SUPPLEMENTARY MATERIAL

Topographic parameters

Topographic parameters are easy-to-calculate proxies for physical processes, such as orographic precipitation, solar radiation effects, wind redistribution and preferential deposition. We derive all parameters (Table S1) for our study from a SPOT-5 DEM (40 × 40 m) (Korona and others, 2009). Two DEMs are stitched together to cover the Donjek Range. An iterative 3D-coregistration algorithm (Berthier and others, 2007) is used to correct the horizontal (∼2 m E, ∼4 m N) and vertical (5.4 m) discrepancy between the two DEMs before stitching.

Visual inspection of the curvature fields calculated using the full DEM shows a noisy spatial distribution. To find an appropriate scale at which the relevant curvature is calculated, various smoothing algorithms and sizes are applied and the combination that produces the highest correlation between curvature and gridcell-averaged WB is chosen. Inverse-distance weighted, Gaussian and gridcell-average smoothing methods, all with window sizes of 3×3, 5×5, 7×7 and 9×9 gridcells are used. Gridcell-average smoothing with a 7×7 window resulted in the highest overall correlation between curvature (second derivative) and gridcell-averaged WB as well as slope (first derivative) and gridcell-averaged WB. We use the smoothed DEM to calculate curvature (κ), slope (m), aspect (α) and "northness" (N).

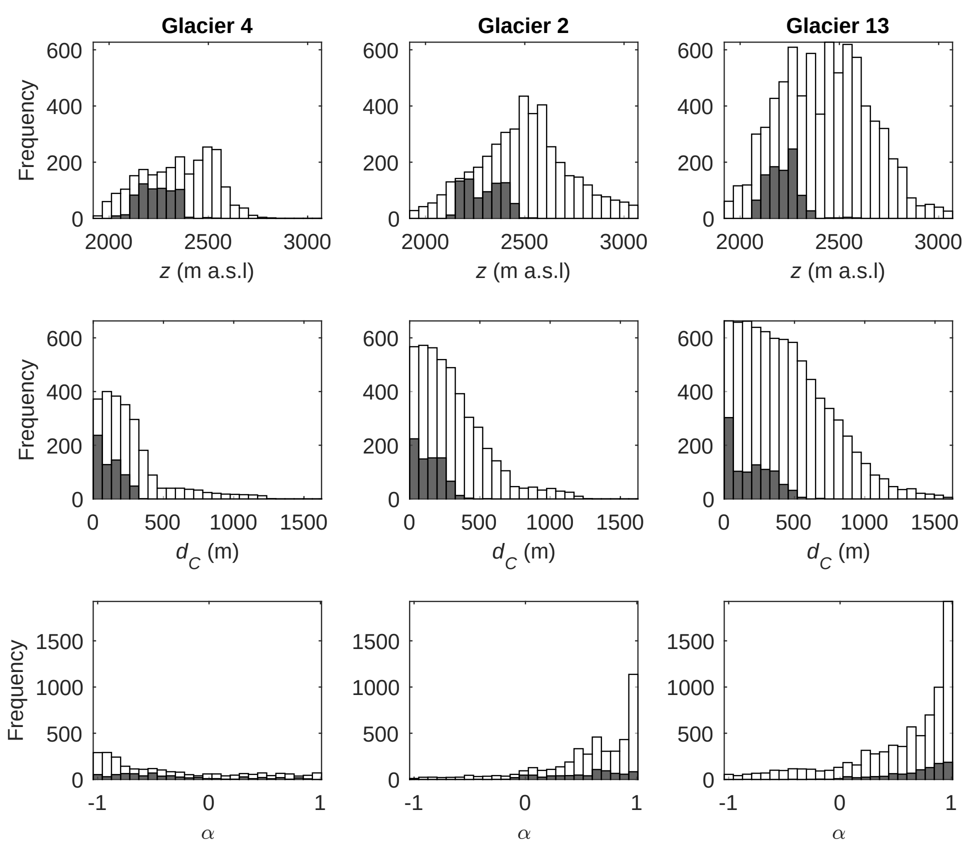

Fig. S1: Distribution of sampled (gray bars) and all (white bars) topographic parameters for over Glacier 4 (left column), Glacier 2 (middle column) and Glacier 13 (right column). From top to bottom, topographic parameters are elevation (z), distance from centreline (d_C), aspect (α), slope (m), northness (N), mean curvature (κ), and wind redistribution (Sx).

