

Monitoring seasonal dust depositions on snow in a high-altitude site of the European Alps

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The seasonal input of mineral dust from Saharan desert impacts the optical properties of snow in the European Alps. The albedo reduction may alter the melting dynamics of the snowpack, resulting in earlier snow melts. In this contribution, we evaluate the impact of dust depositions on snowpack melting dynamics in a high-altitude site (2160 m) in the northwestern Italian Alps (Aosta Valley, IT). In particular, we focus on the two following specific objectives: i) to assess the potential of a spectral index derived from digital camera images to identify the occurrence of dust deposition events; ii) to evaluate the impact of dust depositions on snow melting based on the comparison between observed snow height and the potential snow height simulated with a hydrological model not accounting for melting caused by snow impurities.

The experimental site is equipped with instruments that measure snow albedo (Kipp and Zonen cnr4 net radiometer), snow height (SR50A, Campbell Scientific, Inc), air temperature (HMP45, Vaisala Inc.) and surface temperature (SI-111, Apogee Instr. Inc.). Furthermore, a Nikon digital camera (model d5000) is installed at the site. The camera collects images in JPEG format and features a resolution of 12.3 megapixels, with three color channels (namely Red, Green and Blue). Data were collected from 10 am to 5 pm, with an hourly temporal resolution. Data from 2013 to 2016 are presented here.

The seasonality and timing of dust depositions were determined using two atmospheric transport models: the NAAPS and the BSC-DREAM8 model. Dust depositions were compared with time series of the Snow Darkening Index (SDI) calculated from the channels of the digital camera, combining the Red and Green channels as a normalized difference. SDI time series were extracted from the repeated images using the Phenopix R package (<https://r-forge.r-project.org/projects/phenopix/>).

The impact of dust deposition on snow melt was evaluated by comparing the observed snow height with that simulated using the GEOtop model. This model does not account for the input of impurities from the atmosphere. The mismatch between observed and modeled melting dynamics is discussed in relation to mineral dust depositions.