



## Detailed spatiotemporal albedo observations at Greenland's Mittivakkat Gletscher

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Surface albedo is defined as the reflected fraction of incoming solar shortwave radiation at the surface. On Greenland's Mittivakkat Gletscher the mean glacier-wide MODIS-estimated albedo dropped by 0.10 (2000–2013) from 0.43 to 0.33 by the end of the mass balance year (EBY). Hand-held albedo measurements as low as 0.10 were observed over debris-covered ice at the glacier margin at the EBY: these values were slightly below observed values for proglacial bedrock ( $\sim 0.2$ ). The albedo is highly variable in space – a significant variability occurred within few meters at the glacier margin area ranging from 0.10 to 0.39 due to variability in debris-cover thickness and composition, microbial activity (including algae and cyanobacteria), snow grain crystal metamorphism, bare ice exposure, and meltwater ponding. Huge dark-red-brown-colored ice algae colonies were observed. Albedo measurements on snow patches and bare glacier ice changed significant with increasing elevations (180–600 m a.s.l.) by lapse rates of 0.04 and 0.03 per 100 m, respectively, indicating values as high as 0.82 and 0.40 on the upper part of the glacier. Over a period of two weeks from early August to late August 2014 the hand-held observed mean glacier-wide albedo changed from 0.40 to 0.30 indicating that on average 10% more incoming solar shortwave radiation became available for surface ablation at the end of the melt season.