Supplementary Material: A Lagrangian Analysis of the Dynamical and Thermodynamic Drivers of Greenland Melt Events during 1979–2017

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Table S1. Melt events EV1–31 listed with their start and end date (“YYYY-MM-DD HH”), duration (dur.), maximum elevation (ME), $T2M$ at maximum elevation ($T2M_{avg}^{ME}$), minimum melt extent (min. A.) and maximum melt extent (max. A.) – sorted by date.

ID	start	end	dur. [d]	ME [m]	$T2M_{avg}^{ME}$ [°C]	min. A. [frac]	max. A. [frac]
1	1979-07-24 18	1979-07-26 18	2.25	2606	−1.17	0.32	0.70
2	1981-06-25 18	1981-06-27 18	2.25	2549	−1.29	0.30	0.62
3	1981-07-21 12	1981-07-24 18	3.5	2729	2.44	0.25	0.59
4	1983-06-30 18	1983-07-01 18	1.25	2606	−0.27	0.25	0.67
5	1984-07-03 18	1984-07-08 18	5.25	2549	−1.72	0.19	0.68
6	1984-07-22 18	1984-07-24 18	2.25	2537	−0.57	0.22	0.66
7	1984-07-26 18	1984-07-27 18	1.25	2333	−0.06	0.34	0.61
8	1985-08-12 18	1985-08-14 18	2.25	2810	−0.51	0.23	0.54
9	1986-07-02 18	1986-07-03 18	1.25	2394	0.67	0.16	0.54
10	1986-07-20 18	1986-07-22 18	2.25	2729	2.43	0.29	0.53
11	1987-06-12 18	1987-06-13 18	1.25	2717	−1.17	0.26	0.56
12	1987-06-18 18	1987-06-22 18	4.25	2826	−1.87	0.13	0.63
13	1987-08-07 18	1987-08-10 18	3.25	2734	−1.07	0.15	0.72
14	1988-07-04 12	1988-07-12 18	8.5	2658	−0.10	0.20	0.69
15	1988-07-21 18	1988-07-22 18	1.25	2413	0.27	0.22	0.63
16	1989-07-13 18	1989-07-20 18	7.25	2810	−1.27	0.24	0.69
17	1990-07-28 18	1990-07-30 18	2.25	2748	−0.43	0.18	0.70
18	1990-08-05 18	1990-08-06 18	1.25	2628	−1.27	0.24	0.63
19	1991-06-18 18	1991-06-19 18	1.25	2810	−1.62	0.19	0.57
20	1991-06-26 18	1991-06-27 18	1.25	2394	−1.53	0.25	0.52
21	1991-06-29 12	1991-07-02 18	3.5	2606	−0.47	0.17	0.53
22	1991-07-04 18	1991-07-13 18	9.25	3000	−1.46	0.14	0.68
23	1994-07-07 18	1994-07-08 18	1.25	2443	0.55	0.27	0.68
24	1995-06-30 18	1995-07-03 18	3.25	2810	−0.25	0.17	0.65
25	1995-07-12 18	1995-07-16 18	4.25	2969	−0.36	0.24	0.77
26	1997-08-11 18	1997-08-13 18	2.25	2970	0.99	0.23	0.66
27	1998-08-01 18	1998-08-03 18	2.25	2637	−0.83	0.22	0.61
28	1999-06-28 18	1999-07-03 18	5.25	2721	−0.62	0.17	0.70
29	1999-07-25 18	1999-07-31 18	6.25	2628	−0.89	0.20	0.64
30	1999-08-02 18	1999-08-06 18	4.25	2826	−2.56	0.14	0.61
31	2000-07-28 18	2000-07-29 18	1.25	2637	0.49	0.39	0.70

Table S2. As Table S1 for EV32–64.

