Supplement

Recent Evolution of Supraglacial Lakes on ice shelves in Dronning Maud Land, East Antarctica

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Table S1: *List of image pairs from Landsat-8 and Sentinel-2 captured on the same day for L8 vs S2 depth assessment and comparison*

Pair #	Date	Sensor	Scene ID
1	14-Jan-19	L8 - OLI	LC08_L2SR_154110_20190114_20201016_02_T2
	14-Jan-19	S2 - MSI	S2B_MSIL1C_20190114T063829_N0207_R091_T35DNB_20190114T084121
2	01-Feb-17	L8 - OLI	LC08_L1GT_178111_20170201_20201016_02_T2
	01-Feb-17	S2 - MSI	S2A_MSIL1C_20170201T082931_N0204_R135_T30DXF_20170201T082929
3	12-Jan-18	L8 - OLI	LC08_L1GT_161110_20180112_20201016_02_T2
	12-Jan-18	S2 - MSI	S2A_MSIL1C_20180112T073911_N0206_R063_T34DDG_20180112T111340
4	31-Dec-19	L8 - OLI	LC08_L1GT_179111_20191231_20201016_02_T2
	31-Dec-19	S2 - MSI	S2B_MSIL1C_20191231T093009_N0208_R107_T29CMV_20191231T105324
			S2B_MSIL1C_20191231T093009_N0208_R107_T29DMA_20191231T105324

