Table S1: UAS and camera specification

|  |
| --- |
| **UAS and sensor Specifications** |
| Dimensions | Unfolded: 322×242×84 mm (length×width×height) |
| Max Flight Time (no wind) | 31 minutes (at a consistent 25 kph) |
| Max Flight Distance (no wind) | 18 km (at a consistent 50 kph) |
| Max Wind Speed Resistance | 29–38 kph |
| Operating Temperature Range | -10°C to 40°C |
| Takeoff Weight | 907 g |
| Storage | 8 GB (Internal), External Micro SD™ |
| Global Navigation Satellite System | GPS+GLONASS |
| Sensor | 1” CMOSEffective Pixels: 20 million |
| Lens | FOV: about 77°, 35 mm Format Equivalent: 28 mm Aperture: f/2.8–f/11, Shooting Range: 1 m to ∞ |
| ISO range | Photo:100-3200 (auto) |
| Shutter Speed | Electronic Shutter: 8–1/8000s |
| Image Resolution | 5472×3648 |

Table S2: Overview of UAS survey conducted in May and November 2019

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Total # of flights | Total # of images captured | # of images used | Area mapped | Flying altitude  | GSD (spatial resolution) |
| May 16 -17, 2019 | 9 | 2101 | 2081 | 0.62 km2 | 90 m | 2.1 cm/pixel |
| Nov 20 -21, 2019 | 13 | 3042 | 3026 | 1.197 km2 | 90 m | 2.1 cm/pixel |

Table S3: Estimated pixel matching and model construction errors from SfM processing workflow.

|  |  |  |
| --- | --- | --- |
|  | May 2019 | Nov 2019 |
| 2D keypoints for bundle adjustment | 26,723,614 | 43,438,291 |
| 3D keypoints for bundle adjustment | 9,217,775 | 14,971662 |
| Mean reprojection error | 0.134 | 0.140 |
| Mean GCP *X* error/sigmaRMSE | -0.003758 m ± 0.028974 m0.029216 m | 0.000149 m ± 0.012517 m0.012518 m |
| Mean GCP *Y* error/sigmaRMSE | 0.006088 m ± 0.029652 m0.030270 m | 0.000611 m ± 0.008463 m0.008485 m  |
| Mean GCP *Z* error/sigmaRMSE | -0.024147 m ± 0.066237 m0.070502 m | -0.000719 m ± 0.015976 m0.015992 m |
| Maximum DSM resolution | 0.0217 m | 0.0212 m |
| Average Point cloud density | 274 per m3 | 298 per m3 |



Figure S4: Areas that were interpreted and selected as representing ice cliffs and non ice cliff.



Figure S5: Comparison of elevation difference (DH) before and after flow correction.