Spatialization of subsurface properties and states using geophysical and geostatistical methods

Hocine Henine[1], Rémi Clément[1], Melissa Kouassi, Julien Tournebize[1]

(1) IRSTEA, France

The knowledge of the spatial heterogeneities of the subsurface is major information in many disciplines such as pedology, geology, hydrogeology and geochemistry, and at different scales. However, the lack of coordination between the various tools, disciplines and methods describing each subsurface element does not allow efficiently addressing the hydrological behavior of the soil surface. The spatial heterogeneity can have a significant effect in a study of subsurface processes of groundwater flow and pollutant transfer. In this study, we demonstrated the potential of geophysical methods to provide new momentum to the characterization of soil water content heterogeneities as proxy. More specifically, we hypothesize that a geostatistical framework based on BME (Baysian Maximum Entropy) to assimilate geophysical (considered as uncertain measurement) and hydrological (considered as certain measurement) data can provide *in fine* a representative distribution in space (and time) of subsurface properties.

The BME is a modern spatio-temporal geostatistical method allowing through Bayesian process the integration of reliable datasets with the spatial dataset of different levels of uncertainty. This methodology is applied to a field dataset carried out at Boissy le Châtel plot, in Orgeval carchment (East of Paris, France). Two years of high frequency monitoring experiment allowed to acquire an important datasets composed with: (i) 546 ERT profiles with a pro Syscal resistivitimeter (Dipole-dipole and gradient array)) and (ii) hourly soil water content using 12 buried TDR probes. The measurements of Electrical Resistance Tomography (ERT) allow an indirect and uncertain distribution of the soil water content, because it is subject to errors of measurement inversion and ERT conversion. Despite these inconvenient, the estimation of water content, although indirect and tarnished by errors, can significantly improve the estimation of the water content distribution, when its associated uncertainty are correctly estimated and are rigorously assimilated during calculations. The two datasets were integrated into specialization framework based on the BME method to predict the soil water content distribution.

The results indicate that the BME method creates more reliable model of water content distribution. This approach seems to be a powerful method integrating ERT and TDR measurements to improve the distribution of water content. The effectiveness of this method depends mainly on the estimation of the structure and amplitude of the data uncertainties. The identification and assimilation of these uncertainties is the difficult point, especially when the ERT measurement artifacts are important.