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Multilayer Analysis of Soil Respiration and its Isotopic Signature in Forest Ecosystems
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The overall aim of this study is to contribute to a better understanding of mechanisms behind soil CO2 efflux using carbon stable isotopes. Given (i) the interest of conducting in situ studies with soil multilayer analysis and (ii) the benefits of isotopic tool to improve mechanistic understanding, these two approaches are combined. Quantifying the origin and the determinism of 13CO2 and 12CO2 production and transport processes in the different soil layers is the first step of this project. To meet this first goal, the work includes an experimental and a modeling part.

The experimental set up (see also communication of Parent et al., session BG1.2/IG17) comprised a combination of different systems, which were installed in a Scot Pine temperate forest at the Hartheim site (Southwestern Germany). Measurements include (i) half hourly vertical profiles of soil CO2 concentration (using soil CO2 probes), soil water content and temperature; (ii) half hourly soil surface CO2 effluxes (six automatic chambers); (iii) measurement campaigns for the determination of the isotopic composition of surface CO2 efflux and soil CO2 concentration profile (using circuits with porous tubes connected to a tunable diode laser spectrophotometer - TDLS) and (iv) estimation of soil diffusivity through laboratory measurements conducted on soil samples taken at several depths.

For the modeling part, we developed and used a diffusive transport model to simulate CO2 (13CO2 and 12CO2) flows inside and out of the soil based on Fick's law. Soil diffusivity was deduced from soil water content measurements, using the Ds(SWC) relationship calibrated at the laboratory. Model inputs were the soil water content profile, the CO2 concentration in the deep soil and in the atmosphere (boundary conditions).

In addition to the presentation of the experimental set up and the model, some preliminary results comparing simulated and measured surface CO2 (13CO2 and 12CO2) efflux will be presented. Contrasting situations with different environmental conditions are compared and the importance of rain events and of non-diffusive transport (advection) will be discussed. The vertical profiles of the biological sources contribution to the total soil 13CO2 and 12CO2 production will also be showed. This output could, in the future, give some important information for soil carbon model elaboration with more detailed vertical discretization.