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High-resolution soil moisture mapping through the use of Cosmic-Ray Neutron Sensor and Sentinel-1 data for temperate and semi-arid environments

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Global climate change has a major impact on the availability of water in agriculture. Sustainable agricultural productivity to ensure food security requires good agricultural water management.

Soil moisture is one of the important variables in irrigation management, and there are many different techniques for estimating it at different scales, from point to landscape scales.

Cosmic-Ray Neutron Sensor (CRNS) technology has the capability to estimate field-scale soil moisture (SM) in large areas of up to 20 to 30 ha and has demonstrated its ability to support agricultural water management and hydrology studies. However, measurement of soil moisture on a global or regional scale can only be achieved from satellite remote sensing.

Recently, active microwave remote sensing Synthetic Aperture Radar (SAR) imaging from Sentinel-1 shows great potential for high spatial resolution soil moisture monitoring and can be the basis for producing soil moisture maps. However, these maps can be only used after calibration. Such calibration can be done through traditional, point soil moisture sampling or measurement, which is time-consuming and costly. CRNS technology can be used for calibration and validation remote sensing imagery predictions at field and area-wide level.

In this study a conversion model to retrieve soil moisture from Sentinel-1 (SAR) was developed using the VV (vertical-vertical) polarization, which is highly sensitive to soil moisture, and then calibrated and validated using CRNS data from temperate (Austria) and semi-arid (Kuwait)

Environments. This study is a major step in the monitoring of soil moisture at high spatial and temporal resolution by combining remote sensing and the CRNS based nuclear technology. The preliminary results show the great potential of using nuclear technology such as CRNS for remote sensing calibration of Sentinel-1 (SAR).