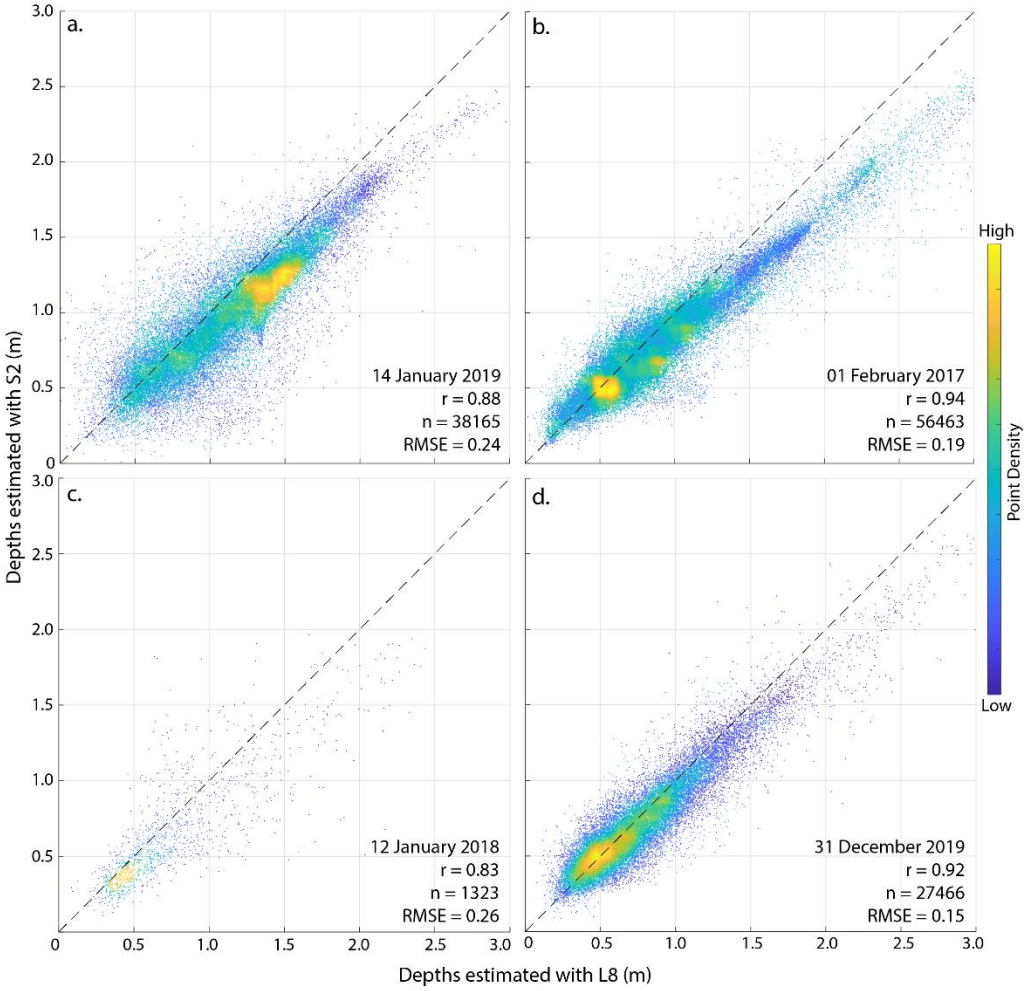

Figure S1. Correlation between depths estimated using Landsat-8 and Sentinel-2 products. Each of the plot represents a different pair of Landsat-8 and Sentinel-2, picked from different regions of the study area. The dashed line is the 1:1 line between Landsat-8 and Sentinel-2 depths. The average *r* is 0.89 and RMSE is 0.21m.

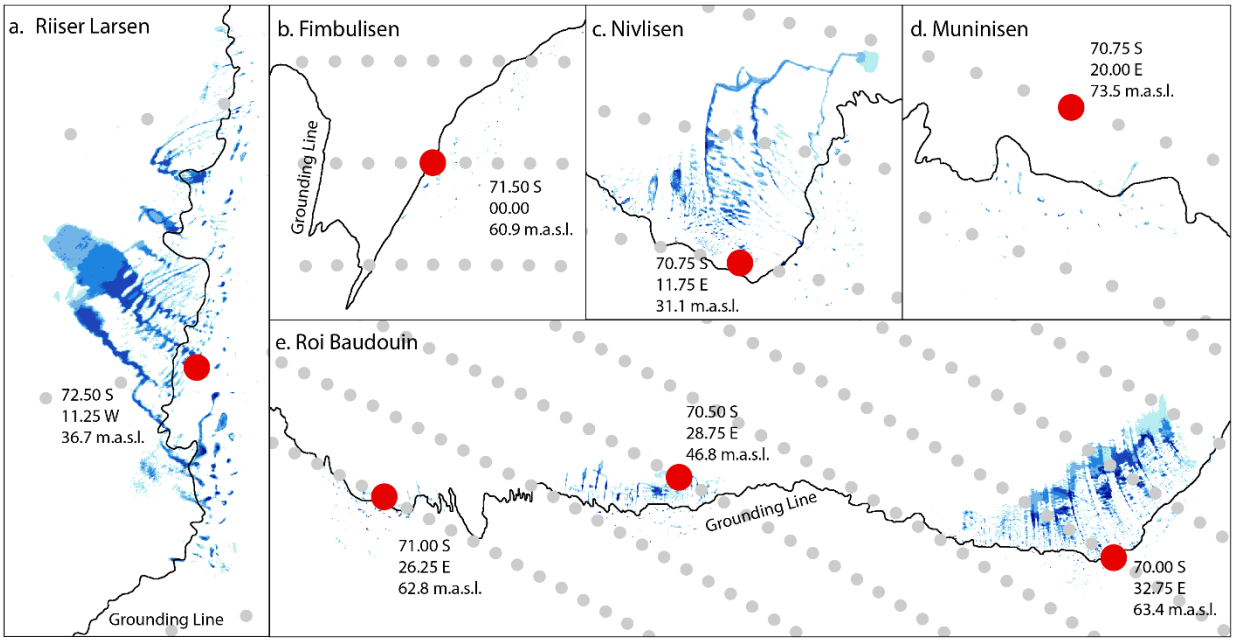

Figure S2. Choice of ERA5 grid points for climatic relationship assessments. The points were chosen based on elevation of the grid point (must be similar for the points chosen across all the ice shelves; typically, close to grounding lines) and the proximity to origin of the SGLs (where meltwater is generally produced, near the grounding zone). The available ERA5 grid points are shown in grey circles and chosen points are shown in red circle. The text on each image shows the latitude, longitude, and elevation of the ERA5 grid point chosen.

