Dear Editor,

Please find attached the revised version of our manuscript entitled “Masked diversity and contrasting soil processes in tropical seagrass meadows: the control of environmental settings”, referenced as egusphere-2022-466.

In this revised version, we performed the adjustment and corrections suggested by the Reviewers, which considerably improved the quality and rigour of our manuscript. We would like to thank Drs Livia Vittori Antisari and Vanessa Wong, who conducted an incredibly detailed and careful examination, including insightful comments for improving the manuscript.

All the changes in the text are marked in red to facilitate the editorial check. Additionally, the responses to Dr Antisari and Wong's questions are as follow. Please let me know if you need anything else.

Reviewer #1. Dr. Livia Vittori Antisari

#1.1. Subaqueous soils profiles (two for each place) have been studied in three different parts of Brasil: a) NE under Tropical wet and dry or savanna climate (Aw) and Hot semiarid climate, seagrass meadows Halodule, and Miocene-Pliocene extensive sedimentary deposit (fine to coarse sand, conglomerate and kaolinite matrix) b) SE Monsoon influenced subtropical climate seagrass meadows Halodule, and granitic/gneiss formation c) Humid subtropical climate, seagrass meadows Rupia and Sandy deposits.

The test of paper is very clearly written: the introduction is exhaustive; the design setting is complete of important information to know the three study areas and also the analytical methods both filed, and lab was very well written.

The authors are thankful for the insightful comments on our manuscript. Considering the length of the introduction, we genuinely believe that a four-paragraph introduction is adequate and concise, whereas a more extended introduction may lead to exhaustion.

However, as suggested, some sentences from the introduction section were rewritten, and some redundant references were removed to avoid exhaustion. Besides, we believe that further introduction shortening may compromise the readability of the text.

#1.2. Generally, I think that the description of horizons sequence according to McVey et al. (2012), and, consequently, the USDA classification were better than FAO description, used in this paper. I'm going to accept it yet.

We kindly disagree with the Reviewer, as she considers that USDA classification would be better than FAO methods. As we look for a broader impact of our study, we decided to use FAO guidelines for morphological description and classification to stimulate international description protocols for subaqueous soils. Additionally, despite the protocol for soil description, the results and interpretations in the study would be the same.

#1.3. In particular in field analysis is very important to determine the presence of monosulfides were observed though the color response of the matrix after adding some drops of 3% H_2O_2 and by recording the odor description of each soil horizon (Fanning and Fanning, 1989, Fanning et al., 2002). Furthermore, I suggest that pseudototal elements (i.e., S, Ca and K, besides of course Fe) could be analysed; S is important to understand the dynamic processes with organic C.

We are thankful for the detailed comments performed by Dr Livia. Unfortunately, despite the prominent sulfide odour, its presence was not correctly described. On the other hand, AVS fraction was quantified, and since the results were very low and not important for characterizing pedogenesis, the authors decided not to include it in this study but include it in a further study regarding the characterization of microbial communities and Fe-S-C dynamics.

Additionally, we believe that total S content may improve the comprehension of the sulfidization process, which influences C dynamics. However, it was impossible to quantify total S due to technical limitations.

In our study, the comprehension of the sulfidization process was assessed by the sulfate concentration in the water column and the content of pyrite (e.g., Fe-pyrite), which is a major S fraction compared to AVS (Rickard and Morse, 2005; Otero and Macías, 2002). The use of Fe-pyrite content to assess the intensity of sulfidization processes and improve the comprehension of C dynamics in coastal wetland soils have been successfully used in a huge number of studies (for example, please see Jimenez et al., 2022; Ferreira et al., 2022; 2015; Queiroz et al., 2022; Jimenez et al., 2021; Cabral et al., 2020; Nóbrega et al., 2016).

In this sense, the lack of total S and AVS content would not affect our study's interpretations.

