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The RHOSSA campaign: Multi-resolution monitoring of the seasonal evolution of the structure and mechanical stability of an alpine snowpack

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The necessity of characterizing snow through objective, physically-motivated parameters has led to new model formulations and new measurement techniques. Consequently, essential structural parameters such as density and specific surface area (for basic characterization) or mechanical parameters such as the critical crack length (for avalanche stability characterization) gradually replace the semi-empirical indices acquired from traditional stratigraphy. These advances come along with new demands and potentials for validation. To this end, we conducted the RHOSSA field campaign, in resemblance of density (ρ) and specific surface area (SSA), at the Weissfluhjoch research site in the Swiss Alps to provide a multi-instrument, multi-resolution dataset of density, SSA, and critical crack length over the complete winter season 2015-2016. In this paper, we present the design of the campaign and a basic analysis of the measurements alongside with predictions from the model SNOWPACK. To bridge between traditional and new methods, the campaign comprises traditional profiles, density cutter, IceCube, SnowMicroPen (SMP), micro-computed-tomography, propagation saw tests, and compression tests. To bridge between different temporal resolutions, the traditional weekly to bi-weekly snow pits were complemented by daily SMP measurements. From the latter, we derived a re-calibration of the statistical retrieval of density and SSA for SMP version 4 that yields an unprecedented, spatio-temporal picture of the seasonal evolution of density and SSA in a snowpack. Finally, we provide an inter-comparison of measured and modeled estimates of density and SSA for 4 characteristic layers over the entire season to demonstrate the potential of high temporal resolution monitoring for snowpack model validation.