Responses to Reviewer 1

Please note that your comments are provided in green text and our responses are marked in blue text. Our major modifications in the revised manuscript are marked as red text.

The manuscript from Chen et al. produced the European soil bulk density and organic carbon stock database (>15000 soil samples) using the recently released BDfine and CFvolumefraction data (around 6000 soil samples) from LUCAS 2018. Authors evaluated the model performance for BD using traditional pedotransfer functions (PTFs) and four proposed machine learning (ML) based PTFs, and found that ML based PTFs (R^2 of 0.56-0.57) greatly improved the accuracy for BD prediction, and this is also much higher than previous PTFs for Europe using Hollis-type PTF (R^2 of 0.41). For the first time, authors produced the European soil organic carbon stock data of topsoil (0-20 cm) for the year of 2018 and evaluated the impact of BD accuracy on the accuracy of soil organic carbon stock data. The produced data and relevant evaluation are of significant importance for informing more precise soil hydrological and biological modelling, so as to support Soil health by 2050 proposed by the European Commission. This manuscript is generally well-written with clear objectives and solid methodology, and therefore I suggest that it can be accepted for publication after minor revision.

Response: Many thanks for your high recognition on our work. We have carefully revised the manuscript based on your comments and suggestions. Please find our response to your concerns one by one below.

Lines 100-101: Several symbols for the units should be superscripts, such as g cm-3, g kg-1. Please correct them throughout the manuscript.

Response: Thanks for pointing out the typos for the units. We have carefully

checked the whole manuscript and corrected all the relevant issues.

Table 2: I think two digits would be enough for the R2 reported here, which is in-line with your previous summary in Table 1. It is also not clear whether the data used to evaluate these traditional PTFs are the same to machine learning PTFs? If not, the results would be not comparable. Please make it clear.

Response: Thank you for this nice suggestion. We have kept two digits for R^2 in Table 2 for the consistency in the revised manuscript. The earlier published PTFs and machine learning PTFs (ML-PTFs) have been validated on the same data to make them comparable. We have added relevant descriptions to make it clear in Lines 184-185: "It is important to note that the same validation set was used to evaluate earlier published T-PTFs and ML-PTFs.".

Line 140: Please specify the k here. 5-fold cross-validation? 10-fold cross-validation?

Response: Here 10-fold cross-validation have been used. We have specified it in Line 161.

Figure 6: What do the colours mean here? More details should be provided in the figure captions.

Response: We appreciate your helpful suggestion. The red points represent topsoil samples with SOC stock<3 kg m^{-2} while the blue points represent topsoil samples with SOC stock≥3 kg m^{-2}. This information has been added in the caption of Figure 7 (previous Figure 6, in Lines 265-266).