

Biogeosciences Discuss., author comment AC2
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Reply on RC2

Kevin R. Wilcox et al.

Author comment on "Assessing carbon storage capacity and saturation across six central US grasslands using data-model integration" by Kevin R. Wilcox et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-164-AC2>, 2022

This is an interesting study and a generally well-written manuscript. The authors provide a quantitative assessment of the C capacity and saturation of 6 US grasslands using both measured and modelled data.

Thanks for the kind words.

The main weak points of the manuscript are (1) the inconsistent and confusing use of terms (2) the limited discussion around the role of soil biogeochemical processes for the C balance/capacity/saturation and (3) the minimal explanation of the *data assimilation process* i.e. what are the assimilated data about ?

Here, we respond to each of the three points above:

- *We agree with the reviewer and we will rewrite the text to limit the number of acronyms used. We think this will substantially improve readability of the manuscript.*
- *This is another good point raised by the reviewer. We have identified a number of literature sources to include in the discussion to address specific biogeochemical processes responsible for the biogeochemical metrics presented in this study. See response to Reviewer 1 for some of these.*
- *Originally, we had minimized the text describing the data assimilation process, but based on this comment and some confusion surrounding Fig. 2-4, we will bring in additional text to better describe the data assimilation process. Briefly though, we used NPP inputs, soil temperature and soil moisture to drive the carbon turnover submodel. Then, we compared model output to observations of ANPP, root standing crop, plant litter, soil carbon, and surface CO₂ efflux measurements through time to optimize C turnover, transfer, and sensitivity parameters. These parameters were then used to calculate carbon capacity.*

After reading the paper carefully I am not able to explain how many key variables were estimated e.g. potential C. I can understand the key findings due to the very nice graphics. I think this reflects what the manuscript is lacking. All the elements of a good publication are in there but not given to the reader in a clear and coherent manner.

This is a good point. We think that the revisions suggested above by both reviewers will result in a manuscript that is more transparent.

Specific comments

- abstract : C can be lost via leaching also

We agree and will incorporate this into a revised version.

- abstract : "The proportion of $\delta^{13}C$ currently stored by an ecosystem (i.e., its C saturation – CSAT)" -- this is assuming a grassland ecosystem *is C saturated*, which is almost never the case (can be close to but not *at* Csat)

We agree. We tried to make this point in Figure 1, where the C capacity changes through time. We will make this point more clear.

- Page 2 : C capacity X_c and C content X_p become a source of confusion as there are points in the MS where X_c is presented as present/current C content and X_p as the potential C (e.g. L77)

We think that removing the symbols and using consistent terminology, based on both reviewer comments, should alleviate this issue.

- L83: Csat is presented as "the distance between X_p and X_c " but later referred to as "proportion" and "percentage" which leads to different readers understanding this variable very differently

Same as previous response – this should be fixed during the revision process.

- L101 : What is the land use history (at least the recent one) of the examined sites? Where they always grasslands?

This is an important point. Many of the sites were abandoned grazing land so there is a legacy of that management that may still be present. We will include this information in a revision.

- Section 2.5 : I believe that all terms used in the MS should be described in one unique section early on. A table and/or schematic would help a lot.

We think this is a great idea, and would implement in a revision.