



Open Access This file is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. In the cases where the authors are anonymous, such as is the case for the reports of anonymous peer reviewers, author attribution should be to 'Anonymous Referee' followed by a clear attribution to the source work. The images or other third party material in this file are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

Web links to the author's journal account have been redacted from the decision letters as indicated to maintain confidentiality

3rd Apr 24

Dear Ms Dietz,

Your manuscript titled "Soil carbon maintained by perennial grasslands but lost by field crops over 30 years in a temperate Mollisol" has now been seen by 2 reviewers, and we include their comments at the end of this message. They find your work of interest, but some important points are raised. We are interested in the possibility of publishing your study in *Communications Earth & Environment*, but would like to consider your responses to these concerns and assess a revised manuscript before we make a final decision on publication.

We therefore invite you to revise and resubmit your manuscript, along with a point-by-point response that takes into account the points raised. In particular, we ask that you address the point made by Reviewer #2 regarding carbon inputs and either provide information on carbon inputs or carefully revise the language used to reflect that your study is focused on soil organic carbon stocks. Please also provide comprehensive details on your methods and the different cropping systems. Please highlight all changes in the manuscript text file.

We are committed to providing a fair and constructive peer-review process. Please don't hesitate to contact us if you wish to discuss the revision in more detail.

Please use the following link to submit your revised manuscript, point-by-point response to the referees' comments (which should be in a separate document to any cover letter), a tracked-changes version of the manuscript (as a PDF file) and the completed checklist:

[link redacted]

** This url links to your confidential home page and associated information about manuscripts you may have submitted or be reviewing for us. If you wish to forward this email to co-authors, please delete the link to your homepage first **

We hope to receive your revised paper within six weeks; please let us know if you aren't able to submit it within this time so that we can discuss how best to proceed. If we don't hear from you, and the revision process takes significantly longer, we may close your file. In this event, we will still be happy to reconsider your paper at a later date, as long as nothing similar has been accepted for publication at *Communications Earth & Environment* or published elsewhere in the meantime.

Please do not hesitate to contact us if you have any questions or would like to discuss these revisions further. We look forward to seeing the revised manuscript and thank you for the opportunity to review your work.

Best regards,

Clare Davis, PhD
Senior Editor
Communications Earth & Environment

www.nature.com/commsenv/
@CommsEarth

EDITORIAL POLICIES AND FORMATTING

We ask that you ensure your manuscript complies with our editorial policies. Please ensure that the following formatting requirements are met, and any checklist relevant to your research is completed and uploaded as a Related Manuscript file type with the revised article.

Editorial Policy: [Policy requirements](#) (Download the link to your computer as a PDF.)

For Manuscripts that fall into the following fields:

- Behavioural and social science
- Ecological, evolutionary & environmental sciences
- Life sciences

An updated and completed version of our Reporting Summary must be uploaded with the revised manuscript

You can download the form here:

<https://www.nature.com/documents/nr-reporting-summary.zip>

Furthermore, please align your manuscript with our format requirements, which are summarized on the following checklist:

[Communications Earth & Environment formatting checklist](#)

and also in our style and formatting guide [Communications Earth & Environment formatting guide](#) .

*** DATA: Communications Earth & Environment endorses the principles of the Enabling FAIR data project (<http://www.copdess.org/enabling-fair-data-project/>). We ask authors to make the data that support their conclusions available in permanent, publically accessible data repositories. (Please contact the editor if you are unable to make your data available).

All Communications Earth & Environment manuscripts must include a section titled "Data Availability" at the end of the Methods section or main text (if no Methods). More information on this policy, is available at <http://www.nature.com/authors/policies/data/data-availability-statements-data-citations.pdf>.

In particular, the Data availability statement should include:

- Unique identifiers (such as DOIs and hyperlinks for datasets in public repositories)
- Accession codes where appropriate
- If applicable, a statement regarding data available with restrictions
- If a dataset has a Digital Object Identifier (DOI) as its unique identifier, we strongly encourage including this in the Reference list and citing the dataset in the Data Availability Statement.

