

Figure S1. Exemplary feature maps over a supraglacial lake and surrounding area after activation of the first convolution within each of the four downsampling blocks.

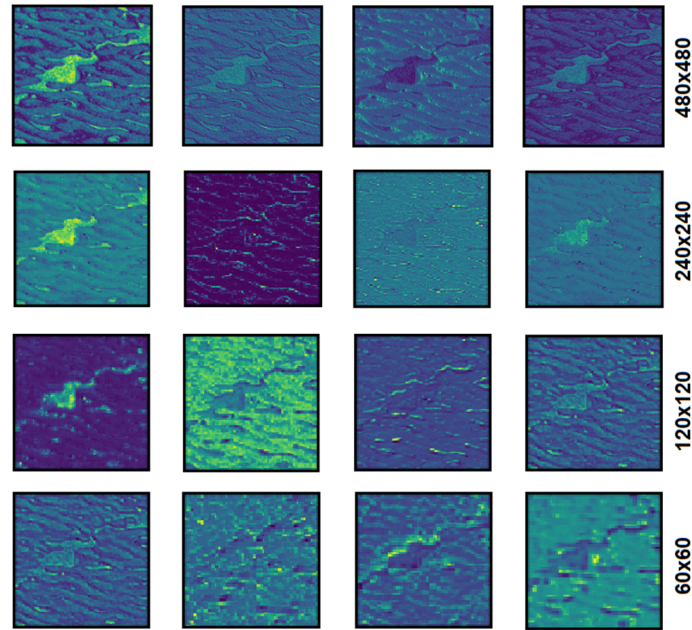


Table S1. Sentinel-1 training acquisitions covering selected regions during the 2018/2019 and 2019/2020 Antarctic summer melt seasons and additional Sentinel-1 test scenes covering northern George VI Ice Shelf during December 2019, January 2020 and February 2020. Acquisitions marked with a star denote their use during both, training and testing whereat training was performed by means of aggregated monthly backscattering minimum products rather than individual acquisitions.

ID	No.	Date	Relative Orbit	Study Area	Study Region	Orbit direction
Training Data						
1	1	06.12.2019	53	Pine Island Bay	WAIS	Descending
1	2	12.12.2019	53	Pine Island Bay	WAIS	Descending
1	3	18.12.2019	53	Pine Island Bay	WAIS	Descending
1	4	24.12.2019	53	Pine Island Bay	WAIS	Descending
1	5	30.12.2019	53	Pine Island Bay	WAIS	Descending
2	6	05.01.2020	53	Pine Island Bay	WAIS	Descending
2	7	11.01.2020	53	Pine Island Bay	WAIS	Descending
2	8	17.01.2020	53	Pine Island Bay	WAIS	Descending
2	9	23.01.2020	53	Pine Island Bay	WAIS	Descending
2	10	29.01.2020	53	Pine Island Bay	WAIS	Descending
3	11*	07.01.2020	169	George VI Ice Shelf	API	Descending
3	12*	13.01.2020	169	George VI Ice Shelf	API	Descending
3	13*	19.01.2020	169	George VI Ice Shelf	API	Descending
3	14*	25.01.2020	169	George VI Ice Shelf	API	Descending
4	15*	06.02.2020	169	George VI Ice Shelf	API	Descending
4	16*	12.02.2020	169	George VI Ice Shelf	API	Descending
4	17*	18.02.2020	169	George VI Ice Shelf	API	Descending
4	18*	24.02.2020	169	George VI Ice Shelf	API	Descending
5	19	04.01.2020	38	Larsen Ice Shelf	API	Descending
5	20	10.01.2020	38	Larsen Ice Shelf	API	Descending
5	21	16.01.2020	38	Larsen Ice Shelf	API	Descending
5	22	22.01.2020	38	Larsen Ice Shelf	API	Descending
5	23	28.01.2020	38	Larsen Ice Shelf	API	Descending
6	24	03.12.2019	93	Nivlisen Ice Shelf	EAIS	Descending

