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**Biogeosciences Discussions**

# *Interactive comment on* "Spatial distribution of soil organic carbon stocks in France" *by* M. P. Martin et al.

**M. P. Martin et al.**

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We would like to thank the referee#1 for the detailed review and the constructive comments. We give below responses to the criticism raised and hope it will statisfy the requests. We have the feeling that the version of the manuscript commented by the referee#1 is the version which was initially submitted to BGD. This initial version was edited before being published on BGD following the remarks resulting from the initial quick review. Hence, some of the remarks made by referee#1 were already addressed in the second manuscript version, published on BGD. However, some of the issues raised by the referee#1 are new and were not addressed in the manuscript discussed on the BGD website. We attach a revised version to this comment, where these new issues are taken into account and the needed changes committed to the text (important



new changes are written in blue).

Please note that this revised version should not be considered as final as it is, at the same time, being edited for improving the general standard of English of the manuscript.

*Referee's comments are italicized.*

*However, the paper is poorly written and lacks rigorous description of the variables.*
The variable description was changed when needed. The section dealing with land use, soil moisture regime, MODIS NPP estimates, mineralization modifiers, and their estimation point-wise *vs.* on continuous spatial layers (used for interpolation) were reworked and detailed. For the comment regarding the English standard, please see above.

*I would like to see some more reference to approaches of country wide assessments of SOC stocks in the Introduction.*
Lines 15-26 p.3 were added to give more information to the reader regarding the current approaches for country wide assessments of SOC stocks.

*The variables used for the empirical modelling are poorly explained in some cases : The three levels of*
*land use are not discussed (lines 65-68), although they are explicitly referrred to in the results (lines 305-306).*
An improved description has been committed l.19-26 p.5.

*The variables for the water budget are not defined and it is not clear how a spatial coverage of these variables was obtained (lines 69-73).*
The description was improved (l.27 p.5 - l.6 p.6). Moreover, these variables were not included in the only model used for interpolation (the *Extra* model). Consequently, no spatial coverage of them was required for this work.

*There should be a short explanation on how the NPP is derived from MODIS imagery (lines 75-76).*
l.10-16 p.6 were added

*The mineralization modifiers in the RothC model should be explained and again it is not clear how a spatial cover of these variables was obtained (lines 102- 105).*
l.9-19p.7 were added. We detailed among other how these modifiers were obtained i) for point data and ii) for the continuous spatial layers used for prediction.

*I am not sure what the authors mean by soil surface data (section 2.2.1). Are these the state of the soil surface (eg crusting ?) or the areas of each land use class ?*
Throughout the paper the "surface" term was removed and replaced by more appropriate terms. For instance "soil surface data" was replaced by "spatial layers used for interpolation" or "Continuous spatial layer". The term "surface was indeed misleading as the presented work does not involve any reference to the state of the soil surface.

*I fully appreciate that the technique of boosted regression trees is quite complex, and I leave it to the experts to judge whether the description is comprehensive. However, the parameter settings for the models (section 2.3.2) is quite difficult to read, mainly because the different values are given in the text, whereas a table would be easier to read.*
This section regarding the parameter setting was reworked and the values are now given in a table (Table 2) as suggested by the referee.

*Finally, I am not sure that the paper needs a long discussion on the effects of each variable on the empirical outcomes.*
See below remarks about the discussion section.

*Section 4.2 is quite long, the graphs 7 and 8 are not clear and the axes lack units.*
These graphs were removed as suggested by other remarks made on the manuscript initially submitted to BGD.



*After all, it is very hard to describe the mechanisms of mineralization based on an empirical model at the national scale. Most of the effects of variables (that are not clearly defined, see above) are not even shown in graphs (eg the RothC mineralization modifiers or the water budget variables). I would reduce this section to the discussion of one or two key variables.*
The discussion section was considerably reworked (partly following comments of previous reviewers). More specifically, the section dealing with the Effect of the different variables has been shortened (4.2) and the section about possible model improvement (4.3) were partly rewritten. In particular, we tried not to be too speculative regarding the interpretation of the results of the model. Shortened, the discussion about the relationships between the predictors and response variable now contains three subsections : effect of the land use , effect of the soil properties and effect of the climatic variables. We chose to display on graphs the relationships between SOC stocks and only the three most important predictors of the *Extra* model according to the variable importance (VIM) values. Displaying too many graphs might have been cumbersome to the reader. Additionally, resulting relationship between SOC stocks and predictors with low VIM values might be questionable (although there is no formal statistical test for assessing the validity of the relationship with BRT).

