GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Abteilung Bodenphysik

Thesis topic description

Deep Soil Respiration

Background

Soils are important terrestrial C pools and soil respiration is a major global C flux. Subsoil (>0.5m depth) usually has lower C and N contents, and contribution to the soil surface gas fluxes, e.g. soil respiration is low. Nevertheless, the total amount stored of C and N in the subsoil (e.g. 0.5-3m) can be large. Slow changes due to global climate change (e.g. in subsoil moisture or temperature) might affect subsoil respiration, i.e. through subsoil C mineralization, and thus, might have an substantial long-term effect on subsoil C storage.

Problem and working hypotheses:

While gas fluxes from soil surfaces are usually measured by chamber methods or the Eddy-covariance method, these methods are not suitable to assess subsoil gas fluxes. The gradient method allows calculation of gas fluxes in a soil profile, that means also in the subsoil, based on a measured soil gas profile and a known soil gas diffusivity.(Maier & Schack-Kirchner, 2014) Estimating the latter is a major challenge, especially in subsoils, and the (unreflective) application of a general soil gas diffusivity model without prior knowledge of the soil physical characteristics of the subsoil can result in large uncertainties. A new indirect method to estimate soil gas diffusivity based on CO_2 time series with high temporal resolution will be developed based on an available dataset (Jochheim et al 2022)

Another approach is core sampling of deep soil with following incubation experiments which need to consider the local (subsoil) temperature regime, which includes the risk of possible sampling artefacts (cut roots etc).

Objectives

Combining the soil gas profile approach and the soil core sampling & incubation approach would allow to minimize the uncertainty in the respective methodology and improve the overall quality of the estimation of the temperature sensitivity of deep soil respiration. We want to use both approaches to determine the deep soil respiration and its temperature sensitivity in a large deep (>5m) lysimeter, in which we want to start long term observations of the subsoil.

Requirements for candidates

The topic requires the interest in working with data so that a certain basic knowledge in data handling with programs like R or SAS or Matlab is required. For the experimental part with the core sampling and lab incubations careful and precise operations in the laboratory are required to ensure reliable gas measurements, which can be learned during the thesis.

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References

Jochheim, H., Wirth, S., Gartiser, V., Paulus, S., Haas, C., Gerke, H. H., & Maier, M. (2022). *Dynamics of Soil CO 2 Efflux and Vertical CO 2 Production in a European Beech and a Scots Pine Forest*. *5*(May), 1–18. https://doi.org/10.3389/ffgc.2022.826298

Maier, M., & Schack-Kirchner, H. (2014). Using the gradient method to determine soil gas flux: A review. *Agricultural and Forest Meteorology*, *192–193*, 78–95. https://doi.org/10.1016/j.agrformet.2014.03.006