Cabral, R. L. et al. How Do Plants and Climatic Conditions Control Soil Properties in Hypersaline Tidal Flats? Appl. Sci. 10, 7624 (2020).

Ferreira, T. O. et al. Pyrite as a proxy for the identification of former coastal lagoons in semiarid NE Brazil. Geo-Marine Lett. 35, 355–366 (2015).

Ferreira, T. O. et al. Litho-climatic characteristics and its control over mangrove soil geochemistry: A macro-scale approach. Sci. Total Environ. 811, 152152 (2022).

Jimenez, L. C. Z., Queiroz, H. M., Otero, X. L., Nóbrega, G. N. & Ferreira, T. O. Soil organic matter responses to mangrove restoration: A replanting experience in Northeast Brazil. Int. J. Environ. Res. Public Health 18, 1–11 (2021).

Jimenez, L. C. Z. et al. Recovery of Soil Processes in Replanted Mangroves: Implications for Soil Functions. Forests 13, 422 (2022).

Nóbrega, G. N. et al. Edaphic factors controlling summer (rainy season) greenhouse gas emissions (CO2 and CH4) from semiarid mangrove soils (NE-Brazil). Sci. Total Environ. 542, 685–693 (2016).

Otero, X. L. & Macias, F. Spatial variation in pyritization of trace metals in salt-marsh soils. Biogeochemistry2 62, 59–86 (2003).

Rickard, D. & Morse, J. W. Acid volatile sulfide (AVS). Mar. Chem. 97, 141–197 (2005).

Queiroz, H. M. et al. Changes in soil iron biogeochemistry in response to mangrove dieback. Biogeochemistry 158, 357–372 (2022).

#1.4. The total carbonate amount lacks in the paper.

Unfortunately, there was a mistake in the interpretation made by the reviewer. In fact, the total carbonate contents results are present in the text, referenced as calcium carbonate equivalent (CCE) since both calcite, dolomite, and other carbonates are quantified through a titration method, as recommended in the procedures for soil analysis (van Reeuwijk, 2002).

The method for CCE quantification is presented in L. 147, whereas the results can be seen in table 2 and section 3.3 (Please see L. 259-261)

Van Reeuwijk, L. P. Procedures for soil analysis. (ISRIC - World Soil Information, 2002).

#1.5. Other information to add, if possible, to the sites' description was the height of the water column at the time of sampling and the tidal movements of the water at the three study sites.

As requested, further information regarding the water column height and tidal phase during the samplings was included in the text. The authors are thankful for such a detailed revision, which considerably improved the rigour of our study.

#1.6. How long were the underwater soils studied in contact with the air?

The soils are permanently submerged throughout the year at the three studied sites, as described in the M&M section. For morphological description, the samples were removed from tubes and described within one to two hours to minimize atmospheric interference.

To improve the comprehension of the text and avoid misinterpretation, further information was included in the text.

#1.7. Does the height of the tides affect the amount of water present in the water column above the soils? Did it vary in the time (seasons/year)?

As answered in question #1.5, further information regarding water column height during sampling was included in the text. Besides, there is no evidence of seasonal variation in water column height for the studied sites.

#1.8. Table 1: Where the table is interrupted for the page change it is necessary to re-enter the name of the variables.

The authors are thankful for such detailed revision and suggestions performed by the Reviewer. Due to a large amount of data, there was a layout problem with the table, resulting in an interruption during the diagramming.

However, as suggested, the columns' titles were inserted on the table's second page to improve the text's comprehension.

#1.9. I see that the structure of soils was classified as massive or single grained, farther the massive structure was classified even in all A horizons rich in organic C (NE). What do the authors think it is due to?

In our opinion, for the studied soils, the difference between the occurrence of single-grained or massive horizons is mostly related to grain size composition. In fact, soil horizons with coarser grain-size composition (e.g., higher sand content, coarse sand or shell fragments) presented single-grain structure, whereas soils with higher clay content presented massive structure.

