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Can we simplify the Keeling Plot Approach to measure Soil $^{13}CO_2$?

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A common method to estimate the carbon isotopic composition of soil respired air are Keeling plots (δ^{13}C versus 1 / CO_2-concentration). This approach requires the determination of both CO_2-concentration and δ^{13}C in air samples. While CO_2-concentration can be measured with an infrared gas analyser (IRGA) in the field, analysis of δ^{13}C requires transport of the samples to the lab. During δ^{13}C- analysis with a mass spectrometer (IRMS), the CO_2-concentration is determined simultaneously as well. We tested if this lab-based CO_2-concentration measurements can replace the field measurements.

The experimental sites were located in grassland at 400 m a.s.l., we applied 0.7 kg m^{-2} of ^{13}C-depleted respectively undepleted biomass (Δ = 10 ‰) at the beginning of the growing season. We measured CO_2-concentrations with an IRGA in the field (n = 688) at several dates within the following six months. Simultaneously we took air samples into pre-evacuated and N_2 filled 12.5 ml gas tight glass vials for analysis of the ^{13}C-values and the CO_2-concentrations within 24 hours using the IRMS. We tested the possible effects of different N_2-amounts in the vials by running additional experiments in the lab using different pressures and CO_2-concentrations.

Preliminary results showed that the IRMS-measurement of the CO_2-concentration during the isotope analysis underestimated the CO_2-concentrations compared with those measured in the field with the IRGA (y = 0.84 x + 41.62; R^2 = 0.87). The dif-

ferences could have several reasons: i) Loss of sample air during transport, ii) slightly differing sample air-amounts, and iii) slightly differing N_2-amounts respectively evacuation while preparing the vials for the field measurement. However, to determine the contribution of litter to the total soil respiration we need the relative isotopic difference of respired soil CO_2 (Δ) between ^{13}C-labelled and unlabelled experimental plots. It remains to be tested if the observed differences in absolute CO_2-concentrations actually will affect the calculated relative difference, and thus the calculated contribution of litter to soil respiration.