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Can we use the same snow scheme to simulate alpine snow packs in France and New Zealand?

Matthieu Lafaysse (1), Pascal Sirguey (2), Jonathan P. Conway (3,4), Nicolas J. Cullen (4), François Tuzet (1), and Marie Dumont (1)

(1) Météo-France - CNRS, CNRM UMR3589, Centre d'Etudes de la Neige (CEN), Grenoble, France, (2) University of Otago, National School of Surveying, Dunedin, New-Zealand, (3) Bodeker Scientific, Alexandra, New-Zealand, (4) University of Otago, Department of Geography, Dunedin, New-Zealand

Snow schemes used in large-scale climate and hydrological models commonly use homogeneous parameterizations and parameters around the world for a number of physical processes. To investigate the robustness of such a homogeneous model set-up in different climate contexts, we compare simulations of the multiphysics version of the SURFEX-Crocus detailed snowpack model (ESCROC) at two different mid-latitude sites in France (Col de Porte grassy meadow, 1325 m a.s.l.) and New Zealand (Brewster Glacier, 1760 m a.s.l.). Most parameterizations calibrated and evaluated in the French Alps appear to be suitable in the Southern Alps of New Zealand without any recalibration of the parameters. However, the parameter used to represent the decay of surface albedo due to light absorbing impurities deposition is not transferable between both sites. Indeed, the default SURFEX-Crocus parameterization underestimates the albedo at the Brewster Glacier site and consequently overestimates snow melt in spring. The multiphysics context of the experiment demonstrates that this difference is significant despite the uncertainties in the other physical processes. This result is consistent with the impurities deposition flux simulated by the MOCAGE atmospheric chemistry transport model, which is 10 times lower in Southern Alps. Therefore, snow schemes in climate and hydrological models may fail in representing the spatial variability of snow surface albedo, even in mid-latitude areas, as long as they are not able to account for the spatial variability of impurities deposition.