Geophysical Research Abstracts
Vol. 19, EGU2017-7729, 2017
EGU General Assembly 2017

Acrotelm pedogenesis of a Sphagnum bog is reflected in effective unsaturated hydraulic properties

Tobias K.D. Weber, Sascha C. Iden, and Wolfgang Durner
Institute of Geoecology, TU Braunschweig, Germany (to.weber@tu-bs.de)

In ombrotrophic peatlands, the moisture content of the vadose zone (acrotelm) controls oxygen diffusion rates, redox state, and the turnover of organic matter. Whether peatlands act as sinks or sources of atmospheric carbon thus relies on variably saturated flow processes. Modeling of these processes is crucial in assessing effects of changed environmental conditions on the future development of these ecosystems. The Richards equation (RE) is the standard model for water flow in soils, but it is not clear whether it can be applied to simulate water flow in live Sphagnum moss. To check the suitability of the RE to describe the water dynamics in drying moss and peat we conducted transient laboratory evaporation experiments on undisturbed samples from the entire acrotelm. The experimental data consisted of measured pressure heads in two depths and water fluxes, and were evaluated by inverse modelling using the RE as process model.

The results showed that the measurements could be matched very well only if the soil hydraulic properties (SHPs) were represented by a suitable model. A successful parameterisation of the SHPs of the moss was based on pore-size distributions (PSD) which combine three distinct pore systems of the Sphagnum moss, reflecting an inter-, intra-, and inner-plant pore space. We had to extend the traditional van Genuchten-Mualem model to account for non-capillary water storage and flow to obtain consistent descriptions of the observations. For the deeper samples, the pedogenesis of the acrotelm, a process of compaction and biochemical degradation of the solid matrix, had considerably impact on the shape of the SHPs. The collapse of the inter-plant pores and their filling with smaller particles led gradually to bi-modal PSDs with increasing depth. This coincides with a homogenisation and a considerably reduction in horizontal variability of SHPs at greater depths. We conclude that the RE with adequate representation of SHPs is a valid process description for variably saturated moisture fluxes over a wide pressure range in peatlands, supporting the conceptualization of the living moss as part of the vadose zone.