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Empirical approaches for the depth-scaling of CRNS-derived soil moisture time series

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Since its invention a decade ago, non-invasive soil moisture monitoring using Cosmic Ray Neutron Sensing (CRNS) underwent an extensive development. Several signal correction procedures have been introduced and different calibration approaches have been tested and further developed to obtain accurate soil moisture estimates from the CRNS signal. However, CRNS-based measurements of soil water content represent an average value over a varying integration volume with a horizontal footprint area of several hectares and depths up to 30 cm. While field scale soil moisture measurements are highly beneficial for different hydrological applications, many operations require differentiated soil water information for individual soil layers, i.e. water budgeting or multi-criteria calibration of rainfall-runoff models at the catchment scale.
Therefore, we apply latest correction and calibration procedures to CRNS time series in the lowlands of north-eastern Germany and test different empirical approaches to depth-scale CRNS derived soil moisture values. Scaling is conducted according to reference time series of different depths using TDR soil moisture probes. Empirical approaches are either solely based on the CRNS soil moisture time series or include physical properties of individual soil layers.
First analyses show promising results, although the applied methods may need to be refined to achieve higher accuracies for specific depths. Depending on the environmental characteristics of individual study sites, further approaches will be tested that also include other non-invasive techniques for soil moisture estimation on a similar spatial scale such as GNSS reflectometry and hydrogravimetry.