

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

Anonymous Referee #3

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Review of “Soils apart from equilibrium - consequences for soil carbon balance modelling” number “bgd-3-1679” by T. Wutzler and M. Reichstein submitted to Biogeosciences Discussions

General Points:

Soil carbon pool models are often calibrated assuming observed carbon stocks being near equilibrium, neglecting disturbance history of the site. For sites where only the slowest pool has not reached equilibrium (last disturbance century ago), the authors propose a relaxed equilibrium assumption and investigate the consequences for soil carbon modelling. Experiments with the Yasso soil model for a spruce forest parame-

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terization revealed high uncertainties for decay rate of the slowest pool and theoretical equilibrium stocks. Application of the relaxed equilibrium assumption at a central European beech forest site showed that model spin-ups assuming equilibrium overestimate the decay rate of the slowest pool carbon stocks at recently disturbed sites. In contrast, the relaxed equilibrium assumption prescribes a lower decay rate, resulting in smaller carbon stock, and an additional carbon fixation of the order of $1 \text{ gC m}^{-2} \text{ a}^{-1}$ over a 100 year simulation.

Overall, this paper is mostly (see below) well laid-out and the presentation is clear and concise. The abstract covers the findings of the paper, and in general the length of the sections is sufficient. The graphical representation and use of scientific literature is adequate.

I think this manuscript will be a welcome addition to the carbon modelling community. If anything, it could give a needed example of how model assumptions need to be questioned (not only on the background of climate change). Therefore, my overall assessment is accept with minor revision.

Specific Remarks

Page 1680, line 24 Is an additional carbon fixation of the order of $1 \text{ gC m}^{-2} \text{ a}^{-1}$ over a 100 year simulation a “substantial” amount of the overall carbon accumulation? Yes, when based on the “first very rough extrapolation” presented on page 1688, line 23-28; yet is this enough for such a strong statement?

Page 1684, eqs. 4&6 Move further down where variables of those equations are explained: eq.4 to line 10, eqs 5+6 to line 12.

Page 1684, line 15 What would be the effects of non constant litter inputs?

Page 1685, line 5ff Consequently, neither equilibrium nor the relaxed equilibrium assumption is applicable for sites with more recent (less than a century ago) disturbances. A point for the discussion section: What are alternatives for such - relatively abundant

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- sites?

Page 1685, line 15-25 Be more explicit: here forest chronosequence sites (plural!) are described, some with disturbance 150 years ago, some with potential disturbance before the 16th century, but in the following there are no results for these different sites. Are the model results for one of the 150 year disturbance-free sites, for the more or less undisturbed site, or for an “average” beech forest? I would assume that the difference between equilibrium assumption and relaxed equilibrium assumption for the 16th century sites are smaller than those for the 150 year sites?

Page 1685, line 25 “across scenarios” - those have not been defined yet. Move sentence to page 1686 line 4?

Page 1688, Discussion The subtitles of the discussion are partly misleading. For example, 4.2 covers more what was done in the paper than discussing alternatives. According to the references in 4.4, there are no tests needed to prove that soil carbon stocks are apart from equilibrium. Why use “How can we test whether soil carbon stocks are apart from equilibrium?” as head line?

Page 1689, line 21-24 With respect to alternatives to the presented approach, this section would be worth to be expanded - especially on the background that part of the forest area is recovering from more recent than century ago disturbances, where neither equilibrium nor relaxed equilibrium assumption apply. One could imagine a model experiment where the order of magnitude of the effects of “no feedbacks” is contrasted against that of (relaxed) equilibrium assumption.

Page 1689, line 27-page 1690, line 20 This section is beyond the scope of the paper. Delete! If you want to keep it, move this paragraph to the introduction, formulate a respective goal at end of introduction, set up a model exercise, etc.

Page 1690, 4.3 Good! Consequences for the research community are what I expect from a discussion!

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Page 1691, 4.4 The first part of this point would be better a “setting the stage” in the introduction, saying “most soils ARE apart from equilibrium”. Why would you still want to test for evident facts?

Page 1692, 4.5 Good! Alternative and subsequent approaches are what I expect from a discussion!

Page 1693, line 9-10 Where now does the figure “two to three centuries ago” come from?

Page 1693, line 11 Tongue twister. Reword?

Page 1693, line 14-15 “or by regional statistical models” Not shown in the paper. Delete.

Page 1693, line 18 “reasonably small” compare with “substantial” at Page 1680, line 24. It has the same order of magnitude as the additional carbon fixation due to the relaxed equilibrium assumption

Page 1693, line 20-22 Did I miss something? Where did you make experiments with changing temperature sensitivities? Clarify.

Page 1693, line 23-24 Add qualifier: “disturbed” or “undisturbed” forest soils. Same in page 1694, line 1

Page 1694, line 14 Add qualifier: “disturbed” or “undisturbed” forest soils. Same in page 1694, line 1

Page 1695, line 4 Spelling “drought” (drought)

Page 1695, line 12, 16, Page 1696, line 4 Add 0 to match number of digits of tabulated values.

Page 1696, line 1 Spelling “pinus” (Pinus)

Page 1696, line 2-4 Remove ext_b column?

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Page 1696, line 7-10 Remove ext column?

Page 1711, y-axis label Spelling “Peditced” (Predicted), x-axis “Standad” (Standard)

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