RC3

Overview: This study focuses on understanding biotic vs abiotic controls on tidal marsh development using four experiments. They conducted two unvegetated controls and two vegetated experiments, one with vegetation colonization by water and the other by air, with the goal of examining how these different experiments evolve channel networks. The authors step through a variety of metrics to examine the development of vegetation patterns and channel networks, concluding that channel network development is dominated by hydrodynamics near the sea and more strongly influenced by vegetation as you move landward. The paper is well-organized and easy to follow with nice figures. Below I outline a number of suggestions to improve the paper, which I believe constitutes minor revisions.

Comments:

The background is notably missing some references of previous vegetated experiments. Though tidal experiments with plants were not necessarily performed, there is a broad body of literature that informs the results found here, including experiments of deltas with vegetation (e.g., Piliouras et al., 2017, Piliouras and Kim 2018, 2019) and experiments at a smaller scale examining flow through and around patches of vegetation (e.g., Chen et al., 2012; Meire et al., 2014; Ortiz et al., 2013; Zong and Nepf 2010, 2011, 2012). These papers provide context to the results in discussing many of the processes at play, such as how flow is steered around patches of vegetation, how patches may encourage bifurcation to increase channel density, and how vegetation influences topographic change. I suggest including a paragraph in the background to elaborate on what we know about vegetation-flow-sediment feedbacks and drawing on this knowledge in the discussion, as well.

Reply: In the third paragraph of the introduction of the original paper, we included a brief summary of previous real-scale experiments on the small scale of flow through and around vegetation patches. We will add the references suggested here by the reviewer to that section of the introduction (Chen et al., 2012; Meire et al., 2014; Ortiz et al., 2013; Zong and Nepf 2010, 2011, 2012). Further, in the fifth paragraph of the intro, we included a summary of previous scaled flume experiments on tidal landscape morphodynamics and the role of vegetation. In that section, we will add a reference to the suggested studies of (Piliouras et al., 2017, Piliouras and Kim 2018, 2019).

I would appreciate more information on the selection of this vegetation species, as it is not widely used in the literature for morphodynamics experiments, in addition to more information on the vegetation protocols. Can you provide some context on plant traits and impact on sediment transport? L165: You state 160,000 seeds to obtain coverage of half of an area – with what intended density? Is this the same density as in the other vegetated experiment? How was this density chosen? What impact might this have on your results? All of this should be justified in the manuscript. Finally, how was the timing of sowing determined? You've got 1000 cycles unvegetated, 10 cycles for wetting (is it not already wet?), 25 cycles to release, 25 cycles to spread, 500 cycles of just water/sediment transport, then more sowing – how were all of these things determined? You describe the experiments as scaled – are these numbers scaled to some timing of seed dispersal in a natural system? How was the number of patches and patch size determined for the manual sowing? Please address these issues in the manuscript text.

Reply: We will discuss the sowing procedure in more detail so that it is clear to readers. We will explain it as indicated below. As this explanation is quite long, we will do it in an online supporting materials section.

For our plant species selection, we relied on (1) the work from Lokhorst et al. (2019), in which the growth rate, hydraulic resistance, and bank strength of 19 different plant species were tested in

Metronome-like tidal flume conditions, (2) previous experience/research done in the Metronome (e.g., Weisscher et al., 2022) and (3) observations from pilot tests.

(1) The fast growth rate of *Lotus pedunculatus* in the timescale we have applied (four days) is one of the main reasons it was selected. Furthermore, the results of Lokhorst et al. (2019) indicated that *Lotus* can represent grass-like species found in marshes in landscape experiments as it can trap sediments and grow in dense patches with high flow resistance.

(2) The results from Weisscher et al. (2022) and Kleinhans et al. (2022) suggest that vegetation (including this species) could stabilize banks and influence the morphological development of (partially-filled) estuaries.

(3) Pilot tests were conducted to select a plant species that could rapidly germinate in both vegetated experiments where different sowing procedures were applied. Since previous experiments only relied on seed dispersal via the tidal flow, we had to examine whether seed viability would not suffer from the sowing procedure used in the patchy experiment.

