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Using the electrical resistivity for describing the temporal variability of the soil water content at the field scale.

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Water transport in the vadose zone greatly depends on the hydric properties of soils which exhibit high variability whatever the spatial scale analysed. The determination of those properties in the field or in the laboratory involves considerable uncertainty. Recently, inverse modelling has been introduced to obtain hydric properties in situ by deducing from a measured time series of soil water content. Anyhow, the soil water content is commonly obtained by gravimetric measurements on soil samples, TDR measurements or neutron probes measurements. At the field scale, these methods give only punctual information on soil water content, with a low spatial resolution. Financial and time constraints limit the numbers of measurements locations and thus the description of the soil water content.

Since recently, geophysical methods enable the monitoring of some soil characteristics on a continuous space with a high resolution. One of them, the electrical resistivity ρ (ohm.m) -or DC method- is well adapted to characterise the soil subsurface and to describe soil properties, even if they are time-dependent. However the electrical resistivity depends on several chemical and physical soil variables that can interact. The influence of one soil parameter like the soil water content on the electrical resistivity is then hard to estimate. Our objective was then to use spatial measurements of electrical resistivity, to define zones of homogeneous electrical resistivity with time, to interpret them in terms of evolution of water content, and to compare them with a soil map. Our assumption was then that the time variation of electrical resistivity at the field scale was only due to the evolution of the soil moisture in our studied field.

A time monitoring of the soil electrical resistivity and the soil moisture was realized during the year 2006, at four dates, both by the MUCEP device (MultiContinous Electrical Profiling), that gives measurements on a whole field area, and by local gravimetric measurements of the soil water content. Homogeneous zones were defined directly from measurements for the electrical resistivity, and after ordinary kriging for the water content.

Our analysis of the spatial and temporal variability has permitted to discriminate three temporal homogeneous zones, both for electrical resistivity and the water content, that were mainly related to the soil map. We show that the use of electrical measurements enables (1) to directly describe the spatial and temporal evolution of soil water content at the field scale and (2) to extrapolate the temporal evolution of the water content in unknown zones. We could then describe some hydric processes, like lateral flows or upward capillary flows that would be difficult to derive from soil maps.