ID	start	end	dur. [d]	ME [m]	T2M_{avg}^{ME} [°C]	min. A. [frac]	max. A. [frac]
32	2000-08-01 00	2000-08-02 18	2	2729	0.61	0.34	0.59
33	2000-08-19 18	2000-08-21 18	2.25	2634	0.43	0.19	0.53
34	2002-06-11 18	2002-06-14 18	3.25	2810	−0.67	0.13	0.71
35	2002-06-27 18	2002-07-03 18	6.25	3156	−0.44	0.25	1.08
36	2002-07-06 18	2002-07-07 18	1.25	2444	1.23	0.18	0.64
37	2002-07-20 18	2002-07-21 18	1.25	2719	−0.67	0.28	0.70
38	2003-08-26 18	2003-08-30 18	4.25	2729	−0.30	0.15	0.63
39	2004-06-18 12	2004-06-23 18	5.5	2826	−1.05	0.15	0.62
40	2004-07-05 18	2004-07-12 18	7.25	3175	−0.15	0.23	0.86
41	2004-08-11 18	2004-08-12 18	1.25	2810	−0.06	0.36	0.69
42	2005-06-13 18	2005-06-16 18	3.25	2628	0.67	0.17	0.70
43	2005-07-02 18	2005-07-03 18	1.25	2486	−0.17	0.23	0.68
44	2005-07-13 18	2005-07-15 18	2.25	2729	2.98	0.35	0.66
45	2005-07-21 18	2005-07-30 18	9.25	2916	−0.58	0.28	0.91
46	2006-07-19 18	2006-07-28 18	9.25	3100	−0.51	0.22	0.85
47	2006-08-03 18	2006-08-05 18	2.25	2606	−0.98	0.26	0.65
48	2006-08-15 00	2006-08-18 18	4	2758	−0.91	0.29	0.78
49	2007-06-10 18	2007-06-13 18	3.25	2637	1.88	0.20	0.63
50	2007-06-22 18	2007-06-29 18	7.25	2637	5.04	0.18	0.73
51	2007-07-06 18	2007-07-22 18	16.25	2658	0.70	0.20	0.74
52	2007-07-24 18	2007-07-25 18	1.25	2381	−2.37	0.27	0.65
53	2008-06-13 18	2008-06-14 18	1.25	2637	1.14	0.39	0.67
54	2008-06-17 18	2008-06-18 18	1.25	2482	2.37	0.18	0.55
55	2008-07-05 18	2008-07-06 18	1.25	2786	−0.91	0.40	0.76
56	2008-07-28 18	2008-07-31 18	3.25	2537	0.59	0.19	0.73
57	2009-07-06 18	2009-07-16 18	10.25	2943	−0.10	0.25	0.82
58	2009-07-20 18	2009-07-23 18	3.25	2486	0.09	0.22	0.71
59	2010-07-18 18	2010-07-19 18	1.25	2486	0.11	0.13	0.60
60	2010-07-23 18	2010-07-27 18	4.25	2486	−0.88	0.20	0.63
61	2010-07-29 18	2010-08-02 18	4.25	2537	−1.22	0.20	0.64
62	2010-08-09 18	2010-08-10 18	1.25	2455	−0.28	0.14	0.49
63	2010-08-15 18	2010-08-16 18	1.25	2628	−0.26	0.16	0.50
64	2011-06-13 18	2011-06-15 18	2.25	2856	0.93	0.10	0.68

Table S3. As Table S1 for EV65–77.

ID	start	end	dur. [d]	ME [m]	T2M^{ME}_{avg} [°C]	min. A. [frac]	max. A. [frac]
65	2011-07-06 18	2011-07-10 18	4.25	2916	−0.78	0.24	0.73
66	2011-07-13 18	2011-07-15 18	2.25	2455	0.20	0.25	0.76
67	2011-07-18 18	2011-07-23 18	5.25	2526	0.03	0.21	0.69
68	2012-06-15 18	2012-06-29 18	14.25	2916	−1.81	0.18	0.81
69	2012-07-02 18	2012-07-17 18	15.25	3175	−0.13	0.23	1.21
70	2012-07-27 18	2012-08-08 18	12.25	3100	−1.08	0.22	0.96
71	2013-07-24 18	2013-07-28 18	4.25	2826	−2.44	0.17	0.71
72	2013-07-30 18	2013-08-02 18	3.25	2608	−1.07	0.16	0.62
73	2015-07-02 18	2015-07-09 18	7.25	2605	0.43	0.27	0.79
74	2016-06-10 18	2016-06-14 18	4.25	2652	−1.47	0.18	0.66
75	2016-06-22 18	2016-06-25 18	3.25	2581	2.50	0.23	0.55
76	2016-07-18 18	2016-07-24 18	6.25	2607	0.25	0.25	0.76
77	2017-07-25 12	2017-07-27 18	2.5	2628	1.98	0.28	0.76

Figure S1. LFP maps of the median potential temperature anomaly θ' wrt. local climatology θ_{cl} at $t = -192$ h (a) during all melt events, (c) during EV69, and (b,d) the respective anomaly wrt. the climatological summertime air streams. The contours indicate elevation in 500 m intervals with the 2000 m isoline in solid. Summit and Southdome are marked with triangles.

Figure S2. As Fig. 7 but for (a) total column water vapor (*TCV*), (b) total column liquid ice water (*TCIW*), (c) surface longwave downward radiation (*STRD*), (d) net surface longwave radiation (*STR*), (e) net surface shortwave radiation (*SSR*) during EV69 melt time steps, and (f–j) their anomalies wrt. climatology.

Figure S3. As Fig. S2 but for melt time steps during all Greenland melt events.