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A new in-situ method to determine the apparent gas diffusion coefficient of soils

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Soil aeration is an important factor for the biological activity in the soil and soil respiration. Generally, gas exchange between soil and atmosphere is assumed to be governed by diffusion and Fick's Law is used to describe the fluxes in the soil. The "apparent soil gas diffusion coefficient" represents the proportional factor between the flux and the gas concentration gradient in the soil and reflects the ability of the soil to "transport passively" gases through the soil.

One common way to determine this coefficient is to take core samples in the field and determine it in the lab. Unfortunately this method is destructive and needs laborious field work and can only reflect a small fraction of the whole soil. As a consequence insecurity about the resulting effective diffusivity on the profile scale must remain.

We developed a new in-situ method using new gas sampling device, tracer gas and inverse soil gas modelling. The gas sampling device contains several sampling depths and can be easily installed into vertical holes of an auger, which allows for fast installation of the system. At the lower end of the device inert tracer gas is injected continuously. The tracer gas diffuses into the surrounding soil. The resulting distribution of the tracer gas concentrations is used to deduce the diffusivity profile of the soil. For Finite Element Modeling of the gas sampling device/soil system the program COMSOL is used. We will present the results of a field campaign comparing the new in-situ method with lab measurements on soil cores.

The new sampling pole has several interesting advantages: it can be used in-situ and over a long time; so it allows following modifications of diffusion coefficients in interaction with rain but also vegetation cycle and wind.