



Supplement of

Extensive and anomalous grounding line retreat at Vanderford Glacier, Vincennes Bay, Wilkes Land, East Antarctica

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Supplementary Material

Table S1. Details of the optical satellite imagery used within this study. Note that multiple scenes were required for each year in order to provide full coverage across Vincennes Bay.

Date	Satellite	Scene ID	Bands	Resolution (m)	Error (m)
10/02/2022	Sentinel 2B	L1C_T49DDG_A025754_20220210T014534	4, 3, 2	10	15
10/02/2022	Sentinel 2B	L1C_T49DDF_A025754_20220210T014534	4, 3, 2	10	15
10/02/2022	Sentinel 2B	L1C_T48DXM_A025754_20220210T014534	4, 3, 2	10	15
08/02/2021	Sentinel 2B	L1C_T49DDF_A020506_20210208T015541	4, 3, 2	10	15
26/01/2021	Sentinel 2B	L1C_T49DDG_A020320_20210126T014540	4, 3, 2	10	15
16/01/2021	Sentinel 2B	L1C_T48DXM_A020177_20210116T014540	4, 3, 2	10	15
27/02/2020	Landsat 8	LC08_L2SR_105107_20200227_20201016_02_T2	4, 3, 2	30	45
01/02/2020	Sentinel 2B	L1C_T49DDF_A015172_20200201T014533	4, 3, 2	10	15
01/02/2020	Sentinel 2B	L1C_T48DXM_A015172_20200201T014533	4, 3, 2	10	15
16/02/2019	Sentinel 2B	L1C_T49DDG_A010167_20190216T014609	4, 3, 2	10	15
16/02/2019	Sentinel 2B	L1C_T48DXL_A010167_20190216T014609	4, 3, 2	10	15
16/02/2019	Sentinel 2B	L1C_T48DXM_A010167_20190216T014609	4, 3, 2	10	15
16/02/2018	Sentinel 2A	L1C_T49DDG_A013856_20180216T014537	4, 3, 2	10	15
16/02/2018	Sentinel 2A	L1C_T49DDF_A013856_20180216T014537	4, 3, 2	10	15
16/02/2018	Sentinel 2B	L1C_T48DXM_A013856_20180216T014537	4, 3, 2	10	15
25/01/2017	Sentinel 2A	L1C_T49DDF_A008322_20170125T015534	4, 3, 2	10	15
12/01/2017	Sentinel 2A	L1C_T49DDG_A008136_20170112T014531	4, 3, 2	10	15
12/01/2017	Sentinel 2A	L1C_T48DXM_A008136_20170112T014531	4, 3, 2	10	15
14/02/2016	Landsat 8	LC08_L2SR_107107_20160214_20201016_02_T2	4, 3, 2	30	45
22/01/2016	Landsat 8	LC08_L2SR_106107_20160122_20201016_02_T2	4, 3, 2	30	45
19/12/2015	Landsat 8	LC08_L2SR_108107_20151219_20201016_02_T2	4, 3, 2	30	45
05/12/2015	Landsat 8	LC08_L2SR_106107_20151205_20201016_02_T2	4, 3, 2	30	45
10/01/2015	Landsat 8	LC08_L2SR_107107_20150110_20201016_02_T2	4, 3, 2	30	45
01/02/2014	Landsat 8	LC08_L2SR_106107_20140201_20201016_02_T2	4, 3, 2	30	45
25/01/2014	Landsat 8	LC08_L2SR_105107_20140125_20201016_02_T2	4, 3, 2	30	45
22/02/2013	Landsat 7	LE07_L1GT_106107_20130222_20200908_02_T2	3, 2, 1	30	45
07/01/2013	Landsat 7	LE07_L1GT_104107_20130107_20200908_02_T2	3, 2, 1	30	45

