GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Abteilung Bodenphysik

Thesis topic description

Measurement of O_2 and CO_2 fluxes: Development and application of a low-cost measurement system for deadwood.

Problem and working hypotheses:

Soil respiration is often considered solely as CO_2 flux from the soil. The corresponding counter-directed O_2 flux into the soil is often simply estimated as equimolar counter-flux, but has so far hardly been measured. However, long-term measurements of soil gas profiles at the FVA show that this assumption is not correct (Gartiser et al. 2021). However, first, technically complex and precise measurements (Knohl et al 2020) show that the O_2 and CO_2 fluxes are partly decoupled in time and are not always 1:1.

Objectives

In an ongoing project (TotC, partner institute at the FVA BW), the carbon turnover of deadwood, and thus also soil respiration from soil and deadwood, is to be investigated. The recording of O2 and CO2 fluxes from both compartments would mean great added value here, as it would also be possible to draw conclusions about underlying processes and source materials. The same applies to different variants of organic fertilisation in agriculture. CO_2 fluxes can be measured using simple chamber systems (Fig. 1, 3), but a sufficient O_2 change must be achieved, as the measurement technique is much less sensitive than for the usual CO_2 measurement technique due to high background concentrations. A set-up with an Arduino microprocessor and NDIR CO_2 sensor was developed as a measuring system, which is now to be extended by a low-cost online O_2 sensor, tested and applied in a project (deadwood/fertilisation) (Fig. 2).

Figure 1 Chamber system for (CO_2) soil measurements

Figure 2: Online O_2 Sensor

Figure 3 Mobile respiration chamber with autosampler for discrete samples for later GC/laser analyses

Requirements for candidates

The setup of the CO_2 measurement system is available, the O_2 sensors as well as loggers and Arduinos are available. The performance, accuracy and measurement routines for the O_2 sensors must be tested and further developed experimentally in the laboratory and in the field close to the laboratory, and finally applied to the experimental areas of the projects. The technical support, handling of the sensors etc. is guaranteed, fun in independent technical work and in the handling and development of measuring instruments is important. A visit to the experimental plots and supplementary sampling are necessary, so that in addition to interest in data analysis, willingness to do field work is also important. Careful experimental work in the field as well as in the laboratory is important. The starting date is flexible.

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Gartiser et al. 2021 https://meetingorganizer.copernicus.org/EGU21/EGU21-7442.html
Knohl et al 2020, https://agu.confex.com/agu/fm20/meetingapp.cgi/Paper/674328
Levintal et al 2022 https://soil.copernicus.org/articles/8/85/2022/soil-8-85-2022.pdf