



Role of Saharan dust and black carbon deposition on snow cover in the French mountain ranges over the last 39 years.

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Light absorbing particles such as black carbon(BC) or mineral dust are known to darken the snow surface when deposited on the snow cover and amplify several snow-albedo feedbacks, drastically modifying the snowpack evolution and the snow cover duration. Mineral dust deposition on snow is generally more variable in time than black carbon deposition and can exhibit both a high inter and intra annual variability. In France, the Alps and the Pyrenees mountain ranges are affected by large dust deposition events originating from the Sahara . The aim of this study is to quantify the impact of these impurities on the snow cover variability over the last 39 years (1979-2018).

For that purpose, the detailed snowpack model Crocus with an explicit representation of impurities is forced by SAFRAN meteorological reanalysis and a downscaling of the simulated deposition fluxes from a regional climate model (ALADIN-Climate). Different simulations are performed: (i) considering dust and/or BC (i.e. explicit representation), (ii) without impurities and (iii) considering an implicit representation (i.e. empirical parameterization based on a decreasing law of the albedo with snow age).

Simulations are compared at point scale to the snow depth measured at more than 200 Météo-France's stations in each massif, and spatially evaluated over the 2000-2018 period in comparing the snow cover area, snow cover duration and the Jacard index to MODIS snow products. Scores are generally better when considering the explicit representation of the impurities than when using the snow age as a proxy for light absorbing particles content.

Results indicate that dust and BC have a significant impact on the snow cover duration with strong variations in the magnitude of the impact from one year to another and from one location to another. We also investigate the contribution of light absorbing particles deposition to snow cover inter-annual variability based on statistical approaches.

