

The optical behaviour of snow during a melting season at Ny Ålesund (Svalbard, Norway)

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Rationale

Polar areas are the most sensitive targets of the climate change, and the continuous monitoring of the cryosphere represents a critical issue. The satellite remote sensing can fill this gap but further integration between remotely-sensed multi-spectral images and field data is crucial to validate retrieval algorithms and climatological models. The optical behavior of snow, at different wavelengths, provides significant information about the micro-physical characteristics of the surface and this allow to discriminate different snow/ice covers. The aim of this work is to present an approach based on combining unmanned observations on spectral albedo and on the analysis of time-lapse images of sky and ground conditions in an Arctic test-site (Svalbard, Norway).

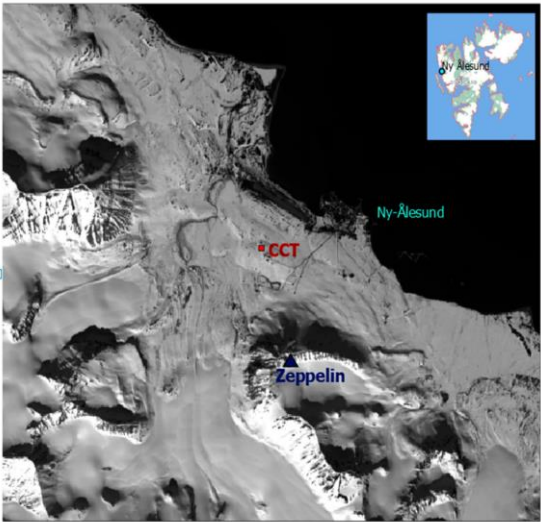


Fig. 1 Location map of the study site

Methods

The activity described in this study was performed at the observation facility of the Amundsen-Nobile Climate Change Tower (CCT), located in a flat area in the surroundings of Ny Ålesund. The study site is about 3 km far from a glacier front and it is a flat area of about 35000 m² where the snow cover remains usually on the ground from October to June, with an average snow duration of 265 days in the last decade.

Results

The presented results cover the 2015 melt season from 20 May to 31 July, when the cloud cover varies significantly, and the Sun is constantly above the horizon. The focus of the experiment was the continuous monitoring of the spectral albedo, the evolution of the normalized difference snow index, the relationship with the fractional snow cover, and the comparison with remotely sensed data. The spectral albedo was estimated using a narrow-band device, named Continuous Reflectance Monitor (CREM).

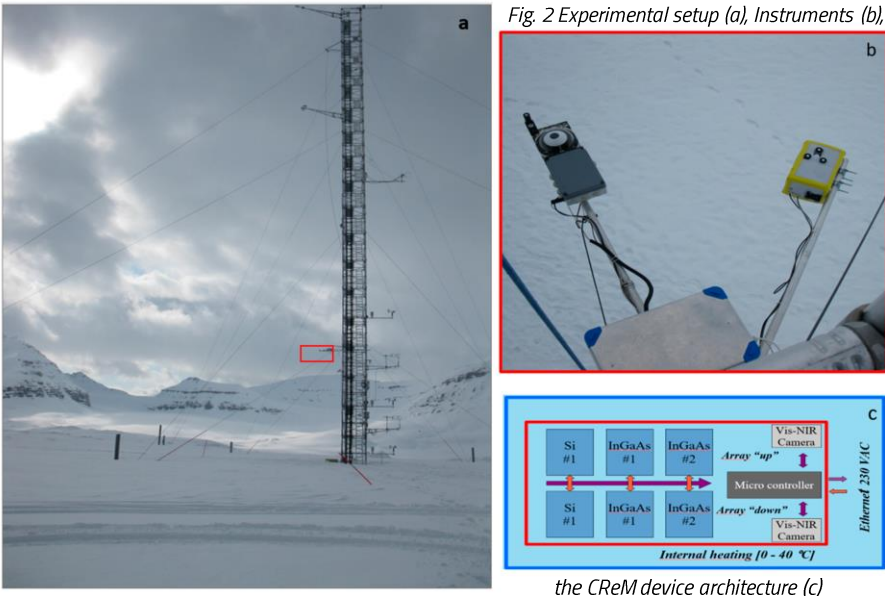
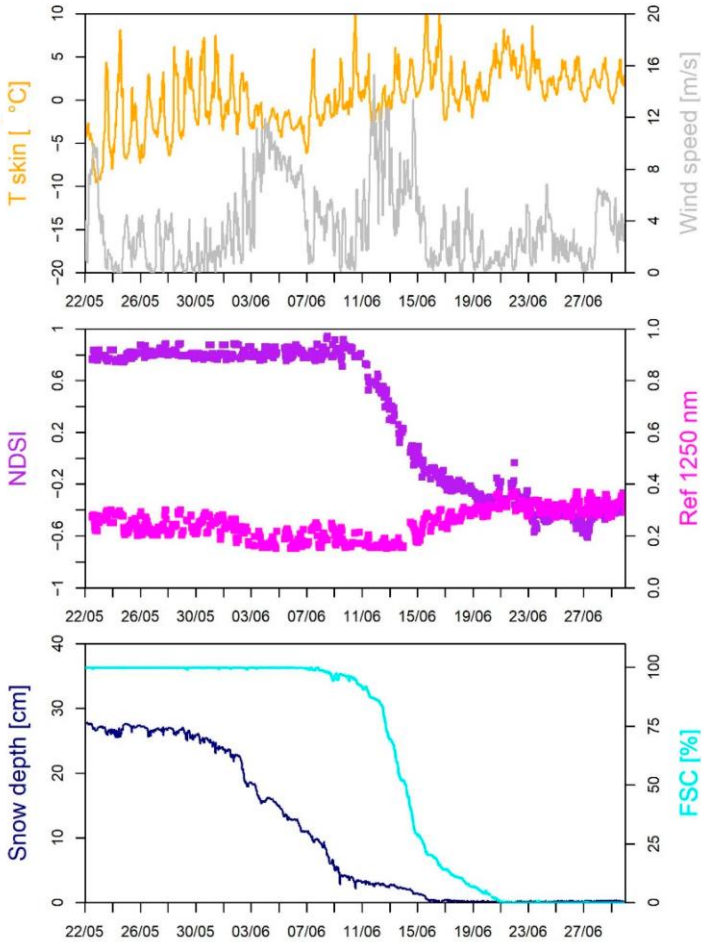


Fig. 2 Experimental setup (a), Instruments (b),

the CREM device architecture (c)

Fig. 3 Evolution of the snow cover features during the 2015 melting season



Conclusions

This work presents the description of the snow spectral behavior during the melting season obtained by a narrow-band spectral device (CREM). The proposed system supports the quality check of the acquired data with sky and ground images useful in assessing the different illumination and surface conditions. The first results permitted us to assess the feasibility of continuously monitoring the spectral evolution of snowed surfaces without any man intervention. It was possible to estimate spectral indexes, such as NDSI and SWIR albedo and we have found interesting links between both features and air/ground temperatures, wind-speed, and precipitations. Different melting phases were detected, and different processes were associated with the observed spectral variations.

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