DATA SOURCES: All new data associated with the paper should be placed in a persistent repository where they can be freely and enduringly accessed. We recommend submitting the data to discipline-specific, community-recognized repositories, where possible and a list of recommended repositories is provided at <http://www.nature.com/sdata/policies/repositories>.

If a community resource is unavailable, data can be submitted to generalist repositories such as

[figshare](#) or [Dryad Digital Repository](#). Please provide a unique identifier for the data (for example a DOI or a permanent URL) in the data availability statement, if possible. If the repository does not provide identifiers, we encourage authors to supply the search terms that will return the data. For data that have been obtained from publically available sources, please provide a URL and the specific data product name in the data availability statement. Data with a DOI should be further cited in the methods reference section.

Please refer to our data policies at <http://www.nature.com/authors/policies/availability.html>.

REVIEWER COMMENTS:

Reviewer #1 (Remarks to the Author):

This MS used a more completed and comprehensive method to evaluated the SOC stock changes using a long-term field experiments. The idea is interesting, the results may help to improve our understandings on the SOC contribution to the atmosphere. There are still some questions that should be considered well:

In all, the whole MS was well -organized, but there were some short paragraphs, especially in the Introduction section. I suggest to synthesize them to make it more logical.

Line 1, As for the title of the MS, it seems to have no novelty as many other studies. I suggest to use the three complete methodology in the title, this is also the main focus and innovation of this study. Lines 20-22, well-managed grasslands can protect SOC as have been reported in many papers, but is not recommended in arable soil under the consideration of economic interests. The conclusion is universal, the author should give a much specific and conductive conclusion here.

Line 36, please add references

Line 61, depth-from-soil-surface, I can not understand.

Line 63, how much?

The author use comprehensive methods, complete methods for many times, but I did not conclude what method is the most comprehensive method to estimate SOC changes in this MS. Why the author choose 0-90 cm depth here? But not the whole soil profile?

Line 86, multiple cropping system, but you only used soils with different plant species, without consideration of tillage practices, organic residue amendments and so on. How to define multiple here?

Line 102, why the author chose 0-90 cm depth in this study?

Lines 105-107, these loses is compared with what treatment?

Line 257, you say the soils are relative deep about 1m, why chose 0-90 cm depth soil to investigate SOC changes in this MS?

Line 279, delete a comma

Line 281, winter white

Line 296, The C contents were measured in 2009, after ten years of the establishment of the experiment. Whether the soil C mineralized during the ten years is unclear. But this is a problem that will affect the results here.

Lines 300-307, When the pb were measured in 1989, 209 and 2019, since this index is significantly related to crop root and other plant residue amendment practices. The sampling time should be given out here.

In addition, the pb were measured at two sampling depths in 1989, but in Table S1, how to use 0-90

cm data in 1989?

Lines 309-312, Did you consider the soil compaction during soil sampling using a diameter hydrolic core? This soil compaction will affect soil samples and bulk density. In addition, soil samples and bulk density were measured in 2019 and 2020, if the crops were the same in these two year? Because plant may affect the SOC and bulk density. What did the author think about this differences?

Line 313, why their are rock fragments in soils? The Mollisol studied was sedimentally formed?

Lines 378-379, unclear

Line 534, the full name of the treatments should be given here. What did Pr and t represent?

From the figures, we can see that the error bar in MIRG treatment was the biggest, why this happen?

I suggest to outline the bulk density in a table including all the soil layers of field treatments for all three sampling years. Since these data are fundamental but necessary in all calculations and estimations.

Reviewer #2 (Remarks to the Author):

The study major claims differences in soil organic carbon across cropping systems. However, the paper does not directly measure the carbon input of the different cropping systems or other evidence to support this theory. It uses only the results of soil organic carbon change to draw conclusions about carbon loss or maintain in crop systems. Nor does it make any concrete conclusions about these differences at all. Therefore, it is not suitable for "Communications Earth & Environment".

