



## Effect of Reindeer Grazing on Snowmelt, Albedo and Energy Balance Based on Satellite Data Analysis

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Surface albedo has a major influence on the energy balance of the Earth. The albedo difference between snow-covered and snow-free tundra is very significant. Therefore, a delay in the snowmelt will decrease the absorbed solar energy on the ground. Earlier studies have shown that higher and denser vegetation causes earlier snowmelt, and that shrub height and abundance, as well as the total biomass in summer reindeer pastures is lower than in winter pastures.

The possibility of using reindeer summer grazing to decrease the vegetation, delay the snowmelt and decrease the ground heating during the snowmelt season is investigated in this study. Satellite data is used to compare between summer and non-summer grazing areas in the northern tundra areas of Fennoscandia. A comparison of vegetation types, NDVI, fractional snow cover and albedo between the Finnish year-round pastures and the Norwegian non-summer pastures is performed. Other factors influencing the snowmelt, such as surface temperature, ground elevation and incoming solar radiation are taken into account. Information about the vegetation on the ground is based on a vegetation map compiled from Landsat TM/ETM+ satellite data and ancillary map information. The NDVI, snowmelt and albedo analyses are performed using multi-temporal remote sensing data such as GlobSnow SE and MODIS based NDVI, snow and albedo products.

The results here support previous studies and indicate that vegetation in the summer pastures is shorter and sparser and that the snowmelt there occurs later than in the more densely vegetated, non-summer pastures. More shrubs protruding above the snowpack and earlier snowmelt on the Norwegian side lower the albedo during the snowmelt season. This causes higher solar energy absorption of up to 6 W/m<sup>2</sup> in the snowmelt season and yearly contribution of up to 0.5 W/m<sup>2</sup> to the yearly energy balance. Therefore this study suggests that summer reindeer herding can be used to delay snowmelt, increase surface albedo and to decrease the ground heating in the snowmelt season.