# GROUNDWATER DYNAMICS AND MANAGEMENT

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KEYWORDS: porous media, heterogeneity, model reduction, inverse problems, risk analysis

The aim of the research consists in developing realistic models for the description of fluid flow, and conservative or reactive solute transport in porous media. The subsurface environment is strongly heterogeneous and the impossibility of a detailed characterization, based on field data, compromises the accuracy of predictions and leads necessarily to the adoption of probabilistic modeling incorporating multiscale representations of media. In addition, climate change and anthropic pressures concur to define complex scenarios involving, e.g., groundwater exploitation, contamination, saltwater intrusion and surface water–groundwater interactions. These scenarios are investigated by means of accurate and efficient computational methods for the quantification of uncertainties, in order to provide robust predictions and indications for the management of water resources and the design of proper mitigation actions. These computational methods consist in the application of model reduction algorithms that allow to perform risk analysis, global sensitivity analysis, calibration and optimization problems (including eco-design solutions), in a straightforward manner. This approach is applied to specific research lines, including: (i) analysis of quantitative and qualitative status of groundwater bodies, under present and future scenarios, in line with the European directives and guidelines (ii) socio-economic and hydrological dynamics affecting groundwater resources in coastal areas, (iii) interactions between agriculture and water resources in rural areas, (iv) evaluation of local contamination processes due to accidental hydrocarbon releases from onshore pipelines and efficiency of remediation techniques, (v) design optimization of geothermal devices for the improvement of thermal efficiency and environmental compliance.

Some of the indicated activities are carried out in collaboration with international research groups, environmental protection agencies, public administrations, agricultural consortia, multiutilities operating in the management of the integrated water cycle.

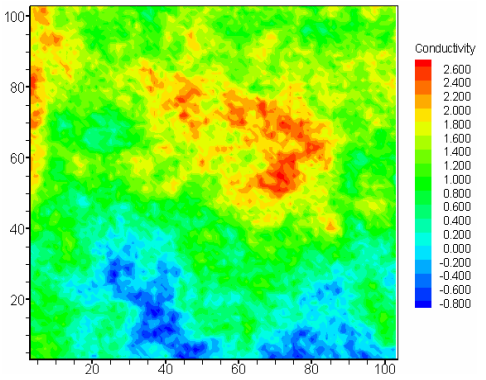


Fig. 1. Heterogeneous hydraulic conductivity field (Author: Vittorio Di Federico)

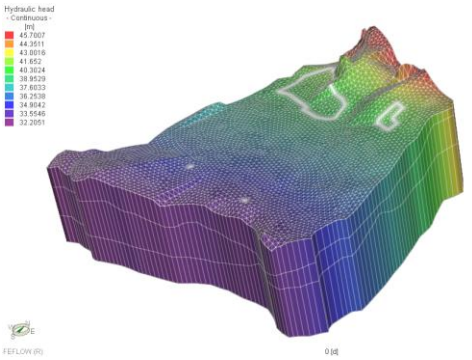


Fig. 2. Numerical model of groundwater body (Author: Vittorio Di Federico)

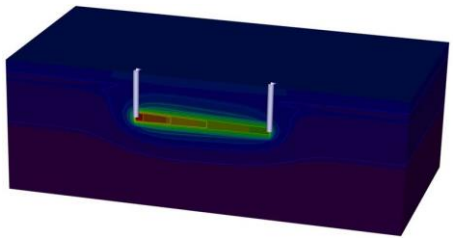

Fig. 3. Modeling of ground heat exchangers (Author: Vittorio Di Federico)

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## RESEARCH PROJECTS

National Project funded by the Italian Ministry of Research, Project: Subsurface fluxes in heterogeneous geologic media, 2000-2002.

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