Geophysical Research Abstracts
Vol. 19, EGU2017-12023-2, 2017
EGU General Assembly 2017

Soil moisture estimation across scales with mobile sensors for Cosmic-Ray Neutrons – The influence of roads

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The regional monitoring of storage, movement, and quality of water is of crucial importance to practical applications such as agricultural production, water resources management, and flood, drought and climate change predictions. A very promising method to cover soil moisture dynamics at scales relevant for land management or modeling purposes is the method of Cosmic Ray Neutron Sensing (CRNS). While the stationary use of instrument has been applied successfully to monitor soil moisture dynamics at a spatial scale up to a footprint of 500 m, a new development, the mobile CRNS rover, promises to cover soil moisture patterns at regional scales. Recently published insights on the physics of the CRNS sensor's spatial response revealed a dynamical nature of the footprint radius depending upon the ambient sources of water as well as the fact that the sensor is highly sensitive to hydrogen in the immediate vicinity. The latter aspect is of particular critical relevance for the practical application of mobile CRNS. During CRNS rover campaigns the sensor is very often moved along existing roads and pathways and it can be assumed that the CRNS measurement could be biased towards road moisture conditions. Thus, precise knowledge about the underlying physics and the relationships between site heterogeneity and sensor response is an essential prerequisite for the successful enhancement of the CRNS rover method. The purpose of the presentation is to highlight this challenge. Here, we present results from dedicated experiments and neutron transport simulations, and will propose approaches to correct the CRNS signal depending on site-specific wetness conditions, road geometry, and road material.