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Snow metamorphism and densification - Comparison of measured, parametrised and modelled data

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This study documents new analysis opportunities for validating snow-cover models and process parametrizations from continuous Snow Micro Penetrometer (SMP) measurements. Here we compare specific surface area (SSA) decrease rates as well as densification rates estimated from in situ continuous stratigraphy measurements taken during the winter 2017 at the Weissfluhjoch study site, Switzerland with rates calculated with (a) a parametrisation derived for new snow from X-ray microcomputer tomography and (b) the widely used snow cover model SNOWPACK . Vertical profiles of both penetration force and structural element length measured with the SMP were used to infer the SSA and density profiles using a statistical relation. From these profiles we could estimate the SSA decrease rate and the densification rate for snow samples of given thickness and position within the snowpack. Knowing the sample temperature also let us apply the above parametrisation to calculate the SSA decrease rates and densification rates. Finally, these same rates could be obtained using the optical-equivalent grain size simulated with SNOWPACK. We show that the parametrisation represents the measured SSA decrease rates better than the model, even though in both cases the measured rates were underestimated, especially for samples subject to high overburden stress. This is consistent with the fact that the parametrization was derived for new snow. The comparison with measured densification rates shows similar results. Our results show that order of magnitude agreement is readily achieved, while it is necessary to further discern methodological uncertainties from potentially missing physical processes in the parametrizations.