Response to referees

Reply to reviewer RC1

Dear Sir,
Thank you very much for your time which you have devoted in order to improve our manuscript. We have already take in consideration your remarks in the manuscript.

Specific comments

Line 22: T-SOCS is introduced without defining what the T stands for. Define it here instead of later.
Answer: T was defined

Line 51: “Increasing the organic C or SOM, directly improves the quality of the soil, hence contributing”- Is that always true or only in soils with low SOM? This would benefit from clarification.
Answer: That is always true since it improves for example the structural index and the CEC of the soil.

Lines 58-59: If this is still true, a more recent reference should be included. Soil and food choices seem to be on the agenda more in recent years. Otherwise, a slight rewording would be good e.g. "has until recently been neglected".
Answer: your suggestion was adopted

Lines 63-64: This is very generalized. Can more figures and references be included here?
Answer: Two new references were added

Line 82: As opposed to what? What is wrong with being available in reports?
Answer: Reports are unpublished. Modifications were made in the text

Line 83: Good point which I believe is still largely true. Give more updated references. The references are too old for a key point like this as it is the basis of your paper.
Answer: Two references of 2020 and one reference of 2021 were added

Line 162: 7.9 is more alkaline than 6.8 is acidic - Perhaps better to omit "acidic" and say close to neutral?
Answer: Suggestion adopted

Line 183: I would recommend changing the heading of either section 3.3 or 4.3 slightly to make them different.
Answer: Suggestion adopted

Lines 190-195: There is potential for an informative figure out of this data which would be more beneficial than the figures with only 4 data points. Just a suggestion.
Answer: A new figure 3 was added

Lines 196-198: This sentence doesn't make sense to me. It says there is a clear link between T-SOCS and latitude but only about 70 km is covered in this study. Three of the four points are within approximately 35 km from each other. It seems very random to suggest these differences are related to latitude.
Answer: Dear Sir, I understand you. Firstly, I delete the word "clearly". I think that it is not very random. There is a high variation of climate characteristics in our northern part of the country along the latitude. This variation has repercussions on soil forming factors and consequently on the composition and the nature of soils even in short distance. Some explanations are also given in the answer for question in lines 310-312.

Lines 199-200: Only 4 data points are used for this when a minimum of 10 is recommended. Four data points are not reliable. I suggest omitting this or use all the replicates.
Answer: Dear Sir, 4 data of T-SOCS correspond to 4 studied sites. To have 10 recommended data, we need then 10 studied sites. T-SOCS in a studied site is obtained through SOCS values from different soil profiles and different increments in soil profiles. This figure is important. In addition to the previous figure, we add another figure with different SOCS values (different replicates). Figure 4 is thus the plots of the soil organic carbon stock (SOCS) (a) and the total soil organic carbon stock (T-SOCS) (b) versus altitudinal gradient.

Line 201: Again, only 4 data points.
Answer: We also add a figure to the previous one; the new figure 5 is the plots of the soil organic carbon stock (SOCS) (a) and the total soil organic carbon stock (T-SOCS) (b) versus precipitations in the study area.

Lines 218-220: If this is correct, a better explanation would be beneficial here. How is the acidic nature of the studied Vertisols attributed to base parent materials?
Answer: Modifications were made in the text. It is "base-rich parent materials". They are parent materials which contain alkali and alkaline earth elements (Ca, Mg, K or Na). The presence of these elements in soils could increase the soil pH, and consequently it could be slightly acidic to neutral as observed in the studied vertisols.

Line 304: Has anybody found similar patterns since then?
Answer: Each author considers Jenny (1930) as a reference in his works.

Line 309: This is not high latitude!
Answer: Modifications were done. "high latitude" was replaced by "a higher latitude"

Lines 310-312: I don't believe there is any evidence of this. From the location map, the southern most site is only about 70 km south of the most northern site with most sites being considerably closer to each other. I don’t believe that is a reasonable distance to make judgments about latitude.
Answer: Some modifications were made in the text. In fact, in our studied area, we are not far away from the Sahara Desert. That is why the maximum daily temperature reach for example 45°C air-shade. The variation of the climate is perceptible. Below 8°N, we have the equatorial climate (dry season=3months and rainy season=9months); from 8° to 10°N we have the Sudanian climate (dry season= 6months and rainy= 6months), from 10° to 12°30'N we have the Sudano-sahelian climate (dry season= 8 months and rainy season= 4 months) and above 12°30'N we have the Sahelian climate with minimum 9 months of dry season and maximum 3 months of rainy season. This

variation of climate will have repercussions on soil forming factors and consequently on the composition and the nature of soils even in short distance. Thus variation of T-SOCS along the latitude is obvious on about 80km due to the high variations of climate characteristics and the fact that we are going towards the Sahara Desert which is not far.

