Development of an *in-situ* CO_2 gradient sampler



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Introduction

Measuring soil gas flux with the gradient method

- in situ measurement
  - macrostructure is included
  - temporal variability can be monitored
- no disturbance of soil-atmosphere interface
- information about depth profile

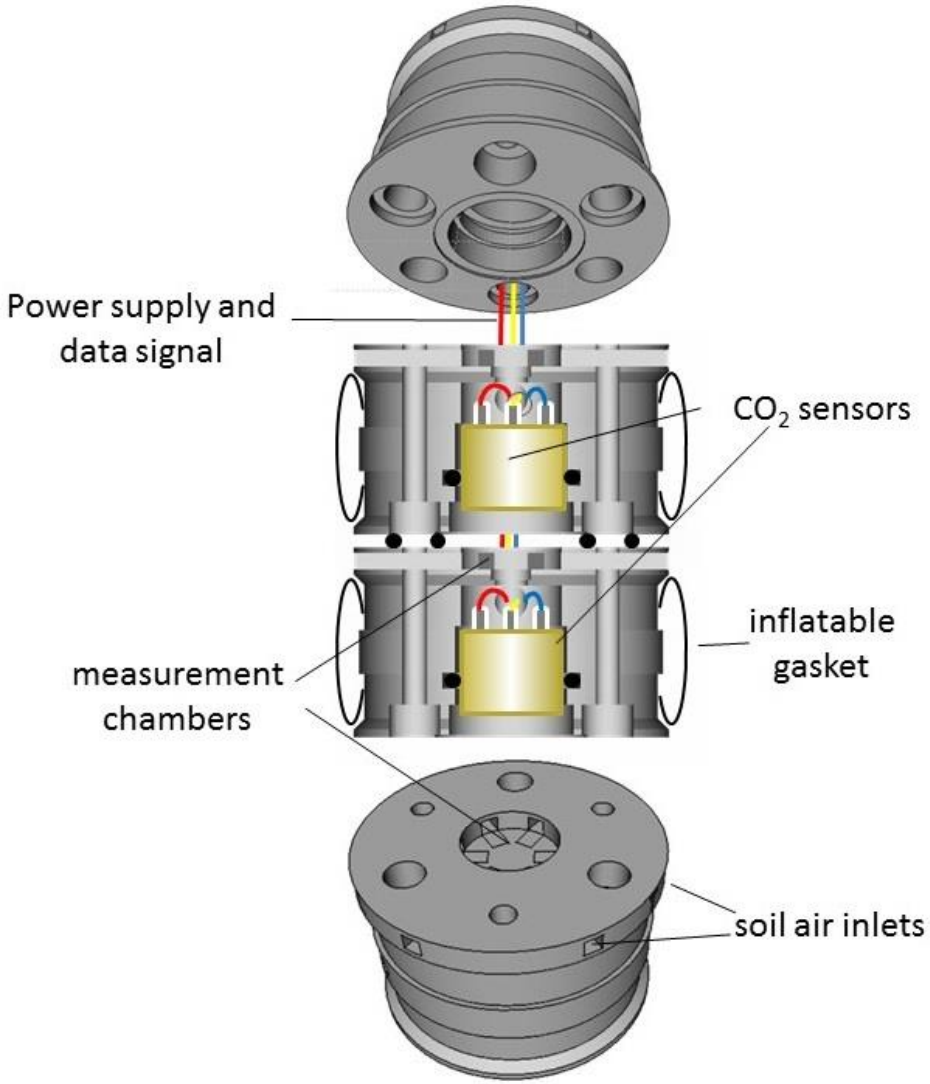
but:

- diffusion coefficient (D_S) needed for flux calculation
  - → injection of a tracer gas to calculate D_S inversely

Concept

Development of a sampler with built in CO_2 sensors

- construction with separate 3D-print segments
- flexible amount of depths
- continuous measurements in multiple depths
- identification of short term effects possible

