We thank the reviewers for their time and constructive comments. Below we respond point by point and indicate the changes made in the manuscript.
Maarten Kleinhans, on behalf of all authors

RC1: William Kearney, https://doi.org/10.5194/esurf-2021-75-RC1
General comments

The authors present the results of laboratory experiments that reproduce the development of floodplains within estuaries. They compare a control case with only sand to one with mud and one with live vegetation, which enables them to show subtle differences in the way mud and vegetation affect floodplain formation. Their conclusion that mud affects tidal propagation in the estuary by filling accomodation space while vegetation imposes additional hydraulic resistance certainly makes sense and is well supported by their data. The vegetated estuary starts off more like the sandy estuary and becomes more like the muddy estuary as vegetation establishes. The main limitation of their experiments seems to be that the experiments were not run long enough to determine if the vegetated and muddy estuaries will completely converge. These experiments provide an important complement to field and numerical studies of estuarine floodplain formation, and this manuscript is an excellent description of the experiments.

REPLY Indeed the experiments did not run long enough for complete convergence, but as with any process that has an exponentially decaying rate of change this would have taken a prohibitive time period as well as have induced growth of pests in parts of the sediment without significant flow (especially in buried nutshell or decaying vegetation, both of which were very limited now), despite pest control.
In Results Section 3.2 on the hydrodynamics we now explain that convergence is not complete. In the discussion we already stated that "given more time for recruitment, or more inundation-resistant species, the vegetated estuary might have developed more similar to the muddy estuary".
The reviewer agrees with us that the experiments are nevertheless interesting complements to modelling and field studies, and that the numerical flow modelling used here is useful and not critically limited, while the comparison between the experiments is the most informative aspect.

Specific comments

I was somewhat skeptical of using a numerical model to replace measurements of hydrodynamics, especially when it comes to the effects of vegetation on the flow, but the citations to Weisscher et al. (2020) and Lokhorst et al. (2019) suggest that this is not unreasonable. In any case the authors' interpretations do not rely too heavily on the exact flow velocities achieved in the different experiments, and the tidal prism estimates are probably more robust to model inaccuracies.

REPLY We now state more clearly in the introduction to the model in the Methods section that this model has been applied successfully to a narrow estuary in the metronome and to a meandering river experiment, and indeed the Weisscher et al reference reports on this, while the method to incorporate vegetation resistance to flow was already tested in other numerical modelling (references to van Oorschot and Brückner were added to the paper). The main reason for using the model is that PIV in the vegetated experiment is impossible as the plastic floating particles would get trapped within the vegetation.

Are the sand and mud experiments identical to some of the runs in Braat et al. (2019) or are they new runs with similar sediment and forcing? The wording was a little unclear, and I am having some trouble matching up the experimental conditions between those described here and those in Braat et al. (2019).

REPLY We made clearer in the paper that the experiment with only mud is indeed that experiment first described in Braat et al. (2019), reanalysed on different aspects here. We checked the description of the experimental conditions carefully and made minor corrections.

MINOR typographic corrections were made as indicated.

RC2: Anonymous Referee, https://doi.org/10.5194/esurf-2021-75-RC2
General Comments

In the manuscript “Estuarine morphodynamics and development modified by floodplain formation”, the authors present a combination of physical and numerical modeling results to demonstrate the role of vegetation and mud in estuarine evolution. The authors suggest two separate mechanisms that affect morphology: mud changes estuarine dynamics by filling in accommodation space, while plants increase roughness. This is interesting because both mud and vegetation are often thought to stabilize systems and prevent change, but the authors demonstrate that they do this in different ways. Overall, I think the paper contributes novel results that directly relate to field observations of estuarine sediment transport and dynamics, and by using a physical model you are able to separate confounding variables that are impossible to separate in field work.

REPLY We thank RC2 for the constructive comments, suggestions and discussion.

Specific Comments; Plants:

One component of the physical experiments that seems perhaps too simplified is the vegetation and the role of the roots. First, root morphology is important for stabilization, which is neglected in this paper. For these experiments, it seems that you chose the two species of plants with the shortest roots and smallest diameters (based on Lokhorst 2019). Do you think your results would be different if you had used plants with more extensive (or interlocking) root structures? How do your plant choice relate to plant root proprieties in the field?