*In general there are many abbreviations. Some of them are not particularly common/useful. Why use 'SOCS' instead of the commonly used SOC stock?*
The SOCS term was removed, we used SOC stock or SOC content instead.

*Please take care that abbreviations can only be used when the term is spelled in full for the first time. GHG line 31 line 32: use the term in full first and then (BRT) in brackets.*
We took care spelling the abbreviations completely when mentioned for the first time.

*Some examples: JRC line 28 (by the way, I would be more specific and refer to Jones et al 2005),*
We referred directly to Hiederer, 2010, for referencing the 0.6PgC value.

*Line 42C SOC stocks can be used directly as SOC was already defined (line 14)*
Done

*Specific comments Abstract line 3 : The statement that the course of climate change will be influenced by soil carbon appears to me a bit strong.*
We replaced the “can” by a “may”, to make the statement less affirmative.

*Abstract, first paragraph : The 2200 measurements do not correspond with the 1974 measurements used in the remainder (eg line 35).*
l.25 p.4, we mentioned the fact that “Soil Organic Carbon Stocks were computed for a set of 1.974 sites from the French soil survey network (RMQS), for which analytical data was available ”.

*Abstract and further in the text e.g. Line 34. I have looked up the word ‘metropolitan’ in the New Oxford Dictionary. It means ‘related to a metropolis’. I guess that you meant to use it for mainland France (without overseas departments).*
This mistake was fixed.

*I would not use ‘the whole’ and ‘mainland’ in the same sentence.*
“the whole” was removed

*Line 9 suggestion: Accurate estimates of this pool are required, however . . .*
Commited

*Line 15 and further in the text (eg line 60): I prefer the term ‘rock fragments’. This term is well defined (see eg the special issue of Catena edited by Poesen (1994?). Coarse elements are confusing as sometimes there is also coarse organic debris.*
“Rock fragments” were used instead of “coarse fragments”

*Lines 26-28 I do not see the point of this example. The fit between the JRC and national estimates seems quite well. Please give the reader your opinion on this fit (good, reasonable . . .). An example of a poor fit would also be welcome.*
l.5-9, p.4. We rephrased this example as it was aimed at being an example of a poor



fit between the JRC and national estimates.

*Lines 28-31 Please be more specific on how measured SOC stocks are used. Are they the initial values SOC values in simulation models? Are they used to calibrate/validate models?*
l.12-15, p.4 were added to the text.

*Line 43: Figure 1 does not give any added information. Please remove. Instead it would be useful to define the abbreviation RMQS here, as it not described in line 77, where it first appears.*
Done.

*Lines 62-64: I do not understand this complex sentence. Do you mean that byou also used land use data from field observations?*
The sentence was replaced by “Field observations were used to assign land use categorical values to the RMQS sites. ”

*Line 76 Describe the principle of the NPP product from MODIS in one sentence.*
L10-16 p.6 We reworked the description of the NPP estimation and added information regarding the MODIS NPP products.

*Line 84 Replace ‘soil usage’ by ‘land use’*
Done

*Line 93 Please use ‘precipitation’ instead of ‘rain’.*
Done

*Line 95 Please check the sequence of the reference to the Figures. You cannot refer to Fig 5 after only Fig 1 has been used.*
The sequence of the reference to the figures has been checked and corrected where needed.

*Line 95 Why do you refer to Fig 5? This is a SOC map, not a P or T map. If it is to*

*demonstrate a 12 by 12 km grid, I do not think that it is useful.*
The reference to Fig 5. was removed.

*Lines 107 and 108 The term 'soil surface data' is ambiguous. It could also mean data on the state of the soil surface such as roughness, vegetation cover or crusting. Please be more precise.*
See above regarding the usage of the "surface" term.

*Lines 109, 110, 119 and 120 Please define 'TERUTI','SCEES', 'MART' and 'GBM'. Line 137 Fitting the algorithm is . . ..*
Done

*Lines 188-193: The land cover levels 'lu1' etc and the minderalization modifiers 'A and b' have not been explained in the Materials and methods section (see major remarks).*
The description of the land cover levels had already been detailed in the manuscript version available on BGD. Detail regarding the description of the mineralization modifiers has been introduced in the attached revised version.

*Lines 224-225/ It is obvious that the statistics such as MPE etc are used for validation. Please delete the sentence.*
Deleted

*Line 229 Why is MPE squared?*
This mistake was fixed.