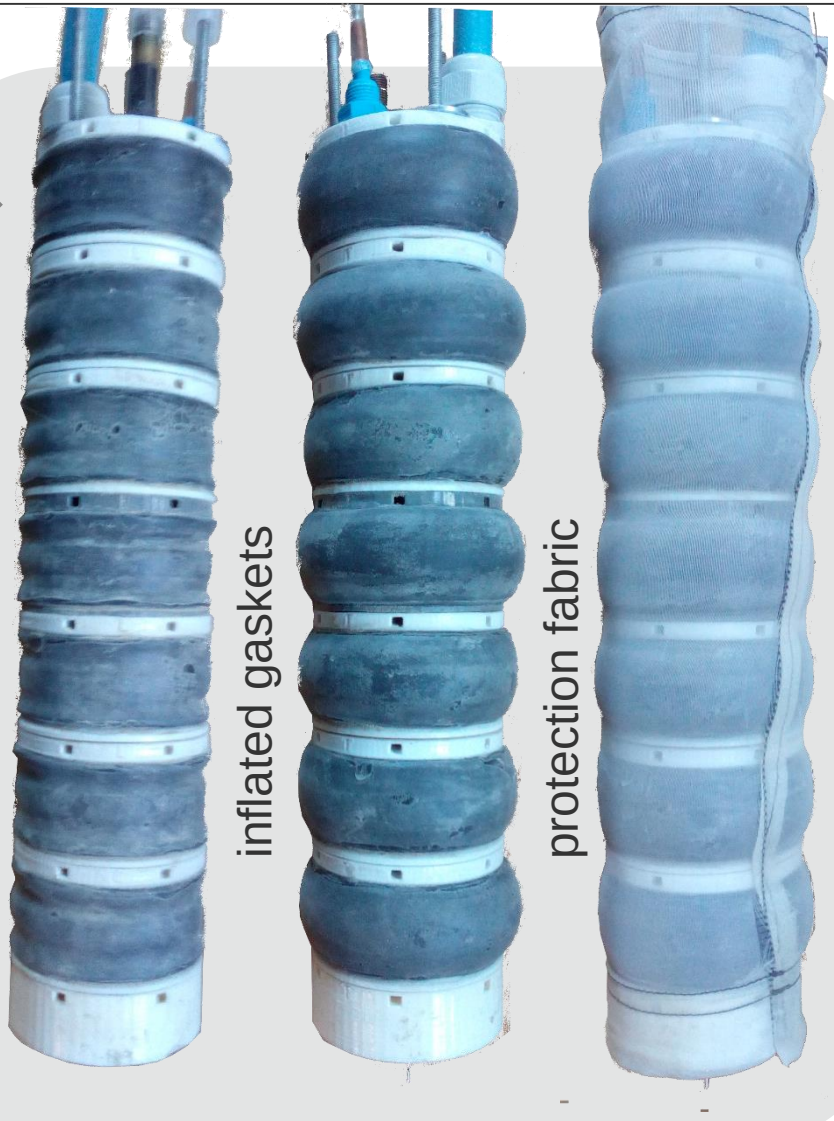


Features

Inflatable gaskets between each measurement depth

→ prevent gas bypassing

Tracer gas injection at the bottom of the sampler



Installation

drill a hole

insert sampler

inflate gaskets

inject tracer

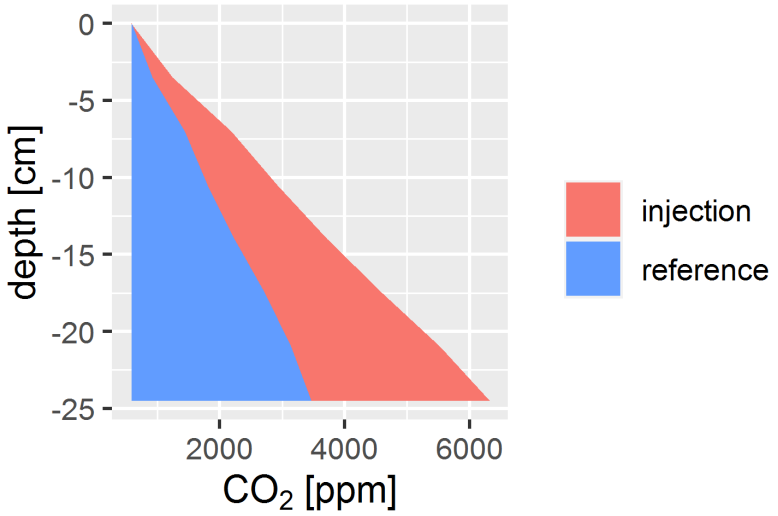
Modelling of diffusion coefficient

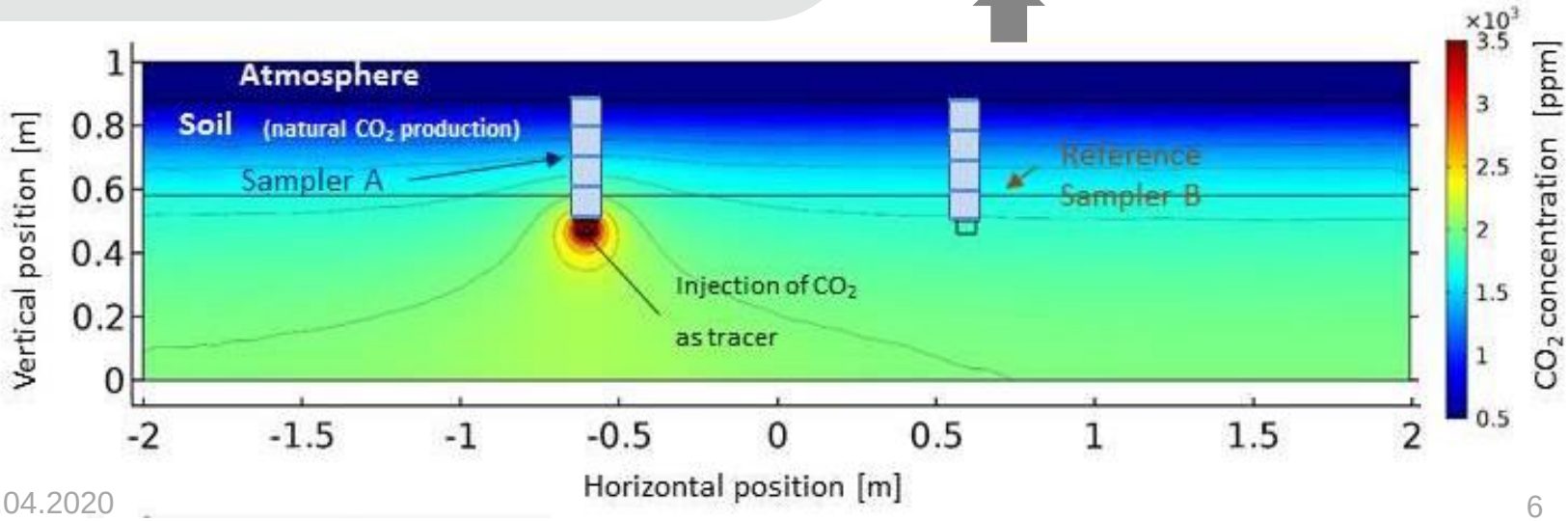
CO_2 as tracer gas

