



EGUsphere, referee comment RC2  
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## **Comment on egusphere-2022-251**

Anonymous Referee #2

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Referee comment on "Effect of hydro-climate variation on biofilm dynamics and its impact in intertidal environments" by Elena Bastianon et al., EGU sphere,  
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Effect of hydro-climate variation on biofilm dynamic and impact in intertidal environment

Bastianon, Hope, Dorrell, and Parsons

Summary of Manuscript:

This study aims to develop a 1D model morphodynamic model that includes the role of biofilms. The authors couple (and adjust) existing models of morphodynamics and biofilm growth to assess how biofilms affect the evolution of tide-dominated channels. The model results demonstrate the importance of growth parameters (growth rate, temperature) on morphodynamic changes. Furthermore, through the many iterations of the model, the results show that biofilms increase the time needed for the profile to reach equilibrium, and result in different profiles.

Scientific Significance:

This study is novel in that it couples existing models of biofilms and morphodynamic evolution to understand how biofilms affect a sandy channel. This is new and different from (the few) previous modeling studies of biofilms and morphodynamics, and provides interesting insights into the biogeomorphic processes that exist in probably all estuaries and are typically neglected.

Scientific Quality: The model approach is of high quality.

Presentation Quality: For better readability, and therefore greater paper impact, I have several suggestions for cleaning up figures and making them more legible. Furthermore, I think the paper could be improved in the format/structure – right now a lot of it reads more like a report rather than a complete story answering the scientific question. I think the results could be shortened in order to emphasize the take-away messages of the study – that biofilm growth and seasonality are important for understanding biomorphic systems.

Comments:

- What about seasonal variability in erosive events? I don't think it is necessary to include new model runs of this in the manuscript (you already did a lot of model runs!), but I think it would be worth discussing the impacts of a system that has seasonal variability in storms – where the two different disturbance scenarios you describe may both exist within a year but at different times.
- The authors do a good job describing the relationship between biofilm biomass and chl a, but neglect to really mention EPS production directly. I would recommend to add a paragraph to the introduction that discusses the relationship between EPS and erodibility (which is much stronger than the chl a – erodibility relationship, and has a stronger process-based explanation), and why you chose to model chl a instead of EPS production. There are some particularly interesting studies that point out that EPS production can be linked to other factors (like nutrient availability, biofilm stress, see Ruddy et al. 1998, Smith and Underwood 2000, Underwood 2002, Orvain 2003, Orvain 2014, Hubas 2018) that may effect erodibility. While I think modeling chl a/biofilm biomass as a proxy for erodibility is fine (and standard practice), I think mentioning these limitations is important.
- Is there residual EPS in the sediments? Once there is erosion, should the sediment really return to an abiotic state? I think this is an assumption that affects your results (also the results of Mariotti and Fagherazzi 2012, Pivato et al. 2019, and others). I think this merits some discussion in the text. There is some evidence that even after erosive events, some remnants of biofilm or EPS may lead to faster biofilm establishment (Chen et al. 2019) or changes in erodibility after repeated erosion (Valentine et al. 2014).

Figure Comments:

I think one big area for improvement in this paper is in the figures. There are a lot of figures with a lot of panels and they are hard to digest as a reader. I have some suggestions about how to improve them to make your arguments stronger! I hope they are helpful.

Generally, I think all figures that showed the evolution of the profile had too many lines which made it difficult to read the figure.

Figure 1 – In the caption, it should be “represents”. Additionally H is not listed in the caption and the dots on the figure (representing grain size?) are not labeled.

Figure 3 – On the x axis, you may consider labeling the months instead of using days. You reference the months in the manuscript, and it takes work for the reader to translate that to days quickly.

I liked that you labeled the two columns on the figure; I think you should also label the rows more clearly (maybe a label that encompasses the first three rows that says “Growth Rate Parameter” and one that encompasses the later two rows that says “Sediment Temperature”). I think this would help with the readability of the figure. The info is in the caption, but I think it would be more effective to put more labels on the actual figure.

I typically agree that the y axis in all panels should be the same, however, it is impossible to see that there is any growth in panel a (as suggested in the text). I’m not sure what to do about this.

You also have the potential to minimize the empty space between the panels in order to make each subplot larger, which I think would look better but use up the same amount of space.

Figure 4: I would label the rows of panels, like you did with the columns. It is a lot of subfigures! I liked how you labeled the mean water surface elevation and initial bed in panel a – that was very useful. I did have some difficulty with the profiles due to the number of lines displayed on each figure, I recommend reducing the number of profiles visualized. I may also try other colorbars, as the yellow was particularly difficult to see.

This is a judgement call on your part, but I would remove the tiny subplots within panels c, g, and k. They are very small and not readable. I understand you were trying to point out what the row represented, but I think simple labels (like how you did the columns) would be more effective.

Figure 5: Again, I recommend labeling the columns or the panels with what they represent (small, medium, and large growth rates) to make for easier reading.

Figure 6: Sorry for the repetitive comment (hopefully it is easy to do at least) – please add the labels for the temperature “treatments” for the different columns on the figure.

Figure 7: Please label the panels (or columns) with the alpha value used.

Specific Comments:

Line 96: Should be "tidal dynamics"

Line 159-160: remove the and between tidal currents and sediment erosion.

Line 356: should be "uniformly distributed"

Line 356: I think you mean the left two columns? (instead of panels)

Line 357: You refer to the fact that some studies have found biofilms in deeper waters, which I agree! You reference some of these papers later in the paper, but I think you should add citations when you say "as it has been also suggested in the literature (cite xx)".

Line 446: Should be "biofilm growth differs"

Line 448: Should be "affect" instead of effect

Line 450: I think neglect is not the right word here. Does absent or negligible fit better?

Citations:

Chen, X., Zhang, C.K., Paterson, D.M., Townend, I.H., Jin, C., Zhou, Z., Gong, Z., and Q.

Feng, 2019, The effect of cyclic variation of shear stress on non-cohesive sediment stabilization by microbial biofilms: the role of "biofilm precursors", *Earth Surf. Proc. Land.*, 44: 1471-1481.

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Mariotti, G., and S. Fagherazzi, 2012, Modeling the effect of tides and waves on benthic biofilms, *JGR: Biogeosciences* 117: G4.

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Pivato, M., Carniello, L., Moro, I., and P. D'Odorico, 2019, On the feedback between water turbidity and microphytobenthos growth in shallow tidal environments, *Earth Surf. Proc. Land.* 44(5): 1192-1206.

Ruddy, G., Turley, C.M., and T.E.R. Junes, 1998, Ecological interaction and sediment transport on an intertidal mudflat I. Evidence for a biologically mediated sediment-water interface, In: Black, K.S., Paterson, D.M., and A. Cramp (Eds.), *Sedimentary Processes in the Intertidal Zone*, Geological Society, London, Special Publication 139: 135-148.

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Valentine, K., and G. Mariotti, 2014, Repeated erosion of cohesive sediments with biofilms, *Advances in Geosciences* 39: 9-14.

