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Evidence for slightly greater Temperature Sensitivity of younger Soil organic Carbon

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Predictions of future atmospheric CO_2 concentrations depend largely on our understanding of the temperature sensitivity of soil organic carbon stability and how it might differ between young or labile and older or more resistant pools. Currently, contradicting hypotheses are upheld. We studied the temperature sensitivity of soil samples from a pair of agricultural fields in southeast Germany (Rotthalmünster, near Passau). Both fields have been C3 grassland until 1969. Since then, both were continuously cropped to wheat (C3 plant) until 1979, when one of them was taken into continuous maize (C4 plant) cropping and the other remained under wheat. The δ^{13}C of C4 plant residues is about 14 per mil PDB more enriched in ^{13}C than that of C3 plant residues, allowing to differentiate between carbon younger and older than the conversion to maize cropping. Soil under maize was 5.8 per mil PDB more enriched in ^{13}C than soil under wheat, indicating that after 26 years, about 40 % of soil organic carbon was maize derived. Parallel incubations of soil samples at 5, 15, 25 and 35 ^{o}C and analysis of ^{13}C/^{12}C ratios in CO_2 were carried out in the laboratory. On average, 54 % of CO_2 was produced from C4 carbon. Increasing temperatures from 5 to 35 ^{o}C resulted in an enrichment in ^{13}C of the CO_2 evolving from the soil cropped to maize, which was almost twice as large as for the wheat field (+2.7 compared to +1.5 per mil PDB per 10 ^{o}C). We assume there are no significant differences in the composition of organic matter between both fields and that temperature dependent changes in δ^{13}C of CO_2 are independent from the absolute isotope ratio of the carbon source. Thus, the relatively greater enrichment in ^{13}C with increasing temperature in the maize field indicates a growing proportion of younger or more labile carbon to be respired with increasing temperatures.