- CO_2 can be measured with low cost sensors

  → no need for gas chromatography

- second reference sampler is used to measure respiration profile





Modelling of diffusion coefficient

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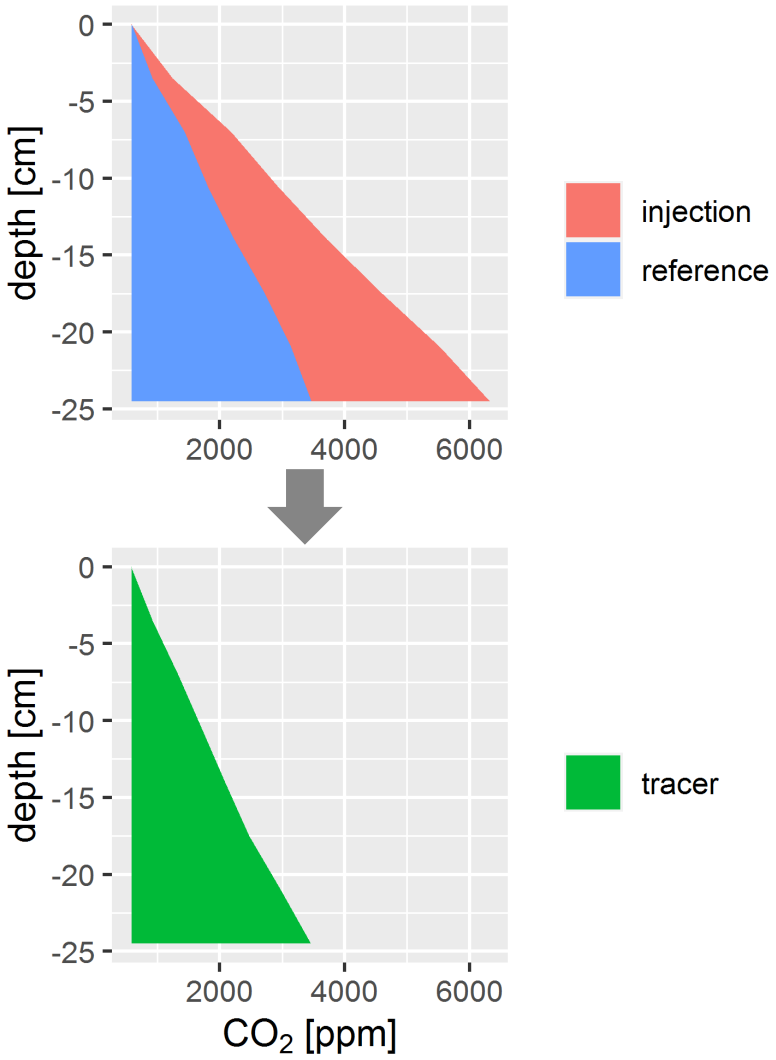
tracer profile = injection profile - reference profile

D_S = injection rate / slope of tracer profile



Modelling of D_S with COMSOL

