Response to editors and reviewers

Editor

Dear Jasper Wubs,
Thank you for addressing the reviewers' comments.
After careful consideration of the feedback from both reviewers, it has been decided that your manuscript would be more appropriately categorized as a "forum article" rather than an "original research article", given that no original data are presented. Additionally, please revise your manuscript to better account for existing studies on this topic, as proposed by the first reviewer. If you agree with this change in the type of manuscript, we can proceed with the revision process after addressing the comments.
Best regards,
Luis Merino-Martí

Dear editor, dear Luis,

Thank you for your consideration and decision, I am happy to have the article be presented as a forum article.

I have addressed the comments of the reviewers as detailed below and added the relevant literature.

Best wishes,

Jasper Wubs

Referee report 1

Dear author,

I commend your efforts to consider the recommendations from the different reviewers. I've appreciated that you shortened the Ms and also deleted the digressions. You will find attached some minor comments to be addressed.

Yours sincerely,

Julien Demenois

- Response: Many thanks for your review and suggestions. I have integrated your comments into the new version of the ms.

Reviewer 2 report

The author clearly feels that presenting a methodology is enough for a perspective paper and, perhaps not surprisingly, disagrees with my initial review. I note that the other reviewers have a different opinion.

- Response: I see the point you have made and appreciate it. Indeed including data was my intention, but since I took a job at another institution I was not allowed to keep the remaining project funds with me to finish my original plan. Nevertheless, I do think there is significant value in this paper, soil health, and measuring soil health is a complicated issue, indeed I know of a number of EU projects scratching their heads and disagreeing as we speak. I am not saying my proposal is the answer to that search, but I do think it is an interesting point of departure. And maybe, this is what I hope, it is better that it is now discussed and augmented first by the scientific community, before we start operationalizing the measurement setup.

While I do agree that SEM and LVM offer an interesting approach to describing soil health, I remain concerned that the paper does not go far enough and that simply presenting an idea for a method or model is not sufficient. I am assuming this is a forum article, since SOIL does not have a ‘perspective ‘ article option. From the SOIL website:

"Forum articles should stimulate an open debate by presenting new ideas and views of soil as part of the larger Earth system. As such, they must strive to be a point of

departure for future work. Purely speculative contributions are discouraged."

My concern is that this paper is not a point of departure for future work. There are already a number of existing papers which have tried to apply SEM to soil health assessments for example Maaz et al. (2023); Romero et al. (2024). These and other papers should have at least been reviewed and the advantages and disadvantages of the approaches that these have taken pointed out. SOIL's readers need to understand how this paper builds on existing work and how it takes us forward beyond the state-of-art. Given the lack of references to previous use of SEM in soil health work I am struggling to understand this.

- Thanks for this perspective and the literature. I think this is where our views diverge, I do think this work is a point of departure for future work. Proper measurement is one of the fundamental steps in any science and for soil health this is something we cannot yet do, not coherently in any case. To me, this is a core discussion to be had.

- The Maaz et al paper is very interesting, thank you. Their approach to soil health is significantly different from mine. Their range of functions is not as broad as mine, and they use various indicators that are not soil functions, but rather stocks and environmental conditions (TOC, DOC, HWEC, pH, aggregates, bulk density). I think zooming in as closely as possible on the functioning of soil, is critical for quantifying and understanding soil health. It is about construct validity, and I think the properties and conditions used do not deliver that.

- The Romero et al 2024 paper is not using SEM to quantify soil health, it only uses it to link a SH index to ecosystem properties. I disagree with the approach in this paper on several counts. They use the wrong measurements to quantify aspects of soil health (they use stocks and properties not functions) and they use the wrong technique to come to an integration of soil health (Z-scoring with equal weights). More to the point here: they don't use an LVM approach to quantification so it is really fundamentally different. On top of that, I disagree with how they combine machine learning and SEM – to them SEM is just a correlation tool, they ignore the causal-inference framework that should go with the application.
- I have integrated the Maaz et al paper into the new version of the ms.

*Note. I have no scientific relationship to the authors of these papers

Maaz, T. M., Heck, R. H., Glazer, C. T., Loo, M. K., Zayas, J. R., Krenz, A., Beckstrom, T., Crow, S. E. & Deenik, J. L. 2023. Measuring the immeasurable: A structural equation modeling approach to assessing soil health. Science of the Total Environment, 870, 161900.

Romero, F., Labouyrie, M., Orgiazzi, A., Ballabio, C., Panagos, P., Jones, A., Tedersoo, L., Bahram, M., Guerra, C. A., Eisenhauer, N., Tao, D., Delgado-Baquerizo, M., García-Palacios, P. & van der Heijden, M. G. A. 2024. Soil health is associated with higher primary productivity across Europe. Nature Ecology & Evolution, 8, 1847-1855.