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Earth Surface Dynamics Discussions

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Interactive comment

Interactive comment on "Morphology of bar-built estuaries: relation between planform shape and depth distribution" *by* Jasper R. F. W. Leuven et al.

Anonymous Referee #2

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The paper investigates the relationship between estuary planform shape and along-channel variations in hypsometry. The authors recall the definition of "ideal estuary" and assume that along-channel changes in hypsometry (e.g. changes from concave to convex hypsometry) depend on the deviation of estuarine cross-sectional width from the "ideal width" dictated by an exponentially decreasing function. The paper builds upon previous findings by the authors (Leuven et al., 2016, 2017) showing that "excess width" (with respect to the ideal width) allows one to predict the location of tidal bars within the estuary. The new finding is that concave hypsometry occurs where no bars are observed and the estuary width is close to the ideal one, whereas convex hypsometry occurs where extensive bars develop at a given location (or cross section) and estuary width is much larger than the ideal one. The paper is well written and clearly organized. It addresses a relevant issue of practical importance, particularly in view of current anthropogenic influence on estuarine morphology and dynamics. As such, it deserves credit and it will be of interest to the readership of ESurf. I have a few minor suggestions made in the effort to improve an already good paper. General Comments The authors use the “ideal estuary” model that is based on a set of assumptions. The authors then discuss their results by relating them to the ratio between the observed estuary width and the “ideal” width obtained by considering an exponential width variation along the estuary. As noted, the “ideal estuary” model embeds a set of assumptions that should be discussed more in detail. As an example, the authors compare “ideal” and observed widths, but then assume a linear landward decrease in channel depth, whereas the ideal model prescribes a different behavior. As to the use of hypsometry, it should be better clarified, from the very beginning, that the theoretical framework is quite different from the one proposed for river basins (Strahler, 1952) and for tidal basins (Boon and Byrne, 1981) because in this case the hypsometric curve is applied across channel width (it is a cross-sectional hypsometric curve). I find the idea clever and interesting, but I’d like to see some more discussion on the reasons leading the authors to set up such an analysis. In addition, in the case of the river and tidal basin, the morphological evolution was accounted for, suggesting that different shapes of the hypsometric curve were associated to young or old systems. Is there any possibility of making such an analogy within the framework proposed by the authors? Can the framework account for the dynamic nature of estuarine landscapes? I also wonder is the framework could be applied to any type of estuary of if there are some limitations. Can micro- and macrotidal systems behave in a different way? Finally, I remembered of a paper proposing quite a similar analysis (Toffolon and Crosato, JCR 2017). I think the paper would benefit from recalling the results of the above paper (analyses were applied to the Scheldt estuary). In that paper, the authors analyzed the case of U-shaped, V-shaped, Y-shaped cross section. This could be done also within this framework, to predict the tendency of the estuary to develop particular shapes. Detailed comments Page 1, Line 19 change “hydrodynamical” to “hydrodynamic” Page 1, Line 22. It should be clarified that the loss of tidal energy by friction is balanced by the gain in tidal energy by convergence Page 4, Line 5. “width” should be “with” Page 5, Lines 4-5. Actually, this could be the other way round: the presence of bars generates excess width. Page 6 line 1 and line 5. I do not think there is the need to recall that “e” is Euler’s number (actually, eˆ(*-x/Lw) is an exponential function) and “ln” is the natural logarithm. Page 6 line 8. Computation of channel width at the landward limit is unclear. Please explain. Page 7 lines 16-20. These lines should be rephrased. If I understood correctly, in the first case, fitting is performed on both r and z (as in the third case with the inverted function). Page 7 lines 25-27. Please discuss why the inverted function was used. Page 9 lines 5-7. The linear decrease in water depth from the mouth to the landward section is an assumption that needs be discussed (also in view of other theoretical frameworks developed for tidal channels, e.g. Toffolon and Lanzoni, JGR 2010). In addition, is such an assumption consistent with those embedded in the “ideal estuary” model? Page 9 equation (5). Please note that computing the tidal prism by multiplying estuary surface area by the tidal range tantamount to assume a flat water surface elevation along the estuary and moreover does not account for the fact that portions of the estuary area A(t) might get dry during the tidal cycle (see Boon, 1975). Figure 3. This figure should be modified. In my view it is a bit confusing to use the same axes for the two columns of panels. The left column should have plots with “bed elevation” on the vertical axis, while the right one should have h_z. Page 10, Figure 5. How was the typical profile for both cases obtained? Please clarify. Page 10, Caption of Figure 5. “disected” should be “dissected”. Page 10, line 6. “suggest” should be “suggests”. Page 12, line 6. “In general, the width at the mouth of the estuary and at the upstream estuary is close to ideal ...” shouldn’t this be straightforward, due to the fact that you impose those BCs in eq. (2) to compute the ideal along-channel width? Please clarify. Page 12, lines 26-30. The reader might wonder why the predictor equation was not applied to the other two estuaries analysed in the manuscript. Page 15 line 5. I find it difficult to support and discuss the results by citing papers that are still in review or in preparation. Please remove, provide other references or update.

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