6	25	09.12.2019	93	Nivlisen Ice Shelf	EAIS	Descending
6	26	15.12.2019	93	Nivlisen Ice Shelf	EAIS	Descending
6	27	21.12.2019	93	Nivlisen Ice Shelf	EAIS	Descending
6	28	27.12.2019	93	Nivlisen Ice Shelf	EAIS	Descending
7	29	02.01.2020	93	Nivlisen Ice Shelf	EAIS	Descending
7	30	08.01.2020	93	Nivlisen Ice Shelf	EAIS	Descending
7	31	14.01.2020	93	Nivlisen Ice Shelf	EAIS	Descending
7	32	20.01.2020	93	Nivlisen Ice Shelf	EAIS	Descending
7	33	26.01.2020	93	Nivlisen Ice Shelf	EAIS	Descending
8	34	11.01.2020	59	Roi Baudouin Ice Shelf	EAIS	Ascending
8	35	23.01.2020	59	Roi Baudouin Ice Shelf	EAIS	Ascending
9	36	05.01.2019	72	Mawson Coast	EAIS	Ascending
9	37	17.01.2019	72	Mawson Coast	EAIS	Ascending
9	38	29.01.2019	72	Mawson Coast	EAIS	Ascending
10	39	01.12.2018	3	Amery Ice Shelf	EAIS	Descending
10	40	07.12.2018	3	Amery Ice Shelf	EAIS	Descending
10	41	13.12.2018	3	Amery Ice Shelf	EAIS	Descending
10	42	19.12.2018	3	Amery Ice Shelf	EAIS	Descending
10	43	25.12.2018	3	Amery Ice Shelf	EAIS	Descending
11	44	06.01.2019	3	Amery Ice Shelf	EAIS	Descending
11	45	12.01.2019	3	Amery Ice Shelf	EAIS	Descending
11	46	18.01.2019	3	Amery Ice Shelf	EAIS	Descending
11	47	24.01.2019	3	Amery Ice Shelf	EAIS	Descending
11	48	30.01.2019	3	Amery Ice Shelf	EAIS	Descending
12	49	05.02.2019	3	Amery Ice Shelf	EAIS	Descending
12	50	11.02.2019	3	Amery Ice Shelf	EAIS	Descending
12	51	17.02.2019	3	Amery Ice Shelf	EAIS	Descending
12	52	23.02.2019	3	Amery Ice Shelf	EAIS	Descending
13	53	01.01.2020	85	Shackleton Ice Shelf	EAIS	Ascending
13	54	07.01.2020	85	Shackleton Ice Shelf	EAIS	Ascending
13	55	13.01.2020	85	Shackleton Ice Shelf	EAIS	Ascending
13	56	19.01.2020	85	Shackleton Ice Shelf	EAIS	Ascending
13	57	25.01.2020	85	Shackleton Ice Shelf	EAIS	Ascending
Additional Test Data						
3	58	08.12.2019	169	George VI Ice Shelf	API	Descending
3	59	14.12.2019	169	George VI Ice Shelf	API	Descending
3	60	20.12.2019	169	George VI Ice Shelf	API	Descending
3	61	26.12.2019	169	George VI Ice Shelf	API	Descending
3	62*	07.01.2020	169	George VI Ice Shelf	API	Descending
3	63*	13.01.2020	169	George VI Ice Shelf	API	Descending
3	64*	19.01.2020	169	George VI Ice Shelf	API	Descending
3	65*	25.01.2020	169	George VI Ice Shelf	API	Descending
3	66*	06.02.2020	169	George VI Ice Shelf	API	Descending
3	67*	12.02.2020	169	George VI Ice Shelf	API	Descending
3	68*	18.02.2020	169	George VI Ice Shelf	API	Descending
3	69*	24.02.2020	169	George VI Ice Shelf	API	Descending

* product used during training and testing

Table S2. List of acronyms introduced throughout the paper.

Acronyms	Meaning
ADD	Antarctic Digital Database
AIS	Antarctic Ice Sheet
API	Antarctic Peninsula
ASF	Alaska Satellite Facility
ASPP	Atrous Spatial Pyramid Pooling
CNN	Convolutional Neural Network
CRF	Conditional Random Fields
DEM	Digital Elevation Model
EA	Expected Accuracy
EAIS	East Antarctic Ice Sheet
EC	Errors of Commission
EO	Errors of Omission
EW	Extra Wide
F_1	F-measure
FAST	Fully Automated Supraglacial lake area and volume Tracking
FN	False Negatives
FP	False Positives
GPU	Graphics Processing Unit
GRDH	Ground Range Detected High Resolution
GrIS	Greenland Ice Sheet
IW	Interferometric Wide
K	Kappa coefficient
LeakyReLU	Leaky non-linear Rectified Linear Unit
P	Precision
R	Recall
RACMO	Regional Atmospheric Climate Model
REMA	Reference Elevation Model of Antarctica
RF	Random Forest
SAR	Synthetic Aperture Radar
SLR	Sea-Level-Rise
SMB	Surface Mass Balance
SNAP	Sentinel Application Platform
TN	True Negatives
TOPSAR	Terrain Observation with Progressive Scans SAR
TP	True Positives
TS	Total Samples
WAIS	West Antarctic Ice Sheet