Abstract

Measuring the cation exchange capacity (CEC) of soil is a hard, costly and time-consuming work. One of the indirect methods for estimating CEC is the application of pedotransfer functions based on readily available soil properties. In this study, the performance of linear regression, artificial neural network and support vector machines for developing pedotransfer functions, in order to estimate soil CEC values in Sistan Dam experiment field was investigated. For this purpose, a number of 110 samples were collected from topsoil (0-20 cm depth) and the amount of CEC as well as readily available soil properties, i.e. soil texture fractions (sand, clay, and silt percentage), bulk density, specific density, EC, pH, organic carbon, organic matter and porosity were measured in the laboratory. The spatial variability of the CEC was investigated using geostatistical methods and its spatial distribution was mapped. Then pedotransfer functions for estimating CEC were developed using data-driven methods and the input uncertainty of the models was also assessed. The geostatistical analysis showed that spatial correlation of CEC is strong, and the best model of semivariogram is the exponential model. Since soil properties e.g. sand and clay percentages, organic matter and organic carbon have a significant effect on the CEC estimation, the regression relations between them and the CEC values were extracted. The results of evaluating data-driven methods for estimation of CEC showed the superiority of the neural network to the support vector machines and multi-stages regression. The linear kernel model with the highest coefficient of determination (R^2 = 0.57) had the best results among the other support vector machine models. For artificial neural network models, the tansig_trainscg model had the best result. The CEC estimation uncertainty were investigated based on 1000 different sampled data series (obtained by the Monte Carlo sampler) to be used in training and testing stages of perceptron neural network and support vector machine. According to the results of neural network uncertainty assessment, the transfer and training function of logsig-trainrp with P95% = 0.94 and NUE = 0.39 is superior to the fifteen other scenarios. For support vector machines, the RBF kernel function resulted in the least uncertainty.

Keywords: Cation Exchange Capacity, Easily Accessible Soil Properties, Linear Regression, Artificial Neural Networks, Support Vector Machine, Uncertainty

Zabol University

Graduate Studies Management
Faculty of Water and Soil

Department of Water
Thesis for obtaining a Master's degree in Water Engineering
Irrigation and Drainage Orientation

Title:

Extraction of Transitional Functions for Estimating the Cationic Exchange Capacity through Data Based Methods and Investigating its Uncertainty in the Sistan Dam Area

Supervisors:

Dr. Masoumeh Delbari
Dr. Peyman Afrasiab

Advisor:
Dr. Abbas Khasheei Siuki

Prepared by:
Mohadeseh Abdi

Summer 2017