From Particle Size Data to Permeability with Artificial Intelligence Algorithms

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Project description

Permeability is a key parameter to characterize groundwater flow velocity. A common way to determine values from soil samples is to identify particle size distributions (PSDs) by sieve analysis and relate key properties such as median particle size and porosity to permeability through empirical relationships. While many relationships have been proposed, they are typically limited in their applicability and imprecise.

In a joined project with TNO (Geological Survey of the Netherlands), we analyse large data sets on PSDs in combination with experimental permeability observations from permeameter tests. As a novel approach, we make use of Artificial intelligence (AI) algorithms, such as decision tree, random forest or neural networks to setup predictive models for permeability. By training multiple AI algorithms on the data of soil samples from shallow depth (50m below surface), we create prediction tools for estimating permeabilities of deep (Paleogene) formations where only PSD data is available. Prediction results are also compared to empirical upscaling relationships.

The student's talks is to extend the workflow for predicting permeability from particle size distribution to several artificial intelligence algorithms, such as decision tree, random forest, artificial neural networks, linear regression and support vector regression. The student will make use of the Scikit-learn package in Python, which provides implementations of these machine learning algorithm. The work contains: (i) preparation of PSD and permeability data as input for AI algorithms; (ii) hyper-parameter testing through cross validation and identification of parameter sensitivity; (iii) comparison of algorithm performance; (iv) preparation of the python implementation of the workflow for publication.

Assistantship will not be affected by the situation with Covid-19 as the work can be performed individually at the office and working from home. Frequent meetings (weekly/biweekly, depending on the specified project schedule) will be arrange on campus and/or via Teams.

Job requirements

Solid programming skills in Python
Background knowledge in hydrogeology