EGUsphere, author comment AC1
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Reply on RC1

Javier Reyes and Mareike Ließ

Author comment on "On-the-go VisNIR spectroscopy to predict SOC at field scale" by Javier Reyes and Mareike Ließ, EGUsphere, https://doi.org/10.5194/egusphere-2022-273-AC1, 2022

Replies are included in bold text

This paper aims to evaluate the ability to use soil vis-NIR spectroscopy to monitor SOC at the field scale. Two instruments (ASD and Veris) are used to acquire spectral data under laboratory and field conditions. Different spectral processing methods are combined with PLS regression to derive the best prediction models. In addition, spectral field data are corrected with the laboratory-based counterparts, which improves the performance of models built with field measurements. The topic is interesting and fits within the scope of SOIL. However, I think the paper needs a major restructuring and more clarity in the objectives and results section.

From the title, abstract (L5-10), and the introduction section (L75-80), I can see that this paper aims to evaluate the possibility of using vis-NIR to detect the spatial-temporal changes in SOC at the field scale. This is an interesting research question because spatially continuous SOC monitoring in an efficient manner is important for studying SOC sequestration and formulating climate mitigation strategies. However, as I advanced in reading through the results and discussion sections, it seems to me that the current analysis actually focuses on 'assessing the ability to use vis-NIR to predict SOC''. Many studies on a field, regional or continental scale actually have done this, using PLS (current study), Memory-based machine learning, or Cubist models combing with different spectral processing techniques. Based on this, it is not clear to me what the main objective of this paper is, and thus the novelty of this paper.

Thank you for your comments. Our work aimed to evaluate the potential of using on-the-go VisNIR data to predict SOC at the field scale for SOC monitoring. Although many studies have evaluated the potential of VisNIR to predict SOC, few studies have shown the application of the on-the-go data which could be used to predict the spatial and temporal variation on the field with appropriate resolution, and, the application of data correction to the on-the-go data is even more uncommon (more examples are found in punctual field measurements or remote sensing data).

If the authors focus on 'spatially continuous SOC monitoring based on the long-term field experiment', I think readers may want to know whether we can accurately detect changes in SOC using field vis-NIR spectroscopy (Veris), and what are the main factors that affect the accuracy of predictions. I am assuming that if the changes in SOC are small (e.g.,

based on a short-term fertilization experiment), then vis-NIR may be unable to capture it because of the higher prediction error based on the field spectral measurements (Figure 4 Veris). Furthermore, the addition of chemical fertilizers (L100) may affect the soil mineral matrix, e.g., by releasing the Fe minerals, which will strongly affect the spectral absorption features in the electronic transition region (425, 480, 513, 650, 903, 1000 nm). So, the treatments (fertilizer addition, and crop rotation… as described in L95) may lead to different interpretations in terms of model performance parameters, RC, and VIP. In my opinion, authors should focus on this perspective and pay more attention to what vis-NIR can do in detecting changes in SOC at spatial and temporal scales. If authors were to add new analysis in this regard, you may delete some previous analysis, i.e., comparing the model performance of 4 spectral processing methods (just pick the best one), because 1) multiple studies have shown that the effect of pre-processing on the accuracy of SOC predictions is very limited (Baldock et al., 2013; Dotto et al., 2018; Igne et al., 2010), and 2) too much information may distract from the key message of this paper.

The manuscript will be adapted to put more emphasis on the potential of on-the-go measurements to obtain reliable data for SOC prediction and how the data could be corrected based on additional laboratory measurements, which is the novelty of the work. We tested different methods of preprocessing methods, as we wanted to achieve the best model performance and identify how it could change when comparing devices and field/laboratory conditions, and also for the methods of field data correction.

In our work, we tested deeply the potential of the on-the-go spectrometer, and for that reason with compared it with conventional laboratory measurements to identify how far it was in terms of model performance. We agree with the referee that further work is needed in terms of evaluating spatial and temporal changes in SOC variation, which could be done in future works as the next steps, considering that temporal changes in SOC in the field need to be evaluated in longer periods to be manifested. The effect of fertilizers noted by the referee will be included as part of the discussion.

In a summary, the manuscript is not appropriate for publication in SOIL in its present form. I suggest authors carefully consider the objectives of this paper and then reformulate the title, results, and conclusions.

Some minor comments:

Abstract Only 3 sentences are about the results and conclusions while concentrating too much on the description of the context and methods. Need to revise.

The abstract will be adapted accordingly in the new version.

L35-42 in the introduction, the authors described the continuous SOC monitoring experiments in detail, so I think this is relevant to your research objectives. but…(see general comment).

The reply is included in the general comment.

L60 be more specific, preferably by providing examples.

The references regarding this aspect were included (Lee et al., 2009; Sarathjith et al., 2016)

L158 I suggest adding the 'Ratio of Performance to Deviation (RPD)' as an additional model performance parameter. This is a robust, widely used indicator to judge spectral models. (Change et al., 2001; Viscarra Rossel et a., 2012 EJSS).

RPD will be added to the results.

L195-197 $R^2 < 0.5$, PRD < 1.4? it seems an un-reliable model, please check with RPD values.

RPD will be part of the revised version. The statement was based on the models with the best performance (which was one of the reasons to test different methods), where we found an $R^2 < 0.75$, and now calculated an RPD < 2 in the Veris Field-gapDer with EPO correction.

L330 revise this conclusion after 1) calculating RPD (previous comment) to judge model performance; 2) adding analysis regarding "monitoring change" (see general comment).

These comments were previously replied.

L250-270 consider that add statistical analysis to compare the differences in model performance between different spectral processing methods and spectral correction methods (L306)

Thank you for the suggestion. We prefer to not include an additional analysis to compare models, as we wanted to find the best models and not focus the study on methods comparison.

L330, L345 be careful with these conclusions: given the low model performance of Veris field IR (Fig. 4 Veris field-SGCR, $R^2 < 0.5$), small changes in SOC may be undetectable using vis-NIR.

The statement was done based on the Veris field corrected data which provided acceptable results on best models as we responded on a previous comment.

Figure cation: explain the elements of boxplot, e.g., min, max, Q1 Q3 outliers...

We prefer to not add a description to the elements of the boxplot, as we understand it is a standardized type of plot.

Figure 3, 5: consider combining the plots that belong to the same categories, e.g., A with B, C with D (using colors to distinguish them).

We prefer to maintain the figures separated to have better visibility of the results.

Figure 9, 10: round the wavelength numbers

The wavelength numbers will be rounded.

Figures 7, 8, 9, 10. If I understand correctly, Figure 9 (median values) only carried part of the information that was already given by Figure 7 (median + range)? If yes, why not combine them? Also for Figure 8 and Figure 10.

As figures 9 and 10 are showing local peaks of important wavelength, they will be maintained. Figures 7-8 will be included as supplemental material, as the ranges vary relatively low.