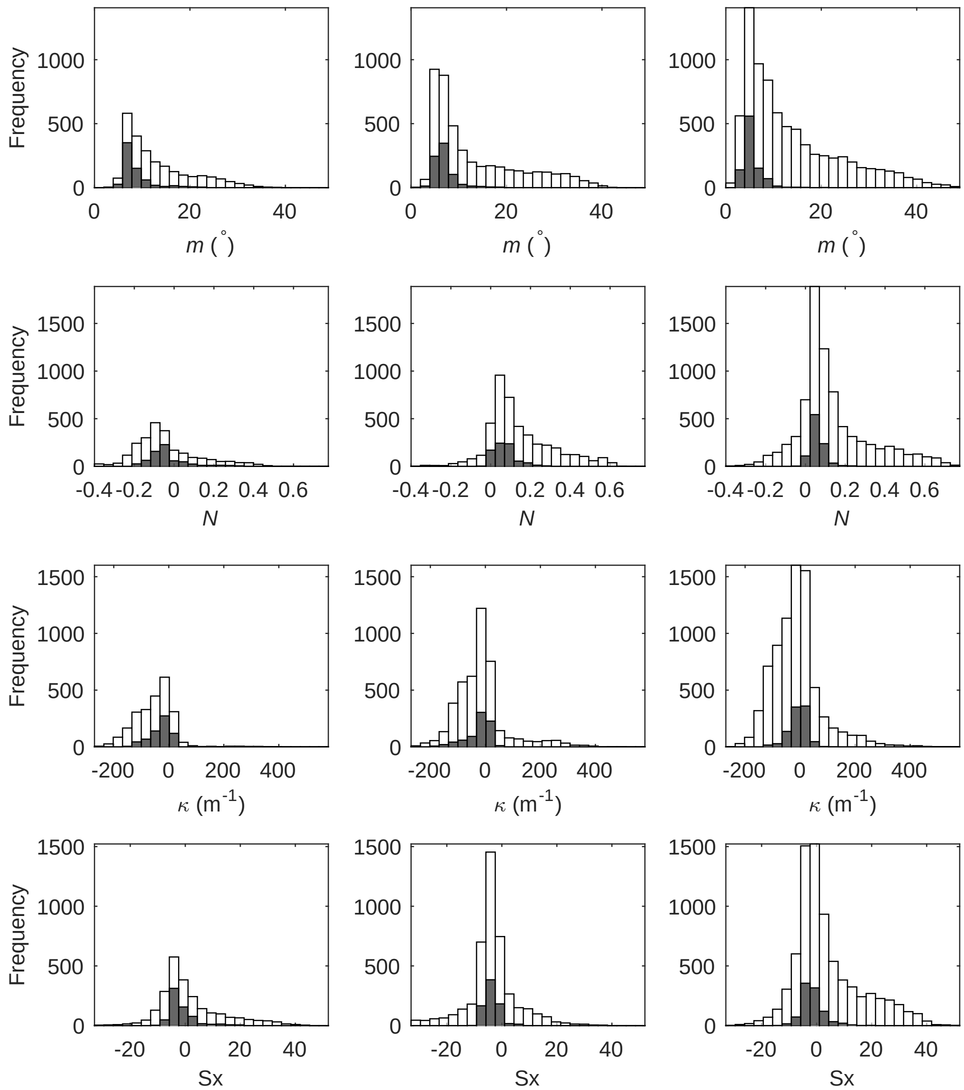

Fig. S1 (Cont.): Distribution of sampled (gray bars) and all (white bars) topographic parameters for over Glacier 4 (left column), Glacier 2 (middle column) and Glacier 13 (right column). From top to bottom, topographic parameters are elevation (z), distance from centreline (d_C), aspect (α), slope (m), northness (N), mean curvature (κ), and wind redistribution (Sx).

Table S1: Description of topographic parameters used in the linear regression.

Topographic parameter	Definition	Calculation method	Notes	Source
Elevation (z)	Height above sea level	Values taken directly from DEM		
Distance from centreline (d_C)	Linear distance from user-defined glacier centreline	Minimum distance between the Easting and Northing of the northwest corner of each grid cell and a manually defined centreline		
Slope (m)	Angle between a plane tangential to the surface (gradient) and the horizontal	`r.slope.aspect` module in GRASS GIS software run through QGIS		Mitášová and Hofierka (1993); Hofierka and others (2009); Olaya (2009)
Aspect (α)	Dip direction of the slope	`r.slope.aspect` module in GRASS GIS software run through QGIS	$\sin(\alpha)$, a linear quantity describing a slope as north/south facing, is used in the regression	Mitášová and Hofierka (1993); Hofierka and others (2009); Olaya (2009)
Mean curvature (κ)	Average of profile (direction of the surface gradient) and tangential (direction of the contour tangent) curvature	`r.slope.aspect` module in GRASS GIS software run through QGIS	(+) mean-concave terrain and (−) mean-convex terrain	Mitášová and Hofierka (1993); Hofierka and others (2009); Olaya (2009)
“Northness” (N)	A value of -1 represents a vertical, south facing slope, a value of $+1$ represents a vertical, north facing slope, and a flat surface yields 0	Product of the cosine of aspect and sine of slope		(Molotch and others, 2005)
Wind exposure/shelter parameter (Sx)	Proxy for snow deposition due to wind redistribution	Executable obtained from Adam Winstral that follows the procedure outlined in Winstral and others (2002)	Calculation based on selecting a cell within a certain angle and distance from the cell of interest that has the greatest upward slope relative to the cell of interest	(Winstral and others, 2002)

Additional results

Table S2: Snow density values used for density assignment methods. Density values derived from snow pit (SP) densities and Federal Sampler (FS) densities. Four interpolation methods are chosen: (1) using a mean snow density for all three glaciers (S1 or F1), (2) using a mean density for each glacier (S2 or F2), (3) using a regression between density and elevation (S3 or F3), and (4) inverse-distance weighted mean density (not shown, S4 or F4). Standard deviation (STD) is given for S1/F1 and S2/F2 values and R^2 values are given for density–elevation regressions (S3/F3).

		SP-derived density ($\mathbf{kg\,m^{-3}}$)		**FS-derived density ($\mathbf{kg\,m^{-3}}$)**	
		Mean	*STD or R^2*	*Mean*	*STD or R^2*
S1 or F1		342	26	318	42
S2 or F2	G4	348	13	355	18
	G2	333	26	286	34
	G13	349	38	316	41
S3 or F3	G4	$0.03z + 274$	0.16	$-0.16z + 714$	0.53
	G2	$-0.14z + 659$	0.75	$0.24z - 282$	0.72
	G13	$-0.20z + 802$	>0.99	$0.12z + 33$	0.21

Table S3: Range and nugget values for simple kriging interpolation

	Range (m)	**Nugget ($\times 10^3$m w.e.)**
Glacier 4	90	10.5
Glacier 2	404	3.6
Glacier 13	444	4.8

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