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On the role of Saharan dust events on snow season duration in the European Alps

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Saharan dust events are frequent in the European Alps during late autumn and spring. These transports of dust are promoted by low pressure systems insisting over North Africa. Dust is constituted of micron-sized mineral particles, it is small enough to be transported in the atmosphere for thousands of kilometers. In the Alps, dust is known to alter the optical properties of both seasonal snow (Di Mauro et al. 2015; Dumont et al. 2017) and glaciers (Gabbi et al. 2015; Di Mauro et al. 2017). Usually, Saharan dust is deposited in the Alps through events that affect different sectors of the mountain chain. The impact of dust on the radiative properties of Alpine glaciers and snowfields become maximum during the melting season, when dust layers are resurfaced and concentrated at the snow-air interface. The main effects of these processes are related to the decrease of the albedo and to the promotion of snow melting. Although the role of dust deposition on snow cover has been largely studied in the Western US (e.g. Painter et al. 2010), our comprehension of the impact of Saharan dust on snow in the Alps is still in its infancy.
In this contribution, we present data from an experimental station located in the Western Alps (Torgnon, Aosta, Italy). Meteorological data from the season 2015/2016 were used to simulate snowpack dynamics with Crocus model (Tuzet et al.2017). This model used prescribed dust and black carbon depositions from the atmospheric model ALADIN-Climat. Furthermore, Crocus uses the radiative transfer model TARTES (Libois et al. 2013) to simulate the spectral albedo of snow and the absorption of solar light in the snowpack. Measured key variables of snow dynamics (e.g. albedo, snow depth, snow water equivalent) were compared with Crocus simulations with and without impurities in snow. The timing of deposition and resurfacing of dust layers were also monitored using repeated digital images acquired from a camera (Nikon d5000) installed at the site. The Snow Darkening Index (SDI) was calculated both from RGB data and spectral albedo derived from TARTES. Furthermore, snow samples collected in the Alps were analysed in laboratory to better constrain modeling results. Size distribution of dust was determined with a Coulter Counter, and its geochemical composition was measured via Instrumental Neutron Activation Analysis.
The deposition of dust on snow during 2016 resulted in an earlier snow melt of about one month. This can alter vegetation phenology, and water availability for hydropower use and agricultural irrigation during summer season. Results from this study pave the way for the assessment of the biogeochemical and hydrological role of dust events in the Alpine chain.