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Hydraulic characterization of rocky subsurface using field infiltrometer measurements coupled with hydrogeophysical investigations

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The shallow and/or karstic and fractured aquifers are among the most important water resources. At the same time, they are particularly vulnerable to contamination. A detailed scientific knowledge of the behavior of these aquifers is essential for the development of sustainable groundwater management. Different investigation methods have been developed with the aim to characterize the subsurface and to monitor the flow and solute transport in these hydrogeology systems.

This study presents the results of an investigation method, that combine large infiltrometer measurements with elettrical resistivity profiles, carried out in two different experimental sites characterized by different hydrogeology systems. One site, close to Altamura a city in the South of Italy, is represented from karstic and fractured limestone that overlays the deep aquifer. This area has been affected by sludge waste deposits derived from municipal and industrial wastewater treatment plants.

The second site, close to San Pancrazio Salentino town in Southern Italy also, is represented from a quarry of calcarenite that has been used as a dump of sludge of mycelium producted from pharmaceutical industry. In both these cases the waste disposal have caused soil-subsoil contamination. Knowledge of the flow rate of the unsaturated zone percolation is needed to investigate the vertical migration of pollutants and the vulnerability of the aquifers.

In this study, subsurface electrical resistivity measurements were used to visualize the infiltration of water in the subsoil due to unsaturated water flow. Simultaneously, the vertical flow was investigated by measuring water levels during infiltrometer tests carried out using a large adjustable ring infiltrometer, designed to be installed in the field directly on the outcrop of rock.

In addition electrical resistivity azimuthal surveys have been conducted to detect principal fractures strike directions that cause preferential flow.

The results obtained support the efficacy of the investigation method to estimate the vertical flow into these two acquifers characterized by different hydrogeologic conditions.