Finite Element modelling of D_S

Tracer injection experiment in sand- and gravel box

→ System without respiration

injection in gravel box

Modelling of D_S with COMSOL

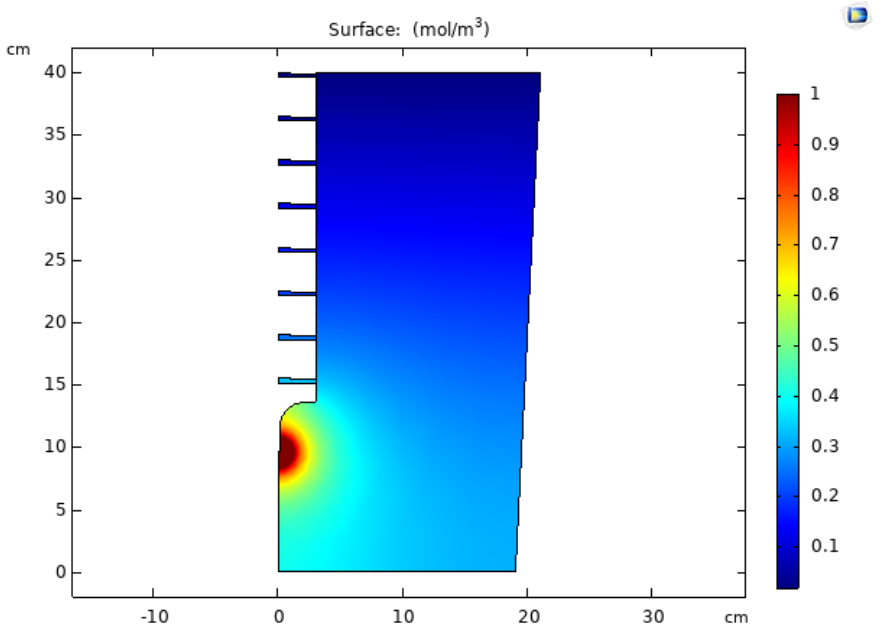
Finite Element modelling of D_S

Tracer injection experiment in sand- and gravel box

→ System without respiration

2D axisymmetric modelling of CO_2 concentration with COMSOL[1]

