Snow spectral reflectance measurements at Ny-Ålesund (Svalbard)

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WP1: Ground-based component for SLCFs

T1.1: Integration of observations provided by research infrastructures and networks

D1.1.3: Harmonized measurements and data of the snow spectral reflectance

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The purpose of this activity is provide field data crucial to validate satellite retrieval algorithms, through the integration with remote-sensed multi-spectral images. Thanks satellite observations of spectral albedo of snowed surfaces, microphysical characteristics of the snow surface and the presence of liquid water in the first layer of the snowpack can be determined in addition to the spatial distribution of snow covers.

The progress in terms of satellite sensors must be coupled to more detailed information on snow microphysics that can support the interpretation and the modeling of snowed surfaces. From this perspective, the availability of continuous monitoring techniques that provide the ground truth is a critical issue. Several ground-based methods have been developed in the last years to improve the in situ characterization of snow. Most of all is based on the optical analysis, and we can distinguish microphysical-oriented approaches (Painter et al. 2007; Gallet et al. 2009) from radiative-oriented techniques (Bourgeois et al. 2006; Marks et al. 2015).

With the aim to address these topics, an unmanned apparatus was installed to provide continuous spectral surface albedo during the 2014 spring/summer period in Ny-Ålesund (Svalbard Islands, Norway). The realized long-period monitoring system was based on a bi-hemispherical sampling geometry that measured the surface spectral albedo $[\rho_\lambda(\theta_i, \phi_i, 2\pi; 2\pi)]$. This parameter can be defined, at a specific solar azimuth (θ_i) and zenith angles (ϕ_i), as the ratio between the reflected and the incoming solar spectral irradiances (Schaepman-Strub et al. 2006). A full-range approach was adopted at the CNR Climate Change Tower. This setup is obtained using a spectro-radiometer with a spectral range between 350 and 2500 nm integrated with a remote cosine receiver, characterized by a field of view of about 180°, mounted on a rotating support. The system was integrated with a camera aimed to acquire sky and ground images. Integration of ancillary information is fundamental for data analysis. It is known, that the albedo of a surface is strongly dependent on the illumination condition that it is not an intrinsic property of the surface. Under the assumption of an isotropic diffuse field, the equation can be described by the combination of two terms, the first pertaining to the direct sun component and the second to the diffuse contribute. Information on cloudiness and radiation fluxes are important to select case where measurements where performed in cloudy conditions (white-sky albedo) or clear-sky (dark-sky albedo).

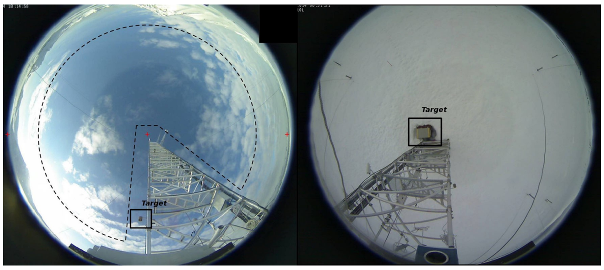

Figure 1 - *Examples of up-facing (left) and down-facing (right) images. The black box evidences in both images the target used for estimating the inclination of the tilting system. The dotted line, only present in the up-facing image, shows the sky mask used for the calculation of the cloudiness index corresponding to the 70 % of the entire hemisphere*

The first results assessed the feasibility of continuous monitoring the spectral variations of snowed surfaces during the melting period. Acquired data allow us to perform a first attempt to associate snow metamorphism to spectral variations and it supports the identification of relevant correlations with meteorological parameters (Salzano et al., 2016)

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