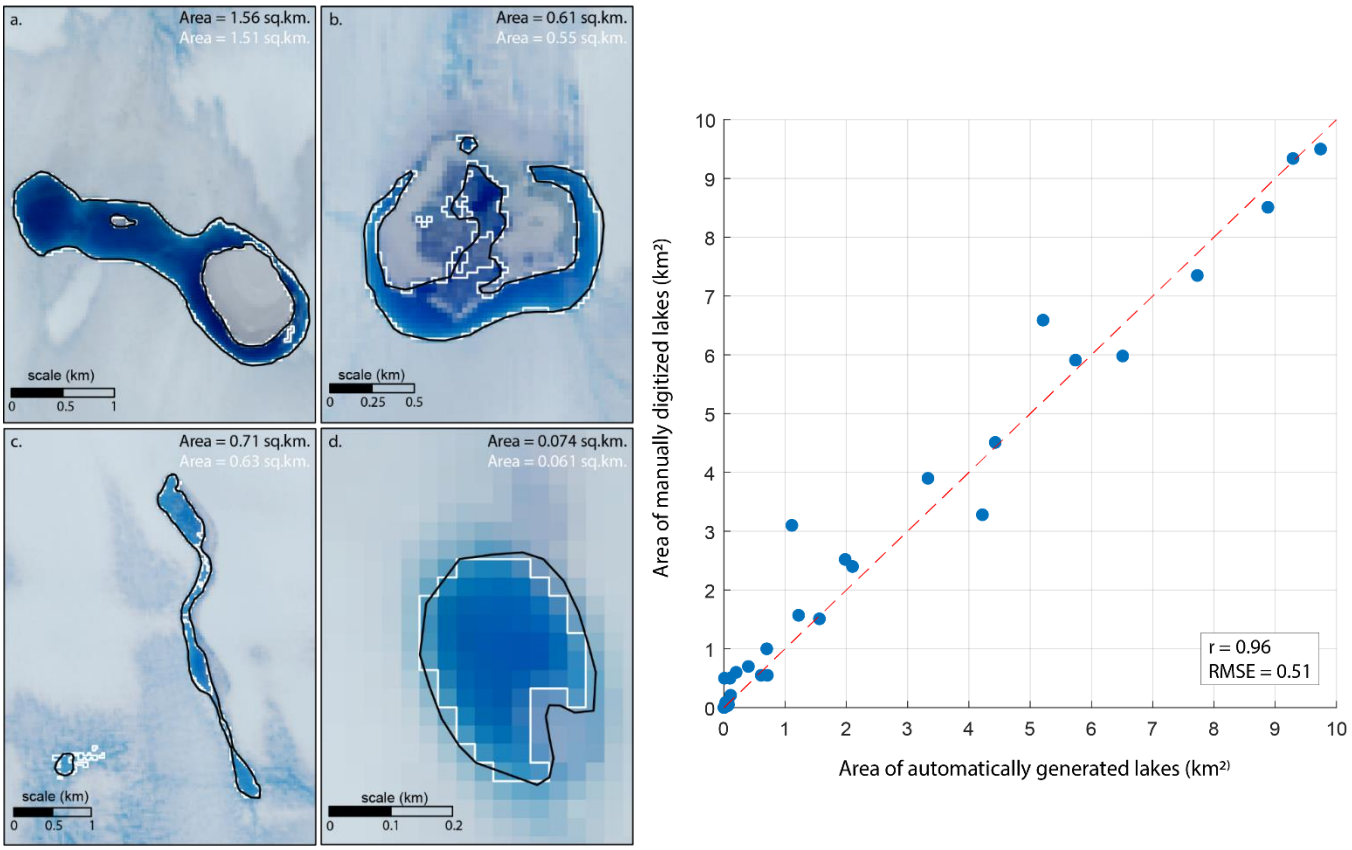

Figure S3. Comparison of automatically generated lakes (using NDWI) and manually digitized lakes. Panels a., b., c., and d. present examples of four lake outlines (automatic in white, and manual in black) that are of different sizes. Panel e. presents the comparison of areas of 34 lakes (estimated using automatically generated outlines and manually digitized outlines) over a scatter plot. Lakes used in this assessment were randomly chosen from homogenous and inhomogeneous (slushy) areas, broadly representing the study area. Small sized lakes had the highest difference between the 2 methods, whereas the larger ones produced relatively similar areas. Background images are Landsat-8 (a, c; Source: USGS) and Sentinel-2 (b, d; Source: Copernicus Open Access Hub) scenes.