REPLY Plant roots: we will discuss the effects of rooting in more detail. Our first, geometric scaling consideration was that roots in natural estuaries have lengths of a fraction of the main channel depth, and our smallest plants still have relatively large roots. Our second, dynamic scaling consideration was that of bank erosion and channel incision reduction. Earlier experiments with vegetation (e.g. in preparation for van Dijk et al. 2013) showed that more extensive and interlocking root systems can completely fixate systems. In view of this experimental difficulty, we chose the smallest plants, which have measureable bank erosion reduction effects as shown in Lokhorst et al (2019) in bespoke bank erosion tests at the scale of the experiments. The third, also dynamic scaling consideration was that of hydraulic resistance. As long as the stems penetrate the water surface and there is sufficient stem density, the vegetation has a strong measureable hydraulic resistance effect. Unlike the roots that are small relative to channel depth in large natural estuaries, the vegetation settles at such elevations that its effect on the hydrodynamics can be large in the field, and this is also the case in the experiments.

Second, stabilization by plants can be affected by the sediment type. Previous studies have demonstrated that in sandy sediments, vegetation may not provide stabilization (e.g., Feagin et al. 2009). I think your experiments may underestimate the potential role of plants in bank stabilization given that you use sandy sediments. Have you considered doing experiments that have both mud and vegetation? That is likely beyond the scope of this paper, but I would be interested to see if plants have a more profound effect with finer grained sediments.

REPLY Stabilization by plants: we agree that the stabilization of sediment by plants under waves would depend on sediment type. However, that kind of stabilization is only relevant on cut banks (and note that there were no waves in the inner estuary in our experiments - that is yet another variable to test by ventilator in the future). In rivers and estuaries, another kind of stabilization also matters: that of surface protection against channel carving (Kleinhans et al. 2018). This protection is done basically by increased hydraulic resistance, and this effect could be amplified if the sediment is also cohesive, and cohesive sediment alone can also have this effect. However, given time investment needed for these experiments, we have yet been unable to conduct an experiment with this narrow estuary setup with both mud and plants. This is unfortunately not beyond the scope of the paper, but it is beyond what we could manage.
Both this and the previous point are now explained in a separate paragraph in the methods section after introduction of the vegetation species.

I was also curious about why you used two different plant species and then did not discuss the difference between the two other than in the methods. For roughness, you used stem density and diameter, which would have taken into account some of the differences between the plants. You also state that the plants have different zonation. Was the use of the two species just to get maximum vegetation cover (plants that would inhabit all elevations of bars and floodplains)? Was there any difference in the flexibility or surface area of the species of plants that may alter the roughness?

REPLY Different plant species: Indeed we used multiple species. We can describe the eco-engineering effects of the selected species from Lokhorst et al. in a bit more detail and we will also explain better what the purpose was. As the reviewer already understood, it is mainly to have a larger vegetation cover. Simplistically one could argue that supplying more seeds would also do that but our controlled experiments in Lokhorst et al. showed that they settle in different places. As such, the landscape becomes biogeomorphologically richer and indeed we saw zonation happen. The effect may be limited to this: for the same density we got similar hydraulic resistance from both species in Lokhorst's experiments so we don't expect flexibility and such traits to play a role here. In this sense, the laboratory vegetation simplifies the vegetation in nature, but as this study addresses the scale of entire estuarine systems, such simplifications are as unavoidable as they are in numerical biogeomorphological models doing entire estuaries. Being an experiment rather than a model, the results are complementary to numerical models.

Specific Comments; Other comments:

Did you measure the grain size distribution of the sand at the end of the mud experiments? I am curious if mud infiltrated the porespace of the sand. This would have morphodynamic importance – if the mud simply deposits on the top, it would behave like mud-capped sands, but if the mud infiltrated, the sand may behave cohesively.

REPLY We have looked at the possibility of infiltration, but because the crushed nutshell is rather course compared to the sand, it does not measureably infiltrate, as now mentioned in the methods.

Small question, but could you clarify the lights used in the lab – are they full spectrum? Were the lights on all the time, or was there a dark cycle ("night")? From the text, it seems that the lights were always on, but experiments often use a light/dark cycle to simulate days. I suppose this would be difficult in scaling your experiments, so how do you think having the light on all the time affected plant growth? (See Smith and Sitt 2007 for some discussion of this).

REPLY We specified the lighting in the methods, which was daylight-toned TL as also used by biologists in our university in their plant growth labs. We checked the Smith and Stitt paper, but the biologists have their lights on at all times (no night) and so did we, and shutting it off weakened the plants in tests as they stretched for light and got weak stems. The aim was to get the plants to grown seedling stage a.s.a.p.

Technical Corrections were implemented as suggested.