
Article:
Patton, H., Swift, D.A. orcid.org/0000-0001-5320-5104, Clark, C.D. et al. (2 more authors) (2016) Distribution and characteristics of overdeepenings beneath the Greenland and Antarctic ice sheets: Implications for overdeepening origin and evolution. Quaternary Science Reviews, 148. pp. 128-145. ISSN: 0277-3791

https://doi.org/10.1016/j.quascirev.2016.07.012

Supplementary Material

Distribution and characteristics of overdeepenings beneath the Greenland and Antarctic ice sheets: Implications for overdeepening origin and evolution

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Quaternary Science Reviews

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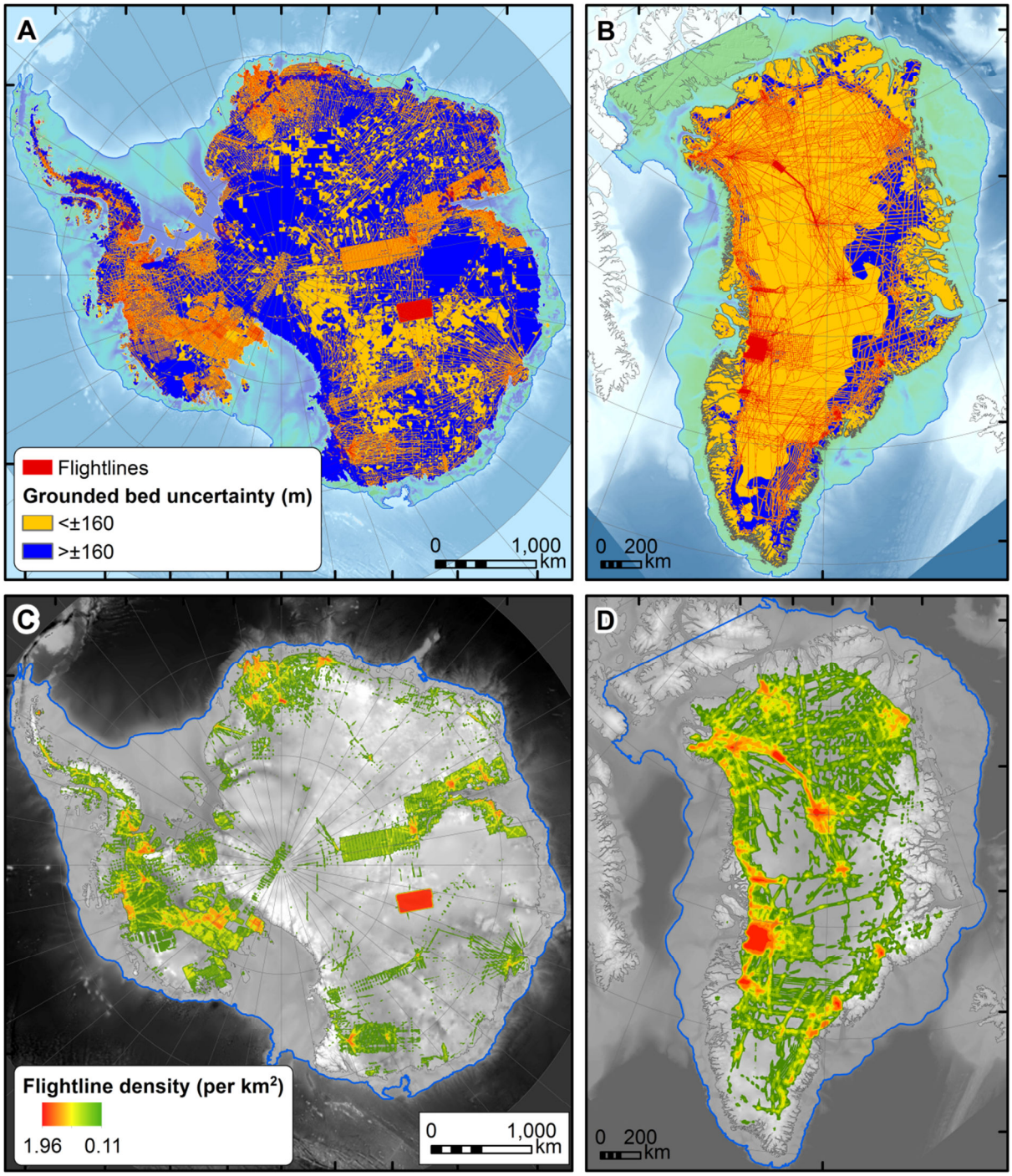