Thus, further information was included in the text to improve comprehension.

#1.10. Table 2 is unreadable. To make it readable I suggest you also see the chapters of the results to which it is possible to match the data, thus breaking down the large table into three smaller ones.

As mentioned in answer to question #1.8, there was a layout problem with the table, resulting in an interruption during the diagramming. The editorial board alerted the authors that the tables should be submitted in a vertical page layout, which resulted in the poor quality of the Table.

However, as suggested, Table 2 was divided into two tables. The "new Table 2" presents physicochemical conditions and attributes related to redox processes (e.g., Eh, pH, EC, and Fe partitioning), whereas "new Table 3" presents soil cation exchange capacities.

Additionally, to improve the readability and fluidity of the text, the section regarding Fe partitioning was moved up, following the sequence of variables on the tables. We believe that these changes improved the quality of the manuscript. The authors are thankful for the insightful suggestions performed by the Reviewer.

#1.11. The chapter Soil physicochemical conditions:

1. Soils redox and pH conditions
2. CEC, salinity and sodicity of investigated soils
3. Organic C and iron partitioning

These could be the paragraphs to link the data to, all solutions are welcome.

As mentioned in answers to questions #1.8 and #1.10, there was a diagramming problem with Table 2.

Thus, to improve the quality of the manuscript, the table was divided into two tables, presenting physicochemical conditions and cation exchange capacities, respectively. Additionally, following the changes in the table, the section regarding Fe partitioning was moved up to improve the readability.

The authors are thankful for the suggestions, which considerably improved the manuscript's quality.

#1.12. Before the line 260: Organic C results. In NE both soils an organic C accumulation was detected, Also from Table 1. In NE1 Crz2 at 37-56 cm an increase of OC was observed. Is it possible that this could be a buried horizon? The change of lithology would make this. Also in NE2 3Cmz1 at 47-91 cm, the lithological discontinuity is marked, but can it a buried A horizons? Different pedogenetic cycles could be develop these soils?

The authors are thankful for such detailed comments performed by Reviewer #1. In fact, it was observed an increase in TOC contents in deeper soil horizons from the NE coast, which may suggest a polygenetic soil formation. Changes in soil grain size composition and the presence of lithological discontinuities reinforce this hypothesis. Thus, further information was included in the text to include these relevant aspects.

#1.13. In this late case 3Cmz1 horizon changed the CCE and Na exchangeable amount.

As suggested, further information was included in the text regarding an increase in the depth of the CCE contents in NE soils. The authors are thankful for the insightful suggestion.

#1.14. In table 2 what does V represent? I have not seen the explanation in the materials and methods.

In fact, there was a mistake in the M&M section, where no information was included regarding the base saturation (V%). Since Table 2 was divided, it was possible to include the complete column title for base saturation.

Additionally, further information was included in the main text to prevent misinterpretation and improve the rigour of the text.

#1.15. I do not think it is correct to call the sum of the two forms of Fe extracted pseudo totals.

Unfortunately, we kindly disagree with the Reviewer regarding the term “pseudo-total”. In our study, the term “pseudo-total” refers to the sum of the two distinct fractions, which do not include Fe associated with organic matter, and silicates; Thus, we truly believe that the term “total content” is imprecise. Therefore, the authors decided to maintain the term “pseudo-total” throughout the text.

Additionally, the term pseudo-total is widely used in studies referring to the sum of fractions obtained by Fe partitioning methods, which would represent the same sum of the fractions used in our study (Araújo Júnior et al., 2016; Lacal et al., 2003; Nemati et al., 2011; Pereira et al., 2020; Santos et al., 2010), since reducible Fe oxy-hydroxides and pyrite are the main Fe fractions in coastal wetlands soils.

