A comprehensive evaluation of pedotransfer functions for predicting soil water content in environmental modeling and ecosystem management.

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Abstract

Many pedotransfer functions (PTFs) have been developed for predicting the soil water content at different matric potentials. The use of these functions has been encouraged because of the time and work typically required for measuring it, while the PTFs require commonly measured soil properties such as sand, silt, clay, organic matter content, or bulk density for predicting water retention. In addition, several environmental and ecosystem management simulation models such as DRAINMOD, HYDRUS, EPIC, SPAW, and WEPP use PTFs for computing soil hydraulic properties. Because of the increasing use of the PTFs and their effect in many soil water simulation and transport models, this study revised and tested 13 different PTFs for predicting soil water content at -33 and -1500 kPa, values usually known as field capacity and wilting point. Three of these PTFs were derived from tropical soils while the rest were developed with soil samples collected across the United States. These PTFs were evaluated in Chilean soils as an independent dataset and their improvement after calibration was assessed with this new data. The results demonstrate that the PTFs performance depends on the soils used for their development as the estimates showed a significant improvement after calibration. When predicting water content, Rawls et al. (2004) was the best function before calibration (RMSE = 0.08 for -33 and -1500 kPa), while Gupta and Larson (1979) was the best after calibration (RMSE of 0.06 and 0.05, and r^2 values of 0.69 and 0.66 at -33 and -1500 kPa, respectively). Nonlinear PTFs performed better than linear PTFs when predicting water content at field capacity. Finally, bulk density proved to be the key variable and can be used as footprint for soils changes through time. Organic matter content was also a significant input but improved the estimates for some specific matric potentials and PTFs.