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Exploring the potential of the cosmic-ray neutron method to measure interception storage dynamics

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Cosmic-ray neutron soil moisture probes are an emerging technology that relies on the negative correlation between near-surface fast neutron counts and soil moisture content. Hydrogen atoms in the soil, which are mainly present as water, moderate the secondary neutrons on the way back to the surface. Any application of this method needs to consider the sensitivity of the neutron counts to additional sources of hydrogen (e.g. above- and below-ground biomass, humidity of the lower atmosphere, lattice water of the soil minerals, organic matter and water in the litter layer, intercepted water in the canopy, and soil organic matter). In this study, we analyzed the effects of canopy-intercepted water on the cosmic-ray neutron counts. For this, an arable field cropped with sugar beet was instrumented with several cosmic-ray neutron probes and a wireless sensor network with more than 140 in-situ soil moisture sensors. Additionally rainfall interception was estimated using a new approach coupling throughfall measurements and leaf wetness sensors. The derived interception storage was used to correct for interception effects on cosmic ray neutrons to enhance soil water content prediction. Furthermore, the potential for a simultaneous prediction of above- and below-ground biomass, soil moisture and interception was tested.