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Monitoring and Mapping of Soil and Snow Water Across Scales with Cosmic-Ray Neutron Sensor Networks and Mobile Platforms

Martin Schrön¹, Sascha E Oswald², Steffen Zacharias¹, Peter Dietrich¹, and Sabine Attinger¹

¹Helmholtz Centre for Environmental Research GmbH - UFZ

²University of Potsdam

Cosmic-ray neutron albedo sensing (CRNS) is a modern technology that can be used to non-invasively measure the average water content in the environment (i.e., in soil, snow, or vegetation). The sensor footprint encompasses an area of 10-15 hectares and extends tens of decimeters deep into the soil. This method might have the potential to bridge the scale gap between conventional in-situ sensors and remote-sensing data in both, the horizontal and the vertical domain.

Currently, more than 200 sensors are operated in the growing networks of national and continental observatories. While single CRNS stations are continuously monitoring the local water dynamics at fixed field sites, mobile CRNS platforms are used for on-demand soil moisture mapping at the regional scale. The sensors are rapidly operational on any ground- or airborne vehicle. The data is particularly useful to study hydrological extreme events, heatwaves, and snow melt/accumulation, and it is being applied in hydrological models and agricultural irrigation management.

In the presentation we will explore the potential of the CRNS method to support and complement in-situ and remote-sensing data for hydrological event monitoring. We will discuss ongoing research activities that are aimed at improving the operability, frequency, and spatial extent of CRNS measurements. New measurement strategies that are currently explored are, for example: dense clusters of 20 CRNS stations fully covering a 100 hectare catchment; heat wave monitoring with mobile car-based CRNS; regular soil/snow water mapping using mobile CRNS on cars and trains; and airborne surveys using CRNS on gyrocopters.

Future CRNS observations could provide a valuable contribution to the multi-sensor approach, e.g. to help tracking and characterizing surface water movement, to map regional-scale soil moisture patterns, or to calibrate and evaluate satellite data.