Besides, my specific comments are as follows:

1.Line 1-2: I believe that the title should be changed because it should also include comparison of methodologies for SOC estimation.

2.Line 39: It is suggested to combine with the previous paragraph.

3.Line 39: Could you add the necessity why you want to compare the data from multiple cropping systems?

4.Line 240: Some further discussion should be developed beyond the simple discussion on data. I mean that how these results are providing useful insights for achieving a sustainable agricultural management in this region. This discussion should be useful for the international audience.

5.Line 279: What is the reference for the division of high-input or moderate-input, which refers to the amount of C input?

6.The different systems description will be more complete, such as fertilization conditions, tillage conditions, etc., in order to better contextualize the representativeness of the experimental design and informing to the international audience the usefulness for other similar regions all over the World.

1 We appreciate the remarks given to us by the reviewers and have addressed them below.

2

3 Reviewer #1:

4

5 In all, the whole MS was well -organized, but there were some short paragraphs, especially in the
6 Introduction section. I suggest to synthesize them to make it more logical.

7 Author response: We agree with the reviewers feedback and have combined the paragraphs
8 between line 33 and line 45.

9

10 Line 1, As for the title of the MS, it seems to have no novelty as many other studies. I suggest to
11 use the three complete methodology in the title, this is also the main focus and innovation of this
12 study.

13 Author response: To address this comment, we have changed the title to include our
14 methodology. It is now “Soil carbon maintained by perennial grasslands but lost in field crop
15 systems over 30 years in a temperate Mollisol according to longitudinal, compaction-corrected,
16 full-soil profile analysis”.

17 Lines 20-22, well-managed grasslands can protect SOC as have been reported in many papers,
18 but is not recommended in arable soil under the consideration of economic interests. The
19 conclusion is universal, the author should give a much specific and conductive conclusion here.

20 Author response: We believe the final sentence of our abstract is clear that we are specifically
21 talking about biogeochemical distinctions and the ability of different agricultural systems to
22 protect SOC. While we disagree with the reviewer that a universal consensus has been reached
23 regarding the economic performance of well-managed grasslands on arable soils, balancing

24 economic interests against the benefits of SOC storage is beyond the scope of this paper.

25 Line 36, please add references

26 Author response: The phrase “they do not mitigate climate change any more than a replanted
27 forest that later burns down” was meant figuratively. We have removed it and replaced it with a
28 more literal statement: “they do not mitigate climate change in the long-term.”

29 Line 61, depth-from-soil-surface, I can not understand.

30 Author response: To address this comment, we have removed the hyphens. Hopefully it is now
31 clearer.

32 Line 63, how much?

33 Author response: To address this comment, we have specified that the differences are
34 “significant” and included sources. The effect of changing management on soil density is well-
35 known but variable between soil types and management types, so it would not be accurate to
36 make specific claims about such a general topic.

37 The author use comprehensive methods, complete methods for many times, but I did not
38 conclude what method is the most comprehensive method to estimate SOC changes in this MS.

39 Author response: Our argument is that using all three methods (longitudinal assessment, ESM
40 correction, and whole-profile sampling) is necessary to accurately assess SOC accrual or loss.
41 We have attempted to make this clearer by adding the phrase “that uses a longitudinal, ESM-
42 corrected analysis of the full soil profile.” at the end of the Introduction.

43 Why the author choose 0-90 cm depth here? But not the whole soil profile?

44 Author response: Sampling depth and depth increments were chosen to be consistent with those
45 used in 1989 for baseline soil sampling (0-6, 6-12, 12-24, and 24-36 inches, corresponding to 0-
46 15, 15-30, 30-60, 60-90 cm). However, there are also important logistical reasons for limiting

our sampling to 90 cm. While these soils are approximately 1 m deep, the large rock fragments of the glacial till are frequently found in the 80 cm to 120 cm layer. Attempting to sample deeper than 90 cm across the field would risk damaging our sampling equipment. To address this comment, we have added the sentence “These increments were first chosen to align with standard agronomic soil tests based on surface soil (agronomic fertility, 0 to 15 cm) and deep soil sampling (soil NO₃–N, 0 to 90 cm). In addition to initial agronomic considerations, the glacial till (found at 80 to 120 cm) precluded consistent deeper sampling across the entire experiment.” to the Soil Sampling subsection of the Methods, as well as a more detailed explanation of how the original depth increments were chosen.