Table S2: *Peak Lake areas and lake volumes in different study areas of Dronning Maud Land over each melt-season between 2014 and 2021.*

STUDY AREA		**2014 – 2015** ***(Value ± Error*)***	**2015 – 2016** ***(Value ± Error)***	**2016 – 2017** ***(Value ± Error)***	**2017 – 2018** ***(Value ± Error)***	**2018 – 2019** ***(Value ± Error)***	**2019 - 2020** ***(Value ± Error)***	**2020 - 2021** ***(Value ± Error)***	**Study Area Average** ***(Value ± Std. Error**)***
RIISER LARSEN	Area	0.96 ± 4.17	0.77 ± 4.17	62.76 ± 4.17	65.30 ± 4.17	21.21 ± 4.17	83.41 ± 4.17	0.40 ± 29.19	**33.54 ± 14.66**
	Volume	0.0003 ± 0.004	0.0005 ± 0.005	0.07 ± 0.005	0.06 ± 0.005	0.012 ± 0.005	0.09 ± 0.005	0.0002 ± 0.03	**0.0329 ± 0.02**
FIMBULISEN	Area	0.70 ± 0.20	0.42 ± 0.20	2.77 ± 0.20	1.08 ± 0.20	1.92 ± 2.41	4.01 ± 0.20	0.57 ± 0.20	**1.64 ± 0.55**
	Volume	0.0005 ± 0.0002	0.0003 ± 0.0002	0.003 ± 0.0002	0.0008 ± 0.0002	0.002 ± 0.002	0.004 ± 0.0002	0.0003 ± 0.0002	**0.002 ± 0.001**
NIVLISEN	Area	62.91 ± 35.58	6.33 ± 5.08	86.26 ± 5.08	96.69 ± 5.08	101.64 ± 5.08	86.77 ± 5.08	20.38 ± 5.08	**65.85 ± 15.55**
	Volume	0.06 ± 0.03	0.006 ± 0.005	0.07 ± 0.005	0.08 ± 0.005	0.1 ± 0.005	0.09 ± 0.005	0.02 ± 0.005	**0.06 ± 0.01**
MUNINISEN	Area	1.23 ± 2.58	0.39 ± 4.42	7.36 ± 0.37	1.63 ± 0.37	1.35 ± 0.37	4.89 ± 0.37	0.18 ± 0.37	**2.43 ± 1.09**
	Volume	0.0005 ± 0.002	0.0003 ± 0.004	0.006 ± 0.0003	0.001 ± 0.0003	0.0008 ± 0.0003	0.005 ± 0.0003	0.0001 ± 0.0003	**0.002 ± 0.001**
ROI BAUDOUIN WEST	Area	8.60 ± 1.00	2.19 ± 1.00	19.97 ± 1.00	9.65 ± 1.00	7.45 ± 1.00	15.16 ± 1.00	1.22 ± 1.00	**9.18 ± 2.73**
	Volume	0.007 ± 0.001	0.001 ± 0.001	0.02 ± 0.001	0.008 ± 0.001	0.006 ± 0.001	0.01 ± 0.001	0.0006 ± 0.001	**0.09 ± 0.003**
ROI BAUDOUIN CENTER	Area	35.22 ± 4.19	11.67 ± 4.19	39.55 ± 4.19	66.61 ± 4.19	44.29 ± 4.19	83.85 ± 4.19	3.14 ± 4.19	**40.62 ± 11.58**
	Volume	0.03 ± 0.004	0.007 ± 0.004	0.04 ± 0.004	0.07 ± 0.004	0.05 ± 0.004	0.08 ± 0.004	0.002 ± 0.004	**0.0387 ± 0.01**
ROI BAUDOUIN EAST	Area	248.25 ± 29.53	252.58 ± 29.53	590.68 ± 206.74	502.53 ± 206.74	18.77 ± 354.41	159.98 ± 354.41	12.32 ± 29.53	**255.02 ± 90.94**
	Volume	0.14 ± 0.02	0.18 ± 0.02	0.46 ± 0.16	0.46 ± 0.16	0.01 ± 0.28	0.11 ± 0.28	0.01 ± 0.02	**0.1947 ± 0.08**
DRONNING MAUD LAND	**Area**	**357.87 ± 35.58**	**274.35 ± 29.53**	**809.37 ± 206.74**	**743.50 ± 206.74**	**196.64 ± 354.41**	**438.08 ± 354.41**	**38.19 ± 29.53**	**408.28 ± 115.03**
	Volume	**0.2337 ± 0.0343**	**0.20 ± 0.02**	**0.67 ± 0.16**	**0.68 ± 0.16**	**0.18 ± 0.28**	**0.39 ± 0.28**	**0.03 ± 0.02**	**0.34 ± 0.10**

