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Interactive comment on "Warming mobilises young and old soil carbon equally" *by* F. Conen et al.

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Thank you for the comments conveying your concerns and point of view on general aspects of our study and also for the technical comments, which help us in improving our paper.

(1) Regarding, treatment of samples, i.e. crumbling and sieving ($<$ 2mm) exposing SOM previously occluded in larger aggregates and destabilising it: Stabilisation of SOM in macro-aggregates is very sensitive to management practice. It may be an important mechanism in grassland and forest soils. In the tilled horizon of an arable soil, macro-aggregates are shorter lived and certainly harbour much smaller proportions of old SOM. Most SOM protected by occlusion will be found in the longer-lived micro-aggregates ($<$ 0.25mm) or in even smaller clay micro-structures. We would not expect these structures to be greatly affected by gentle crumbling and sieving through a 2mm

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mesh. In particular, the soil from Halle with 69 % sand and only 8 % of clay content is unlikely to have had a noteworthy amount of SOM stabilised in macro-aggregates. It practically fell through the sieve by itself. The silty soil from Rotthalmünster (73 % silt, 17 % clay) exhibited more structure and mechanical treatment in the laboratory may have exposed a small proportion of previously occluded SOM and lead to a limited over-estimation of the CO2 flux from old organic matter. However, this should not matter as long as we are interested in how temperature affects the relative contribution of old SOM to total CO2 evolution. All temperature treatments had the same pre-treatment, so possible bias through disruption of aggregates would not affect the overall conclusion.

(2)) Regarding stability and age of SOM not always being the same: We agree that age and stability will not always be 100% congruent. However, from our point of view, age of SOM is a good measure of its stability. Furthermore the <delta>13C values in our experiment provide a direct measure of age, not stability. We do not rule out the possibility of biochemically labile material to resist for long periods in soil due to the various stabilisation mechanisms involved (i.e., it ages). Following the argumentation in Davidson & Janssens 2006 (Nature 440: 165-173) that biochemically unfavourable material should have a higher temperature sensitivity, our analysis indicates that the isotopically older SOM remaining decades after the C3/C4 conversion resists longer in soil not because of its biochemical stability (i.e., its molecular composition inducing the so-called 'intrinsic' temperature sensitivity), but more likely because of physico-chemical stabilization mechanisms as discussed for example by von Lützow et al. (2006; European Journal of Soil Science 57: 426-445). Regarding the greater enrichment of CO2 in 13C with temperature from the C4 soil at the RM site, we feel that there has been a misunderstanding of our interpretation. We tried to argue that larger litter input may have increased the proportion of 13C enriched compounds or changed the ratio of Gram-negative to Gram-positive bacteria in the C4 soil compared with the C3 soil. Both changes might promote an enrichment of CO2 in 13C with increasing temperature in general (see our discussion of possible causes for 13C enrichment in CO2 from the C3

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control soils). Thus, the findings at the RM site do not necessarily imply a greater temperature sensitivity of young SOM. We tried to clarify this in the revised manuscript by inserting the following sentences on page 1361, line 12: 'Thus, the greater enrichment of CO2 in 13C with increased temperature at the C4 site might not necessarily indicate a greater temperature sensitivity of younger soil organic carbon. It could equally result from a greater influence of the same factors that have possibly caused the 13C enrichment of CO2 at the C3 control sites.'

(3) We completely agree that the response of C inputs to climate change is as important an issue to study as that of C output, if we are to make predictions about carbon cycle feedbacks. However, plant ecologist seem to agree that global change will not increase plant productivity substantially (Gitay et al., 2001, IPCC Report, 2001, Impact, Adaptation and Mitigation of Climate; Körner, 2003, Journal of Ecology 91: 4-17). Thus, net carbon input to ecosystems is unlikely to increase. Furthermore, the findings in Janssens et al. (2001; Global Change Biology 7: 269-278) indicate that climatic trends, as found for example across latitudinal gradients in Europe, induce systematic differences in SOC stocks with those of warmer sites being smaller than those at cooler sites (Jones et al. 2004)*. This pattern may probably serve as an indicator for the future condition of our soils in a warmer world. Nevertheless, to study both questions within the same project is highly desirable but requires larger financial means and a much larger time frame than we had available here. Still, no single study, however well funded, will provide a full answer. Our understanding can only be improved by a multitude of different studies. In this sense we see our study is a useful little contribution to a much larger and on-going effort.

We added a sentence on the calculation of the C4 contribution (second sentence in Results and Discussion now reads: 'The fraction of new carbon equals the difference in <delta>13C between C3 soil (or CO2) and C4 soil (or CO2) divided by the difference in <delta>13C between previous C3 and new C4 carbon input.'). We also corrected the error on page 1361, line 2 by changing the sentence to: 'In other words, a con-

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ceivable temperature increase of 5 oC above the current mean annual temperature of 8.7o C by the end of this century, would cause a 9.6 % increase in stimulation of the decomposition of soil carbon younger than 26 years, compared with older soil carbon.'

*Jones, R.J.A., Hiederer, R., Rusco, E., Loveland, P.J., Montanarella, L. 2004. The map of organic carbon in topsoils in Europe. Version 1.2, September 2003: Explanation of Special Publication Ispra 2004 No.72 (S.P.I.04.72). European Soil Bureau Research Report No.17, EUR 21209 EN, 26pp. and 1 map in ISO B1 format. Office for Official Publications of the European Communities, Luxembourg.

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