Supplement of

Calving front positions for 19 key glaciers of the Antarctic Peninsula: a sub-seasonal record from 2013 to 2023 based on a deep learning application to Landsat multispectral imagery

Erik Loebel et al.

Correspondence: Erik Loebel (erik.loebel@tu-dresden.de)

Table S1. Temporal coverage of the reference data used in this study. The numbers and the color intensity indicate the amount of calving front positions in the respective year. Calving fronts from 2013 to 2021 were used for model training, and calving fronts from 2022 and 2023 were used for model testing.

Greenland

Year	Jakobshavn Isbræ	Eqip Sermia	Helheim Glacier	Kangerdlussuaq Glacier	Daugaard Jensen Glacier	Nioghalvfjerdsbræ	Zachariae Isstrøm	Humboldt Glacier	Ingia Isbræ	Ryder Glacier	Academy Glacier	Hagen Bræ	Kangiata Nunaata Sermia	Hayes Glacier	Sverdrup Glacier	Upernavik Isstrøm	Kong Oscar Glacier	Døcker Smith Glacier	Harald Molke Bræ	Waltershausen Glacier	Tracy Glacier	Rink Isbræ	Store Glacier
2013	4	1	4	7	1	4	3	2	4	4	4	6	3	2	3	2	1	1	3				
2014	5	3	5	6	8	8	8	3	2	2	6	10	8	1	4	4	1	2	5				
2015	8	3	3	6	6	5	6	3	3	4	6	4	9	3	6	6	5	6	5				
2016	10	3	8	8	11	8	9	4	5	7	5	6	8	5	7	7	5	4	5				
2017	7	3	6	5	10	7	7	2	3	5	4	6	4	4	4	8	4	5	4				
2018	8	2	2	9	13	5	5	4	4	4	2	9	8	4	4	4	4	4	4				
2019	6	6	9	9	8	13	8	3	4	6	2	8	5	7	9	8	8	7	3				
2020	8	5	5	5	7	4	6	4	5	5	5	8	7	6	5	7	5	5	5	6	5	5	3
2021	2	1	2	2	2	2	2	1	2	2	2	2	2	1	2	1	2	1	1	2	4	4	3
2022																							
2023																							
Total	58	27	44	57	66	56	54	26	32	39	36	59	54	33	44	47	35	35	35	8	9	9	6
	869																						

Antarctic peninsula

Year	Jorum	Punchbowl	Prospect	HGE	Drygalski Glacier	Birley	Bleriot	Crane	Edgeworth	Hugi	Murphy Wilkinson	Stringfellow	Trooz	Widdowson	Cayley	Fleming	Hariot	Sjogren	Boydell	Total
2013	1	1	1	1		2								2		1		2	2	1105
2014	3	3	3	6	2	2								1		1		1	1	
2015	2	2	5	4		2		1						2		3		2	2	
2016	2	2	4	6	2	2		2						1		3		2	2	
2017	4	4	6	3		1		4						2		5		1	1	
2018	5	5	2	2	1	3		3						2		1				
2019	3	3	3	1	1	1		2						2		1				
2020	4	4	2	4	5	2		5						1		1		4	4	
2021	4	4	3	8	4	2		4						2		2		3	3	
2022	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	57
2023	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Total	31	31	32	39	18	20	3	24	3	3	3	3	3	18	3	21	2	18	18	1162
	293																			

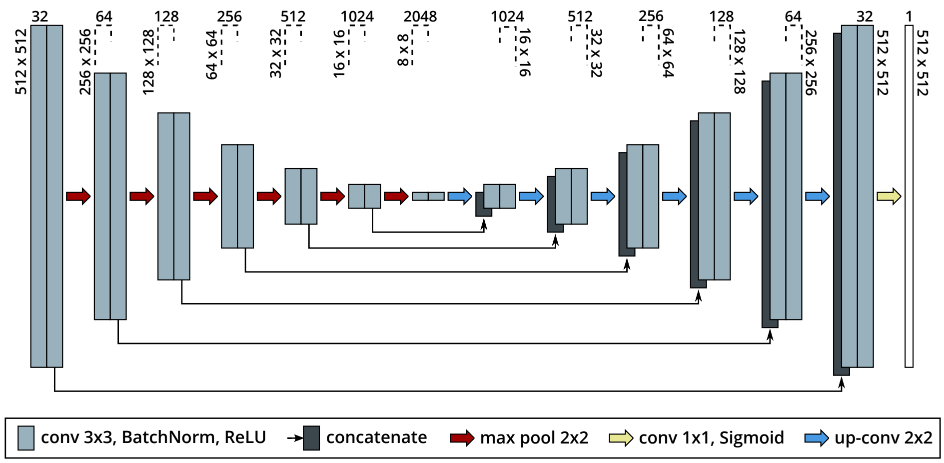

Figure S1. The U-Net based ANN architecture that was applied in this study. One single contracting sequence comprises convolutions followed by batch normalization, a rectified linear unit (ReLU), and a max-pooling operation. One single expanding sequence consists of concatenation with spatial context from the contracting path, convolutions followed by batch normalization, and a ReLU. All dimensions are denoted at the top of the blocks.

