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Estimating Particle-Size Distribution from Sand, Silt, and Clay Content

Maryam Roostaee, Behzad Ghanbarian-Alavijeh, and Abdolmajid Liaghat
Department of Irrigation and Reclamation Eng., University of Tehran, Iran (maryamroostaee@ut.ac.ir)

Particle-size distribution (PSD) is one of the soil properties which not only is used in estimation of soil water retention curve as well as unsaturated hydraulic conductivity, but also is applied in the most hydrological studies. Since the measurement of particle-size distribution, soil water retention curve and unsaturated hydraulic conductivity is time consuming and expensive especially in large scale hydrological investigations, in this study, a method was developed based upon the least squares optimization approach to estimate cumulative particle-size distribution from sand, silt and clay content. A revised form of van Genuchten retention model which has been previously applied to represent cumulative particle-size distribution was fitted to the measured three points of PSD, and its two unknown parameters such as N and Dg were determined. For this purpose, we used curve fitting toolbox of MATLAB software. Then estimated N and Dg values were applied to estimate cumulative particle mass for other particle radii in order to determine the whole shape of PSD. A total of 80 soil samples from the UNSODA database including 10 soil textures were selected to verify the presented method. We divided our database into three groups, (1) is coarse soil texture including sand, sandy loam and loamy sand (32 soil samples), (2) medium soil texture such as sandy clay loam, loam, silt loam (31 soil samples), and (3) fine soil texture including clay, sandy clay, silty clay and clay loam (17 soil samples). The RMSE value was calculated to evaluate the presented method. For groups 1, 2 and 3, the RMSE values were 0.071, 0.064, and 0.046, respectively. The linear regression between the estimated and measured cumulative particle mass showed that this method is capable for estimating PSD from three measured points. The line slope for groups 1, 2 and 3 were 0.93, 0.94 and 0.95, respectively, and correlation coefficient (R2) values were obtained greater than 0.96. For all 80 soil samples, the RMSE, R2 and line slope values were 0.062, 0.97 and 0.94 indicating the proposed method estimated PSD accurately.

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