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# Evaluation of RothC at three chronosequence sites in Zimbabwe and France using $^{13}$Carbon measurement data

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We evaluate the ROTHC model at three tropical chronosequence sites in Zimbabwe against total carbon (C) and $\delta^{13}$C measurements. The sites exhibit a transition from $C_3$ plants, dominated by miombo woodland, to a low input $C_4$ maize rotation. The different $^{13}$C signatures of the woodland plants and maize are used to distinguish between the woodland derived C and the maize derived C. Default model applications show that the model underestimates the fast drop in C stocks in the first 20 years after land-use change but overestimates C losses in the long-term after 80 to 100 years. Several hypotheses were tested to evaluate the simulations. Input data and internal model parameter uncertainties had minor effects on the simulations results. Accounting for erosion and implementing a simple tillage routine did not improve the simulation fit to the data. To exclude specific sub-Saharan effects that could explain the discrepancy between simulated and measured data we simulated a comparable chronosequence in a temperate region, France. The simulation showed the same pattern as for the chronosequence sites in Zimbabwe. We therefore hypothesize that a generic process that is not yet explicitly accounted for in the ROTHC model could explain the loss in soil C after land use change. Such a process could be the loss of the physical protection of soil organic matter (SOM) as would be observed following cultivation of a previously uncultivated soil. Future work will quantify C loss through the disruption of the physical protection within soil aggregates using $\delta^{13}$C measurements and derive a simple modelling approach to describe the physical protection of SOM within the

ROTHC model.