Figure S1. Greenland and Bedmap2 flightline coverage and bed-elevation uncertainty. A and B. Absolute bed-elevation uncertainty with airborne radar flight lines overlaid. C and D. Flightline data density maps were used by Patton et al. (2015) to develop quality control criteria for metric analyses based on the density of flightline data within a 10-km radius of each grid cell . Data sources: (Bamber et al., 2013a; Fretwell et al., 2013). Continental shelf topography is derived from the GEBCO 2008 bathymetric compilation mosaiced with sub-ice shelf data sourced from a recent compilation (Timmermann et al., 2010).

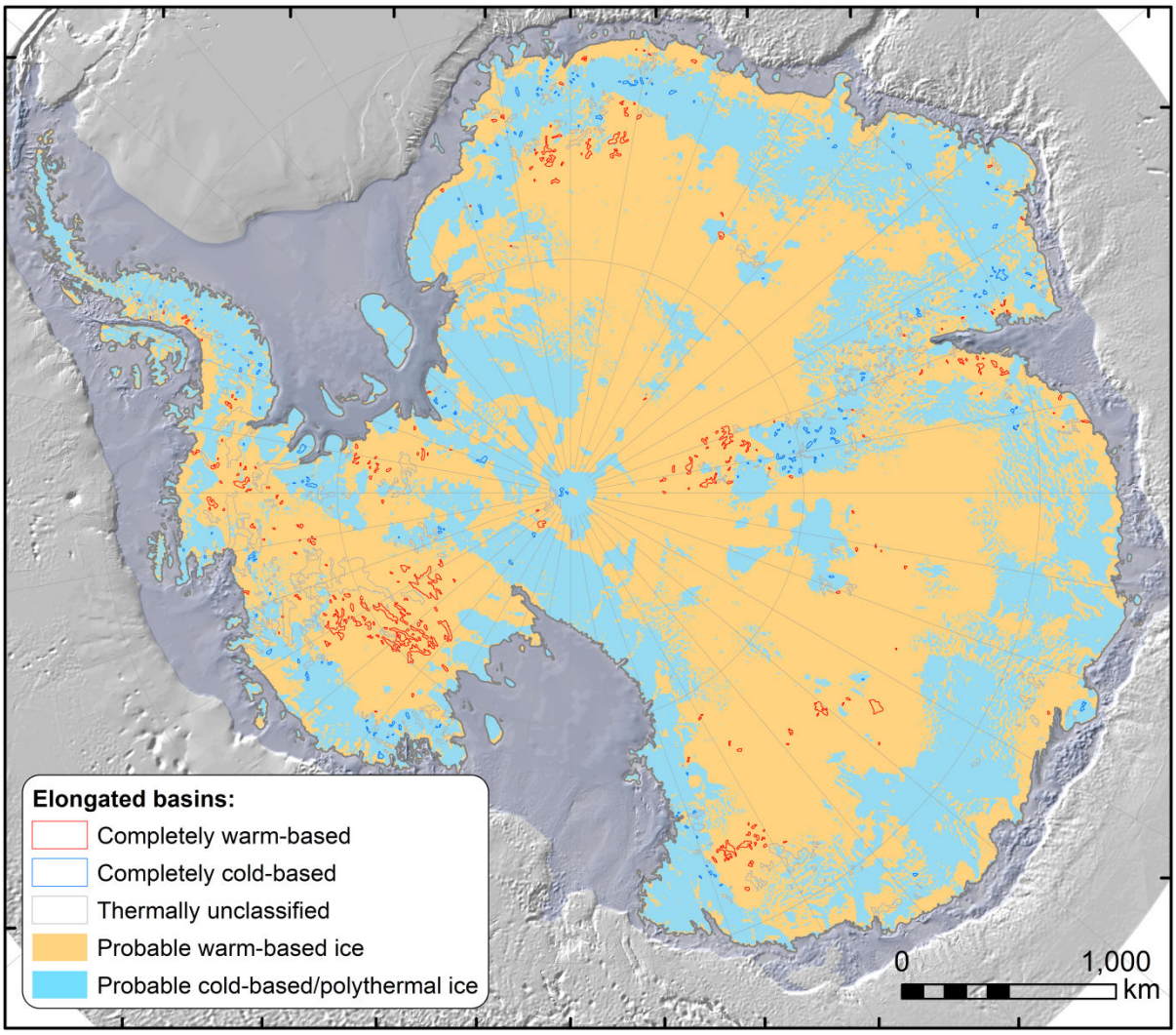

Figure S2. Mapped depressions classified according the modelled, subglacial thermal-regime of the present-day Antarctic ice sheet. Data source: (Pattyn, 2010).

Table S1. Morphological properties of overdeepenings as indicated by values from the metric dataset.

	Antarctica			Greenland		
	Mean	Median	± σ	Mean	Median	± σ
Depth (m)						
Elongated	222	169	± 178	227	173	± 195
Elongated and topographically confined	290	233	± 206	360	296	± 249
Length (km)						
Elongated	52.3	22.5	± 340.2	22.2	17.1	± 16.5
Elongated and topographically confined	63.6	22.3	± 481.4	24.5	16.8	± 21.1
Width (km)						
Elongated	8.5	6.8	± 6.3	5.6	4.9	± 3.2