Line 86, multiple cropping system, but you only used soils with different plant species, without consideration of tillage practices, organic residue amendments and so on. How to define multiple here?

Author response: The Wisconsin Integrated Cropping Systems Trial is, as its name implies, a ‘systems’ experiment. Because of that, we do not have a full factorial array of all possible management practices. Instead, we sought to compare typical land uses (“systems”) of the North Central USA. The systems and their corresponding management practices that we compared are typical of different agricultural land uses in the North Central USA.

Line 102, why the author chose 0-90 cm depth in this study?

Author response: To address this comment, we have added the sentence “These increments were first chosen to align with standard agronomic soil tests based on surface soil (agronomic fertility, 0 to 15 cm) and deep soil sampling (soil NO₃–N, 0 to 90 cm). In addition to initial agronomic considerations, the glacial till (found at 80 to 120 cm) precluded consistent deeper sampling

69 across the entire experiment.” to the Soil Sampling subsection of the Methods.

70 Lines 105-107, these losses are compared with what treatment?

71 Author response: Because this is a longitudinal study, we did not calculate losses compared to a
72 treatment. Losses were calculated compared to baseline sampling in 1989. We believe our
73 explanation of the difference between space-for-time studies and longitudinal studies (lines 46-
74 54) address this comment.

75 Line 257, you say the soils are relatively deep about 1m, why chose 0-90 cm depth soil to
76 investigate SOC changes in this MS?

77 Author response: While average soil depth is 1 m, this varies by as much as 0.2 m across the 24-
78 ha experiment. We conservatively chose 90 cm based on historical sampling and logistical
79 considerations (glacial till & equipment). We added the sentence “These increments were first
80 chosen to align with standard agronomic soil tests based on surface soil (agronomic fertility, 0 to
81 15 cm) and deep soil sampling (soil NO₃-N, 0 to 90 cm). In addition to initial agronomic
82 considerations, the glacial till (found at 80 to 120 cm) precluded consistent deeper sampling
83 across the entire experiment.” to the Soil Sampling subsection of the Methods.

84 Line 279, delete a comma

85 Author response: We deleted the extra period following “U.S.” in this line.

86 Line 281, winter white

87 Author response: This comment is unclear. This line mentions “winter wheat” but we are unsure
88 what the reviewer meant by “winter white.” In case this was a reference to type of winter wheat,
89 we have clarified in this paragraph that it is a soft red winter wheat.

90 Line 296, The C contents were measured in 2009, after ten years of the establishment of the

experiment. Whether the soil C mineralized during the ten years is unclear. But this is a problem that will affect the results here.

Author response: We do not expect the C in the archived soils to have mineralized during the 20 years in storage. To address this comment, we have added the phrase “which is expected to be stable in dried archival samples” and a citation to a relevant paper to this line.

Lines 300-307, When the pb were measured in 1989, 209 and 2019, since this index is significantly related to crop root and other plant residue amendment practices. The sampling time should be given out here.

Author response: In 2009, samples were collected between April and July. In 2019, they were collected between October and November. Since we removed roots, other plant residue, and corrected for bulk density changes using Equivalent Soil Mass, we do not expect the different sampling times to affect our carbon stock calculations. We have addressed this comment by adding the sampling time to this section.

In addition, the pb were measured at two sampling depths in 1989, but in Table S1, how to use 0-90 cm data in 1989?

Author response: We believe this is explained in lines 344-350. We used bulk density (pb) measurements from 2009 for the lower 2 depths in 1989, on the assumption that pb did not change below 30 cm between 1989 and 2009.