Araújo Júnior, J.M. de C., Ferreira, T.O., Suarez-Abelenda, M., Nóbrega, G.N., Albuquerque, A.G.B.M., Bezerra, A. de C., Otero, X.L., 2016. The role of bioturbation by Ucides cordatus crab in the fractionation and bioavailability of trace metals in tropical semiarid mangroves. Mar. Pollut. Bull. 111, 194–202. https://doi.org/10.1016/j.marpolbul.2016.07.011

Lacal, J., da Silva, M.P., García, R., Sevilla, M.T., Procopio, J.R., Hernández, L., 2003. Study of fractionation and potential mobility of metal in sludge from pyrite mining and affected river sediments: changes in mobility over time and use of artificial ageing as a tool in environmental impact assessment. Environ. Pollut. 124, 291–305. https://doi.org/10.1016/S0269-7491(02)00461-X

Nemati, K., Abu Bakar, N.K., Bin Abas, M.R., Sobhanzadeh, E., Low, K.H., 2011. Comparison of unmodified and modified BCR sequential extraction schemes for the fractionation of heavy metals in shrimp aquaculture sludge from Selangor, Malaysia. Environ. Monit. Assess. 176, 313–320. https://doi.org/10.1007/s10661-010-1584-3

Santos, S., Costa, C.A.E., Duarte, A.C., Scherer, H.W., Schneider, R.J., Esteves, V.I., Santos, E.B.H., 2010. Influence of different organic amendments on the potential availability of metals from soil: A study on metal fractionation and extraction kinetics by EDTA. Chemosphere 78, 389–396. https://doi.org/10.1016/j.chemosphere.2009.11.008

Pereira, W.V. da S., Teixeira, R.A., Souza, E.S. de, Moraes, A.L.F. de, Campos, W.E.O., Amarante, C.B. do, Martins, G.C., Fernandes, A.R., 2020. Chemical fractionation and bioaccessibility of potentially toxic elements in area of artisanal gold mining in the Amazon. J. Environ. Manage. 267, 110644. https://doi.org/10.1016/j.jenvman.2020.110644

#1.16. The literature is not very clear on the DOP parameter, but it brings it back to the sum and it is not called pseudototal.

To improve comprehension regarding the degree of pyritization (DOP), further information was included in the text. Additionally, as stated in answer to question #1.16, the authors decided to maintain the term pseudototal referring to the sum of Fe-oxyhydroxides and Fe associated with pyrite.

Reviewer #2. Dr. Vanessa Wong

###Masked diversity and contrasting soil processes in tropical seagrass meadows: the control of environmental settings

Gabriel Nuto Nóbrega et al.

#2.1. This study describes the environmental drivers for differences found in sub-aqueous soils in seagrass meadows at three sites on the Brazilian coast. The study addressed some key knowledge gaps in pedogenesis and pedological processes in these soils in Brazil. The study sampled sites located in the NE, S and SE coastlines of Brazil, and presents an detailed analysis of cores to identify the key environmental factors and processes which influence pedogensis in these regions. The study finds distinct differences in soil characteristics at the three sites, which are driven by differences in the environmental characteristics of each site (geology, salinity, vegetation) and the processes that occur (hydrodynamics). It is a comprehensive study which adds to our understanding of these sub-aqueous soils in tropical seagrass environments.

The authors are thankful for the insightful comments and suggestions performed by Reviewer #2, which considerably improved the quality and rigour of the manuscript.

General comments

#2.2. The title suggests that the focus on soils in seagrass meadows, however, I would suggest that the seagrass meadows is secondary here – and the study is largely focused on sub-aqueous soils, so I suggest removing the reference to seagrass meadows

We are thankful for the suggestion performed by Dr Wong, but we kindly disagree with removing the reference to seagrass meadows. In fact, the main motivation of this study was to raise information regarding seagrass meadows. Despite being globally important ecosystems, there is a lack of information regarding the soils from these ecosystems, which are responsible for most of the ecosystem services provided by seagrass meadows.

