Reply to referee #2: Ingrid Bauer

We would like to thank Ingrid Bauer for giving useful feedback on our manuscript. We have responded in red.

This manuscript examines the biogeochemical feedback between vegetation and soil, specifically in soft, dredged sediments. Ultimately, this paper and similar work will enable designers of these created wetland habitats to select plants that will aid in accelerating ecosystem development created using such soils. With the increasing desire world-wide to restore wetlands for their many natural benefits, and the potential to aid existing wetlands in the race against sea level rise, these results and results of studies using this methodology can have great benefit to the ecosystem restoration community.

We thank the reviewer for acknowledging the importance of our study.

Overall, the study is informative and well written, though a few language improvements and additional explanation on a couple points would enhance the reader's background and general understanding. A few questions/comments on specific points in the manuscript:

*** Sentence spanning lines 64-66: Agreed that the roots may enhance consolidation processes by increasing drainage. Did you also consider increased consolidation through evapotranspiration?

In principle, the hydraulic design of a plant root follows that of a porous pipe (Zwieniecki et al., 2003). Hence, plant roots potentially drain soils by extracting water, of which 97% is lost through the leaves (i.e. plant transpiration) (Sinha, 2004). Therefore, increasing drainage and (evapo)transpiration can be seen as the same process.

*** Line 115: Why was Dorsilit selected? Recommend providing a few additional details about its properties.

We mixed the soft mud with sand to see how increasing the grain size would affect biogeochemical processes in the soil. This is relevant because there are numerous cases were mud was mixed with sand to enhance soil stability. However, since we are interested in the influence of grain size on biogeochemical processes, it is important that the chemical properties of the sand itself do not influence these biogeochemical processes. Therefore, we selected Dorsilit, which is sand that consists almost exclusively of unreactive crystal silica (c. 99% SiO2), with the remaining part consisting of aluminum oxide (c. 0.6% Al_2O_3). The grains are 0.3-0.8 mm in size with a median diameter (D50) of 0.57 mm. We added information about the grain size of this material after line 115.

*** Paragraph beginning on line 180: Were these timeframes identified through research and then used? Or were they identified during this study? Please clarify this point. If identified through the former method, make sure to cite references; if the latter, provide a few details on how the stages were differentiated. Recommend changing the word "used" in line 180 to "identified" which would be accurate whether it was identified through literature or during the study.

The first time frame represents the period where no plants were growing in the pot – i.e. before transplantation. Time frame 2 and 3 were *identified* during this study by looking at the measured data at 1 and 11 cm depth. After transplantation, it takes a while before the roots have sufficient biomass to start interfering with the biogeochemical processes in the deeper part of the soil. The time it takes before sufficient biomass is produced is highly species specific, so no attempt was made to identify this period through literature research. When pore water chemistry at 11 cm depth in the planted condition started to deviate from the unplanted condition, we regarded that as a sign that roots were influencing the biogeochemical processes in this part of the soil. For some chemical variables this was the case after 64 days, for other chemical variables it was after 92 days (see Figures 1 and 2). Therefore, we chose the more conservative period of t=64-176 as the time frame where roots influenced these processes. Furthermore, *P. australis* is known for its high radial oxygen loss, so oxidation processes at 11 cm depth are largely expected in the third time frame for the planted condition. This is also what the model calculated (Table 3). We added a few sentences in this paragraph for clarification:

"These time frames were identified by analysing the chemical data that was collected. When concentrations at D11 in the planted condition started to deviate from the unplanted condition, this was seen as a sign that plant roots started to influence pore water chemistry."

*** Paragraph beginning on line 280: Do you feel the aeration occurring at D11 would also occur in situ, when the soil extends further from the plant roots, or is it possible that this occurred due to the close boundary with the container? Were any decisions made about the set-up of the experiment to reduce such boundary influences?

