

Interactive comment on “How to link soil C pools with CO₂ fluxes?” by Y. Kuzyakov

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Response to the comments of Y.-D. Wang

> I am confused with the line of C₄/C₃ in CO₂ in Fig. 3 (bottom). In my opinion this line should be similar to the line of C₄/C₃ in SOM in the same figure.

This is the important issue that because the availability of new C (here C₄) in SOM is much higher than that of the old C (here C₃) their contributions to the CO₂ fluxes do not correspond to the ratio C₄/C₃ in SOM. During the time course after C₃-C₄ changes the remaining C₃-C is getting every year less available. The decrease of availability of C₃ is stronger than the decrease of its contribution to the SOM. Therefore, both lines presenting the ratios of C₄/C₃ in SOM and in CO₂ are different: the C₄/C₃ in SOM is a saturation curve, and in contrast the C₄/C₃ in CO₂ is an nearly exponentially growing line.

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> Furthermore in contrast with dry soil, the soil carbon cycle and ¹³C signature of fluxes (CO₂ and CH₄) are different in wetland. Could you give some comments on how to link soil C pools with CO₂ and CH₄ fluxes in wetland? Thank you very much!

CO₂: The differences between isotopic signature of CO₂ under oxic and anoxic conditions are connected with isotopic fractionation, which depends beside other factors on 1) completeness and 2) the rate of C oxidation. As the completeness and the rate of C oxidation decrease under anoxic conditions compared to the oxic conditions, the isotopic fractionation increase, and is much higher compared to isotopic fractionation under oxic conditions. Surely it is possible to consider isotopic fractionation, but separate experiments are necessary. Another frequently unaccounted source of apparent isotopic fractionation is preferential utilization of substrates with different $\delta^{13}\text{C}$. There are some approaches to evaluate isotopic fractionation and preferential utilization (see Hobbie and Werner 2004; Werth and Kuzyakov, 2010; Blagodatskaya et al., 2011).

CH₄: Isotopic fractionation by CH₄ production is much higher than that by CO₂ production and is much more variable depending on environmental conditions (including the redox potential). Additionally, the source of C is especially important for CH₄. Commonly, easily available substrates will be converted to CH₄ and therefore, their isotopic signature should be measured. So, I fully agree that it is much more difficult to link CH₄ flux with its sources. However, the addition of various ¹³C or ¹⁴C labelled (strongly enriched) substrates to soil help to solve this problem.

References

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