REVIEW – Lokhorst *et al.* (esurf-2018-29)

This paper contributes to an exciting body of quantitative work on the morphodynamics of estuaries. The authors use the numerical model Delft3D, along with two new sub-component models for (1) sediment transport of mud and (2) tidal pioneer vegetation, to examine the consequences of ecogeomorphic feedbacks between mud transport and vegetation growth in a generic, shallow, sand-bedded estuary system.

There is a lot to like about this paper. Overall, it is clear and well-presented, hewing close to the simplicity of its main premise: that coupling mud- and vegetation-related processes yields estuarine morphodynamics quantitatively different from those produced by the same processes in respective isolation.

My main remark is one I'm reluctant to make, because it involves more runs of the numerical model, and I know what that entails. However, I think expanding the exploratory modelling effort here would strengthen the findings this work has to offer.

To ground their modelling exercise, the authors collect morphometric traits from nine real estuaries. In Fig. 13, which shows the vegetated surface-area fraction versus normalised distance upstream, they pair the modelled result of the coupled mud-vegetation simulation with an ensemble mean of the empirical measurements. I would like to see two things here: (1) an envelope (+/- one standard deviation, or the max/min) around the ensemble mean of the "natural systems", to capture some sense of what the variation looks like, moving upstream from the estuary mouth; and (2) a comparable ensemble and envelope produced by the numerical model.

I may be wrong, but I think the model generates one "final" landscape for a given initial condition. The authors are using for their initial condition the sandy equilibrium morphology resulting from Braat *et al.* (2017); and with one initial condition, the model result in Fig. 13 will look the same every time. To generate a range of vegetated surface-area fraction relative to normalised distance upstream, the authors would need to (1) begin with a variety of different patterns of in-estuary bathymetry; (2) test minor variations of the estuary's idealised convergent shape; or (3) a combination of both. Overall, this result would reflect the effect of changing *only* morphology (as opposed to adjusting other input parameters, such as mud fraction or vegetation traits), and thus maintain the simplicity of the present comparison.

I understand the computational expense of running several different idealised estuary planforms to their 1000-year equilibrium, and then conducting the modelling experiment central to this paper. So, short of that, an alternative may be to run more simulations of this experiment with bathymetry *almost like* the 1000-year equilibrium bathymetry from Braat *et al.* (2017) – for example, perhaps the 800–950-year bathymetries, sampled 25–50 years apart.

This exercise would be interesting for a couple of reasons. The ensemble mean of real estuaries in Fig. 13 already reflects variation across a number of snapshots (each estuary at a single moment in time, based on the satellite image in which it was captured). The ensemble mean of model estuaries would reflect something of the century-scale variation inherent in any given estuary. Although not an explicit comparison of like-to-like, the figure would then demonstrate, or at least indicate, the kind of variation possible across examples and within any one example. (A like-to-like comparison would require variations on the idealised convergent shape of the model estuary.)

And a related question, also relevant to Fig. 13 – could the authors also plot (or indicate the range of) the mixed-energy zones in the natural and model examples? That metric, or the basis for that metric, appears in Fig. 11c (for three real estuaries, at least) – I think

adding a column to Table 4 listing the normalised upstream position (relative to the estuary mouth) of the tidal-fluvial convergence would be interesting to see (and, just squinting at Fig. 11c, is probably quite consistent across the examples). Plotting that fulcrum in Fig. 13 would enhance the model-empirical comparison.

I also have a number of minor comments, enumerated below, that might help clarify parts of the manuscript. I wish the authors the best of luck with their revision, and I will look forward to the publication of this work in *ESurf*.

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Specific comments

- Title (and related uses) – I suggest flipping the transition to read "tidal–fluvial transition", since your physical "position zero" reference throughout the paper is the mouth of the estuary. (This switch in the terminology would propagate through the manuscript.)
- Abstract – the first line is a bit misleading. I don't think the question is "<u>whether</u> similar…feedbacks exist" (they do, as the authors demonstrate) but <u>how they manifest</u> in full-scale estuarine settings that is poorly understood.
- Abstract, L5 – the mention of mud in a "sandy" estuary model is confusing here. Suggest deleting "sandy" for clarity. (More detail comes later in the manuscript, anyway.)
- Abstract, L10–15 – These sentences are confusing because the "results show" delivery bounces between the coupled/isolated/coupled results. This full bottom third of the Abstract could be revised for clarity.
- Abstract, L14 – the fluvial-tidal transition is synonymous with the "mixed energy zone"?
- P1, L22 – Cut "It is well known that" and begin sentence with "Vegetation"…
- P1, L23 – Cnclear to what "this" (in "this has also been shown") refers here.
- P2, L1–3 – Restructure this sequence in terms of increasing spatial scale (individual, patch, estuary)?
- P2, L4 – "three biggest challenges to overcome" in what? or with regard to what?
- P2, L8 – Suggest "Our hypothesis <u>derives</u>…" to avoid confusion with other "results".
- P2, L10 – "feedback on estuary size" is unclear, as written – suggest revising sentence.
- P2, L13 – Change "ideal" to "idealised"?
- P2, L22 – Cut "pragmatically".
- P2, L23 – "what explains" is imprecise here – tighten these framing questions?
- P2, L27 – This section doesn't really constitute a review. I suggest merging it into the Introduction without making it stand apart as its own section, and make it do more work for you. In fact, the paragraph beginning at L27 is stronger than similar material