Numerous studies have shown that radial oxygen loss by *P. australis* in anoxic soils oxidize the rhizosphere (e.g. Armstrong and Armstrong, 2001; Armstrong et al., 2006; Tercero et al., 2015). In our experimental design, we decided to maintain a water level of 9 cm, which is 3 cm *above* D11. D11 was at all times submerged which prevented oxygen to penetrate: De Lucas Pardo (2014) showed that oxygen could only penetrate the first 2 mm's in soft mud and clay from lake Markermeer in submerged conditions illustrating the reduction capacity of the materials studied. Furthermore, the rhizons extracted pore water 5 cm from the pot wall (at the center of the pot). The water level and the placement of the rhizons are described in lines 119-125 but we added extra information now, to clarify this better for the readers.

*** Paragraph beginning line 286: You use the phrase "some differences" were noted, but then only mention one specific difference. Consider summarizing other differences you wish to highlight or referring to the differences discussed earlier in the section.

Since we want to highlight the difference explained in lines 286-289, we changed that sentence so that it is no longer confusing.

*** Sentence spanning lines 399-401: For the additional studies/testing you recommend, would you recommend this be done in-situ or using the methodology developed during this study? Recommend including a few additional details to this point.

Thank you, we added some points to this paragraph. To come up with a sound hypothesis/prediction with respect to ecosystem development/feedback mechanisms on the constructed wetlands, an in-situ experiment should be carried out as a number of other factors are

in play that are not tested ex-situ (e.g. wave action, wind). However, such an experiment can only be carried out when the crest has stabilized sufficiently on the constructed wetland. Ex-situ testing enables us to focus more on specific interactions. We made this point more clear by adding the following:

"*Not all environmental factors that potentially interfere with the processes and feedbacks described in this study could be taken into account with this experimental design (e.g. wave action, wind). Therefore, we recommend to carry out experiments on the wetlands themselves once the crest has stabilized sufficiently.*"

*** Sentence spanning 420-422: Recommend emphasizing whether the impact was positive or negative. Also, do you feel the results show wetland creators should add sand or not?

We changed line 420-422 as follows:

"*However, when the mud is mixed with sand, the enhanced aeration due to the change in grain-size composition results in higher oxidation rates, increasing the impact of the positive feedback mechanisms involving P mobilization and iron toxicity.*"

From a physical perspective, it is clear that mud mixed with sand would enhance consolidation and crest stability. However, in practical mixing sand with mud is more expensive. Given the difference in plant development between Mud_{soft} and Mud_{sand} we do not recommend adding sand to the mud in the amount we did in the experiment (Figure 3).

*** In Table 2, consider listing clay first so that its composition can easily be compared to the soft mud.

Thank you for this valuable suggestion. We changed Table 2 accordingly.

*** In Figure 4, it appears the results for soft mud are significantly different from the results for clay–should soft mud still have both b and a indicators?

No mistake was made in Figure 4. The difference between clay and soft mud for N is not significant ($p = 0.051$).

Additional language and typographical recommendations:

All the recommendations below are implemented in the revised version of the manuscript with one exception (outlined in red).

*** Lines 19-20: Recommended wording of last half of sentence–". . .is an example; here, dredging some of the... will soon begin." (More direct wording.)

*** Lines 26-27: The subject of the first part of the sentences is N:P ratios, and I believe this is not the subject of the portion after "and." Insert appropriate subject between "and" and "were affected," potential suggestions include plants, plant health, plant growth, etc.

*** Line 27: Insert a comma– "...uptake of N, but by..."

*** Line 35: Use "be used" instead of "are used," or restructure sentence to read "Given these two feedback mechanisms, we propose the use of Fe-tolerant species rather than species that thrive in N-limited conditions."