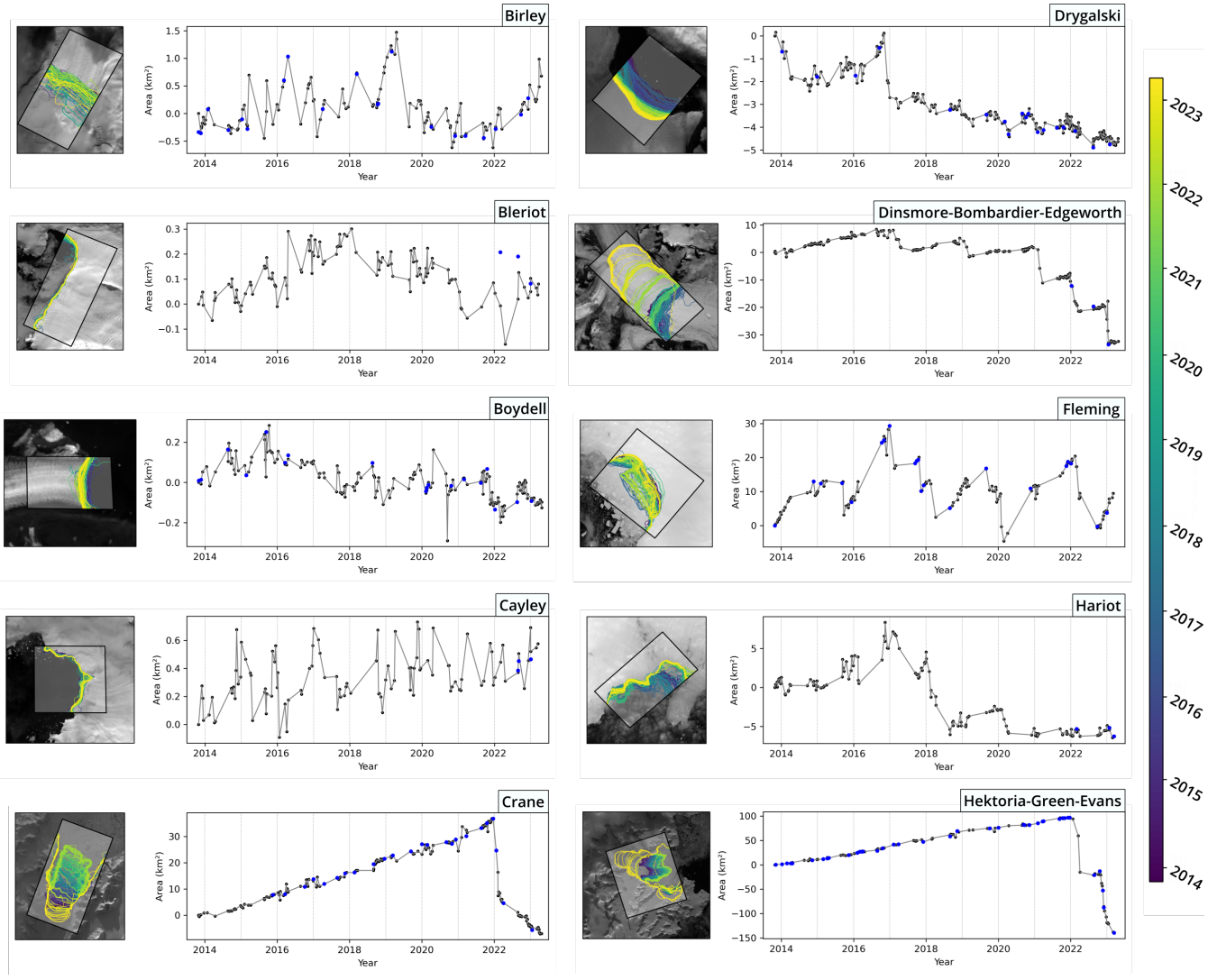

Figure S2. Time series generated by our ANN algorithm for 10 of the 19 glaciers provided in our data product. For each glacier, a satellite image, containing the color-coded calving front trajectories, and the corresponding time series is shown. Black dots connected by solid lines mark the automatically delineated calving front positions. The blue dots are additional validation marks that indicate the frontal positions of the manually delimited reference data set. The ANN model was trained using reference data from 2013 to 2021 and tested using data from 2022 and 2023. Note that the ordinate axis is scaled differently for each glacier. Landsat imagery courtesy of the U.S. Geological Survey.