that comes before it – and might easily substitute (more or less) into the very first paragraph of the manuscript.

- P4, L11 – as accretion rates balance with SLR? (switch their sequence here, given implied causality).
- P4, L16 – "importance of the boundary conditions" unclear here.
- P4, L18 – "from the channels into the marsh" is confusing, as written. Reframe?
- P4, L27 – Wherever "in other words" appears, the sentence that follows tends to be excellent, and far more clear than whatever it is rephrasing. Use these sentences as focal points? Move them up in the paragraphs (and cut whatever repetition is less illuminating)? See a similar example at P17, L10–14.
- P4, L33 – "will be based" – here, it <u>is</u> based. (Check tenses throughout modelling description? See also P5, L29.)
- P5, L11 – Cut "It could be argued that" and simplify sentence. Suggest: "Although *Spartina anglica* is not the only pioneer species in these systems (e.g., *Salicornia*), the vegetation modelling here is simplified,…"
- L8, L8–9 – The model's morphological scale factor first appears here, then gets fully explained in the "Parameters" section on P5. Recommend combining these two mentions. The scale factor is basically an accelerator – so I think these lines could move down, to the "Parameters" section, without confusing the description of the hydrology. I suggest amending L8–9 to read: "To calculate mortality due to flooding and flow velocity, the maximum, minimum, and average water depth at each cell are determined during the tidal cycle."
- P8, L32–33 – Sentence is unclear.
- P9, L5 – "i/o" is the only shorthand like this in the manuscript – spell out?
- P9, L14 – Suggest changing "natural systems" here to "real estuaries". More broadly, perhaps the authors should look at where "natural systems" appears throughout the manuscript, and consider when "real estuaries" might be a less ambiguous phrase. For example, at P11, L9, it's immediately clear which "natural systems" the authors are talking about (mud/vegetation processes?), when really they are referring to estimates for the real estuaries.
- P10, L1–3 – Revise to simplify. The "unvegetated" polygons come from Leuven *et al.*, correct? And this analysis adds "vegetated" polygons to that existing dataset?
- P11, L7 – This morphometry/normalisation step is an interesting one, and I encourage the authors to push it a bit further (e.g., to delineate the "mixed energy" transition, as discussed in the main comment, above).
- P13, L1 – Suggest that these deck paragraphs are unnecessary and can be cut. (See also P19, L6–8.)
- P13, L7 – "The mouth of the <u>modelled</u> estuary…"?
- P13, L9 – Edit "more stronger".
- P13, L10 – "optimum" – do the authors mean a maximum?
- P13, 11–12 – Sentence is unclear, as written.

- P14, L5 – "system is very small in this area" – revise to clarify?
- P13–14 – I suggest revising the sequence in which the authors discuss the results. As presented, the reference scenario appears after vegetation- and mud-only; the coupled scenario gets its own section. I recommend the sequence in the text match the sequence shown in Fig. 3. (Note that Figs. 3 & 4 are consistent: reference/veg/mud/coupled.)
- P17, L3 – Sentence is unclear.
- P18, L1–7 – This section on relative flood/ebb dominance is unclear (and may require clarification elsewhere in the document, such as P24, L6, and P24, L23).
- Fig. 12 caption appears incomplete (a, b, c).
- P24, L6–8 – Sentence beginning "Regardless…" is great. But I agree with Reviewer #1 that there is an opportunity here (probably ahead of this sentence) for the authors to briefly summarise what potential (albeit secondary) effects waves and these other environmental factors might have. (Push the mixed energy node up or down the estuary? Widen/narrow the vegetation fringes?)
- P24 – Manuscript ends abruptly with a set of very fine-scale conclusions. Suggest the authors attempt to zoom out to a wider scope of consideration here and frame the implications of these findings, as they do at the end of the Abstract.