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Reply on RC2

Gabriel Nuto Nóbrega et al.

Author comment on "Masked diversity and contrasting soil processes in tropical seagrass meadows: the control of environmental settings" by Gabriel Nuto Nóbrega et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-466-AC2, 2022

Dear Editor,

Please find the responses to all questions raised by Dr. Wong about 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 final response, we performed the adjustment and corrections suggested by Dr. Wong, which considerably improved the quality and rigor of our manuscript. We would like to thank Dr. Vanessa Wong who conducted an incredibly detailed and careful examination, including insightful comments for improving the manuscript.

Reviewer #2. Dr. Vanessa Wong

#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 rigor 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 H2SO4 (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.