****Error is calculated based on the uncertainty and error estimation approach explained in Section 3.7 of the manuscript.***

*****Standard Error is calculated using the formula Std. Error = Std Dev of values from each melt year / √ number of melt-years – 1***

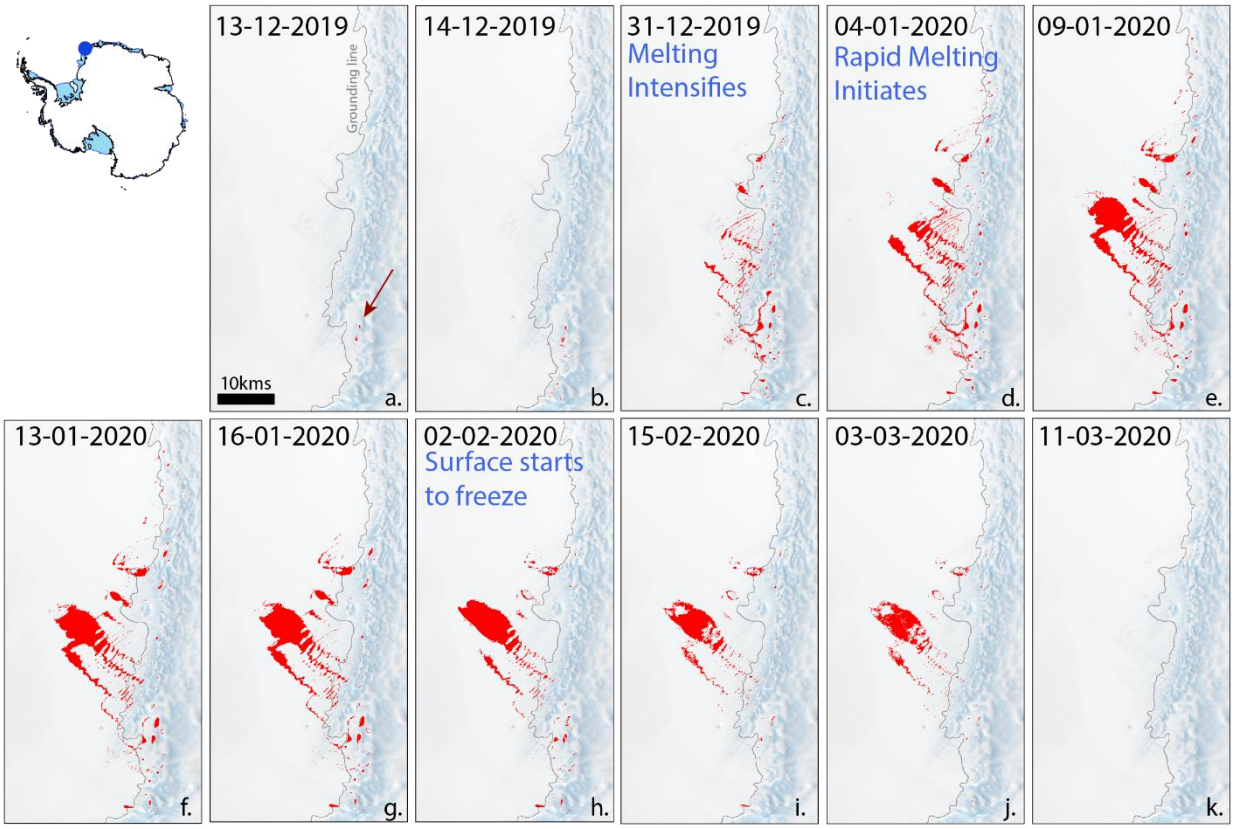

Figure S4. Seasonal development of SGLs over Riiser Larsen (RL) ice shelf in Dronning Maud Land during a high melt year (2019 – 2020) with red color representing the extent of lakes on