

3D geostatistical modelling of clastic lithological distributions at the urban area of Girona city (NE Catalonia) for the assessment of the shallow geothermal potential

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Abstract

3D modelling of the lithology distribution in a reservoir is an important step before approaching the realization of FMH (Flow, Mass and Heat transport) models. For the assessment of the shallow geothermal energy (SGE) potential, it is important to know the distribution of the lithology since the hydraulic and thermal properties depend on it. The main objective of this research is to study through the use of 3D geostatistical modelling tools, their distribution in the Neogene and Quaternary aquifers of the study area located in the urban area of the city of Girona (NE Catalonia, Spain). This information will help to determine the most promising and interesting areas to implement shallow geothermal exploitation schemes. To address the objectives, two approaches have been used.

The first approach is based on the **traditional variogram-based geostatistical methods**. Among the different available geostatistical algorithms, the SISIM (Sequential Indicator Simulation) within the SGeMS software ([Remy, 2005](#)) for simulating the lithological spatial distribution was selected.

The second approach is based on the **transition probability geostatistical simulation methods**. To address it, the open source R package “spMC” for 3D lithological reconstructions based on spatial Markov chains ([Sartore, 2013](#)) was selected within the RStudio desktop graphical user interface version 1.2.5033 ([RStudio Team, 2020](#)).

Based on the results obtained from both approaches, further analysis could be undertaken to identify the most promising areas to implement OLS or CLS.

Keywords: *shallow geothermal energy, stochastic modelling, OLS, CLS, SGeMS, SISIM, spMC*