modelled CO_2 profile



[1]COMSOL Multiphysics® v. 5.2a. www.comsol.com. COMSOL AB, Stockholm, Sweden.

Modelling of D_S with COMSOL

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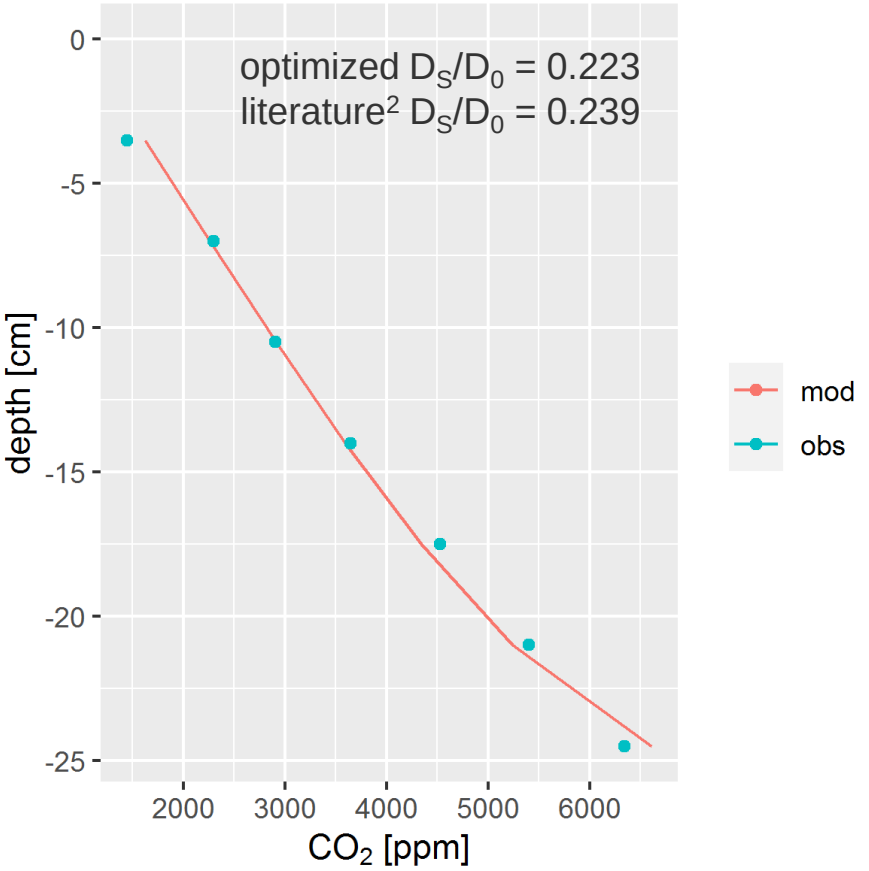
2D axisymmetric modelling of CO_2 concentration with COMSOL[1]

Optimizing D_S until modelled CO_2 fits measurements

Evaluation of the sampler still in progress

Modelled and observed values from sandbox experiment



[1]COMSOL Multiphysics® v. 5.2a. www.comsol.com. COMSOL AB, Stockholm, Sweden.

[2]Laemmel, T., Maier, M., Schack-Kirchner, H., & Lang, F. (2017). An in situ method for real-time measurement of gas transport in soil. *European Journal of Soil Science*

Thanks for your attention!

Any questions?

I‘ll be there to answer them in the chat

8 may 10:45 – 12:30