a specified date. The background image used for representation is a Landsat 8 RGB Composite from 03 November 2017 (Source: USGS).

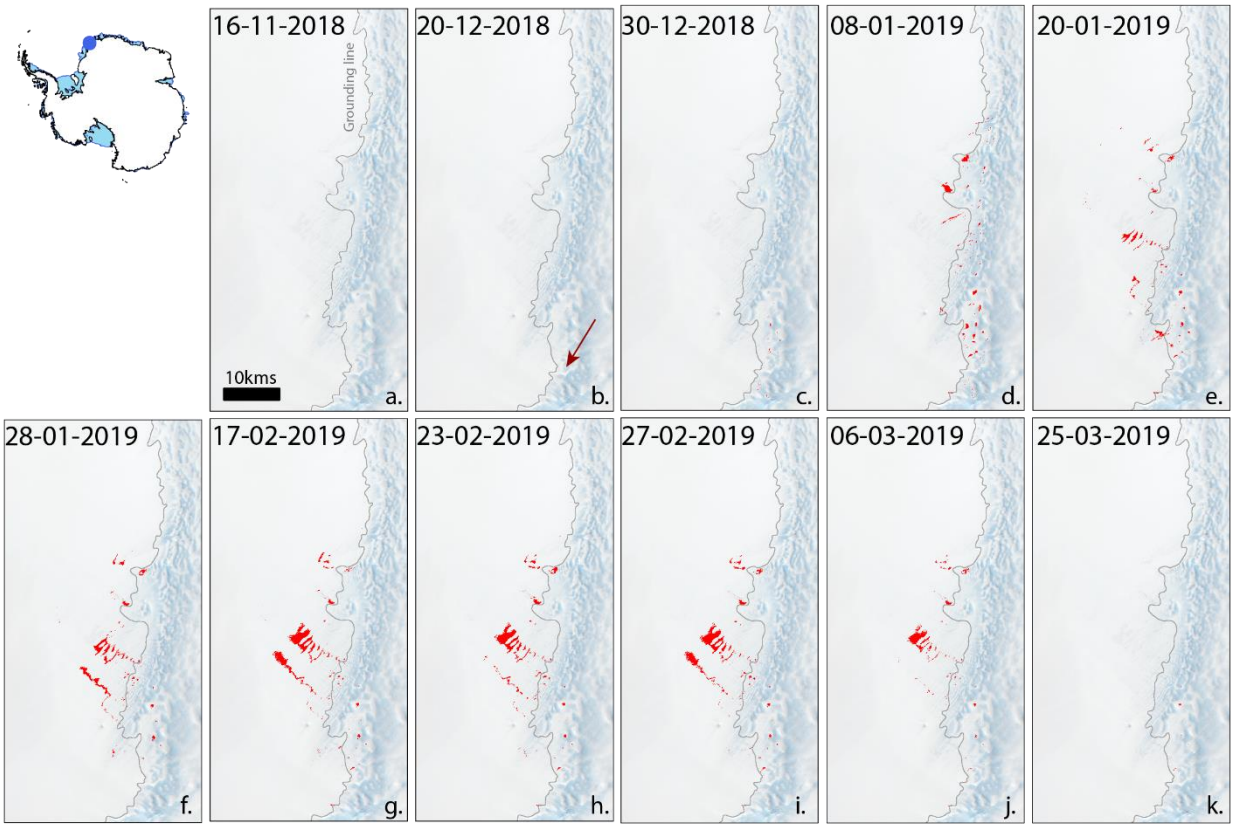

Figure S5. Seasonal development of SGLsover Riiser Larsen (RL) ice shelf in Dronning Maud Land during a low melt year (2018 – 2019) with red colour representing the extent of lakes on a specified date. The background image used for representation is a Landsat 8 RGB Composite from 03 November 2017 (Source: USGS).

