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2 D patterns of soil gas diffusivity , soil respiration, and methane oxidation in a soil profile

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The apparent gas diffusion coefficient in soil (DS) is an important parameter describing soil aeration, which makes it a key parameter for root growth and gas production and consumption. Horizontal homogeneity in soil profiles is assumed in most studies for soil properties - including DS. This assumption, however, is not valid, even in apparently homogeneous soils, as we know from studies using destructive sampling methods. Using destructive methods may allow catching a glimpse, but a large uncertainty remains, since locations between the sampling positions cannot be analyzed, and measurements cannot be repeated.

We developed a new method to determine in situ the apparent soil gas diffusion coefficient in order to examine 2 D pattern of DS and methane oxidation in a soil profile. Different tracer gases (SF6, CF4, C2H6) were injected continuously into the subsoil and measured at several locations in the soil profile. These data allow for modelling inversely the 2 D patterns of DS using Finite Element Modeling. The 2D DS patterns were then combined with naturally occurring CH4 and CO_2 concentrations sampled at the same locations to derive the 2D pattern of soil respiration and methane oxidation in the soil profile. We show that methane oxidation and soil respiration zones shift within the soil profile while the gas fluxes at the surface remain rather stable during a the 3 week campaign.