Geophysical Research Abstracts
Vol. 19, EGU2017-10367-1, 2017
EGU General Assembly 2017

Improving prediction of hydraulic conductivity by constraining capillary bundle models to a maximum pore size

Sascha Iden (1), Andre Peters (2), and Wolfgang Durner (1)

(1) Division of Soil Science and Soil Physics, Technische Universität Braunschweig, Braunschweig, Germany, (2) Institut für Ökologie, Technische Universität Berlin, Germany

Soil hydraulic properties are required to solve the Richards equation, the most widely applied model for variably-saturated flow. While the experimental determination of the water retention curve does not pose significant challenges, the measurement of unsaturated hydraulic conductivity is time consuming and costly. The prediction of the unsaturated hydraulic conductivity curve from the soil water retention curve by pore-bundle models is a cost-effective and widely applied technique. A well-known problem of conductivity prediction for retention functions with wide pore-size distributions is the sharp drop in conductivity close to water saturation. This problematic behavior is well known for the van Genuchten model if the shape parameter n assumes values smaller than about 1.3. So far, the workaround for this artefact has been to introduce an explicit air-entry value into the capillary saturation function. However, this correction leads to a retention function which is not continuously differentiable and thus a discontinuous water capacity function. We present an improved parametrization of the hydraulic properties which uses the original capillary saturation function and introduces a maximum pore radius only in the pore-bundle model. Closed-form equations for the hydraulic conductivity function were derived for the unimodal and multimodal retention functions of van Genuchten and have been tested by sensitivity analysis and applied in curve fitting and inverse modeling of multistep outflow experiments. The resulting hydraulic conductivity function is smooth, increases monotonically close to saturation, and eliminates the sharp drop in conductivity close to saturation. Furthermore, the new model retains the smoothness and continuous differentiability of the water retention curve. We conclude that the resulting soil hydraulic functions are physically more reasonable than the ones predicted by previous approaches, and are thus ideally suited for numerical simulations with the Richards equation or multiphase flow models.