Pore-scale imaging of soil structure and associated flow and transport processes

Soil hydraulic and transport properties at the Darcy scale emerge from the millimeter and micro-scale, i.e. from individual soil pore network architectures. In the past, direct investigations on the 3-dimensional pore network had been highly impractical due to the opaque nature of soil. Meanwhile we have arrived at the brink of a new era in soil research. Non-invasive X-ray imaging is now allowing quantitative measurements on soils’ internal structures and processes. New image analyses software and more powerful computers are helping to reduce the processing time per image and make X-ray imaging a high-throughput method.

In this Kolloquium, I am presenting recent results from the Biogeophysics research group at the SLU in Uppsala that involves our X-ray scanner. More specifically, I will be talking about the soil structure evolution in a garden soil, the relationship between macropore network morphology and saturated hydraulic conductivity, a 3-dimensional water retention curve and a 3-dimensional movie of macropore flow in an undisturbed soil. The selected examples will help to illustrate that knowledge at the microscale is fundamental for understanding processes at the field and catchment scales.