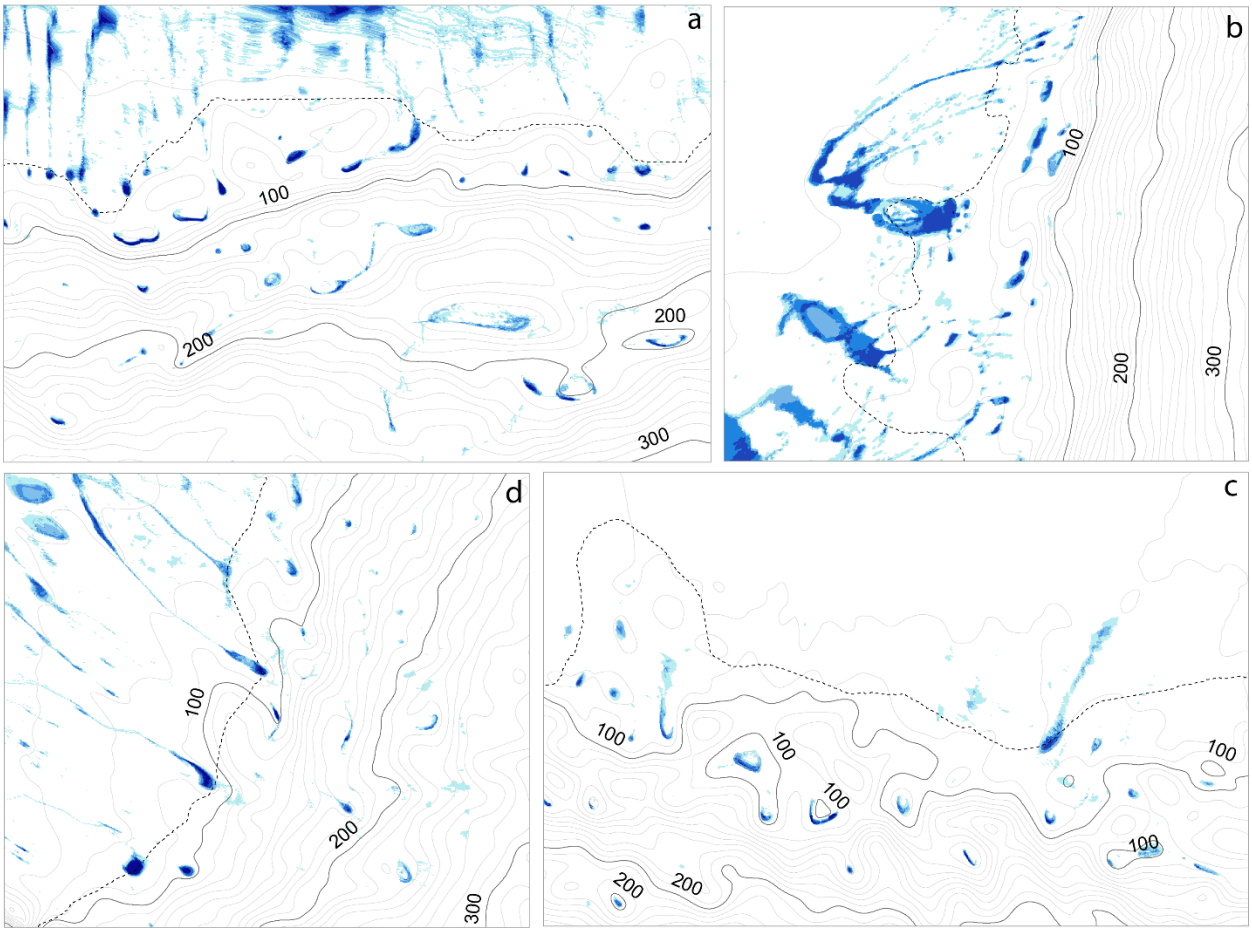

Figure S6: Examples of formation of lakes in topographical depressions over four selected ice shelf areas in Dronning Maud Land; a) Roi Baudouin Center, b) Riiser Larsen, c) Nivlisen and d) Muninisen. The grey lines represent 10 m a.s.l contours, and the dotted black line is the grounding line separating floating ice shelves and grounded ice sheet. Blue colored polygons are lakes from different years. Contours were generated using the Reference Elevation Model of Antarctica (REMA, Howat et al. (2019)).