Thus, we truly believe that it is important to focus on the ecosystem, i.e., seagrass meadows, to provide a better understanding of these ecosystems but also to increase the relevance of our study to other marine-related study areas.

#2.3. Given that organic matter is a key driver of the soil properties in terms of Fe reduction, the density estimates should be given (Lines 64-68).

The authors are grateful that the reviewer has brought it to our attention. Unfortunately, there is no available data on plant density. The plant densities mentioned in the M&M were based on field observation and reported in Fig. S1 (please see supplementary file).

To improve the comprehension of the text, further details were included in the supplementary material section.

#2.4. The description of the Fe-partitioning in the methods could be made a little clearer and described in the sequence of steps that this analysis was undertaken. It's unclear when HF was used to remove Fe from phyllosilicates. It would also be useful to include why the Fe in this extraction wasn't quantified, as this will give the total Fe concentrations, and not just the near-total concentration as reported. The naming of Oxy-Fe and Py-Fe as pseudo-total is misleading because the HF-extracted Fe and other Fe fractions have not been quantified (see Claff SR, Sullivan LA, Burton ED, Bush RT (2010) A sequential extraction procedure for acid sulfate soils: Partitioning of iron. Geoderma 155(3-4), 224-230.)

To avoid misinterpretation regarding the method for Fe-partitioning we rephrased the sentence, as follows:

> *"Additionally, after the extraction of Oxy-Fe (i.e., before the extraction of Py-Fe) the residue was pretreated to remove Fe bound to phyllosilicates and organic matter using 10 mol L−1 HF for 16 h under agitation and concentrated H_2SO_4 (2 h under agitation), respectively."*

Regarding the Fe associated (i.e., Fe II) with phyllosilicates, this fraction was not quantified. We would like to point out that Fe associated with phyllosilicates in soils from coastal ecosystems is assumed to be a non-relevant fraction, as the concentrations are considered low and represent less than 1% of total Fe content. As a result, these very low values of FeII would not change the observed results in our manuscript. This procedure is widely reported in different studies (please see Araújo Júnior et al., 2016; Otero et al., 2009; Ferreira et al., 2007; Queiroz et al., 2018; Otero and Macias, 2003; Sartor et al., 2018; Nobrega et al., 2013).

Araújo Júnior, J.M. de C., Ferreira, T.O., Suarez-Abelenda, M., Nóbrega, G.N., Albuquerque, A.G.B.M., Bezerra, A. de C., Otero, X.L., 2016. The role of bioturbation by Ucides cordatus crab in the fractionation and bioavailability of trace metals in tropical semiarid mangroves. Mar. Pollut. Bull. 111, 194–202. https://doi.org/10.1016/j.marpolbul.2016.07.011

Otero, X.L., Ferreira, T.O., Huerta-Díaz, M.A., Partiti, C.S.M., Souza, V., Vidal-Torrado, P., Macías, F., 2009. Geochemistry of iron and manganese in soils and sediments of a mangrove system, Island of Pai Matos (Cananeia — SP, Brazil). Geoderma 148, 318–335. https://doi.org/10.1016/j.geoderma.2008.10.016

Ferreira, T.O., Vidal-Torrado, P., Otero, X.L., Macías, F., 2007. Are mangrove forest substrates sediments or soils? A case study in southeastern Brazil. CATENA 70, 79–91. https//doi.org/10.1016/j.catena.2006.07.006

Queiroz, H.M., Nóbrega, G.N., Ferreira, T.O., Almeida, L.S., Romero, T.B., Santaella, S.T., Bernardino, A.F., Otero, X.L., 2018. The Samarco mine tailing disaster: A possible time-bomb for heavy metals contamination? Sci. Total Environ. 637–638, 498–506. https://doi.org/10.1016/j.scitotenv.2018.04.370

Otero, X.L., Macias, F., 2003. Spatial variation in pyritization of trace metals in salt-marsh soils. Biogeochemistry 62, 59–86. https://doi.org/10.1023/A:1021115211165

