The RHOSSA snow campaign: monitoring the seasonal evolution of an alpine snowpack at daily resolution

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To improve snowpack modeling, a more physical representation of snow microstructure is required with a focus on snow density, specific surface area (SSA) and a better assessment of snow instability. Model developments need to be guided and evaluated against measurements. Up to now, model evaluations were performed using data sets with limited temporal and vertical resolutions and, hence, only allow to conclude on rather general model performance. Only very coarse information is generally available on when in the season and at which location in the snowpack simulation errors occur, making it difficult to identify causes. We presents the design and results of a comprehensive stratigraphy field campaign to provide benchmark data for the evaluation of snowpack models. The campaign was tailored to address issues of layer dynamics at different vertical and temporal resolution from the combination of traditional profiles, density cutter, ice cube, SnowMicroPen, computed-tomography, propagation saw tests and simulations with the snow cover model SNOWPACK. We provide the first time series of millimeter-resolved profiles of density and specific surface area, at a daily resolution. Besides overview data for the temporal evolution of parameters profiles over the entire season, we demonstrate the strength of the data set via the combination of methods targeted to concrete problems. Our specific results comprise (i) a calibration of microstructure parameters retrieval from SnowMicroPen measurements, (ii) comparison of different measurement techniques, and (iii) the assessment of densification and metamorphism modeling in SNOWPACK, by tracking properties within defined layers.