SUBSOIL GEOSTATISTICAL MODELING AS TOOL FOR HYDROGEOLOGICAL MODELING: TRANSITIONAL PROBABILITY APPROACH APPLIED UPON A HETEROGENEOUS SITE

Nico DALLA LIBERA [1], Paolo FABBRI [1], Leonardo MASON [2], Leonardo PICCININI [1], Marco POLA [1]

[1] Department of Geosciences, University of Padua, via G. Gradenigo 6-35131 Padua, Italy, nico.dallalibera@phd.unipd.it; paolo.fabbri@unipd.it; Leonardo.piccinini@unipd.it; marco.pola@unipd.it
[2] ARPA Veneto, Department of Venice, via Lissa, 6-30100 Venice, Italy, leonardo.mason@arpa.veneto.it

Nowadays, a detailed hydrogeological characterization is the base of an effective hydrogeological modeling aimed to plan and manage both the groundwater and the environment systems. Every single groundwater numerical simulation needs a hydrogeological conceptual model of the subsoil in order to define parameters and boundary conditions as well. The better the subsoil is reconstructed, the more accurate the results of the modelling will be. Several methods are available to perform a 3D simulation of the subsoil; however, their application depends on the heterogeneity of the investigated area. This study aims to perform a 3D model of a heterogeneous site covering an area of 3.8 km^2 close to the Venice lagoon (northeastern Italy). This area is relevant from the environmental perspective because the shallower aquifer (about -4 meters above sea level) is affected by arsenic contamination (Dalla Libera et al., 2016; Trevisani & Fabbri, 2010). Approximately 119 stratigraphic logs are available in this site, confirming the presence of alluvial deposits (clay, silt, sand and peat) with high heterogeneity. Considering that, we decided to use a transitional probability geostatistics approach to perform the 3D subsoil model (Carle, 1996). Firstly, we analyzed borehole data to calculate material proportions, mean lens lengths and transitional probabilities. Secondly, the transition probabilities were used to generate multiple realizations of the subsoil heterogeneity. Every realization was conditioned by borehole data, preserving the geologic tendencies. The results produced a detailed 3D structure of lithological architecture that is fundamental to perform a further reactive transport numerical model of groundwater (in our case for arsenic contamination). Therefore, the considered approach enhances the geological/stratigraphic knowledge of the hydrogeological system for a further discussion on the regional environmental management.

References

Carle S.F. and Fogg G.E., 1996. Transition Probability-based indicator geostatistics. Mathematical Geology, v. 28, no. 4, p. 453 – 477.

Dalla Libera, N., Fabbri, P., Piccinini, L., Pola, M., Leonardo Mason, L., 2016. Natural Arsenic in groundwater in the drainage basin to the Venice lagoon (Brenta Plain, NE Italy): the organic matter's role. Rend. Online della Soc. Geol. Ital. 41, 30–33. doi:10.3301/ROL.2016.85.

Trevisani, S., Fabbri, P., 2010. Geostatistical modeling of a heterogeneous site bordering the Venice lagoon, Italy. Ground Water 48, 614–623. doi:10.1111/j.1745-6584.2009.00632.x.