University of Zabol

Management of graduate education

Faculty of Water and Soil - Department of Water Science and Engineering

The Dissertation for PhD degree in the field of Irrigation and Drainage

Scaling of soil water retention and hydraulic conductivity curve for dissimilar soils with minimal data

Supervisor:

Dr. MohammadMahdi Chari

Advisors:

Dr. Peyman Afrasiab

Dr. Hadi Galavi

By:

GholamHossein LakzaianPour

February 2024

Abstract:

Obtaining the humidity curve, one of the basic principles in the irrigation planning, is time-consuming and expensive in the laboratory. So that, researchers have proposed methods such as scaling that reduce the required number of soil sampling and measurements for expressing the characteristics of water dynamics in the soil such as moisture and hydraulic conductivity curve. The aim of this research is to scale the moisture curve and soil hydraulic conductivity with minimal data. To this end, the Brooks-Curry and the log-normal models are scaled for all soil textur classes. In this method, a reference curve and the amount of moisture in a specific suction are needed. For the Brooks-Curie model, the scale factor is equal to the value of logarithm of moisture in a specific suction (for example, θ_1000) in the reference soil to the value of logarithm of moisture in the same suction in the desired soil. The scale factor obtained by this method has been evaluated with the scale factor obtained from the statistical optimization method and the results have shown that the scale factor obtained based on humidity θ_330, θ_700 and θ_1000 is close to the optimal scale factor. The average value of the sum of squared errors of the proposed method was equal to 0.047 and the statistical optimization method was equal to 0.045. The average geometric mean error for the proposed method and the statistical optimization method was equal to 1.024 and 1.047, respectively. The results of this research showed that the selection of the reference curve is optional and any soil can be selected as the reference curve. In the scale mode, the humidity curve obtained by the proposed method in this study matches with the humidity curve obtained from the Brooks-Curie model with appropriate accuracy. For the log-normal model, the method presented in this research was compared with the Kosugi and Hopmans scaling method for scaling the hydraulic conductivity curve and moisture curve. For this purpose, 14 dissimilar soil samples from UNSODA databases were used. The scale factor obtained by the method presented in this research was evaluated with the scale factor obtained by the statistical optimization method (α_Opt). The results showed that the average scale factor based on 〖Se〗_1000, 5000 and 〖Se〗_10000 with values of 10.34, 10.57 and 10.51, respectively, is the closest to the average scale factor α_Opt (10.51) The scaling efficiency value for the Kosugi and Hopmans (K-H) method, the proposed method, and the optimization method were equal to 23, 68, and 70%, respectively, which indicates the appropriate accuracy of the proposed method compared to the Kosugi and Hopmans method. In the scale mode, the humidity curve obtained by the method presented in this research matches with the humidity curve obtained from the log-normal model. In general, it can be concluded that the method presented in this research can scale the humidity curve with acceptable accuracy.

Key words: curve, scaling, factor, hydraulic conductivity, Cosoggi method