Interactive comment on "Interactions between biogeochemical and management factors explain soil organic carbon in Pyrenean grasslands" *by* Antonio Rodríguez et al.

Anonymous Referee #1

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Overall, the manuscript entitled 'Interactions between biogeochemical and management factors explain soil organic carbon in Pyrenean grasslands' would have potential to be of great interest for the readers of Biogeosciences Journal. It provides interesting results on the effect of different drivers on soil carbon stocks in Pyrenean grasslands. However, I have noticed some important points that need to be addressed before this manuscript can be considered for publication.

Concerning the abstract, I think that the scope and objectives of the study need to be better defined. After reading it, we do not have a clear idea of what factors have been tested. I have the same feeling after reading the introduction. Overall, we understand

that there are many factors which can influence soil C stocks at different scales, but it is difficult to understand what are the real objectives of the study. Is the objective to determine which factors influence the most the soil C stocks, is this analysis done for different scales? In the material and methods section, the main issue that I noticed concerns the statistical approach. It is not clear for me why two separate approaches were done. It adds a certain complexity to the article and it needs to be better presented according to the objectives for each approach. Are both the approaches really relevant for the paper? The links between the objectives and the chosen modelling approach needs to be better defined. Also, concerning the calculation of soil C stocks, it would have been appropriate to correct soil C stocks according to the equivalent soil mass approach to account for possible differences in bulk density values (Ellert and Bettany, 1995; Ellert et al., 2008). Concerning results and discussion, even if the ideas are, overall, well supported by relevant references and the limits are underlined, I think that the organization will be improved after the clarification of the objectives and the corresponding analyses. Also I noticed repetitions of results in the 'results' section and in the 'discussion' section so I would suggest to group all the results and discussion in one section if the journal guidelines allow it. Finally, it would be important that the manuscript be reviewed for the English. Some corrections might be necessary.

In the next paragraph, I developed some detailed comments that will help the authors to improve the manuscript.

L 53-54 "at small spatial scales" instead of "at detailed spatial scales" L 56-57 I am not sure that it is a good reason to do a study... What is the objective of the study by using this set of data? L 58 Do the authors have an explicative purpose or a predictive purpose ? That is not clear for me, as they also use the 'predictors' term. L 59 This factor should be better defined. L 65 I think that the coma is not necessary. L. 95-96 I think that these variables should be better described. Also "be" should be removed. These factors are not studied or they are not factors with a relevant impact in other studies? L.112 Same question than earlier: are they omitted because they do not

impact the SOC stocks? L. 113 "focusing" instead of "focus" L. 116 Overall, for the whole manuscript, the authors need to specify if it is SOC stock or concentration. L. 127 What type of management do you consider? L. 136 And what was their conclusion in regards of your objectives? L. 140 Among which drivers? There are many factors that can interact or be correlated together. We need to know which drivers will be tested. The authors should be clearer on the objectives of this study. L. 141 Âń assess Âż L. 151-153 Do the authors want to study the effects of various factors, their links between them, the importance of the factors...? L. 175 Âń grazer type Âż instead of Âń grazing management Âż, no ? L 189-190 Are the soil samples from the 4 quadrats composited to form one soil sample per depth for each grassland patch? L. 192-193 I think this paragraph should appear before... L. 194 There should be a coma between landscape and livestock L. 199 But you don't speak of mean summer temperature before... L. 200-201 How did you appreciate that? We need to have more details on this factor. L. 218 For each patch considered? L. 229 For determination of bulk density? L. 233-234 This sentence is not clear. L. 243 It should have been important to correct soil C stocks according to the equivalent soil mass approach. L. 249 What was the vegetation : grassland species etc. L. 267 The size of the police is not the same for all this paragraph. Does this paragraph of NIRS analysis refer to the analyses presented in the previous paragraph? It is not clear. L. 293 Among which variables? L.301 "Firstly" instead of "First" L. 306-307 What is this new set of variables? L. 314-316 Why choosing these two models, on which hypothesis did you decide these two groups? L. 316-320 Maybe it should be more appropriate in the introduction... L. 374 Why there are not all the predictors described in the introduction in this model? Grazing management for example? L.381 Why these two variables are not selected in the model? L.411 Some repetition from the results section... L.444-447 I wonder if the BRT model is really relevant for the manuscript... Also, Are you sure it is table S3 ??? L. 487 SOC decrease with increase of slope L.489 Not clear... L.491 What I see is that SOC stocks are lower under low intensity of grazing for low values of TSIS... L.494-499 It is not really clear. L.507 high soil water contents? L.525 "which might be

explained by" instead of "which is an indicator"

Ellert, B.H., Bettany, J.R., 1995. Calculation of organic matter and nutrients stored in soils under contrasting management regimes. Can. J. Soil Sci. 75, 529–538. Ellert, B.H., Janzen, H.H., VandenBygaart, A.J., Bremer, E., 2008. Measuring change in soil organic carbon storage. In: Carter, M.R., Gregorich, E.G. (Eds.), Soil Sampling and Methods of Analysis. CRC Press Taylor & Francis Group, Boca Raton, FL, pp. 25–38.