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Interactive comment on "Variation of soil organic carbon, stable isotopes and soil quality indicators across an eroding-deposition catena in an historical Spanish olive orchard" *by* José A. Gómez et al.

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We would like to thank to the Reviewer for the careful assessment of the manuscript and the helpful suggestions to improve the quality of our work.

We detail below each of the reviewer's comments and how we plan to address those suggestions in a revised version of the manuscript that we have not uploaded by the time of closing the period for posting comments due to the lack of time to prepare a convenient review. For the shake of clarity, the original comments by R1 are between

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Discussion paper

quotation marks.

“General comments: The manuscript is a case study in Spain to compare the variation of SOC, soil quantity indicators and isotopes induced by land-use change and erosion issues. The subjects addressed here were clear and worthy of investigation. Authors have chosen appropriate indexes (e.g. OC fractions, N, P et al.) to illustrate how olive orchard use coupled with soil erosion degrades soil quality, however, the data mining/ interpretation is insufficient and need to dig into further. In addition, the way of presenting results (Figures and Result section) are not well-structured and need to be reorganized.” After reading the reviewer’s comments we agree that the dataset deserves a more thorough analysis in the manuscript, part of which was done but was discarded (erroneously) trying to have a clearer manuscript. In addition, data presentation can be organized by combining several bar charts into one using bars of different colours and textures.

“Comment 1: Firstly, there are too many figures (29 figures) which are quite information poor. I highly recommend authors to reshape and combine some of them. For example, combine four individuals of Fig.3 into only one by a stacked bar chart (see attached Fig.1 as an example). Also, try to combine Fig. 2 A and B (Fig.2 as an example). Hopefully, it can reduce the number of figures from 29 to c. 11.” We will combine Figure 2a and b into a single Figure 2 combining the 4 bars into one graph. For Figures 3a, b, c, d and Figures 4a, b, c, d, the four bar charts of each Figure will be merged into one distinguishing among treatments and depths using different colours and textures. For Figures 5a, b, c, d and Figure6a, b, c, d, the four bar charts in each one will be combined into one using a cumulative bar chart.

“Comment 2: Secondly, a good dataset has been created in the manuscript but it is not deeply explored yet. Except for ANOVA, there are many statistics that would help out (e.g. PCA, correlation et al.). Why not try to correlate erosion/deposition rates with SOC or soil quality variables. In addition, authors have made ANOVA on reference vs orchard and orchard erosion vs orchard deposition, please give a further try to find a tendency on reference vs deposition if there are any." We will perform a correlation analysis between the normalized evaluated soil parameters vs. erosion/deposition rates and slope length for the topsoil values in the orchard area. Additionally, we will perform an exploratory analysis using PCA using the evaluated soil properties comparing the three areas (olive eroded, olive deposition, reference area). "Comment 3: Thirdly, please reorganize and give the subtitles for the Results section to make it clear and readable for audiences." We will reorganize the results and discussion sections using clear subtitle names to facilitate a more clear reading and understanding.

" Additional minor comments" "1. L130 L170 How did you define unprotected, physically, chemically and biochemistry protected C? POM is unprotected C, iPOM physically protected C? Please clarify in Material & Method." We agree with the reviewer comment. In the revision version of the manuscript we have added the following sentences: This three-step process isolates a total of 12 fractions and it is based on the assumed link between the isolated fractions and the protection mechanisms involved in the stabilization of organic C (Six et al., 2002). The unprotected pool includes the POM and LF fractions, isolated in the first and second fractionation steps, respectively. The physically protected SOC consists of the SOC measured in the microaggregates. It includes not only the iPOM but also the hydrolysable and non-hydrolysable SOC of the intermediate fraction (53–250 μm). The chemically and biochemically protected pools correspond to that hydrolysable and non-hydrolysable SOC in the fine fraction (< 53 μm), respectively.

"2. L120 Authors collected 13 micro pits from reference sites and 8 pits from olive orchard sites. Then you created one or three composite samples for fraction/isotopic measurement or measured all micro pigs as repeats?" This comment helps us to realized that there are unclear sections in the manuscript that need to be clarified. In the olive orchard area (8 points for core samples) we treated each point and depth as a single unit for all the analysis (fraction, isotopic, . . .). In the reference area we sampled 13 pits and all of them were used for the isotopic analysis of 137Cs shown in Table 1, while only 4 of them were used to determine the carbon fractions, and δ 15N and δ 13C isotopic analysis.

"3. L155 Please indicate the method you measuring bulk density, which was used in table 5." Soil bulk density in Table 5 was measured using a hand cylindrical core sampler with a volume of 100 cm3.

"4. L205 Authors mentioned that "protected Corg in the reference and olive orchard area account for 87% and 64% of maximum soil stable Corg, respectively at the top-soil", it means reference area has a higher percentage of protected SOC than that of an olive orchard. This tendency is contrary to what has shown in Fig.5. How do you explain it? Please detail the way you calculated maximum soil stable Corg in Material & Method (insert equation for example?)". 1.- As mentioned in line 204, maximum capacity to stabilised SOC in the reference and olive orchard sites was estimated according to Hassink and Whitmore (1997). The amount of protected C in the reference and olive orchard soils accounted for 87 % and 64 % of the maximum capacity, respectively. In the revised version of the manuscript these percentages will change as reviewer 2 found an error in our calculations that has been corrected. Nevertheless, in the new recalculations, the amount of protected C respect to maximum soil stable Corg in reference site doubled that of the olive groves soils.

2.- Figure 5 shows the percentages of total organic carbon in each of the fraction. The fact that the percentage of SOC in protected fraction in olive grove soils is higher than that of the reference soil is due to SOC concentration in the reference site which is much higher than that of the olive grove soil, although in the former most of the SOC is unprotected, therefore the contribution of the protected SOC respect to the total in the reference soil could be lower than that of the olive grove soil, even when protected SOC in the reference site is higher than that of the olive grove site.

"5. (L20 L300) authors suggested using δ15N as a proxy to identify degraded areas; does annual input of 5 kg N-P fertilizers play a role in the dynamic of δ15N?" We agree that in the revised version of the manuscript the influence of the NP fertilizer in modifying the δ15N in relation to the reference area, probably with an slight enrichment see Alison et al. (2007), need to be considered too. Alison S. Bateman & Simon D. Kelly (2007) Fertilizer nitrogen isotope signatures, Isotopes in Environmental and Health Studies, 43:3, 237-247, DOI: 10.1080/10256010701550732

“6. Please also note the supplement to this comment: https://www.soil-discuss.net/soil-2019-59/soil-2019-59-RC1-supplement.pdf” We have checked the comments made in the annotated version of the manuscript and these indications will be incorporated in the revised version of the manuscript.

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