Application a piece-wise linear regression for estimation parameters of van Genuchten's equation

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Water retention curve, i.e. the dependence between soil moisture and soil water potential can be both measured and estimated. Determination of soil water retention characteristics is time and labour consuming and requires the use of expensive and specialized equipment. Therefore methods of estimation water retention curve have been intensively developed.

A lot of models for estimation of water retention curve (pedotransfer functions) were elaborated in the last 20 years. The compendium of knowledge about pedotransfer function developed up to now is presented by Pachepsky and Rawls in their book "Development of Pedotransfer Functions in Soil Hydrology". The models presented in literature are based on various kinds of regression equations. Other mathematical techniques including neuron networks and fractals are also applied for the solutionof this problem.

The model proposed in this study is based on a piece-wise linear regression to estimate parameters α, θs, n of van Genuchten's equation. Also the algorithm applying the model is presented.

The research is based on data for 823 soil samples, which represent 25 generalized soil units according to the Bank of Mineral Arable Polish Soil representing 9 types of soils taken from surface, subsurface and subsoil (parent material) horizons.

The investigations were performed in the following stages: (1) determination of parameters: α, θs, θr, n, m for van Genuchten's equation by using least square method, (2) random partition of the data base into 2 parts: 2/3 soil samples – model elaboration; 1/3 soil samples – model verification, (3) availability analysis of physical parameters

of soil solid phase, (4) selection the physical parameters by statistical analysis, (5) verification of the elaborated model.

Easily measured parameters of soil solid phase: bulk density, porosity, mean particles diameter, geometric surface area, percentage sand, silt and clay content
are used for the elaborated model.

The parameters α, θs, n, m estimated by the use of a piece-wise linear regression correlated well (R=0,7-0,93) with parameters of van Genuchten's equation: α, θs, θr, n, m, which were elaborated by least square method.

Water retention curves determined by using a piece-wise linear regression correlate with the measured ones on the level R=0,76-0,98.