

Manuscript esd-2022-240: Response to reviewers

Point-by point response the reviewers' comments with:

RC : referee comment; **AR** : author response

Report #1: 'Comment on esd-2022-240', Anonymous Referee #2, 4 Feb 2023

RC: Thank you for addressing all the comments. The paper is ready to go in my opinion.

AR: We thank again the reviewer for his constructive comments.

Report #2: 'Comment on esd-2022-240', Chaoqun Lu, 6 Jul 2023

RC: Could you please clarify the regression equation used for calculating bulk density? Do you use one single equation (eq. 1) for all three layers, including organic active layers, mineral active layers, and permafrost soil layers? How does this equation perform in explaining the variations of samples in each layer (I suppose $R^2=0.73$ is for 443 samples in total)? If the equation differs in explaining the layer-specific variation, could you discuss its impacts on the stock calculation? In conclusion #2, the higher CEC density in mineral and permafrost layers is attributed to higher bulk density in mineral layer than organic soil layers. Could you provide your opinion about whether and how this one-equation regression (same slope, intercept) affect your conclusion?

AR: To answer this question, we have included a new figure (Fig 2) with the regression for the single equation. We have clarified how the equation should be considered: (L139-141) “ *This regression reflects the higher bulk density in mineral horizons than in organic horizons (Figure 2), even if the variability in bulk density is higher in soils with low SOC content (mineral horizons).*” Following the suggestion of the reviewer, we have clarified the impact on the stock calculation in the text and in the conclusion #2: (L353-354) “... *considering a higher variability in the estimation for mineral than for organic soils according to the bulk density estimates (Figure 2).*”; (L379) “...*even if the variability in bulk density is higher in mineral horizons (Figure 2)*”; (L432-433) “... *even if the bulk density estimation is more variable in mineral than in organic horizons.*”

RC: Please indicate the meaning of error bars in Fig 2, 4, and box plot (middle line, upper, bottom lines and whiskers) in Fig 5.

AR: The Fig 2, 4, and 5 from the previous version are now Fig 3, 5 and 6 (in response to the previous comment). We have specified the meaning of the error bars in Fig. 3 and 5: “*The error bars (horizontal lines) represent the standard deviation on the mean values (of 3 to 7 samples).*..”, and in Fig. 6: “*In each box plot, the horizontal line represents the median, the end of the box the 25-75% quartiles, and whiskers are 1.5 interquartile ranges from the median. Data points outside of the 1.5 interquartile ranges are represented as dots.*”

Files validated: 'Comment on esd-2022-240', Polina Shvedko, 23 Jan 2023

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AR: We changed the terms in CC-BY and we added the citation at L451 and L602-604 in the references