

Minor Revisions

Manuscript Identification: esurf-2020-58

Manuscript Title: Biophysical controls on marsh soil shear strength along an estuarine salinity gradient

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The authors would like to thank the two anonymous referees for their useful comments that helped improve this manuscript. We would also like to thank our associate editor for their help overseeing the manuscript review process. Below are explanations of our response to reviewer 2's comments with regards to minor revisions, with line numbers specified for reference where relevant. (RC2: Referee #2 comment, AR: author response)

Response to Comments from Anonymous Referee #2:

RC2: 1. Line 144: "Interior sites yielded higher values of shear strength than edge sites in the brackish and the salt marshes (Fig. 4)."

Reviewer Comment: Does the following statement signify a significant interaction between marsh type and marsh zone? It would appear so, but it should be specifically stated.

AR: We have revised this section of the results and added: "This result from the ANOVA indicates that the effect of marsh zone on shear strength varied with marsh type" (line 146-147) to clarify the significant interaction between marsh type and marsh zone.

RC2: 2. Lines 144-146: "While shear strength values appear nearly equal between the edge and interior sites for freshwater marshes (Fig. 4), the ANOVA test showed significant differences in shear strength between marsh edge and interior across all marsh types ($p = 5.62e-20$)."

Reviewer Comment: This sentence appears to state that the main effect of marsh zone (edge versus interior) is significant. However, because there is a significant interaction between the main effects of marsh type and zone (as shown in the ANOVA tables provided as responses to the first review), the main effects are little value, i.e., the effect of marsh zone on shear strength varies with marsh type. Hence, there is a need to discuss the results with respect to the significant interactions. Statements of main effects are misleading because they give a picture that all marshes are responding similarly. Where ANOVAs have been conducted, explicit statements regarding statistically significant interactions, or the lack thereof, are necessary to better interpret the study's inferences.

AR: Thank you for your comment. We have revised this section discussing the ANOVA results:

“While both marsh type ($p = 1.48e-9$) and marsh zone ($p = 5.62e-20$) yielded significant influence on shear strength values, the interaction between these variables was also significant ($p = 4.67e-11$). This result from the ANOVA indicates that the effect of marsh zone on shear strength varied with marsh type. Interior sites yielded higher values of shear strength than edge sites in the brackish and the salt marshes (salt: 5.1 kPa at edge, 18.5 kPa in interior; brackish: 4.5 kPa at edge, 16.6 kPa in interior) (Fig. 4). There was a negligible difference between edge and interior shear strength values at the freshwater marsh sites (5.41 kPa at edge, 5.38 kPa in interior) (Fig. 4).” (lines 145-150)

RC2: 3. Lines 147-148: “The most substantial difference between edge and interior shear strength values occurred at the salt marsh sites, with an increase from 5.1 kPa at the edge to 18.5 kPa in the interior (Fig. 4).”

Reviewer Comment: The difference presented is not likely statistically significant. If this is so, why state it. If fact, it looks to me that the absolute difference between edge and interior for the brackish marsh is of the same magnitude as that for the salt marsh.

AR: We have revised this statement to include mention of brackish marshes: “Interior sites yielded higher values of shear strength than edge sites in the brackish and the salt marshes (salt: 5.1 kPa at edge, 18.5 kPa in interior; brackish: 4.5 kPa at edge, 16.6 kPa in interior) (Fig. 4).”

RC2: 4. Lines 150-151: “Belowground biomass had the most significant influence on shear strength in the marsh interior ($R^2 = 0.58$, $p = 1.09e-5$) (Fig. 5).”

Reviewer Comment: Figure 5b shows clearly that this statement is indeed true for salt and brackish marshes, but not for freshwater marshes. This should be clearly stated in the results. The slopes of the three lines in Figure 5b could be statistically compared to confirm that the fresh marshes differ from the salt and brackish marshes, which do not differ.

AR: We have clarified this point by adding the phrase “for salt and brackish marshes” after “interior” (line 151).

RC2: 5. Lines 151-152: Insert “(data not shown)” after biomass in line 151.

AR: We have added “(data not shown)” after line 151 (now line 152).

RC2: 6. Lines 188-189: “Nevertheless, our findings indicate that belowground biomass drives soil shear strength variability in the marsh interior (Fig. 5), and soil properties influence marsh edge shear strength (Fig. 6).”

Reviewer Comment: In addition to the soil properties controlling the edge shear strength, isn't low root biomass, especially low root mass per unit volume of soil, found

at virtually all edge sites another important factor (Figure 5a). In fact, it may equally important as soil water content. This point needs mention in the Discussion both here and again in lines 211-212.

AR: We have added: “Low concentrations of belowground biomass present at the marsh edge (Fig. 5a) in tandem with processes actively reworking sediment may also contribute to lower soil shear strength values (Silliman et al., 2019).” (line 196-197) in addition to revising lines 211-212 (now lines 227-228): “...we suggest that processes (e.g., sediment deposition, erosion, and resuspension) and environmental conditions (e.g., low belowground biomass, eutrophication, etc.) associated with a more dynamic marsh edge obscure patterns that would otherwise be evident.”

RC2: 7. Line 231: Delete “along the York River”

AR: We have deleted “along the York River” from line 231 (now line 244).

Additional Revisions:

- Line 12: added “in” before “biodiverse freshwater marshes”
- Line 105: added “these segments” before “over a 1 mm...”
- Line 106: changed “Live belowground biomass was” to “Samples were then”
- Lines 279-280: added & revised “The authors would like to thank the two anonymous referees for their useful comments that helped improve this manuscript. We would also like to thank the Pamunkey Indian Tribe and the Chesapeake Bay National Estuarine Research Reserve System...” to the acknowledgements.

References:

Silliman, B. R., He, Q., Angelini, C., Smith, C. S., Kirwan, M. L., Daleo, P., Renzi, J. J., Butler, J., Osborne, T. Z., Nifong, J. C., and van de Koppel, J.: Field Experiments and Meta-analysis Reveal Wetland Vegetation as a Crucial Element in the Coastal Protection Paradigm, *Curr. Biol.*, 29, 1800-1806.e3, <https://doi.org/10.1016/j.cub.2019.05.017>, 2019.