

## ***Interactive comment on “How to link soil C pools with CO<sub>2</sub> fluxes?” by Y. Kuzyakov***

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Response to the comments of Y.-D. Wang

> I am confused with the line of C<sub>4</sub>/C<sub>3</sub> in CO<sub>2</sub> in Fig. 3 (bottom). In my opinion this line should be similar to the line of C<sub>4</sub>/C<sub>3</sub> in SOM in the same figure.

This is the important issue that because the availability of new C (here C<sub>4</sub>) in SOM is much higher than that of the old C (here C<sub>3</sub>) their contributions to the CO<sub>2</sub> fluxes do not correspond to the ratio C<sub>4</sub>/C<sub>3</sub> in SOM. During the time course after C<sub>3</sub>-C<sub>4</sub> changes the remaining C<sub>3</sub>-C is getting every year less available. The decrease of availability of C<sub>3</sub> is stronger than the decrease of its contribution to the SOM. Therefore, both lines presenting the ratios of C<sub>4</sub>/C<sub>3</sub> in SOM and in CO<sub>2</sub> are different: the C<sub>4</sub>/C<sub>3</sub> in SOM is a saturation curve, and in contrast the C<sub>4</sub>/C<sub>3</sub> in CO<sub>2</sub> is an nearly exponentially growing line.

> Furthermore in contrast with dry soil, the soil carbon cycle and  $^{13}\text{C}$  signature of fluxes ( $\text{CO}_2$  and  $\text{CH}_4$ ) are different in wetland. Could you give some comments on how to link soil C pools with  $\text{CO}_2$  and  $\text{CH}_4$  fluxes in wetland? Thank you very much!

$\text{CO}_2$ : The differences between isotopic signature of  $\text{CO}_2$  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).

$\text{CH}_4$ : Isotopic fractionation by  $\text{CH}_4$  production is much higher than that by  $\text{CO}_2$  production and is much more variable depending on environmental conditions (including the redox potential). Additionally, the source of C is especially important for  $\text{CH}_4$ . Commonly, easily available substrates will be converted to  $\text{CH}_4$  and therefore, their isotopic signature should be measured. So, I fully agree that it is much more difficult to link  $\text{CH}_4$  flux with its sources. However, the addition of various  $^{13}\text{C}$  or  $^{14}\text{C}$  labelled (strongly enriched) substrates to soil help to solve this problem.

## References

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