20/12/2012	Landsat 7	LE07_L1GT_106107_20121220_20200908_02_T2	3, 2, 1	30	45
28/01/2012	Landsat 7	LE07_L1GT_105107_20120128_20200909_02_T2	3, 2, 1	30	45
26/01/2012	Landsat 7	LE07_L1GT_107107_20120126_20200909_02_T2	3, 2, 1	30	45
01/02/2011	Landsat 7	LE07_L1GT_106107_20110201_20200910_02_T2	3, 2, 1	30	45
25/01/2011	Landsat 7	LE07_L1GT_105107_20110125_20200910_02_T2	3, 2, 1	30	45
21/02/2010	Landsat 7	LE07_L1GT_107107_20100221_20200911_02_T2	3, 2, 1	30	45
14/02/2010	Landsat 7	LE07_L1GT_106107_20100214_20200911_02_T2	3, 2, 1	30	45
02/02/2009	Landsat 7	LE07_L1GT_107107_20090202_20200912_02_T2	3, 2, 1	30	45
19/01/2009	Landsat 7	LE07_L1GT_105107_20090119_20200912_02_T2	3, 2, 1	30	45
10/01/2009	Landsat 7	LE07_L1GT_106107_20090110_20200912_02_T2	3, 2, 1	30	45
03/01/2009	Landsat 7	LE07_L1GT_105107_20090103_20200912_02_T2	3, 2, 1	30	45
11/02/2008	Landsat 7	LE07_L1GT_104107_20080211_20200913_02_T2	3, 2, 1	30	45
09/02/2008	Landsat 7	LE07_L1GT_106107_20080209_20200912_02_T2	3, 2, 1	30	45
21/01/2007	Landsat 7	LE07_L1GT_106107_20070121_20200913_02_T2	3, 2, 1	30	45
14/01/2007	Landsat 7	LE07_L1GT_105107_20070114_20200913_02_T2	3, 2, 1	30	45
12/01/2003	Landsat 7	LE07_L1GT_104107_20030112_20200916_02_T2	3, 2, 1	30	45
16/12/2002	Landsat 7	LE07_L1GT_107107_20021216_20200916_02_T2	3, 2, 1	30	45
06/12/2001	Landsat 7	LE07_L1GT_106107_20011206_20200917_02_T2	3, 2, 1	30	45
22/01/2001	Landsat 7	LE07_L1GT_104107_20010122_20200917_02_T2	3, 2, 1	30	45
02/01/2000	Landsat 7	LE07_L1GT_106107_20000102_20200918_02_T2	3, 2, 1	30	45
11/02/1991	Landsat 5	LT05_L1GS_105107_19910211_20200915_02_T2	3, 2, 1	30	45
02/02/1991	Landsat 5	LT05_L1GS_106107_19910202_20200915_02_T2	3, 2, 1	30	45
08/01/1990	Landsat 4	LT04_L1GS_104107_19900108_20200916_02_T2	3, 2, 1	30	45
30/12/1989	Landsat 4	LT04_L1GS_105107_19891230_20200916_02_T2	3, 2, 1	30	45
18/02/1989	Landsat 4	LT04_L1GS_108107_19890218_20200916_02_T2	3, 2, 1	30	45
06/12/1973	Landsat 1	LM01_L1GS_112107_19731206_20200908_02_T2	7	60	90
17/11/1973	Landsat 1	LM01_L1GS_111107_19731117_20200909_02_T2	7	60	90
12/03/1973	Landsat 1	LM01_L1GS_113107_19730312_20200909_02_T2	7	60	90
1963	KH-5 ARGON	ARGON mosaic (Kim <i>et al.</i> , 2007)	-	140	210

Table S2. Percentage velocity data coverage within defined boxes a) Inland (IN), b) Up-glacier of the grounding line (GL), c) Floating tongue (FT). Missing values reflect velocity data omitted from our analysis due to either < 25% data coverage or associated errors being > 50% of the calculated velocity magnitude (Section 2.3).

a) IN

Year	Vanderford	Adams	Anzac	Bond East	Bond West	Underwood
2000	39	61	-	-	-	49
2002	-	-	-	100	-	97
2006	41	65	-	100	-	-
2007	-	-	100	100	-	75
2008	58	98	100	100	34	97
2009	35	68	68	100	-	85
2010	-	84	100	100	-	59
2011	99	100	100	100	-	98
2012	47	82	-	100	44	-
2013	100	100	100	100	100	100
2014	100	100	100	100	100	100
2015	100	100	100	100	100	100
2016	100	100	100	100	100	100
2017	100	100	100	100	100	100
2018	100	100	100	100	100	100
2019	100	100	100	100	43	100
2020	100	100	100	100	43	100
2021	100	100	100	100	32	100

