



A high-resolution airborne survey of the albedo of Midre Lovenbreen, Svalbard

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The energy balance of high Arctic glaciers is very sensitive to changes in the absorbed shortwave flux. As such, the albedo is a strong control on the degree of ablation, and thus the mass balance as a whole. Measurements of albedo have previously been limited in spatial representation, and variation on scales of meters has been difficult to assess. A second problem concerns the anisotropic nature of reflectance from icy surfaces, which can result in systematic underestimation of glacial albedo.

In August 2003, a NERC ARSF data collection mission overflew Midre Lovenbreen, Svalbard, carrying a LiDAR unit and a Daedalus 1268 ATM multispectral scanner. Here, we present an analysis combining this data with measurements of solar radiation from Koldewey Station, Ny-Alesund, Svalbard, to give a map of integrated broadband albedo over the glacier at 2m resolution. We find systematic discrepancies between this data and that measured previously in situ, and suggest possible explanations for these differences.

In the creation of this map, a model of anisotropic reflection in the upper layers of the glacier was developed, which we also present, along with derived bidirectional reflectance distribution functions (BRDFs), which can be used in future albedo measurements to correct for any anisotropy present. We also give a simple quadratic parameterisation of the model output, which is usable in conditions with a fixed geometry of sun, slope and observer.