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AXISYMETRICAL WATER INFILTRATION IN SOIL IMAGED BY NON-INVASIVE ELECTRICAL RESISTIVIMETRY

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Axisymetrical infiltration of water in soil has been largely studied since the development of tension disc infiltrometers. Procedures have been developed to derive the hydraulic properties of soils from axisymetrical infiltration measurements but rely on some simplifying and/or a priori assumptions on the homogeneity of the soil from the point of view of its hydraulic properties and its initial water status prior to infiltration. Such assumptions are difficult to ascertain. We present here an attempt to image in a vertical 2D plane the development of the axisymetrical infiltration bulb in soils using non-invasive electrical resistivity measurements.
Bi-dimensional images of the soil electrical resistivity were obtained at various times during the infiltration process by inverting apparent electrical resistivity measurements taken by a 32-electrodes Wenner array with a 10 cm spacing laid across a diameter of the infiltrometer. The inversion was done using the Res2Dinv software. The infiltration experiments used either a CaCl2 or a KBr solution at 40 g/Litre to enhance the soil electrical resistivity contrast, and either 8-cm or 25-cm diameter disks. Most of the infiltration experiments were done at one single water potential (-0.1 kPa) and lasted 3.5 to 5 hours. A multipotential experiment was conducted just as classically done to derive hydraulic conductivity values according to Reynolds & ElrickŠs method. At the end of each experiment, the soil was sampled for Cl or Br concentrations on the 2D plane corresponding to the resistivity measurements.
Electrical resistivity measurements provided clear images of the infiltration bulb and allowed the user to monitor the development of the infiltration bulb through time.

The infiltration bulb imaged by resistivimetry at the end of the infiltrations matched well that imaged from the anion concentrations in soil. Some geometrical distortions of the infiltration bulb could be seen both through resistivity and anion concentration measurements and were consistent between both imaging methods. High-resolution geophysical imaging of water infiltration in field soils seems a fruitful approach to the development of efficient methods for the hydraulic characterisation of soils.