Lines 309-312, Did you consider the soil compaction during soil sampling using a diameter hydrolic core? This soil compaction will affect soil samples and bulk density. In addition, soil samples and bulk density were measured in 2019 and 2020, if the crops were the same in these two year? Because plant may affect the SOC and bulk density. What did the author think about this differences?

114 Author response: Our use of equivalent soil mass (ESM) corrections should address this concern
115 about bulk density. Differences in bulk density do not affect our carbon stock estimates, since
116 ESM functionally translates all samples to the bulk density measured in the baseline year.
117 Samples for percent carbon estimation were collected in 2019, not 2020. We believe the
118 paragraph (lines 351-362) adequately addresses this comment.

119 Line 313, why their are rock fragments in soils? The Mollisol studied was sedimentally formed?

120 Author response: The Mollisol was formed from loess deposits over glacial till. Glacial till is
121 rock fragments deposited from the movement of glaciers. We believe our “Site description and
122 history” subsection adequately addresses this comment. We have also added the phrase “from
123 glacial till” to the line in question.

124 Lines 378-379, unclear

125 Author response: Based on this comment, we cannot determine which part of the sentence the
126 reviewer found unclear. We have attempted to address their concern by replacing the phrase
127 “since the shallow sampling regime assumes no meaningful change in SOC due to management
128 below 30 cm” with the phrase “simulating a scenario where we did not measure below 30 cm.”

129 Line 534, the full name of the treatments should be given here. What did Pr and t represent?

130 Author response: We have added the full name and description of the treatments as a footnote to
131 this table. “Pr>t” is a common statistical term, sometimes referred to as the “p-value” with
132 respect to a specific t-value.

133 From the figures, we can see that the error bar in MIRG treatment was the biggest, why this
134 happen?

135 Author response: Due to the experimental design, we took fewer samples for MIRG (n=6) than
136 most of the other treatments. This likely led to larger uncertainty in our estimates of SOC stocks

and stock changes. To address this comment, we have added the phrase “leading to greater uncertainty in our estimates of SOC stocks” to the end of the sentence “The lack of evidence for SOC change below 15-cm in MIRG and Prairie may reflect limited sample size (n=12 and n=6, respectively)” in line 168-170 of the Discussion. Additionally, the perennial grasslands under MIRG likely have diverged over the 30 years since they were planted while the annual systems are replanted each season, which homogenizes the inputs, soil structure, soil microbial communities, etc.

I suggest to outline the bulk density in a table including all the soil layers of field treatments for all three sampling years. Since these data are fundamental but necessary in all calculations and estimations.

Author response: Because we use Equivalent Soil Mass corrections, our SOC stock values already account for changes in bulk density over time. Inclusion of a bulk density table would be interesting but redundant for understanding the trends in SOC stocks in this experiment, which is what this paper seeks to do.

Reviewer #2:

The study major claims differences in soil organic carbon across cropping systems. However, the paper does not directly measure the carbon input of the different cropping systems or other evidence to support this theory. It uses only the results of soil organic carbon change to draw conclusions about carbon loss or maintain in crop systems. Nor does it make any concrete conclusions about these differences at all. Therefore, it is not suitable for “Communications Earth & Environment”.

160 This study claims differences in soil organic carbon across systems, which we estimated by
161 measuring soil organic carbon in year 0, year 20, and year 30 of our four-block randomized
162 complete block design cropping system experiment. We have corrected the language which we
163 believe lead the reviewer to believe this was a study about carbon inputs (Line 279 of the
164 original MS, which referred to cropping systems with large inputs of synthetic pesticides and
165 fertilizers as “high input”). Hopefully the MS is now clear that this was a study about soil
166 organic carbon.

167

168 Besides, my specific comments are as follows:

169 1.Line 1-2: I believe that the title should be changed because it should also include comparison
170 of methodologies for SOC estimation.