Sartor, L.R., Graham, R.C., Ying, S.C., Otero, X.L., Montes, C.R., Ferreira, T.O., 2018. Role of Redox Processes in the Pedogenesis of Hypersaline Tidal Flat Soils on the Brazilian Coast. Soil Sci. Soc. Am. J. 82, 1217. https://doi.org/10.2136/sssaj2018.01.0023

Nóbrega, G.N., Ferreira, T.O., Romero, R.E., Marques, A.G.B., Otero, X.L., 2013. Iron and sulfur geochemistry in semi-arid mangrove soils (Ceará, Brazil) in relation to seasonal changes and shrimp farming effluents. Environ. Monit. Assess. 185, 7393–7407. https://doi.org/10.1007/s10661-013-3108-4

Moreover, we kindly disagree with the reviewer regarding the use of the term “pseudo-total”. In our study, the term “pseudo-total” refers to the sum of the two distinct fractions, which do not include Fe associated with carbonates, organic matter and silicates. However, these fractions frequently represent less than 5% of Fe content in coastal wetland soils (Ferreira et al., 2007; 2022). Thus, we truly believe that the term “total content” is imprecise. Therefore, the authors decided to maintain the term “pseudo-total” throughout the text.

#2.5. There should be some discussion on the role of Fe-monosulfides, as it is likely that this fraction is most likely present, but was not quantified and would have been extracted together with the Py-Fe and is not considered in the discussion on the role of Fe.

The authors respect the reviewer's point of view. In fact, we assessed the Fe-monosulfides (e.g., AVS fraction) contents, and these results will be used to characterize microbial communities and improve the comprehension of Fe-S-C dynamics.

Since we observed very low AVS values (ranging between 0.1 to 1.0 µmol g-1), we concluded that this is not an important fraction for the comprehension of pedogenesis in these soils and decided not to include it in the paper

The authors are thankful for the suggestion performed by Dr Wong.

#2.6. It would be useful to describe briefly the role of the tidal regimes in influencing the physical properties of the soils at each of the sites in the discussion.

As requested, further information regarding the water column height and tidal phase during the samplings was included in the text. The authors are thankful for such a detailed revision, which considerably improved the rigour of our study.

#2.7. The discussion describes the processes and evidence for gleization and sulfidization separately, however, these two processes do not occur independently. It would be useful to link the two processes to the evidence from cores in a short paragraph.

The authors are thankful for the comment performed by Dr. Wong. In fact, gleization and sulfidization may occur in a concatenated pathway, linking Fe and S dynamics. However, the intensity of these processes may vary according to different factors of soil formation, i.e., high intensity of gleization may not result in a high intensity of sulfidization, or a significant amount of pyrite may be formed beside the presence of the crystalline Fe-oxyhydroxides (e.g., SE soils).

Since these processes occurred in different intensities along the Brazilian Coast, the authors decided to describe these processes separately, to improve the comprehension of the text and clarify the differences among sites.

To avoid misinterpretation, further information was included in the text clarifying that the geochemical conditions to which the studied soils are subjected are prone to both gleization and sulfidization.

Specific Comments

#2.8. Line 54: Quaternary should be capitalized (here and elsewhere)

As requested, the word Quaternary was revised, and the use of capitalized letters was corrected.

#2.9. Figures 1-3: identify the horizons in b) in each case so that the descriptions that follow can be related to the whole core

As suggested, we included the horizons identification from each core in the figure captions to improve the comprehension of the text. The authors appreciate the suggestion performed by the Reviewer.

#2.10. Table 2: Include column headings for each site
Citation: https://doi.org/10.5194/egusphere-2022-466-RC2

The authors are thankful for such detailed revision and suggestions performed by the Reviewer. Due to a large amount of data, there was a layout problem with the table, resulting in an interruption during the diagramming. Thus, table 2 was divided into two new tables, to improve the readability of the text.