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On the impact of Saharan dust deposition on the evolution of an alpine snowpack

François Tuzet (1), Marie Dumont (1), Matthieu Lafaysse (1), Anne Missiaen (1), Pascal Hagenmuller (1), Yves Lejeune (1), Matthieu Joly (2), Jonathan Guth (2), Pierre Nabat (2), Ghislain Picard (3), Laurent Arnaud (3), and Samuel Morin (1)

(1) Meteo-France - CNRS, CNRM/CEN UMR 3589, Grenoble, France , (2) Meteo-France - CNRS, CNRM UMR 3589, Toulouse, France , (3) UGA/CNRS, IGE, Grenoble, France

Alpine snowpacks are frequently affected by Saharan dust outbreaks events resulting in a yellowish or reddish snow layer. These events introduce a strong discontinuity in the vertical profile of light absorbing impurities content within the snowpack. This induces changes in the amount of solar radiation absorbed by the snow and in turn changes in the vertical temperature profile and on snow metamorphism. The impact of such phenomena on snow stability and melt rate is currently not addressed using current snowpack models which either totally ignore impurity-related phenomena are account for them in a very simplistic manner.
In this work, we implemented new capabilities within the detailed snow model SURFEX/ISBA-Crocus to account for impurities deposition and evolution within the snowpack. We also refined the original radiative transfer model into a comprehensive spectrally-resolved radiative transfer scheme to explicitly account for their direct and indirect radiative effects.
This upgraded model was evaluated against in-situ snow measurements and spectral albedo measurements spanning one winter season at Col de Porte site (French Alps) using two different atmospheric models as inputs for aerosols deposition fluxes. The effect of an observed Saharian dust deposition event on snow temperature, specific surface area and density vertical profiles was numerically investigated with the model and compared to snow observations. The objective is to understand under which snow and meteorological conditions such a deposition event leads to significant modifications of the snowpack physical properties and to the observed decrease in snowpack stability.