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From spatial-continuous electrical resistivity measurements to the soil hydric functioning at the field scale: a case study in a small field area

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The aim of this paper was to discuss the hydric functioning of a small field area by using measurements of the soil electrical resistivity. We made the hypothesis that the difference in electrical resistivity data recorded at different dates in the field were only due to differences in water content: indeed, the data were corrected for temperature by the Keller & Frischknecht equation (1966) and ancillary laboratory experiments showed that the influence of the electrical conductivity of the soil solution did not influence significantly the soil electrical resistivity. As

The studied 2 ha field area comprised several soil units developed either in white calcareous or in cryoturbated calcareous. A pedological prospection by auger holes enabled to determine the real soil depth in each soil unit. The spatial soil electrical resistivity was recorded at a high resolution on a 2 ha area by the MuCEP device -MultiContinuous Electrical Profiling- (Panissod et al., 1997) at two dates. The MuCEP enabled the measurements of electrical resistivity at three pseudo-depth, due to interelectrode spacings equal to 0.5m, 1m and 2m. The interpretation of the electrical resistivity measurements was analysed in four steps:

- firstly, the apparent electrical resistivity measurements were interpreted in terms of local electrical resistivity by 1D inverse modelling;
- secondly, the interpreted electrical values were translated in soil volumetric water content by using an empirical law, that was independently demonstrated in the field by a temporal monitoring of both electrical resistivity and water content;
- thirdly, the soil volumetric water content were transformed into soil water potential values by using the water retention curve of the studied soil (the latter was independently determined on undisturbed samples in the laboratory).

The interpretation of both the water content and matric potential maps demonstrated that these two state variables are not constant in a given soil unit. Some soil hydric processes, like lateral overland flow, could occur in some soils of the studied zone. They would never have been detected by local measurements of soil characteristics or by the use of the soil map. As a consequence, this study demonstrated the interest of spatial electrical resistivity at high resolution to interpret the soil spatial hydric functioning, and will be achieved and improved in the Digisoil project.