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A European vision for hydrological observations and experimentation

CRNS-based monitoring technologies as solutions for climate-resilient agriculture

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Accurate soil moisture (SM) measurements are key in hydrological observations and subsequent applications as it can greatly improve our understanding of soil processes. Recently, Cosmic-Ray Neutron Sensors (CRNS) have been recognized as a promising tool in SM monitoring due to its large footprint of several hectares and half a meter in depth. The key characteristic feature of the method is the exceptionally high moderation strength of hydrogen, which makes it nearly independent of the soil chemistry. CRNS has a great potential for irrigation and monitoring applications as to the non-invasive nature of the method and the low-maintenance, independently operating sensors. From the initial focus on hydrological research. CRNS are increasingly used in agriculture, e.g. irrigation management and soil moisture mapping, and have been integrated LoRa or NB-IoT networks for fast data transmission. Two projects are discussed which advance CRNS technologies into monitoring networks.

COSMIC-SWAMP aims to provide an open-source water monitoring platform that integrates cosmic ray sensing data with FiWare Smart Application compliant analysis routines. Extending the existing Smart Water Management Platform (swamp-project.org), COSMIC-SWAMP supports dynamic processing of multiple co-located cosmic ray sensor streams to support automated and continuous growth forecasting using Wageningen/WOFOST crop models.

ADAPTER involves the development and provision of innovative simulation-based information products. Addressing weather- and climate-resilient agriculture, daily and comprehensive long-term weather and soil information are made available to the agricultural community and all interested parties as easy-to-use analyses, data products, and information interfaces (adapter-projekt.org). The hydrological model ParFlow coupled to its Common Land Model (CLM) module provides a nationwide water balance prediction with 600 m spatial resolution. The data assimilation within the product platform is supported by an independent network of CRNS stations (12 agricultural locations in North Rhine-Westphalia).

This contribution provides an overview about the current state of the art in CRNS methodological

integration, neutron detection technology and development of IoT interfaces with measurements and forecasts focusing on the water balance, including groundwater.