Line 312: The reference is incorrect or not listed at the end. Do you mean Tan et al. (2020)? Tan's study covered 3000 km which is a lot greater than 70 km.
Answer: Tan et al. (2020) is listed in the reference list. I think that if we take a portion in the sequence of Tan et al. (2020) in which high climate variation is observed as in our study area, a latitudinal variation of T-SOCS will also be observed.

Lines 313-314: This sentence makes it sound like Plaza et al had an r2 value of 0.7104 but from the figures I see it was this study. You only have 4 data points when a minimum of 10 is recommended for regression analysis. I therefore suggest that you don't report this in the text as it can't be considered reliable. Alternately, why not include the replicates?
Answer: An additional figure with replicate for SOCS was added and modifications were made in the text.

Line 331: Yes, I thought this point would be closer to the beginning of the discussion since it is one of the first things mentioned in the abstract and there is a lot of detail about it in Table 1. You could make more of this.
Answer: Thank you very much

Line 343: Again, I don't believe you can conclude this from this study.
Answer: Dear Sir, it is obvious in our study area since there is high variation in climate characteristics.

Lines 357-358: I don't think there is a scientific basis for the statement of 71 % explanation based on the number of data points. The discussion on vegetation would benefit from being extended.
Answer: Some modifications were made in the text.

Line 378: Thank you.
Answer: Thank you very much for what you have done in order to improve our manuscript.

Technical comments

Line 14: "Researches" should be "Research" and referred to as "is" rather than "are".
Answer: Suggestions were adopted

Line 15: Research should not be referred to as "ones". Better to say "the few existing **studies** are…."
Answer: Suggestions were adopted

Line 36: "**Their** organic C stocks are crucial". Soil is referred to singularly in the previous sentence so would be "Its" rather than "Their", but it would be better to say "Soil".
Answer: Suggestions were adopted

Line 47: The word “their” is unnecessary and incorrect.
Answer: Suggestions were adopted

Lines 48-50: “Thus, loss of organic C or SOM results in the loss of soil quality and impaired associated functions including soil degradation, decline in agronomic productivity, food insecurity, malnutrition and starvation” Good points but the sentence needs rewording, malnutrition and starvation are not soil functions.
Answer: Modifications were made in the text.

Line 72: Stock is singular so it should be “its” not “their”.
Answer: Modifications were made in the text.

Line 74: What is "they", soil? "Soil has the potential..." would read better.
Answer: Suggestions were adopted

Line 101 (and other places): sudano-sahelian – capitalise this to Sudano-Sahelian to be consistent throughout the text.
Answer: Suggestions were adopted

Line 159: Be consistent with capitals. Better to use BD than Bd.
Answer: Suggestions were adopted

Lines 212-213: Should be especially, not specially and no need for the word "and".
Answer: Suggestions were adopted

Line 305: Better to say “only a small fraction….”
Answer: Suggestions were adopted

Line 307: Delete the word “part”.
Answer: Suggestions were adopted

Reply to reviewer RC3

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Specific comments

Lines 28-30: I think it’s a bit confusing to switch between “T-SOCs” and “SOCS” here, I would just get rid of the term “T-SOCS” altogether and just use SOCS.
Answer: I think there is no confusion. T-SOCS is the total SOCS in the site. SOCS is obtained in each increment in each profile; that is why we can easily identify that 60% of the SOCS was stored below the first 25 cm from the soil surface

Line 40: I think this might be a better opportunity to define SOM here than to just vaguely mention it.
Answer: SOM was defined

Lines 48-52: I think removing “organic C” and replacing it with SOC in each case might make this passage less confusing and wordy.

Answer: Suggestion was adopted

Line 67: I think you need to insert specify why we care about these natural factors, you should specify that these are natural factors that contribute to SOC degradation/loss.
Answer: Suggestion was adopted

Lines 69 – 75: This entire passage should be revised. This can easily be shortened and you need to refer to soils (or soils in dry areas specifically) instead of using "their.
Answer: Modifications were done

Lines 185-191: In this section I would suggest not stating that SOC values are either high or low, and simply report the values here.
Answer: In order to be clear, a new figure 3 was added

Lines 199-202: There are some interpretations here that should be moved to the discussion section.
Answer: I think that we can leave this part like this since this interpretation help us to discuss in discussion section.

Line 202: I assume the word "globally" is used to refer to your entire dataset? Please remove this word and replace it with "overall," or something similar as it is confusing.
Answer: Suggestion was adopted

Lines 208-210: I'd suggest just stating that clay content increased with depth instead of referring to the surface/base of the profiles.
Answer: Suggestion was adopted

Line 244-246: Suggesting that SOM is not homogenous is a given, I suggest this sentence be removed.
Answer: Suggestion was adopted

Line 250-254: Again I think you can just state that SOC was highest in the top 25 cm, I don't think this needs to be substantiated by citations as it is usually the case.
Answer: Suggestion was adopted

Line 304-311: Is the latitudinal gradient in the study area great enough to exert an effect on SOC?
Answer: There is a high variation of climate characteristics in our northern part of the country along the latitude. This variation has repercussions on soil forming factors and consequently on the composition and the nature of soils even in short distance.

