Investigation and Simulation of Soil Fields with Copula based Approach

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The heterogeneous structure of the soil fields is the main influence factor of groundwater flow and substance transport. The spatial heterogeneity is often characterized by an empirical variogram or covariance function. These traditional geostatistical methods have problems if the marginal distribution of the soil property is highly skewed. In addition, they are somehow blind of the structures which cannot be captured by the second moment of the distribution. As a solution to those problems, a copula based approach is used in this work to reveal the spatial dependence over the entire range of the distribution without the influence of the marginal distribution.

In order to study the influences of the spatial dependence of the soil structures on the flow and transport behavior, it is necessary to generate a large amount of random soil fields. For this purpose, copula based conditional sequential simulation is applied to generate different realizations of the fields. The parameterization of the copula based stochastic model is done through a novel multi-point approach.

In the presentation, first, the methodology of using copulas to investigate spatial variabilities will be introduced. Second, the Gaussian and a non-Gaussian copula model and the corresponding sequential simulation methods will be discussed. Several random Guassian and non-Gaussian fields will be presented and compared. Third, the multi-point parameterization method will be described. Finally, an outlook of this work will be given.