Elongated and topographically confined	8.0	6.4	± 6.8	5.6	5.0	± 3.4
Elongation ratio						
Elongated	4.43	3.36	± 8.77	4.05	3.43	± 2.15
Elongated and topographically confined	4.92	3.41	± 12.10	4.40	3.70	± 2.74
Lip elevation (m a.s.l.)						
Elongated	-105	-150	± 672	359	250	± 469
Elongated and topographically confined	81	0	± 669	649	600	± 569
Surface Area (km^2)						
Elongated	468	140	± 1584	138	74	± 241
Elongated and topographically confined	469	135	± 1931	161	73	± 349
Adverse-slope length (km)						
Elongated	25.6	11.2	± 97.7	12.5	9.2	± 9.5
Elongated and topographically confined	26.9	10.4	± 110.7	13.8	9.6	± 11.8
Mean adverse-slope gradient						
Elongated	0.018	0.013	± 0.019	0.023	0.017	± 0.023
Elongated and topographically confined	0.024	0.018	± 0.022	0.036	0.030	± 0.030
Asymmetry (%)						
Elongated	-14.6	-20.7	± 40.6	-20.3	-22.0	± 36.0
Elongated and topographically confined	-14.5	-18.8	± 40.8	-22.3	-21.6	± 37.8
Adverse slope to surface slope relation						
Elongated	-4.23	-3.02	± 3.85	-3.64	-2.51	± 3.43
Elongated and topographically confined	-4.55	-3.20	± 4.04	-3.69	-2.17	± 4.20

Table S2. Morphological properties of overdeepenings within warm and cold- based regions of the Antarctic ice sheet as indicated by values from the metric dataset

