

shallower vadose zone is composed by eolic sand with homogeneous isotropic properties. In these quasi-ideal conditions the geophysical data are accurately examined to achieve the potential knowledge on the water processes and to identify possible misleading information. Field ERT data have been compared with numerical simulations using both traditional uncoupled hydrogeophysical inversion and an innovative Bayesian framework for coupled hydrogeophysical modeling. The coupled data assimilation process is able to estimate reliable hydrological parameters and to reproduce the proper evolution of the water plume in the vadose zone. The uncoupled approach leads to misleading estimations of hydrological quantities, that are essentially due to the geophysical inversion procedure. The lack of knowledge in the inversion process may generate artifacts in the geophysical parameter distributions, which shall be translated in uncorrected hydrological states. GPR data are used separately to analyze capabilities and limitations of this technique in unsaturated environment. GPR surveys on the topographic surface could be wrong analyzed if a clear understanding of the wave propagation in the soil is not realized. So, where a straightforward interpretation of direct and reflected waves is not possible, the presence of guided modes of propagation must be deeply examined to achieve useful information on fluid flow dynamics. The results clearly demonstrate that two key points are fundamental in the hydrogeophysical inversion. The starting point is the proper understanding of the physical phenomena acting during the geophysical surveys, as misinterpretations cause a detachment from the true system. Second, an adequate choice of the hydrogeophysical approach may strongly reduce the propagation of errors and artifacts during the process of parameter estimation.

Procedure to manage potential groundwater contamination by arsenic, iron and manganese in lower Po Plain: a proposal from the case study of Cremona

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The Legislative Decree (D.Lgs.) 152/09 on environmental regulations also governs polluted site remediation (Part IV). A potentially contaminated site is defined when concentrations exceed the limits reported in the Attachment 5 (Title V). Nevertheless, the D.Lgs. 152/09 considers the possibility of higher limits than Attachment 5 for trace elements in the case of natural high contents. In the lower Po Plain, previous studies reported high natural concentrations of As, Fe and Mn in groundwater. The lower Po Plain is also one of the most important areas for the Italian productive system, and thus, possible direct sources of As, Fe and Mn or indirect anthropogenic influences could exist. Therefore, an operative tool is required to determine Natural Background Levels (NBL) and to understand if measured high concentrations are attributable to NBL or to anthropogenic sources/influences, and consequently to decide on the beginning of the D.Lgs. 152/09 procedure with the site characterization phase. This work presents a proposal of procedure to manage potentially contaminated site by As, Fe and Mn in the lower Po Plain, developed within a scientific collaboration between the Province of Cremona and the Univ. Milano-Bicocca. This procedure consists of 3 points. Point 1 is the derivation of NBL following the BRIDGE methodology. If measured As, Fe and Mn concentrations

exceed the NBL, the procedure moves to point 2, otherwise they can be considered as natural background. Point 2 verifies the presence of direct anthropic sources by checking the public authorities registers of industrial activities. For example, As can be used in ceramic, glass, leather tanning and electronics industry; other sources could be pesticides and wood preservatives. In case of anthropic source, the site characterization phase is required, otherwise the procedure moves to point 3. Point 3 verifies the presence of organic matter, which is considered a redox driver for As, Fe and Mn release. Organic Matter is distinguished into Natural (NOM), e.g. peat, and Anthropic (AnOM), e.g. hydrocarbons. If NOM is identified and AnOM is not identified, measured concentrations can be considered as natural background. If NOM and AnOM are identified, an anthropogenic influence could exist, and thus further investigations are required to distinguish natural and anthropic components. If NOM and AnOM are not identified, measured concentrations can be considered as natural background. If NOM is not identified and AnOM is identified, an anthropogenic influence can exist, and thus the site characterization phase is required.

Quantitative assessment of the karst aquifer feeding the Pertuso spring in the south east of Latium Region

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The study area is located in the Upper Valley of Aniene River, between the Pertuso spring and the city of Trevi nel Lazio (FR). In this area it outcrops an important carbonate karst aquifer outcrops, mainly made of dolomitic limestones and dolomites of Cretaceous age. The limestones outcropping in the Upper Valley of Aniene River are very fractured and mostly soluble; karst erosion has occurred on a large scale on this area, assuming great importance in the modeling of the soil and also of the subsoil. The surface karst activity led to the formation of a typical karst landscape with rutted fields, sinkholes and flat filled by red soils, while the underground activity has given rise to cavities, sinkholes and cave systems. The hydrogeological framework is therefore closely related to the karst nature of carbonate rocks constituting the reliefs strongly shaped by surface and underground karst activities. The alternation of carbonate formations, limestone and dolomite, together with the epikarst, made of residual of karst activity, and some marly horizons, dating back to the Miocene age, are the main responsible for the hydrogeological system of this area. In this karst aquifers the major contributions to the Aniene River are provided by the major springs lie close the boundary of the carbonate hydrogeological system. Before the town of Trevi nel Lazio (FR), at the altitude of 700 m a.s.l. the Aniene River receives an important contribution on the right side by the Pertuso spring, a karst spring which is the largest one in this area. The peculiar fragility of this aquifer, which feeds the Pertuso spring, requires special attention in the planning and implementation of monitoring, as regards the aspects related to surface and groundwater. This spring is going to be exploited to supply an important water network of the south part of Roma district, so it was interesting to know in details the quantitative characterization of it, in the aim of do not let the catchment works to affect the natural hydrogeological balance of the aquifer. In this aim it has been set up a multidisciplinary