

General comments

This is a well-organized study that addresses a genuine gap: whether in-situ Vis–NIR spectroscopy can predict SOC fractions (POC/MAOC) in forest soils, and how spectral correction (EPO) and model transfer strategies affect that feasibility. The four-workflow comparison is a clean way to isolate the effects of spectral correction versus direct in-situ calibration, and the addition of SHAP-based interpretation and independent cross-year validation strengthens the manuscript considerably. The writing is generally clear and the figures are informative. That said, several points need clarification or stronger support before the manuscript can be fully accepted. Most of these points are addressable through clarification and revision.

Specific comments

1. L23–24 vs. L345–347: The workflow A performance values reported in the Abstract (POC: $R^2 = 0.80$; MAOC: $R^2 = 0.59$) do not match the range reported for workflow A in the Results (POC: $R^2 = 0.04$ – 0.70 ; MAOC: mostly below 0.43). Please clarify which specific model/preprocessing combination the abstract values correspond to, and ensure consistency between the abstract and the results text.
2. L89–90: for four modeling strategies, spectral-correction-assisted in situ modeling is not included. It would better to mention both direct in situ modeling (direct and EPO corrected spectra).
3. Fig. 2: "Rebuilding models" branch, the Yes/No decision box in the flowchart is not explained in the text, what criterion triggers rebuilding the KS train/test split?
4. L288–289: for claiming "stable spectral importance patterns.", please describe some indication of stability, e.g., variance across the ten local models, it would help.
5. L328: On selection of the "three best-performing models", It would help to state explicitly that these three models were selected and carried forward (presumably PLSR, Cubist, MBL) rather than requiring the reader to infer this from Fig. 5/6.
6. L339: Fig.S4 was not included in supplementary data, please ensure it is available. It could be Fig.?
7. The POC:MAOC ratio deserves comment. In most mineral soils MAOC dominates SOC; here POC is almost 4x larger than MAOC. This is plausible for these albic forest soils but is unusual enough relative to the global literature that a sentence explaining why (parent material, low clay content, litter inputs) would help readers judge generalizability.
8. Fig. 5: It can be helpful to remind the preprocessing description in the figure description.
9. Fig. 6: It has REF acronym, while it is not one of the optimal preprocessing methods in the figure.

10. Fig. 6 "optimal R^2 obtained under laboratory conditions", since laboratory R^2 spans a wide range across algorithms/preprocessing (POC: 0.85–0.96; MAOC: 0.30–0.74), it isn't clear which single value the dashed line represents. Please specify if AB_SNV is intended for all three models, as in Fig. 5, SNV looks better in PLSR and MBL for MAOC.
11. L351: "under SNV + PLSR, R^2 for POC decreased compared with Workflow A." this is not shown in the figure 6, supplementary data or a table. Please present the mentioned result somewhere.
12. Fig. 8b/8d labeling. Panel (b) is labeled "REF_AB + Cubist" — this preprocessing tag doesn't correspond to any of the six preprocessing options defined before. Is this a typo for "AB"? Also, please use a bigger font to improve readability of numbers in plots. It's better if the label describes each panel rather than left and right columns.
13. The weaker spectral signal of MAOC (mediated by iron oxides/mineral surfaces) may be related to albic characteristic of these soil. I suggest the authors discuss this pedogenic connection explicitly.

Technical corrections

1. L22 in the abstract, please define EPO at its first occurrence.
2. L24: There is a phrase that seems to be incomplete or separated from the main sentence: "In contrast, direct in-situ modeling", it seems it could be "in contrast to".
3. L122-123 uses "POM"/"MAOM" (particulate/mineral-associated organic *matter*) while the rest of the manuscript uses POC/MAOC (*carbon*); a one-line clarification that carbon content was measured on the POM/MAOM fractions would avoid ambiguity.
4. L194-196: Several ML algorithm abbreviations are not spelled, SVMR, GPR, ANN, RNN, CNN. RF and GBDT appear in Fig. 5 legend/axis labels, but the text only writes "Random Forest" and "Gradient Boosting Decision Trees" in full.
5. L213: the (c) seemed to be a leftover symbol from a mathematical description of EPO. Remove or explain please.
6. L251: please define the CV at first mention, for consistency.
7. Eq. (2) RMSE and Eq. (3) Bias use opposite sign conventions for the residual ($\hat{y}_i - y_i$ vs. $y_i - \hat{y}_i$); harmless for RMSE (squared) but worth aligning for clarity.
8. L263: Citation formatting: "R.A. Viscarra Rossel et al., 2006" needs a spacing.
9. L269: Space after "."
10. L297–299: "training and test sets showed comparable ranges" — the POC training max (134.88) is roughly double the test max (67.89); consider softening "comparable" or reporting IQR instead of full range for this comparison.
11. L312: Principal component analysis to PCA

12. L317-318: In “while the surface layer exhibited lower reflectance and smoother spectral concavity.”, lower reflectance is redundant as it is stated in the previous sentence.
13. L350: “ R^2 for POC decreased compared with Workflow A”, consider rewording for clarity.
14. L355-L362: Consider rephrasing this part to improve readability and make it easier to follow.
15. Fig 7. Please improve the quality of the figure.
16. L556–558: “Providing new methodological insights...” is a sentence fragment; should read “This provides new methodological insights...” or similar.
17. L557: Hyphenation of “in situ” is inconsistent.
18. In references: Kaiser & Guggenberger 2003 and Viscarra Rossel et al. 2016 appear in the reference list but not in-text.