	Mean warm/cold	Median warm/cold	± σ warm/cold
Depth (m)			
Elongated	145/225	119/176	± 92/169
Elongated and topo. confined	183/265	141/235	± 114/159
All depressions	148/238	124/196	± 95/164
Length (km)			
Elongated	33.8/20.6	20.7/16.6	± 35.8/16.7
Elongated and topo. confined	25.9/20.0	18.3/16.5	± 21.9/17.9
All depressions	29.8/19.5	18.3/15.9	± 32.3/16.4
Width (km)			
Elongated	8.0/6.3	6.4/5.5	± 5.0/3.4
Elongated and topo. confined	6.6/6.1	6.1/5.2	± 3.8/3.5
All depressions	7.7/6.3	6.3/5.6	± 4.6/3.3
Elongation ratio			
Elongated	3.92/3.26	3.16/2.90	± 2.26/1.27
Elongated and topo. confined	3.84/3.31	3.10/2.98	± 1.63/1.35
All depressions	3.62/3.11	2.94/2.76	± 2.15/1.32
Lip elevation (m a.s.l.)			
Elongated	-432/498	-500/525	± 571/606
Elongated and topo. confined	-235/593	-400/600	± 707/562
All depressions	-402/544	-475/550	± 584/590
Surface Area (km^3)			
Elongated	336/133	116/75	± 718/163
Elongated and topo. confined	206/122	90/72	± 381/159
All depressions	284/124	103/74	± 631/153
Adverse-slope length (km)			
Elongated	18.5/11.1	10.5/8.2	± 20.3/12.1
Elongated and topo. confined	14.2/11.4	8.1/8.4	± 16.3/13.8
All depressions	16.4/10.8	9.4/7.9	± 18.8/12.1
Mean adverse-slope gradient			
Elongated	0.012/0.027	0.009/0.019	± 0.009/0.026
Elongated and topo. confined	0.019/0.031	0.016/0.024	± 0.012/0.026
All depressions	0.013/0.028	0.011/0.021	± 0.010/0.025

Table S3. Correlation matrices for metrics extracted for overdeepenings in the quality controlled metric dataset. Grey cells indicate correlations that are not significant at $p<0.05$.

		Depth	Width	Length	SurfArea	ASLength	AdvGrad	a:sRatio	ER
Antarctica (all)	Width	0.454							
	Length	0.426	0.835						
	SurfArea	0.480	0.938	0.943					
	ASLength	0.350	0.672	0.843	0.773				
	AdvGrad	0.478	-0.264	-0.448	-0.338	-0.656			
	a:sRatio	-0.202	0.011	0.198	0.092	0.386	-0.525		
	ER	0.203	0.267	0.754	0.530	0.674	-0.468	0.333	
	LipElev	0.116	-0.231	-0.213	-0.241	-0.205	0.286	-0.135	-0.097

		Depth	Width	Length	SurfArea	ASLength	AdvGrad	a:sRatio	ER
Antarctica Topo Confined	Width	0.459							
	Length	0.398	0.820						
	SurfArea	0.481	0.936	0.929					
	ASLength	0.342	0.656	0.855	0.764				
	AdvGrad	0.451	-0.267	-0.504	-0.352	-0.684			
	a:sRatio	-0.239	0.020	0.215	0.078	0.397	-0.562		
	ER	0.142	0.231	0.747	0.492	0.691	-0.546	0.342	
	LipElev	-0.045	-0.261	-0.267	-0.292	-0.239	0.192	-0.140	-0.151

		Depth	Width	Length	SurfArea	ASLength	AdvGrad	a:sRatio	ER
Greenland (all)	Width	0.290							
	Length	0.278	0.720						
	SurfArea	0.320	0.888	0.925					
	ASLength	0.186	0.506	0.805	0.713				
	AdvGrad	0.763	-0.076	-0.283	-0.185	-0.492			
	a:sRatio	-0.187	-0.156	0.106	-0.037	0.328	-0.381		
	ER	0.056	-0.147	0.580	0.277	0.553	-0.314	0.335	
	LipElev	0.441	-0.087	-0.188	-0.166	-0.156	0.493	-0.029	-0.167

		Depth	Width	Length	SurfArea	ASLength	AdvGrad	a:sRatio	ER
Greenland Topo Confined	Width	0.428							
	Length	0.383	0.734						
	SurfArea	0.464	0.888	0.932					
	ASLength	0.201	0.579	0.813	0.756				
	AdvGrad	0.632	-0.120	-0.340	-0.231	-0.632			
	a:sRatio	-0.209	-0.098	0.242	0.095	0.424	-0.500		
	ER	0.092	-0.021	0.664	0.394	0.559	-0.369	0.464	
	LipElev	0.383	-0.014	-0.187	-0.127	-0.176	0.442	-0.295	-0.260