The number of seeds supplied to the tidal inlet was based on the vegetation protocol used in Weisscher et al. (2022). The authors aimed to obtain vegetation covering half the flume in this study. Since, in this case, only one-half of the flume was used, we decided to use the same quantity supplied at the tidal inlet in Weisscher et al. (2022), which was 160 000 seeds. Before the hydrochorous experiment, we did not have a specific plant density in mind as we worked in a new setting with a single species. We used the plant density obtained in the hydrochorous experiment (ca. five plants/cm^2) to decide what plant density we wanted to achieve in the patchy experiment.

The timing of the sowing events was also based on previous experiments conducted in the Metronome. We initiated sowing events after 1000 tidal cycles as we wanted to have an initial channel network while also trying to prevent fixation of the network by establishing vegetation. A DSM was acquired immediately after a system development of 1000 tidal cycles was reached. Therefore, we had to drain the flume and refill it afterwards. Hence, every sowing event required a short wetting phase (10 tidal cycles) to re-establish a normal flow pattern, followed by the release (25 tidal cycles) and dispersal of seeds (25 tidal cycles). After a four-day germination period, a new 440 tidal cycle interval was initiated to obtain 1500 tidal cycles, which was followed by a DSM acquisition and a new sowing event (60 tidal cycles).

The number of patches and their sizes were determined on the knowledge that 60% of the tidal basin had to be covered by 5000 tidal cycles, and eight sowing events would occur. We also wanted to ensure that the patch size and number would create sufficient interaction between vegetation patches and tidal flow. Moreover, it had to be practically feasible since we manually sowed all patches (which required quite a lot of work).

L193: How did you determine if equilibrium was reached?

Reply: We ensured that the morphodynamic equilibrium was reached by quantification of global system properties such as volume and channel migration (e.g., Figs 9 & 10 and supplementary Fig 6). In these graphs, we can see that around 5000 tidal cycles the rate of change of these system properties stabilizes, indicating that we have reached a "morphodynamic equilibrium".

Section 3.2: It seems from your methods that you are intentionally not sowing seeds in channels and not re-sowing if channels eroded through parts of patches. It's worth a sentence or two in this section to explain that in the context of your results because you are pointing out things like channel bends having the lowest vegetation cover, but this is not surprising given your methods that intentionally do not sow in channels.

Reply: We will give a short explanation about this in the manuscript. In the patchy vegetation experiment, to resemble natural processes, we decided not to sow seeds in channels. If we had sown seeds in these locations, it would likely not have had any effect on the vegetation cover around the channel bends. The strong tidal forces would have uprooted the plants, creating the channel bends in these zones. The uprooted plants could have led to more plants establishing in calmer parts of the tidal basin. In the hydrochorous experiment the seeds that ended up in the channels did not germinate.

Figure 9 and other similar figures: It would help to differentiate the runs a bit more by changing line style and marker shape, in addition to color. This will likely also help folks who have difficulty discerning color.

Reply: Indeed, we are going to change this.

I strongly suggest including movies of the experiments in supplemental. The results section is quite difficult to follow without having the movie available to the reader, especially when you talk about specific channels developing in specific runs and how that affected various metrics.

Reply: Thank you for your suggestion, we will include movies of the experiments in the supplementary material.

386-388: though they were not tidal experiments, this result is quite similar to that found by Piliouras et al., 2017, that rapid vegetation colonization can inhibit channel network development. Their later papers also found similar results about plant patches encouraging channelization and bifurcation around them. I suggest including these citations, as described in more detail above.

Reply: We will carefully look at published experiments to refer to this effect.

Figure 12: what are the gray shaded regions?

Reply: The gray shaded regions represent zones varying in levels of tidal prism in which we see the highest drainage density for bare and vegetated landscapes. This is explained.

Regarding the phrasing of your conclusion that vegetation 'dominates' in the landward zone – does it really dominate? Or does it just have additional influence here? It seems that channel development is still a physical process that is initiated by abiotic factors, but that the initiation and evolution of the network is more strongly controlled by the combination of biotic and abiotic factors in the landward region, compared to a real dominance of abiotic factors near the coast. I suggest rewording this.

Reply: This sentence will be reworded as suggested since it does indeed only have additional influence.

Data are not accessible. Please place data in a repository with DOI.

Reply: The data will be placed in a DOI repository.

References:

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