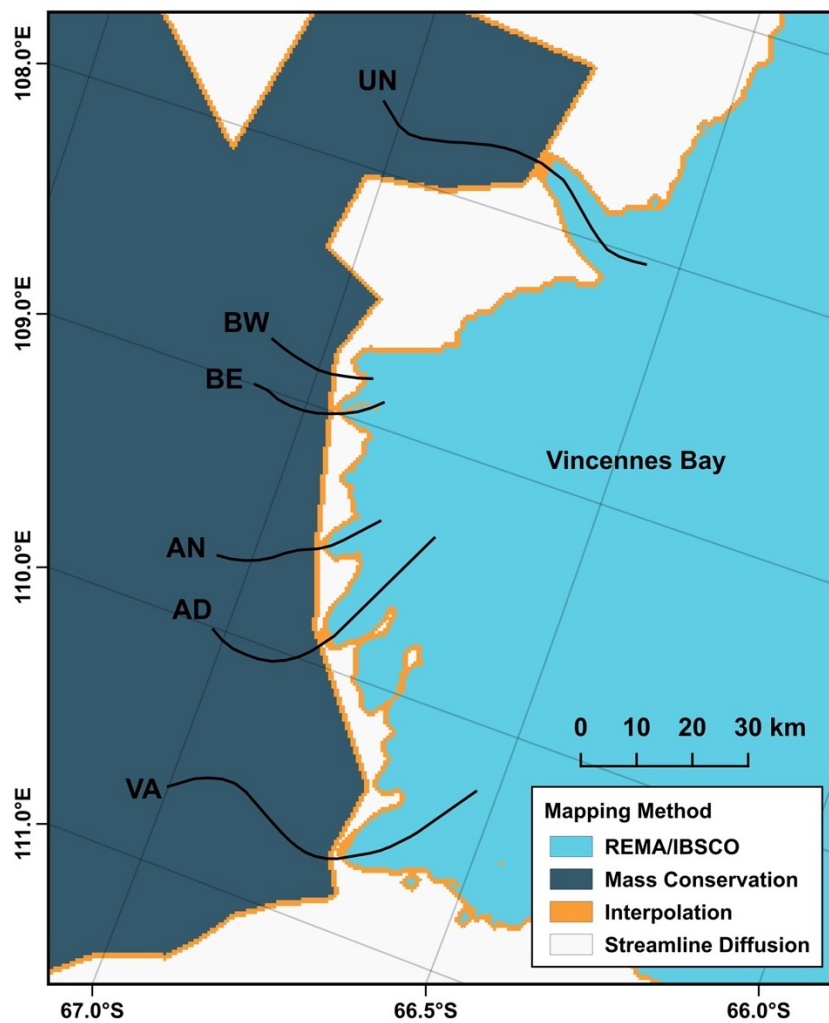
b) GL

Year	Vanderford	Adams	Anzac	Bond East	Bond West	Underwood
2000	100	94	70	-	-	27
2002	100	-	67	100	99	91
2006	99	98	89	92	100	-
2007	100	98	91	100	100	80
2008	100	99	100	100	100	100
2009	100	97	99	100	100	94
2010	100	99	88	100	100	77
2011	100	100	100	100	100	99
2012	100	90	-	100	100	79
2013	100	100	100	100	100	100
2014	100	100	100	100	100	100
2015	100	100	100	100	100	100
2016	100	100	100	100	100	100
2017	100	100	100	100	100	100
2018	100	100	100	100	100	100
2019	100	100	100	100	100	100
2020	100	100	100	100	100	84
2021	100	100	100	100	100	92

c) FT

Year	Vanderford	Adams	Anzac	Bond East	Bond West	Underwood
2000	39	61	-	-	-	49
2002	-	-	-	100	-	97
2006	41	65	-	100	-	-
2007	-	-	100	100	-	75
2008	58	98	100	100	34	97
2009	35	68	68	100	-	85
2010	-	84	100	100	-	59
2011	99	100	100	100	-	98
2012	47	82	-	100	44	-
2013	100	100	100	100	100	100
2014	100	100	100	100	100	100
2015	100	100	100	100	100	100
2016	100	100	100	100	100	100
2017	100	100	100	100	100	100
2018	100	100	100	100	100	100
2019	100	100	100	100	43	100
2020	100	100	100	100	43	100
2021	100	100	100	100	32	100

15 **Figure S1.** Map displaying the different mapping methods employed within BedMachine to map bed elevation across Vincennes Bay (Morlighem, 2020).