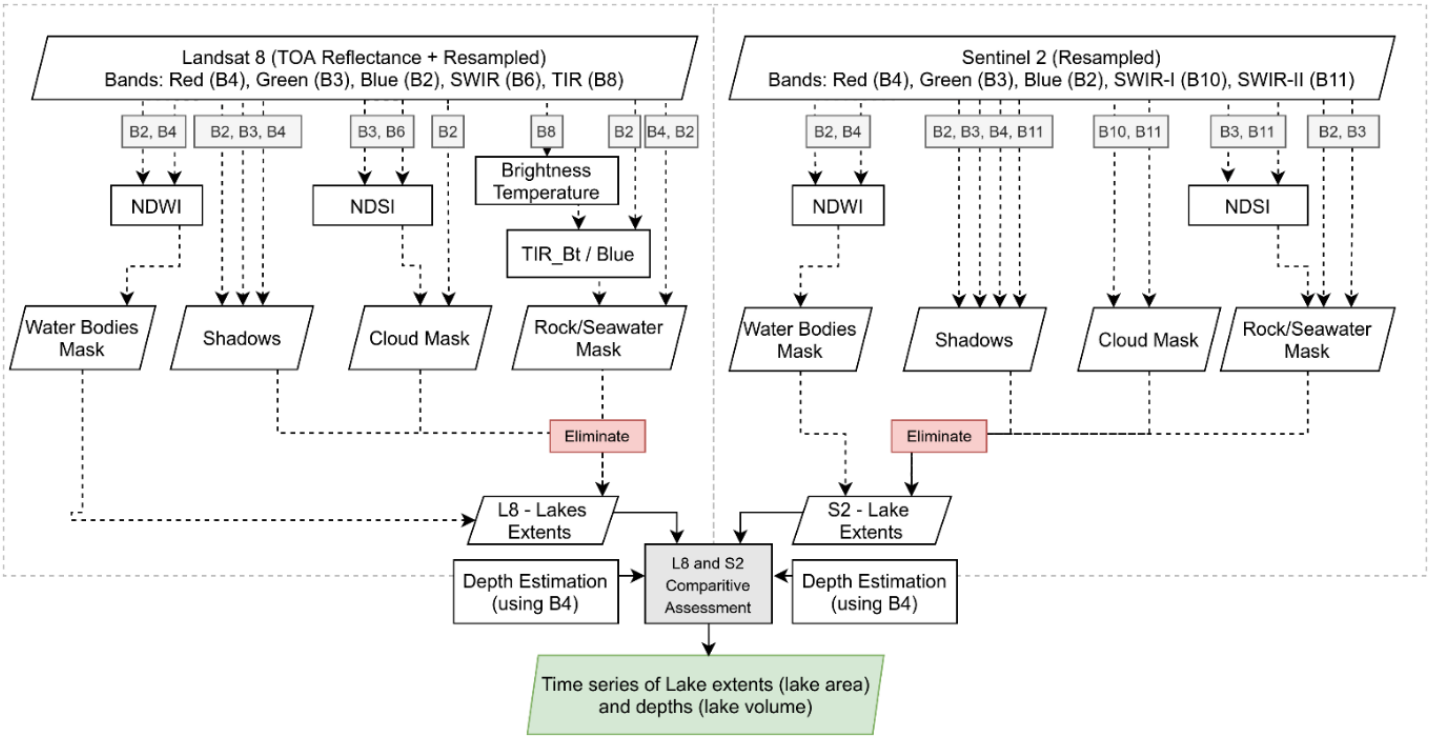

Figure S7. Methodological flowchart for automated SGL mapping and depth estimation using Landsat-8 and Sentinel-2 scenes.