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Accounting for spectral albedo, solar light penetration and impurity content in detailed snowpack simulations

Marie Dumont (1), Matthieu Lafaysse (1), Ghislain Picard (2,3), Laurent Arnaud (2,3), Quentin Libois (2,3,4), and Samuel Morin (1)

(1) Météo-France – CNRS, CNRM – GAME (UMR 3589), Centre d'Études de la Neige, Grenoble, France, (2) Univ. Grenoble Alpes, LGGE (UMR5183), 38041 Grenoble, France, (3) CNRS, LGGE (UMR5183), 38041 Grenoble, France, (4) now at: ESCER Centre, Department of Earth and Atmospheric Sciences, Université du Québec à Montréal, 201 Av. du Président-Kennedy, Montréal, H3C3P8, Canada

The energy balance of the snowpack, driven in particular by its spectral albedo and the penetration depth of solar light, is of primary importance to drive the time evolution of snow on the ground. Here we introduce new developments of the detailed snowpack model SURFEX/ISBA-Crocus (Brun et al., 1992 ; Vionnet et al., 2012) which now includes a spectrally-resolved two-stream calculation of solar light absorption within the snowpack (Libois et al. ,2013) and of the spectral partitioning of the direct and diffuse atmospheric irradiance and a prognostic snow impurity content. The added value of these refined representation of processes is evaluated with respect to field measurements of snow spectral reflectance and snow water equivalent. Simulations were performed at Col de Porte site (Chartreuse, France, 1325 m a.s.l.) using in situ meteorological forcings during winter 2013-2014 and aerosols deposition fluxes from MOCAGE chemistry transport atmospheric model. A major Saharian dust deposition event occurred in February 2014. Using simulations and measurements, we investigate in particular the impact of this event on the physical characteristics of the snowpack with a special focus on metamorphism and on the timing of melt.