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Table S3. Width-averaged terminus position change across the Vincennes Bay outlet glaciers. Note that distance is measured relative to the earliest observation, with positive values indicative of advance and negative values indicative of retreat.

Width-averaged terminus position change (m)

Date	Vanderford	Adams	Anzac	Bond East	Bond West	Underwood
10/02/2022	674.9	-3754.4	2096.9	-657.7	-183.9	-848.1
08/02/2021	-	-4140.5	2071.7	-972.9	-682.4	-
26/01/2021	-311.1	-	-	-	-	-
16/01/2021	-	-	-	-	-	1941.5
27/02/2020	-1209.4	-	-	-	-	-
01/02/2020	-	-2365.9	2306.7	422.4	110.7	3785.3
16/02/2019	-1566.2	-2528.1	2310.9	123.1	-143.3	2471.0
16/02/2018	-2363.9	-2961.4	1976.6	-253.1	476.1	1709.0
25/01/2017	-	-3222.2	2392.4	-685.9	409.8	-
12/01/2017	-3356.3	-	-	-	-	136.1
14/02/2016	-	-3683.8	2294.0	-1087.7	-359.0	656.1
22/01/2016	-886.0	-	-	-	-	-
19/12/2015	-	-	-	-	-	372.7
05/12/2015	-992.4	-	-	-	-	-
10/01/2015	-	-3817.8	2111.5	-516.7	-576.8	-
01/02/2014	-	-	-	-	-	-813.5
25/01/2014	-2165.5	-2583.4	1796.7	-468.0	-565.9	-
22/02/2013	-	-2855.7	1466.5	-273.9	-64.2	-2096.0
07/01/2013	-1952.6	-	-	-	-	-
20/12/2012	-1992.8	-	-	-	-	-
28/01/2012	-	-3251.1	1139.2	-891.9	-988.8	-
26/01/2012	-	-	-	-	-	-2605.6
01/02/2011	-	-	-	97.5	-151.6	-2492.0
25/01/2011	-2277.6	-3560.1	886.2	-	-	-
21/02/2010	-	-	-	-	-	-1827.1
14/02/2010	-2590.0	-3513.3	678.3	-394.6	-306.0	-
02/02/2009	-	-	-	-411.3	396.0	-
19/01/2009	235.2	-	-	-	-	-
10/01/2009	-	-	-	-	-	-811.0
03/01/2009	-	-3047.7	2003.1	-	-	-
11/02/2008	-552.6	-	-	-	-	-
09/02/2008	-	-3550.7	1717.5	112.8	-10.5	-1575.0
21/01/2007	-	-	-	-388.9	-392.7	-349.5
14/01/2007	1312.9	-2166.7	1537.3	-	-	-
12/01/2003	1445.9	-	-	-	-	-
16/12/2002	-	-2224.3	2175.5	-680.5	-594.3	-857.5
06/12/2001	-	-2618.3	2042.4	-402.6	455.1	-1924.9
22/01/2001	1944.3	-	-	-	-	-
02/01/2000	931.9	-1948.1	1356.9	358.1	-547.0	-1784.5
11/02/1991	-5102.0	-983.6	501.7	-709.1	-199.1	-
02/02/1991	-	-	-	-	-	-3592.8
08/01/1990	-4325.7	-	-	-	-	-
30/12/1989	-	-1200.2	130.6	-1047.1	-113.8	-
18/02/1989	-	-	-	-	-	-1747.9
06/12/1973	-1078.5	2511.8	1165.9	-	-	-
17/11/1973	-	-	-	0.0	0.0	-
12/03/1973	-	-	-	-	-	0.0
01/10/1963	0.0	0.0	0.0	-	-	-

Figure S2. Monthly surface elevation anomalies observed in each IN box at (a) Vanderford Glacier, (b) Adams Glacier, (c) Anzac Glacier, (d) Bond East Glacier, (e) Bond West Glacier, and (f) Underwood Glacier between 1992 and 2020. Elevation anomalies are calculated relative to the long-term 1992-2017 mean. Bold lines represent 24-month rolling means.

