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Interactive comment on "Soils apart from equilibrium – consequences for soil carbon balance modelling" *by* T. Wutzler and M. Reichstein

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We would like to thank Jens Leifeld for his complementary contribution to our discussion of the model results found. Jens Leifeld highlighted the findings that, soil mineralogy and spatial inaccessibility of carbon limits the late stage decomposition of litter more than chemically defined litter quality itself (Mikutta et al., 2006; von Lützow et al., 2006). We agree that these mechanisms of carbon stabilization should generally be mentioned in this context. However, we have to face that neither of these processes are represented in the considered decay pool models. Often, it is necessary to abstract from these processes in some way in order to match available data sources of a nation or European wide application. The insufficient representation of these processes in the Yasso model was acknowledged at the application of the transient correction by

varying the slow pool decay rate by three orders of magnitude. We tried to think of relatively simple and practical ways to improve current decay pool models without explicitly including these processes. However, we concur with Jens Leifeld's implicit notion, that explicit representation of these processes should be pursued in the development of soil carbon models. The main point of our contribution was to show the errors introduced by the common steady-state assumption in typical applications of soil carbon pool models, irrespective of the question why the steady assumption might be violated.

Another valid point raised was to try to find soils with long track (i.e. more than millennia) of stable conditions for parameterization of current models. However this is a real challenge within the boreal and temperate zones because of the former ice cover. The Yasso model and the dependence of the decomposition rate parameters on environmental conditions have been established for these zones and the transfer of parameterization to and from tropical conditions has to be thoroughly validated. We note that the shown carbon stocks in Fig. 4.5 are results of a theoretical limit consideration for a boreal forest, when the decay rate approaches zero. Values are not readily comparable with tropical conditions of litter inputs and decomposition. However, imposing an upper limit on theoretical stocks after a millennium period with unchanging vegetation, climate and absence of disturbance would provide another way of calculating a lower bound of the slowest pools decomposition rate. We do not want to argue about the magnitude of the equilibrium stocks, which are truly theoretical. Yet, we only want to show that it is practically neither possible to determine the size of equilibrium stock nor to decide, if current soil carbon stocks are in equilibrium. We developed the transient correction in order to deal with the lack of knowledge about equilibrium stocks. The inclusion of data on current carbon stock observations with the transient correction makes it possible to relax the assumption of a strong equilibrium.

The approach of relating continental scale analysis of soil carbon increases to runoffs by rivers (Hedges et al., 1997) is especially interesting. In this way a new equilibrium at a much coarser scale can be defined that includes the disturbance of erosion. Further,

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it emphasized the need to include disturbances of this kind in model applications at coarser scale. In our study, however, we focused on soils that were not disturbed for centuries and calculated carbon accumulation with the assumption of absence of non-CO2 carbon losses during the simulation period. These assumptions should be stated more clearly in the paper.

Again, we thank Jens Leifeld for his complementary and clarifying comments. We will include the necessary qualifications and clarifications in a revised version of the paper after the comments of the reviewers are available.

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