Geophysical Research Abstracts
Vol. 16, EGU2014-14760-2, 2014
EGU General Assembly 2014

High resolution electrical resistivity tomography of golf course greens irrigated with reclaimed wastewater: Hydrological approach

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Actually, there are over 300 golf courses and more than three thousand licensed players in Spain. For this reason golf cannot be considered simply a hobby or a sport, but a very significant economic activity. Considered as one of the most rapidly expanding land-use and water demanding business in the Mediterranean, golf course development generates controversy. In the recent years there has been a considerable demand for golf courses to adopt environmentally sustainable strategies and particularly water authorities are forcing by law golf managers to irrigate with alternative water resources, mainly reclaimed wastewater. Watering practices must be based on soil properties that are characterized by samples removed from the different zones of the golf course and submitted to an accredited physical soil testing laboratory. Watering schedules are critical on greens with poor drainage or on greens with excessively high infiltration rates.

The geophysical survey was conducted over the greens of the Girona Golf Club. Eighteen electrical resistivity tomographies were acquired using a mixed Wenner-Schlumberger configuration with electrodes placed 0.5 meter apart. Small stainless-steel nails were used as electrodes to avoid any damage in the fine turfgrass of greens The resistivity meter was set for systematically and automatically selects current electrodes and measurement electrodes to sample apparent resistivity values. Particle size analysis (PSA) has been performed on soil materials of any putting green. The PSA analysis has been composed of two distinct phases. The first has been the textural analysis of the soils for determining the content of sand, silt, and clay fraction via the use of a stack of sieves with decreasing sized openings from the top sieve to the bottom. Subsequently, the hydraulic conductivity of the substrates has been evaluated by means of Bredding and Hazen empirical relationships.

The results of this research show that the electrical resistivity tomography is a non-invasive and cost-effective technique for high resolution characterizing the subsurface below golf course greens. The obtained models have provided detailed information on the lateral and vertical variability of each the subsurface and from an empirical correlation between the values of electrical resistivity and hydraulic permeability to assess the preferred areas of drainage that could pose in risk to the vulnerability of the underlying aquifers.