



## Rail-based cosmic ray neutron sensing (CRNS): pushing the boundaries towards expanding footprints and temporal resolutions

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Cosmic ray neutron sensing (CRNS) has become an established method for deriving the soil water content (SWC), based on the inverse relationship of neutron counting and the SWC of the surrounding area. The provided footprint, lateral up to 200m and vertical of several decimeter, qualifies CRNS to bridge the information gap between classical hydrogeophysical approaches and remote sensing. While stationary CRNS offers continuous long-term SWC measurements at high temporal resolution, the covered area remains fixed and predefined. Car-borne CRNS roving on the other hand, allows to expand the mapped area. However, the method requires active operation and is limited to snap shot information only. As an alternative, the operation of a permanent mobile CRNS platform on trains promises to combine the advantages from stationary and car-borne CRNS measurements, as recently suggested by Schrön et al. (2021), while also its technical implementation, data processing and interpretation raises new challenges and complexity.

In this study we introduce a fully automatic CRNS railway system, installed in a conventional locomotive of a freight train, as first and novel of its kind. Results of the first phase of operation will be presented. The measurements along an experimental rail track were supported by local SWC measurements, gravimetric and dielectric records (Mobile Wireless Ad-hoc Sensor Network), at three areas along the railway, and by a newly installed weather station. Additionally, car-borne CRNS data were recorded on two days close to the railway track.

Preliminary results of data collected between September and December 2021 showed very stable spatial pattern in relation to the segments crossed by the train, which have been confirmed by the car-borne dataset. Temporal variations within hours were also evident as direct or indirect response to local rain and snow events. Based on the first results, we are confident, that rail-based CRNS offers the chance to play a prominent role in addressing soil hydrology at landscape scale in the future.

Schrön, M., Oswald, S. E., Zacharias, S., Kasner, M., Dietrich, P., & Attinger, S. (2021). Neutrons on rails: Transregional monitoring of soil moisture and snow water equivalent. *Geophysical Research*

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