Lines 331-336: This should be changed from "high" to "higher latitude," but I would recommend removing the discussion on latitude entirely. Instead, the authors can explain regionally how precipitation/temperature/vegetation/elevation vary, and then discuss how this relates to regional SOC storage.
Answer: I change "low latitude" to "lower latitude" and "high latitude" to "higher latitude".

Line 346-349: What led to this idea regarding parent material? Why does this contradict previous findings on dryland ecosystems?
Answer: I think this is due to the fact that in the tropical area, weathering is essentially geochemical, and climate is the main driving of chemical reactions depending on the intensity of rainfall.

Section 4.1: This section (and the discussion overall) is lacking any references to values, tables, figures, etc. as there is not a single instance of this. As it stands the discussion simply states soil properties were high, low etc. I think the authors could help the flow of the manuscript by reporting values in the text and re-orienting the readers on where they can find the relevant data.
Answer: We leave references to tables and figures since they were referenced in detail in section 3 (results).

Section 5: I wonder if the data supports some of the assertions in this section. Are data from four soils enough to conclude that climate is controlling SOC storage in the region? I also think the section ends abruptly and is lacking in highlighting the study's importance – what are the broader implications of this work?
Answer: Some data were added in the section

Figs. 3&4: Why haven't you included uncertainties here? Instead of using linear regression you might consider box and whisker plots.
Answer: Modifications were made in these two figures including also the RC1 comments

Table 1: I think the list of dominant plant species here makes the table too cluttered and should be moved to the supplement if possible.
Answer: Dear Sir, we choose to leave the list of plant species here.

Table 2: I think these descriptions can be summarized in the text and this table can also go in the supplement.
Answer: Dear Sir, we also choose to leave the table with those characteristics.

Technical comments

Line 14: Suggest using the word "region" in place of "part" here.
Answer: Suggestion was adopted

Lines 19-21: Shorten this to simply state "Three replicates were collected at each site…"
Answer: Modifications were made

Line 20: Remove "the."
Answer: Suggestion was adopted

Line 35: "Represents"
Answer: Suggestion was adopted

Line 36: Remove "their" here.

Answer: Suggestion was adopted

Line 41: I think you should specify that it is a CO2 (or simply C) sink.
Answer: Suggestion was adopted

Lines 41-43: This sentence seems a little out of place here and I suggest you remove it.
Answer: Dear Sir, I think it is linked the ecosystem evoke in the sentence below. That is why I leave the sentence.

Line 44: Do you mean 50% by weight? Is this even necessary to mention?
Answer: "by" was added and I think it is necessary to mention.

Line 47: Remove “their”
Answer: Suggestion was adopted

Lines 52-54: I wouldn’t recommend beginning a sentence with but or using the word “nowadays.”
Answer: "But" was removed

Line 63: Remove “the” and just say “SOC content.”
Answer: Suggestion was adopted

Lines 64-67: I think these two sentences can easily be merged together.
Answer: Dear Sir, we choose to maintain the two sentences

Line 79: The authors switched back to using carbon instead of C here.
Answer: Changes were made

Line 81: Again, use “studies” or something similar in lieu of “ones.”
Answer: Changes were made

Line 95: Use commas or scientific notation when reporting the extent of the study area.
Answer: Changes were made

Line 169: We need some more context here – what are these averages?
Answer: Dear Sir, these are average values obtained from the three replications.

Lines 177-178: This is an interpretation of C:N values and should be moved to the discussion.
Answer: suggestion adopted

Line 187: I would remove the term “zigzag.”
Answer: I think this word is correct because it permit to note that there is differences in the evolution SOC with depth

Line 191: Using “this content” is vague, just say “SOC content” or just SOC.
Answer: suggestion was adopted

Line 230: Why mention this here?
Answer: we mention here that the studied soils are the most common under dryland ecosystems in order to make known that the studied soils are sufficiently representative of the dryland

Lines 234-237: This should be moved to the introduction.
Answer: I think it is important to mention the role of SOM here in order to better understand the relation with nitrogen in the following sentences.

Line 268-271: Odd word choices here “parental” and “departure,” please revise.
Answer: modifications were made

Lines 354-355: I don’t think it’s important to mention the soil taxonomy here.
Answer: I think that it is important because the added adjective "Haplic" and "Dystric" permit to have an idea on the min soil characteristics

Lines 361-362: This sentence should be revised for clarity.
Answer: Modification were made