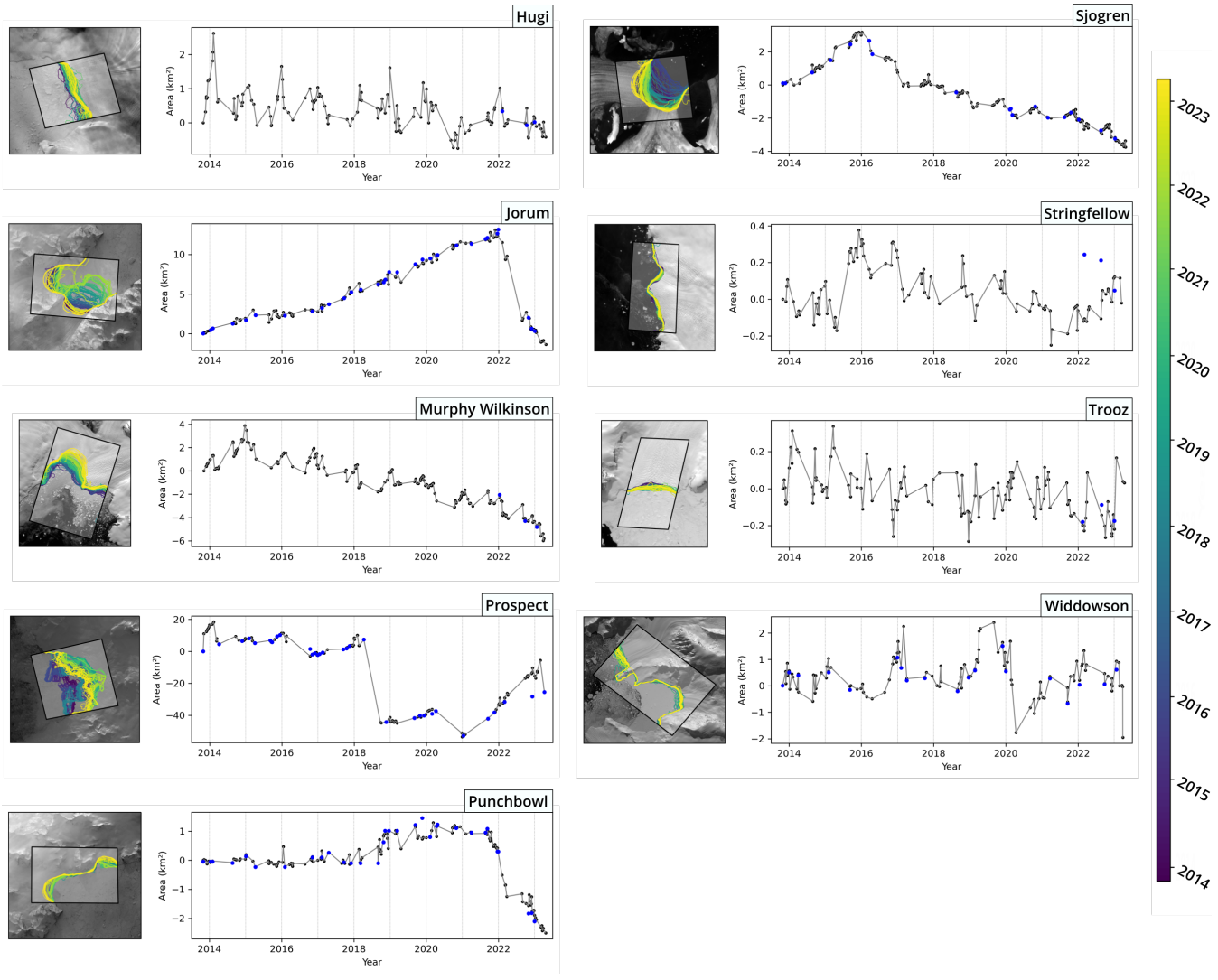

Figure S3. Time series generated by our ANN algorithm for 9 of the 19 glaciers provided in our data product. For each glacier, a satellite image, containing the color-coded calving front trajectories, and the corresponding time series is shown. Black dots connected by solid lines mark the automatically delineated calving front positions. The blue dots are additional validation marks that indicate the frontal positions of the manually delimited reference data set. The ANN model was trained using reference data from 2013 to 2021 and tested using data from 2022 and 2023. Note that the ordinate axis is scaled differently for each glacier. Landsat imagery courtesy of the U.S. Geological Survey.