171 Author response: We have addressed this comment by including our methods in the title. The
172 title is now “Soil carbon maintained by perennial grasslands but lost in field crop systems over
173 30 years in a temperate Mollisol according to longitudinal, compaction-corrected, full-soil
174 profile analysis”

175 2.Line 39: It is suggested to combine with the previous paragraph.

176 Author response: We have addressed this comment by combining these paragraphs.

177 3.Line 39: Could you add the necessity why you want to compare the data from multiple
178 cropping systems?

179 Author response: We were unable to find a mention of multiple cropping systems near line 39.
180 However, at line 84, we have added the phrase “, which limits the generalizability of their
181 results” to hopefully address the reviewer’s concern.

182 4.Line 240: Some further discussion should be developed beyond the simple discussion on data. I

183 mean that how these results are providing useful insights for achieving a sustainable agricultural
184 management in this region. This discussion should be useful for the international audience.

185 Author response: We have expanded and clarified the second-to-last paragraph in our Discussion
186 to be more specific about how our results might provide insights to improve agricultural
187 sustainability. Hopefully these insights are useful to an international audience.

188 5.Line 279: What is the reference for the division of high-input or moderate-input, which refers
189 to the amount of C input?

190 Author response: In this line, “input” refers to the amount of synthetic chemicals and mechanical
191 work used in that cropping system. To address this comment, we have added a phrase “or
192 chemically and mechanically intensive,” in that line to clarify our meaning as well as adding
193 additional clarifying details to Table 1.

194 6.The different systems description will be more complete, such as fertilization conditions,
195 tillage conditions, etc., in order to better contextualize the representativeness of the experimental
196 design and informing to the international audience the usefulness for other similar regions all
197 over the World.

198 Author response: This was a very good suggestion. We would like our paper to be interpretable
199 and useful for an international audience. To address this, we have added more detailed
200 descriptions of the systems to the Methods section.

14th May 24

Dear Ms Dietz,

Thank you for submitting your revised manuscript titled "Soil carbon maintained by perennial grasslands but lost in field crop systems over 30 years in a temperate Mollisol according to longitudinal, compaction-corrected, full-soil profile analysis". We are delighted to say that we are happy, in principle, to publish a suitably edited version in Communications Earth & Environment under the open access CC BY license (Creative Commons Attribution v4.0 International License).

We therefore now ask that you edit your manuscript to comply with our format requirements and to maximise the accessibility and therefore the impact of your work.

EDITORIAL REQUESTS:

Please review our specific editorial comments and requests regarding your manuscript in the attached "Editorial Requests Table".

*****Please take care to match our formatting and policy requirements. We will check revised manuscript and return manuscripts that do not comply. Such requests will lead to delays. *****

Please outline your response to each request in the right hand column. Please upload the completed table with your manuscript files as a Related Manuscript file.

If you have any questions or concerns about any of our requests, please do not hesitate to contact me.

SUBMISSION INFORMATION:

In order to accept your paper, we require the files listed at the end of the Editorial Requests Table; the list of required files is also available at <https://www.nature.com/documents/commsj-file-checklist.pdf>.

OPEN ACCESS:

Communications Earth & Environment is a fully open access journal. Articles are made freely accessible on publication under a [CC BY license](#) (Creative Commons Attribution 4.0 International License). This license allows maximum dissemination and re-use of open access materials and is preferred by many research funding bodies.

For further information about article processing charges, open access funding, and advice and support from Nature Research, please visit <https://www.nature.com/commsenv/article-processing-charges>

At acceptance, you will be provided with instructions for completing this CC BY license on behalf of all authors. This grants us the necessary permissions to publish your paper. Additionally, you will be asked to declare that all required third party permissions have been obtained, and to provide billing

information in order to pay the article-processing charge (APC).

Please use the following link to submit the above items:

[link redacted]

**** This url links to your confidential home page and associated information about manuscripts you may have submitted or be reviewing for us. If you wish to forward this email to co-authors, please delete the link to your homepage first ****

We hope to hear from you within two weeks; please let us know if you need more time.

Best regards,

Alice Drinkwater, PhD
Associate Editor
Communications Earth & Environment