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Characterization of Soil Heterogeneity Across Scales in an Intensively Investigated Soil Volume

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Heterogeneous water flow in undisturbed soils is a natural occurrence that is complex to model due to potential changes in hydraulic properties in soils over changes in space. The use of geophysical methods, such as Electrical Resistivity Tomography (ERT), can provide a minimally-invasive approximation of the spatial heterogeneity of the soil. This spatial distribution can then be combined with measured hydraulic properties to inform a model. An experiment was conducted on an Intensively Investigated Soil Volume (IISV), with dimensions of 2m x 1m x 0.8m, located in an agricultural field that is part of the Gryteland catchment in Ås, Norway. The location of the IISV was determined through surface ERT runs at two sequential resolutions. The first run was used to find an area of higher apparent electrical resistivity in a 23.5 x 11.5 m area with 0.5 m spacing. The second run measured apparent electrical resistivity in a 4.7 x 1 m area with 0.1 m spacing, from which the final IISV volume was derived. Distinct features found in the higher resolution run of the IISV, including a recent tire track from a harvester, were used as a spatial reference point for the installation of 20 pairs of TDR probes and tensiometers. The instruments measured water content, temperature and pressure potential at 10 minute intervals and ran continuously for a period of two weeks. After completion of the data collection the IISV was intensively sampled, with 30 samples taken for bulk density, 62 for hydraulic property measurements, and 20 to be used for both CT scanning and hydraulic property measurements. The measurement of hydraulic properties is ongoing and retention will be measured in the 0 – 100 cm range on a sand table, and from 100 – approx. 900 cm with an automated evaporation method. The formation of spatial clusters to represent the soil heterogeneity as relatively homogeneous units based on mesoscale properties like apparent electrical resistivity, bulk density, texture, in-situ measurements and image-derived properties at the microscale will be presented and discussed. Work combining the spatial clusters with estimated and measured hydraulic properties to inform the HYDRUS 3D model will also be discussed.