



EGUsphere, author comment AC1  
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## Reply on RC1

Alexandre M. J.-C. Wadoux et al.

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Author comment on "Shapley values reveal the drivers of soil organic carbon stock prediction" by Alexandre M. J.-C. Wadoux et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-1034-AC1>, 2022

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### **Review for "Shapley values reveal the drivers of soil organic carbon stocks prediction"**

**In this paper, Shapley values are used to interpret soil organic carbon variations nationwide in France using Shapley values. According to the results, this approach can explicitly explain the effect of soil-forming factors on SOC variation. This study was well-structured, well-written, and well-designed. There are, however, a few minor corrections and modifications that need to be made before publication, as listed below.**

We thank the reviewer for his/her positive evaluation of our manuscript. We address below all the comments and criticisms raised.

#### **Abstract.**

**Currently, the abstract is mainly narrative, so some quantitative results would provide a better insight into the research.**

In the revised version we will add one quantitative result in the abstract.

#### **L30-31: Please provide citations to support the statement, "there has been studies that attempted..."**

We agree that it would be useful to add a few references to support this claim. In the revised manuscript we will provide some example references:

*Van Wesemael, B., et al. "Agricultural management explains historic changes in regional soil carbon stocks." Proceedings of the National Academy of Sciences 107.33 (2010): 14926-14930.*

*Wang, B., et al. "Modelling and mapping soil organic carbon stocks under future climate change in south-eastern Australia." Geoderma 405 (2022): 115442.*

*Rahman, N., et al. "Changes in soil organic carbon stocks after conversion from forest to oil palm plantations in Malaysian Borneo." Environmental Research Letters 13.10 (2018): 105001.*

**L64: remove “, Challenge 3” it is unnecessary.**

The paper on the ten challenges of pedometrics contains 10 challenges and we would like to keep citation to a specific challenge so as to be precise to as which challenge we are referring to. Many of the challenges from this paper are irrelevant to our study.

**L67: There was no explanation of the "SHAP" in this abbreviation.**

Here SHAP refers to the method from Lundberg et al. but we will add the definition of the acronym in the revised manuscript. SHAP stands for SHapley Additive exPlanations.

**L73: A key issue is convincing of the novelty of the research and highlighting the current research gap in the existing research. This is missing from the present manuscript.**

The main novelty of this study is to propose a method to interpret complex models used to predict spatially a soil property. This method relies on Shapley values, which has not been described thoroughly in the soil science literature. To show the relevance of the use of Shapley value in interpreting a complex model, we use a study case in which the processes are well known and described (our French case study on SOC stocks), and use it to highlight that the Shapley values captured relationships between the SOC stocks and the environmental covariates that are meaningful. We believe the results presented in this study are novel and relevant to many studies mapping soil properties. For example, it is very common to report an estimate of the overall variable importance in prediction in soil mapping studies, but here we show that much more can be obtained, such as the partial dependence and the local importance. This is to our knowledge the first study in soil science showing how we can obtain a high level of insights into a complex model predicting a soil property.

**L80: “carbon stocks” replace with “SOC stocks” in case it is related to soil organic carbon.**

We agree and will make the change in the revised manuscript.

**L80-92: adding citations to this section is necessary.**

In the revised manuscript we will add the following two citations to this section:

*Laroche, B. et al. "Le programme inventaire gestion conservation des sols de France: volet référentiel régional pédologique." Étude et gestion des sols 21.1 (2014): 25-36.*

*Jones, A., Luca M. and Robert J.. Soil atlas of Europe. European Commission, 2005.*

**L89: Leptosols**

Thank you for spotting this mistake, we will make the change.

**L209: By adding a workflow of the study, the authors will make it easier for readers to follow the method's steps and understand the results.**

We understand but the manuscript is already quite long for a regular article (almost 8000 words and 9 figures), and the workflow is fairly simple and common to any mapping study: building of a regression matrix of soil properties with environmental covariates, fitting of a model, interpretation of the relationships found by the model (using Shapley values), and prediction.

**L224 "Fig. 2b further shows that the four most important covariates have"**

We will make the suggested change in the revised manuscript.