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Membrane based measurement technology for in-situ monitoring of trace gases in soil

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The representative measurement of gas concentration and fluxes in heterogeneous soils is one of the current challenges when analysing the interactions of biogeochemical processes in soils and global change. Therefore, an in-situ measurement method based on selective permeation of gases through tubular membranes has been developed. Combining the element-specific diffusion rates through a membrane set and Dalton's principle of partial pressures, the gas concentration (or its partial pressure) can be determined by the measurement of physical quantities (pressure or volume) only. Due to the comparatively small diffusion constants of the membranes used, the influence of the sensor to its surrounding can be neglected. The design of the sensor membranes can be optimized for a representative measure for the individual observation plane. Furthermore, a continuous time-averaged measurement is possible where the time constancy for averaging corresponds simply to the wall-thickness of the membrane used.

The measuring method is demonstrated for continuous monitoring of O_2 and CO_2 inside of a sand filled Lysimeter. Using three monitoring planes which were installed normal to the gas flow direction and a reference measurement system, we demonstrate the precise in-situ gas-detection for different flux-based boundary conditions.