*** Line 45: Insert a comma after "Nowadays."

*** Throughout, but noted on line 54: I was a little uncertain whether “soft clay-rich” was referring to a soil rich in soft clay or one that was rich in clay and also soft. If the former, consider using “soft-clay-rich,” if the latter, change to “soft, clay-rich.”
*** Lines 54-55: Restructure sentence: “In the Netherlands, a soft-clay-rich lake-bed sediment is causing serious turbidity problems in the Markermeer (and artificial like of 691 km^2).”
*** Line 58: Recommend “plans are underway” instead of “it is planned.”
*** Line 69: insert comma after “formation.”
*** Line 69: Believe should use “signs” instead of “sign.”
*** Lines 73-74: Recommend the following after the comma: “it is essential to determine which eco-engineer is most appropriate for accelerating ecosystem development in these protosoils.”
*** Line 74: I am unfamiliar with “protosoils,” but that may just be my background, consider whether this is a common term for others in the industry and change or explain if appropriate.
*** Lines 79-80: Recommend rewording last sentence as follows: “Two types of clay-rich deposits are the indented building material for the wetlands.”
*** Line 80: Recommend changing beginning of the sentence use “their presence is” or “their composition is” in place of “they are.”
*** Line 80: “Products” should be singular because it refers to “a combination,” which is also singular.
*** Sentence lines 91-94: Recommend moving “We set up. . . pore water,” to the beginning of the sentence for added clarity.
*** Line 153: add “content” after “Nitrogen.”
*** Line 191: Delete “below” and begin the sentence with “First.” Also add a comma after “First.”
*** Line 202: use “than” instead of “then.”
*** Line 227: insert a comma between “without plants” and “the.”
*** Line 234: Believe the reference should be to Figure 1g rather than Figure 2g.
*** Line 242: Delete “it must be taken into account that” (More direct wording.)
*** Lines 268 and 271: ConC3 BGD Interactive comment Printer-friendly version Discussion paper sider indenting the chemical equations.
*** Line 272: Appears to be an unintended blank line after the equation (2). If line 273 is a new paragraph, indent it; if it is a continuation of previous paragraph, simply delete blank line.
*** Line 284-285: Recommend moving this sentence up to be a part of the previous paragraph.
*** Lines 292-293: Recommend providing clarity by rewording to say “While the pore water compositions did not show clear differences between unplanted and planted conditions during the initial stage of plant growth, . . .”
*** Line 347: Add a comma after “the experiment.”
*** Line 411: Add comma after “plant growth.”
*** Line 412: Change to “. . .promotes P mobilization, enhancing plant growth.”
*** Line 416: Delete comma after “P uptake.”
*** Line 422: Consider whether using “of” rather than “on” would be more appropriate.
*** Line 423: Insert comma after “detail.”
*** I believe it is customary to eliminate the use of “we” and “our” in scientific papers, though I know it is difficult to do.

Answer: We believe there is no general rule anymore of (de-)personalization of scientific papers. It seems to be a matter of taste. We chose not to change our wording, since we think it is concise and direct as it is now.

*** Line 608: delete comma after “(a-c).”

References used in this reply

Armstrong J, W Armstrong (2001). Rice and *Phragmites*: effects of organic acids on growth, root permeability, and radial oxygen loss to the rhizosphere. American Journal of Botany 88: 1359-1370.

Armstrong J, RE Jones, W Armstrong (2006). Rhizome phyllosphere oxygenation in *Phragmites* and other species in relation to redox potential, convective gas flow, submergence and aeration pathways. New Phytologist 172: 719–731.

De Lucas Pardo MA (2014). Effect of biota on fine sediment transport processes. A study of lake Markermeer. PhD dissertation, Delft University.

Sinha RK (2004). Modern plant physiology. Chapter 5: loss of water from plants (transpiration, guttation, exudation). Alpha Science Internation Ltd., Pangbourne, United Kingdom.

Tercero MC, Álvarez-Rogel J, Conesa HM, Ferrer MA, Calderón AA, López-Orenes A, González-Alcaraz MN (2015). Response of biogeochemical processes of the water-soil-plant system to experimental flooding-drying conditions in a eutrophic wetland: the role of Phragmites australis. Plant and Soil 396:109-125.

Zwieniecki MA, Thompson MV, Holbrook NM (2003). Understanding the hydraulics of porous pipes: tradeoffs between water uptake and root length utilization. Journal of Plant Growth Regulation 21: 315-323.