*Line 231: Please check sequence of the figures. If I am not mistaken you have so far referred to Figs 1, 2 and 5.*
Figures ordering and referencing was checked

*Line 234 please add '(eq. 2)' at the end of the sentence.*
Done.

*Section 2.3.3 See also major remarks. The section is difficult to read because of the frequent use of 'respectively' sometimes with even two levels. I would suggest*



*constructing a small table for the model parameters.*
Done.

*Line 270 Please use 'MPE' instead of 'bias'.*
Replaced.

*Line 271: Are you sure that you mean 'validated' not calibrated?*
Yes, The model may be fitted on (or calibrated) and then validated against the full dataset. There, the validation simply represents the quality of the fit.

*Line 272 and further. Please mention the units for RMSE and MPE etc. Lines 281, 287: Please do not forget the units*
Done

*Line 317-318 Not clear. Please re-formulate. Line 320 Please refer to equation 2 for the uncertainty.*
This was reformulated and a reference to the equation added.

*Line 329: Please use another formulation for 'sharp pattern'.*
Done l.27 p.14

*Line 358 Please define 'ecdf'*
Done l.23 p.14

*Line 362 . . ..values were not predicted correctly by the model.*
*Line 374 . . . between both methodologies. . . . .*
Replaced

*Line 382 What do you mean by 'multiplicative'? These sentences are not very clear. Please describe in one sentence how SMNs can be used to refine their own performance, and specify more precisely how SMN's can contribute to continental scale SOC dynamics modeling.*
This was done by reworking this whole part of the text (l.19 p.16 – l.2 p.17)

*Lines 405 and 406 The difference between 'global' and 'elementary' is not entirely clear.*
The "elementary" term was removed because it was not needed here.

*Line 425. Please re-formulate in order to avoid using the plural of rainfall.*
The sentence was removed along with the reworking if the discussion section.

*Line 455. . . ..may imply that on average. . ..*
Done.

*Where is the relation NPP/SOCS shown for instance? See also major remarks.*
This empirical relationship is not displayed and no longer considered in the paper. The VIM for NPP was, according to us, too low to draw conclusions regarding the empirical relationship.

*Section 4.2.3 Difficult to follow without reference to figures.*
This section 4.2.3 titled "Information about land use and plant photosynthesis" was removed, following the major remarks of the referee#1 and replaced by a shorter section about land use only (section 4.2.1).

*Line 511 delete 'for whom . . .surfaces'.*
Done.

*Lines 552-562 Please delete this section. You do not show any data on mineralogy. See also major remarks.*
Done.

*Line 583 What are 'octop bulk density maps'?*
We remove this reference to 'octop bulk density maps' as it was inappropriate. Description of the bulk density layer is given at the beginning of the section 4.1.

*Line 587 Please check. I think you mean 'former'*
In this paper, we recommend the use of the RMQS-based estimate. Thus, referring to "It was [...] much higher than the estimate provided in this paper and based on RMQS



data"; the "latter" seems appropriate. However we replaced another "latter" by "second" earlier in the text in order to avoid confusion.

*Line 593 Avoid using references in the conclusions*
Removed

*Table 1: Please give the units where applicable.*
Done

*Fig. 3 caption: Please refer the reader to the M&M section for the definition of the variables.*
Data from Fig. 3 was put in Table 3 following the comment of another reviewer. A reference to sections 2.1.1 and 2.3.1, where variables are defined, was added to the caption of the table.

*Are you sure that you defined all of them, also 'ce'?*
'ce' was replaced by 'rf' (rock fragments) and is defined l.18 p.20.

*Fig. 7 caption: I cannot see the bars on the lower axis.*
Bars were removed as they were not commented in the text.

*Fig. 8 I am not sure that I understand this figure. Please explain in the caption more clearly.*
Fig.8 was remove as it was not commented in the text.

*Technical corrections Abstract, last line on page 1: These relationshipS Line 7: CO2 Line 94 (Â◦ C) Line 276 the same AS Line 277 develoPed Line 280 ON average Line 281: bias Line 301 typo: . . .the the. . . Line 312 Variable should be in italics . . ...transformed a variable. . .. . .. Line 349 . . ..because of itS systematic . . .. Line 354 unbiassed Line 356 . . .values below the SOC. . .. Line 368 . . ..argued that the resolution. . . Line 481: . . .that the importance of pet was always . . .. Line 584 laTter Line 636 I believe this paper is now printed. Please update .*
All these corrections were committed.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/7/C4704/2011/bgd-7-C4704-2011-supplement.pdf

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