Measuring area-average soil moisture using stationary and roving cosmic-ray probes

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Area-average soil moisture at the horizontal scale of hectometers and vertical scale of decimeters can be inferred from measurements of intensity of cosmogenic fast neutrons in air above the ground surface. Neutron probes respond to all hydrogen within the support volume, and isolating the signal that is due to soil moisture is possible by locally calibrating the probe on independently determined soil moisture, or by estimating all known sources of hydrogen and computing appropriate corrections to neutron count rate. Cosmic-ray neutron probes can be stationary or mobile. Stationary probes are being used to form the COsmic-ray Soil Moisture Observing System (COSMOS) that provides continental-scale soil moisture data in the USA. Mobile probes, called the COSMOS rover, can be used to map neutrons and infer soil moisture content over large areas or along long lines.

Acknowledgements: The COSMOS project is supported by the National Science Foundation (USA).