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The sensitivity of CRNS and Sentinel-2 products to detect differences in soil water content along a toposequence with two contrasting parent materials

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Soil moisture controls hydrological processes in natural and agricultural systems. A clear understanding of their temporal dynamics and spatial variability is essential to control soil degradation processes, irrigation management and water use efficiency. In recent years, the measurement of soil water content (SWC) with ground-based neutron sensors and remote sensing products have become promising non-invasive methods for different spatial scales. In this study, we are investigating the sensitivity of using cosmic ray neutron sensor (CRNS) and Sentinel-2 SWC index for quantifying different dynamics of soil moisture along a toposequence with underlying contrasting parent materials. For this study, three sites were selected in the upper section (US) soils on limestones correspond to Muschelkalk facies, and another three in the lower section (LS) siliciclastic materials composed of low-permeability marls and claystone formation with primarily silty clay texture (Keuper facies). During two surveys, which correspond to wet (spring 2018/05/05) and dry conditions (summer 2018/08/05), a set of soil moisture data were obtained by using i) portable CRNS backpack, ii) satellite-based information and iii) HS200 sensor Delta-T Devices. The physical composition of the studied soils reflects the clear difference in parent material, with mean content of soil organic carbon of 6% in US against 1% in LW, while the mean clay content was lower in US (21%) than in LS (26%). The infiltration measurements also show different responses for water infiltration capacity, with a much higher mean value of hydraulic conductivity for the soils in the US (317 mm per day), reflecting the karst features, than in the LS (35 mm per day) corresponding to the siliciclastic materials. Our results show similar trends during the two surveys, obtaining significantly lower soil water content on limestones at the US where infiltration processes prevailed thus facilitating leaching and limiting runoff. In contrast, the higher soil water content was on siliciclastic soils at the LS where the low permeability of soils due to the clayed substrate promoted increased runoff. Focusing on the comparison of soil moisture data obtained during the wet and dry surveys, a soil characteristic dependency is observed, with a more different soil moisture state on siliciclastic soils (LS) between the two surveys than for the soils on limestones. Our preliminary results pinpoint that CRNS, Sentinel-2 index and field data captured soil moisture dynamics along the toposequence and demonstrated the sensitivity of neutron sensors and remote sensing products to investigate the effect of parent material on soil water

content at sampling scale.