Geophysical Research Abstracts
Vol. 18, EGU2016-40, 2016
EGU General Assembly 2016

Temporal stability of the apparent electrical conductivity measured in seasonally dry sandy soil

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Soil is spatially heterogeneous due to differences in parent material, climate, topography, time and management practices. The use of non-invasive and non-contact geophysical methods facilitates the exploration of natural landscapes or cropped areas. Electromagnetic induction (EMI) sensors which measure the soil apparent electrical conductivity (ECa) express soil spatial variability in terms of spatial soil ECa variability. In an agricultural context, knowledge and understanding of the soil spatial variability will allow us to delimit areas where precision agriculture techniques could be used to improve management practices. These practices enhance soil and water conservation, especially for sandy soils in Mediterranean climates where soils are dry for substantial periods of time. The first objective of this work was to apply principal component analysis (PCA) to see if a temporally stable component could be found. The second objective was to see if temporal stability information acquired from several ECa surveys could be used to better interpret results of a single survey in terms of relationships between ECa and soil water content (SWC). The experimental catchment, "La Manga", is located in SW Spain and covers 6.7 ha of a rainfed olive orchard. Soil profile samples were collected at 41 locations on a pseudo-regular grid. Samples were analyzed in the laboratory for soil texture, stone content, and bulk density (b). The catchment was sampled for gravimetric SWC at the 0-0.1 and 0.1-0.2 m depth intervals at the same 41 locations on 18 occasions. At the same 41 locations ECa was measured during 9 of the 18 SWC surveys using a DUALEM-21S EMI sensor. In addition, 7 field-wide ECa surveys were conducted. Soil ECa values were used to delimit three areas in the orchard, based on the spatial distribution of the first principal component (PC), which represented the spatial ECa pattern. Soil properties were studied within each area, and using analysis of variance, significant differences were detected among the three classes for clay, stone and SWCs. Relationships between ECa and SWC were modeled using an exponential relationship, and parameters from the model showed significant differences between classes. Results indicated a strong relevance of the first PC, the time-stable dominant spatial ECa pattern, on the relationship between SWC and ECa, indicating that the soil properties influence such a relationship. Therefore, a spatial classification of the study field based on ECa gives more insight into the relationships both between ECa and SWC, and between soil properties such as clay, stone and SWCs in water limited environments.