

***Interactive comment on “How will organic carbon stocks in mineral soils evolve under future climate? Global projections using RothC for a range of climate change scenarios” by P. Gottschalk et al.***

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Many thanks for the comments. Please see our response below.

To the first comment on NPP as a surrogate for soil carbon (C) inputs: NPP-C data from IMAGE or MIAMI are not directly used as soil C inputs to the RothC model. Soil C inputs are initially estimated by the model itself using an equilibrium simulation. Such a simulation uses the given soil organic carbon (SOC) content, here from the ISRIC-WISE data base, and long-term average climate and land use data to estimate soil C

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inputs assuming that the soil C content is at steady-state under given climate and land use conditions. This procedure accounts for the fact that soil C inputs, including plant and animal residue, rhizosphere depositions and manure inputs are rarely known nor estimated. However, it does implicitly account for carbon export due to harvest since the calculated soil C inputs include only the C that is needed to achieve the measured SOC level, and thus excludes any removal through harvest. Our approach uses the NPP-C data from IMAGE, and the MIAMI model is only used to scale the soil C inputs which were initially estimated by the model. If NPP-C changes by +5% from one year to the next, the soil C inputs change likewise. RothC simulates carbon dynamics within a single soil layer. Therefore, C inputs are not distributed according to soil depth, only according to the quality of the input. Since NPP is not directly used as an input to the model, no assumptions need to be made about the proportion of NPP derived C inputs to the first 30 cm of the soil profile. To the second comment on the evaluation of soil C inputs: Since we are not using NPP values from IMAGE or MIAMI as inputs to RothC directly, our simulations do not depend on the values being correct in absolute terms. Our simulations rely on the robustness of the relative changes of NPP (from IMAGE or MIAMI) over time and that these relative changes can be transferred to absolute changes in soil C inputs. As correctly mentioned, the measured NPP values only reflect approximately soil C inputs in natural ecosystems which can be assumed to be in equilibrium in terms of their carbon budget. Therefore, the comparison of modeled soil C inputs and NPP values could only be carried out for natural ecosystems such as forests and steppe since all other ecosystems are modified to a greater or lesser extent.

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