Soil moisture monitoring using cosmic rays

Synthesis of remote sensing and novel ground truth sensors to develop high resolution soil moisture monitoring in China and the UK.

PROJECT LEAD Lincoln University

AREAS IN FOCUS
Beijing and Nanjing

"Not only has this STFC project enabled great science, but the collaboration has united Chinese and UK teams to address some of the most significant questions impacting global food security; for our project real concerns with the impact of water availability on crop productivity."

Project Leader, Professor Simon Pearson, Lincoln University

PROJECT SUMMARY

Availability of water is a key driver of agricultural productivity. Water availability is highly variable across China and in many cases, is in very short supply. Over-abstraction and climate change are exacerbating the problem.

Assessing water availability across spatial and temporal scales is notoriously challenging, inhibiting effective water management planning.

This project is applying space-enabled solutions to improve understanding of spatial variability of water resources, allowing producers to drive water use efficiency.

SOLUTION

The project will deploy two new sensors (one static, one mobile) within China that measures soil moisture content as a function of the albedo of cosmically-generated fast neutrons (Cosmos sensor, designed by Hydroinova, US). The static sensor measures soil moisture within a field up to a 200m radius from the measurement point. A mesh of static sensors will be deployed within Henan and Hebei province (which produces 40% wheat of China). The mobile sensor will be deployed on a bespoke autonomous vehicle or rover to measure soil moisture variation within a field.

The vehicle will be developed within the project and will be the first autonomous deployment of this sensor technology. Data from the static and mobile soil moisture sensors will be used to calibrate SAR sensor measurements from the Sentinel-1 satellite to scale up soil moisture measurements across a much wider area and to 500m x 500m spatial resolution. This is a 5-fold improvement on current resolution from SAR.

PROJECT IMPACT

Ultimately, the technology will enable near real time forecasts of soil moisture at a field scale. This information will be invaluable to agricultural producers and for flood risk forecasting, including key insights to improve water use efficiency, irrigation practices, land drainage and the implementation of precision agricultural techniques.

UK PARTNERS

- Project Leader, Professor Simon Pearson, University of Lincoln
- Centre for Ecology and Hydrology
- University of Aberystwth

CHINA PARTNERS

- Institute of Eco-environment and Agrometeorology, Chinese Academy of Meteorological Sciences (CMA)
- School of Atmospheric Physics, Nanjing University of Information Science and Technology (NUIST)

IMPACT FACTS

- **70% of the world's fresh water is used in agriculture.**