Geophysical Research Abstracts
Vol. 19, EGU2017-16590, 2017
EGU General Assembly 2017

Spatial variability of soil water conductivities obtained with classical laboratory methods and their relation to electrical resistivity measurements

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Soil water conductivity plays a critical role when estimating water transport using the Richard's equation. Modelers often take one value of the saturated hydraulic conductivity (Ksat) per soil layer and that value is decreased for unsaturated conditions following the equations of Mualem and van Genuchten. This approach can lead to inconsistencies between model and natural soil, because in the field Ksat can vary by several orders of magnitude on short (centimeter) distances and Ksat often expresses water movement through macropores which cannot be downscaled without caution towards matrix flux. To improve existing knowledge we established a field experiment on an agriculturally used silty clay loam (Stagnosol) in SE Norway. More than 100 undisturbed soil samples were taken to determine soil water retention, saturated and unsaturated hydraulic conductivities and bulk density in the laboratory. A subset of these samples was scanned at the computer tomography facility at the Swedish University of Agricultural Sciences in Uppsala with special emphasis on characterizing macroporosity. Centimeter to decimeter scale heterogeneities were investigated in the field by using electrical resistivity tomography (ERT) in a quasi-3D and a real 3D approach. The latter covered the soil volume of 2x1x1 m where the soil samples were taken. We will present comparisons between hydraulic conductivities obtained in the laboratory using different methods, and between laboratory hydraulic conductivity results and electrical resistivities obtained in the field.