

Earth Surf. Dynam. Discuss., referee comment RC1  
<https://doi.org/10.5194/esurf-2021-66-RC1>, 2021  
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## Comment on esurf-2021-66

Anonymous Referee #1

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Referee comment on "Biogeomorphic modeling to assess the resilience of tidal-marsh restoration to sea level rise and sediment supply" by Olivier Gourgue et al., Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2021-66-RC1>, 2021

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This paper present a biogeomorphic model applied to a specific tidal marsh restoration project in the Scheldt Estuary.

The authors demonstrate model performance by way of application, comparing modeling results with morphological and ecological features of an active salt marsh located close to the restoration site.

It is demonstrated that different options in the restoration schemed can critically lead to different evolutionary trajectories of the restored marsh, both in terms of morphological and ecological developments in space and time.

The innovative side of the model lies in the fact that it combines different numerical techniques to couple both fine-scale vegetation dynamics and vegetation-flow interactions (occurring at sub metric scales) and the ecomorphodynamic evolution of the overall marsh systems (at km<sup>2</sup> scale).

I have read the paper very carefully and found it much interesting and very well written. I only have minor comments that I'd like to submit to the authors before the paper can be published.

### **MAJOR COMMENTS**

l.230: It would be interesting to compare the values of SLR rates used here with the IPCC SLR projections for the same study area, in order to put the values used in this study in a proper context.

l.295: I am not entirely sure it is correct to refer to O'Brien's law here. The reason is twofold.

First, the classic O'Brien's law is derived based on the tidal prism computed within tidal channels (not the over marsh tidal prism as it was done here). Second, the exponent of the power-law relationship in O'Brien's law is well defined and typically equals  $\sim 6/7$ , which

is quite different from the values proposed here (perhaps because of the difference in the way tidal prism is computed, as said before). Herefore, I'd rather refer to a generic tidal prism vs. cross-sectional channel area, without invoking O'Brien's law.

l.365: this is perhaps too big of a step since the propagation of suspended sediment depends not only on the tidal prism but also on well-known processes of sediment advection and dispersion. In fact, sediment transport of suspended sediment is by no means related to the tidal prism, the latter being only related to the channel cross-section as clearly demonstrated by the cited O'Brien's law, according to which the size (i.e., cross-section) of the channel depends on the flowing tidal prism regardless of the concentration sediments carried in suspension by tidal flows. This applies also to l.544-545.

I'd be curious to know model sensitivity to some of the input parameters, in particular those related to vegetation lateral expansion (e.g.,  $R^{(exp)}$ ). I think these parameters are critical in determining the evolution of marsh vegetation through time. Also, the authors state that different species have different  $R^{(exp)}$ , but looking at table S3 it seems that  $R^{(exp)}$  is held constant for all marsh perennials considered in this study. This would signify, if my interpretation is correct, that middle- and high-marsh species have nearly the same competitive ability, which I doubt is the case in real marshes. Also, related to this point, I wonder if the grid resolution for vegetation dynamics can be somehow dependent on the imposed  $R^{(exp)}$  and numerical timestep (i.e., should the resolution not exceed a certain threshold for a given  $R^{(exp)}$  and timestep in order to obtain reliable results with respect to vegetation dynamics)?

### **MINOR COMMENTS**

l.15: add "restored" before "tidal marshes"

l.17: too generic. Explain why difficult to assess these key questions.

l.18: strange sentence...it looks like you're applying model by dike breaching.

l.19: add a comma after "transport"

l.24: it affects -> they affect (referred to options)

l.26: to more -> higher

l.26: diversity in terms of what? Morphological? Ecological?

l.39: dams -> damming (?)

l.42: often as -> the

l.53: landwards -> landward

l.63: add a comma after ref to Staver

l.110: misplaced apex in km<sup>2</sup>

l.225: is determining -> determines

l.339: vegetated -> vegetation

Fig.9: colors are hard to differentiate in b/w printed copy.

l.473: above all -> mostly

l.477: are depending -> depend

l.485: certain -> specific

l.502: that -> this