Geophysical Research Abstracts
Vol. 19, EGU2017-17967, 2017
EGU General Assembly 2017

Soil Moisture Monitoring using Surface Electrical Resistivity measurements

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The relevant role played by the soil moisture (SM) for global and local natural processes results in an explicit interest for its spatial and temporal estimation in the vadose zone coming from different scientific areas – i.e. eco-hydrology, hydrogeology, atmospheric research, soil and plant sciences, etc... A deeper understanding of natural processes requires the collection of data on a higher number of points at increasingly higher spatial scales in order to validate hydrological numerical simulations.
In order to take the best advantage of the Electrical Resistivity (ER) data with their non-invasive and cost-effective properties, sequential Gaussian geostatistical simulations (sGs) can be applied to monitor the SM distribution into the soil by means of a few SM measurements and a densely regular ER grid of monitoring.
With this aim, co-located SM measurements using mobile TDR probes (MiniTrase), and ER measurements, obtained by using a four-electrode device coupled with a geo-resistivimeter (Syscal Junior), were collected during two surveys carried out on a 200 $\times$ 60 m2 area. Two time surveys were carried out during which Data were collected at a depth of around 20 cm for more than 800 points adopting a regular grid sampling scheme with steps (5 m) varying according to logistic and soil compaction constrains.
The results of this study are robust due to the high number of measurements available for either variables which strengthen the confidence in the covariance function estimated. Moreover, the findings obtained using sGs show that it is possible to estimate soil moisture variations in the pedological zone by means of time-lapse electrical resistivity and a few SM measurements.