Geophysical Research Abstracts
Vol. 21, EGU2019-15382, 2019
EGU General Assembly 2019
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Application of electromagnetic induction methodology and TerraEM inversion software to a timelapse experiment in southern Italy

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Soil bulk electrical conductivity is being used as a surrogate measure of soil hydraulic variables, such as water content. In this framework, the electromagnetic induction methodology is a fast and non-invasive tool which is very useful for hydrological and agronomic purposes, nevertheless some theoretical and applicative issues are still unsolved. The aim of this study is to detect spatio-temporal dynamic of soil water content from non-invasive and fast electromagnetic induction measurements in two experimental fields located in southern Italy. The first one was on bare soil (Colluvic Regosol) in Valenzano (Bari) and the second on corn cultivation in Acerra (Napoli) (Mollic Vitric Andosol) . Both experiments consists of two sub-plots irrigated with water at about 1 and 8 dS m-1. To achieve this goal, the apparent electrical conductivity was measured in the field by means of a CMD MiniExplorer sensor based on the electromagnetic induction (EMI) methodology. The EMI sensor was used with horizontal and vertical dipole orientations in order to measure apparent electrical conductivity at 6 depths (depth range 0.25-1.8 m). TDR field measurements were also performed during the experiments. In addition, laboratory analyses were performed on undisturbed soil samples previously collected in the field in order to define the relationship between the electrical conductivity and the water content. From the collected electromagnetic data, by means of an inversion algorithm performed by TerraEM software, we calculated the bulk electrical conductivity. Then, we retrieved the volumetric water contents by means of the relationship bulk electrical conductivity vs. volumetric water content previously defined in the laboratory. Here we will present some drawbacks and methodological issues encountered during the physical and numerical (inversion algorithm) experiments on two completely different soils.