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Land cover impact on close to saturation hydraulic properties of silt loam soils

Mélanie Weynants (1) and Mathieu Javaux (1,2)

(1) Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium (melanie.weynants@uclouvain.be), (2) Forschungszentrum Juelich, Germany

Historically, pedotransfer functions (PTF) have been mainly developed for cropped soils in agricultural areas. For managing forests or grasslands for instance, it is of interest to know whether PTF apply as well under other land covers. However, soil structure can be quite different under different land covers because of different amounts and dynamics of organic matter in the upper horizon, because of the tillage practices and also due to the different types of plant roots. In combination with the textural and chemical properties of the soil particles, land cover may therefore deeply affect close to saturation soil hydraulic properties. In this study we focused on 50 soil samples sharing the same soil texture (silt loam) but developed under different land covers (grassland, forest and cropland). We characterised their hydraulic properties with a particular attention to the wet range, for which specific experimental protocol were developed.

Macroporosity indicators showed us that macropores were present in all land covers at a comparable extent. They also confirmed that forest topsoil can contain much more water than the subsoil and than other land covers. We showed that for moisture retention curves (MRC), data show water content discrepancies until pF3 for soils under forest and grass. We also illustrated that pedotransfer functions (PTF) developed for cropland soils are not suited for other land covers, especially for forest soils. Hydraulic conductivities close to saturation (-1 cm < h < -300 cm) also differ between land cover and according horizon position in the profile in a much larger extent than retention curves. Based on our hypothesis that land cover conditions soil structure, we explain these observations by the differences of rooting architectures and activity of soil micro-fauna in the tested land covers. We tested the link between morphological indices and hydraulic properties at the sample scale but this did not give any satisfactorily results. This suggests that class PTF by land cover could be a good option for further developments, rather than including morphological information directly in continuous functions.