Earth Surf. Dynam. Discuss.,
https://doi.org/10.5194/esurf-2020-28-RC1, 2020

Interactive comment on "Dominant process zones in a mixed fluvial-tidal delta are morphologically distinct" *by* Mariela Perignon et al.

Anonymous Referee #1

Received and published: 23 April 2020

This is a very interesting and thought-provoking article that I enjoyed reading. The main contribution of the paper is to set out a new method of classifying zones of homogenous morphology using a machine learning algorithm. The method is illustrated using an example from a delta, specifically the Ganges (GBM) delta. In essence, the approach works by using remote sensing imagery to identify the patterns of channels and islands in the delta, employs a range of morphological metrics, and then the ML algorithm builds and identifies a network of homogenous zones across the area of interest. The result in this study is a map that classifies the delta into 6 main morphologically discrete zones (that are themselves further sub-divided), which in principle relate to different process dynamics in each area. Although in some respects we do not learn anything completely new about the morphological zones of the GBM (a point

I return to below), the method is exciting and interesting and its potential is well illustrated with this particular case study. Specifically, the very large extent of this delta (and its complexity) illustrates very well the potential of the approach to identify process/morphological zones of variable dimensions and across a large area. There is no doubt that the approach has potential to be employed in other morphological settings and, taken together with the point that the methodological aspects of the paper appear to be delivered robustly, I do think that the criteria for publication (significance, scientific quality, and presentation quality) are met.

Having said that, there are some aspects of the paper where I did feel that the overall significance and originality of the work could be better highlighted. Specifically, I had the sense that the paper as it stands does a very good job of describing the method, but it is not as strong at explaining the significance of the work in terms of showing clearly how the method could be applied to gain insight into morphodynamic processes. The paper as it stands builds a classification of process/morpho zones based on a mosaic of satellite images dating from 1990 – if it were possible to repeat the method, using much more recent imagery, it would presumably be possible to demonstrate more clearly how these morphological zones have evolved in space-time in response to some of the changing process drivers that the authors speculate on in their discussion. I do accept that undertaking that analysis is not a trivial task and I emphasise that the paper is acceptable as it stands, it's just that the paper could be magnificent if such an analysis were also included. Admittedly, that magnificence could equally be achieved in an additional paper somewhere down the line!

Irrespective of that suggestion, I have a number of other specific suggestions that could potentially be addressed to clarify further some aspects of the discourse. I now list those here:

1) On p3, L13, the citation to Meshkova and Carling (2013) is slightly misleading. The sentence implies that their paper is about deltas, but it is about a stretch of river well upstream of one. It just needs to be rephrased to make it clear that the process they

used could presumably be applied to deltas. 2) At the end of the introduction (the paragraph at p3-4), I think it would be helpful for the reader to have a stronger and explicit statement here concerning the overall aims and objectives of the paper, but also in particular the originality and significance of the work. How does the new method build on previous approaches and what does that mean for potentially enhancing our understanding of (delta) morphodynamics? In fact this is slightly a recurring theme through the paper. The main result (Figure 5) provides a classification that is not that dis-similar (it does have much more detail) to previous classifications (the authors recognise this as the classes are in essence taken from that prior work). So elsewhere in the paper too the extent to which the new work really offers new insight needs to be discussed and addressed (this concern partly motivates my main suggestion above). 3) In the methods section (p5, final paragraph) I felt that a little bit more detail could be provided regarding the source imagery, rather than relying exclusively on the citation to Passalacqua et al (2013). When I went and read that paper I only then realised that the imagery being used was acquired in 1990, which of course means that the classification that is developed of the GBM's morphodynamic zones is one that is pertinent to conditions three decades ago. . ..this point at least needs to be absolutely clear to the reader. 4) In turn, this point raises some further questions about the way in which the mapping results are interpreted. Throughout the paper it is implicitly and explicitly assumed that the distinctive morphological zones represent distinctive *process* zones. This is not an unreasonable assumption, but presumably the morphological zones represent the outcome of ongoing dynamic processes whose response and relaxation times vary according to spatial scale, such that the observed morphology is presumably not instantaneously responsive of process conditions in 1990, but rather also reflect process conditions years or decades before. I would like to see a clearer discussion of this point because this would aid in understanding how a classification approach such as this – which is geared towards working at large spatial scales because of the advantages of the remote sensing and ML techniques – can adequately reflect (lagged) processes operating over those large spatial scales. The answer to

that question fundamentally conditions the utility and hence significance of the new approach in terms of understanding process dynamics. Also on this theme, I wonder if the paragraph from L24 in section 5.2 should also be modified to reflect this point more closely. Specifically, the authors comment on their analysis not yet detecting the amplified tides and prevented sedimentation identified in previous work – but in relation to the Pethick and Orford study there is only a single gauge (at Khulna) that has any data before the 1990 acquisition date of this study, and actually the increase before and up to 1990 (the period that is pertinent to the acquired imagery, as per point 3) is not very large. So, I am not surprised that they find this result, it's just that my interpretation of why the authors do not is different from theirs (image resolution, feature discrimination, etc).

Finally, I would like to suggest also that some minor modifications to some of the Figures (which in general are very good) may help the overall clarity of communication. In particular: âĂć I found it very hard to discriminate the two white lines demarking the tidal extent and backwater extent on Figure 1. Perhaps the use of an alternative (bright) colour for one of these lines would help? âĂć On Figure 4, it was not clear to me (presumably they mark ranges of correlation coefficients) what the significance of the coloured shading of the cells in the matric represents. Either a legend needs to be added to illustrate the meaning of the shading, or perhaps add some detailed text to the figure caption for the same? By the same token, there is not enough information in the figure caption to be able to understand what the line and scatter plots actually represent (at least without extensive cross-referencing to the text). âĂć I wondered – this is not a critical point – if the logical sequence of diagrams should actually be that Figures 6 and 7 (which outline in effect the inputs into the overall classification) should precede Figure 5, which is the outcome of the classification process? In any case, as with Figure 4 I felt that the figure caption and legend for Figure 5 could be a little bit more detailed. It took me a little bit of work to figure out exactly what the 6 classes in the caption are (and the 14 clusters) – adding the details of the 6 classes to the caption would be helpful.

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