	236	60	12	17
1951	-5.01	250.8	87.8	-3263.0	199	28	34	60

References

GISTEMP Team, 2019: GISS Surface Temperature Analysis (GISTEMP). NASA Goddard Institute for Space Studies. Dataset accessed 2020-04-13 at data.giss.nasa.gov/gistemp/.