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Establishment of a network of soil moisture and cosmic ray neutron sensors for data assimilation and optimization of high-resolution, real-time predictions

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Climate change and its impacts at local scales, such as the more frequent occurrence of extreme weather events like droughts or floods, pose an increasing problem for agriculture. Our aim is to support farmers with soil condition and weather forecasting products that provide the basis for optimal adaptation to short-term weather variability and extremes as well as to long-term, regional climate change.

For this purpose, a prototypical monitoring and real-time forecasting system was established. The monitoring networks consist of a novel cosmic ray neutron sensor (Styx Neutronica), soil moisture and temperature sensors in four depths between 5 and 60 cm (SoilNet) and an all-in-one weather station (ATMOS-41, METER Environment) to measure the atmospheric conditions including air temperature, humidity, pressure, solar irradiance, wind speed and precipitation at 2 meter height above ground. The observation data are transmitted in real time to a cloud server via the cellular solution NBIoT (Narrow Band Internet of Things). After data post-processing the meteorological and hydrological parameters measured on site are directly assimilated into the fully coupled multi-physical numerical model system TSMP (Terrestrial Systems Modeling Platform, www.terrsysmp.org) at Forschungszentrum Jülich. ParFlow hydrologic model (www.parflow.org) is used in combination with the Community Land Model (CLM) to predict hourly, high-resolution (near plot level) information on soil moisture or other soil and meteorological parameters for the next 10 days. A special feature here is the prediction on the temporal development of plant-available water between 0-60cm depth for the sites of our monitoring network partners.

Observation data as well as the forecasting products are published in near real time on the digital product platform www.adapter-projekt.de. Users thus have direct access to relevant information that support them in planning agricultural management, e.g. irrigation and fertilization requirements, trafficability or workability.