Supplementary - Color calibrated field photography enables quantitative analysis of ice sheet surface darkening

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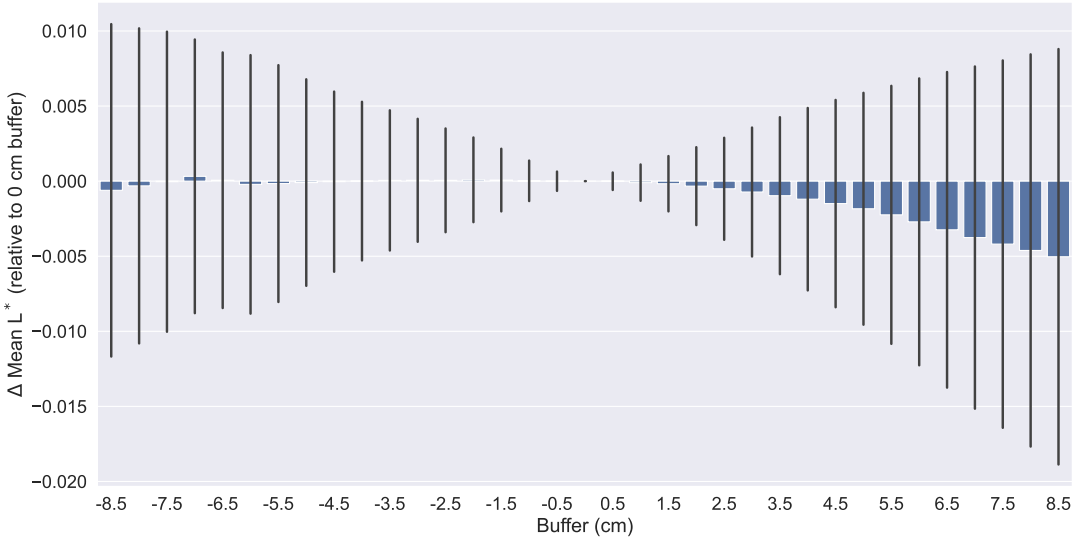


Figure S 1. Change in mean image lightness (L*) as a function of ROI buffer size. For each image, the mean L* value measured at each buffer distance was compared with the corresponding value from the original ROI (0 cm buffer). Positive values indicate higher mean lightness than the original ROI, whereas negative values indicate lower mean lightness. Bars represent the mean change across all images and error bars denote ±1 standard deviation.

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To assess the impact of image acquisition height on the derived image lightness (L*), we conducted a sensitivity test using an old Danish flag with spatially heterogeneous colors and surface features (Fig. 2). The camera height above the target was controlled using a measuring tape, and images were acquired at 10 cm intervals between 90 and 120 cm. All images were processed using iCalibrateImage v1.1 following the same calibration workflow as applied to the field photographs.

The mean L^* values were 0.70±0.18, 0.70±0.17, 0.70±0.17, and 0.72±0.17, for images captured at heights of 90, 100, 110, and 120 cm, respectively (Fig.3). The 30-cm increase in camera heights resulted in the mean difference in L^* of 0.02 and the spatial resolution reduced by 0.01 mm as the height increases from 90 cm to 120 cm. These results indicate that moderate variations in camera height have limited impact on the calibrated L^* values and are unlikely to introduce substantial uncertainty into the image calibration procedure or affect the interpretation of the results.



Figure S 2. Sensitivity test on the impact of height on derived image lightness (L^*). The height was controlled by a measuring tape.

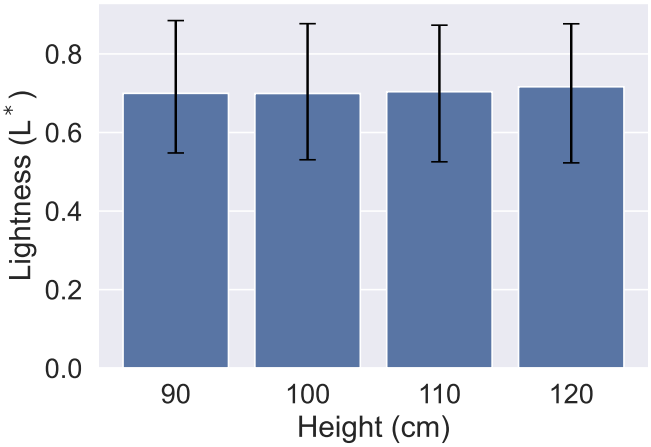


Figure S 3. The mean (barplot) and standard deviation (error bar) of the derived L^* values at different heights