Stochastic modeling of subsurface heterogeneities and soil categories in Goettingen area (Lower Saxony, Germany)

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Subsurface hardly reveals its secrets. The sources of information about subsurface is too limited especially due to the economical and technical limitations.

On the other hand, geological and hydrogeological characteristics in subsurface are very much prone to complicated and important heterogeneities, while these heterogeneities play very significant roles in our further predictions such as subsurface water flows and contamination transport modeling. One of the most important parameters that can affect these heterogeneities very considerably is the type of medium in which the fluids will flow.

As mentioned before, having limited numbers of samples and measurements, one must estimate all unknown parts of the study area. Due to the complicated nature of these changes, using stochastic modeling can be among the best choices for our estimations. One also can parameterize the categories to make this modeling possible. Geostatistical approaches help us to calculate and model the spatial variability of these parameters. However, using a parameterization method like indicator variography and kriging may cause special drawbacks such as having too few data to get clear and reliable variograms to model, facing order relation violations, and probably getting some nonsense estimations. Using Markov chains is an option to fill information gap and reduce mentioned problems.

In Goettingen area, rather many boreholes were drilled and the characteristics of soil samples were described. Based on mainly descriptive and some analytical evaluations, the soils have been categorized into different classes, and using indicator variography and kriging the probability of occurrence of each category has been estimated. For improving models, the Markov chain Transition Probability method has been applied to get better estimation.

The mentioned estimation methods show considerable advantages in our modeling.