Potential to use Proximal Electromagnetic Induction and inversion modelling for non-invasive and expeditious mapping of clay content distribution with depth

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Knowledge about the spatial distribution of clay fraction is very important for soil and water management. Traditional soil sampling is commonly used to infer clay fraction; however, this method difficultly leads to a comprehensive soil mapping. This is because they cover only small and localized sites and may not be representative of the soil properties at the management scales. Furthermore, they are highly time and work consuming, resulting in costly surveys. Geophysical techniques as electromagnetic induction (EMI) provides enormous advantageous compared to soil sampling because they allow for in-depth and non-invasive analysis, covering large areas in less time and at a lower cost.

In the scope of SOIL4EVER project and in the area of the Roxo irrigation perimeter in Alentejo, Portugal, we carried out EMI surveys using a DUALEM21 to evaluate the potential use of this methodology in mapping spatial distribution of soil physical (e.g. clay content) and chemical (e.g. salinity) properties. We firstly inverted field apparent conductivity data (σa) using a Quasi-3D inversion in order to obtain 3D electromagnetic conductivity images (EMCI) of the real soil electrical conductivity (σ) with depth. This is because the σa measurements in the field is a depth-weighted, average conductivity measurement and does not represent the σ with depth.

Afterward, we evaluated the possibility of establishing a linear regression (LR) relationship between σ and soil properties (including clay) collected from 10 soil sample locations to a depth of 0.80 m. We concluded that it is possible to establish a relatively good LR between σ and clay with R2>0.60, allowing us to convert EMCI to clay content and generate clay maps for different depth down to a depth of 0.80 m.