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Interactive comment on "A global delta dataset and the environmental variables that predict delta formation" *by* Rebecca L. Caldwell et al.

Anonymous Referee #3

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General comments

This paper presents a valuable dataset of the global distribution of coastal rivers and deltas. The authors conducted a statistical analysis using available data for upstream (Qw, Qs, basin area) and downstream (significant wave height, tidal range, modern sea level rise rate, and nearshore basement slope) variables to determine which variables best predict the existence of a coastal delta, defined as either a protrusion from the shoreline or a visible distributary channel network with more than one channel. Overall, the paper is well-written, the figures are clear, appropriate, and informative, and the statistical analysis provides some useful interpretation of controls on delta existence. I do, however, have several concerns that can be addressed with a bit more data analysis and some reframing of the paper.

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Specific comments:

Major:

My first and largest concern is with the presentation of the constructive vs. destructive argument. The current manuscript implies that this is a new idea and a new way of thinking about delta formation, when in fact this idea has been widely discussed in the deltaic literature (both sedimentology- and geomorphology-related) since at least the 1960s. Yes, it is slightly in contrast to the Galloway diagram, but it is not in contrast to an abundance of delta literature. It needs to be made clear through (1) an enhanced discussion section (and possibly some more background as well) and (2) increased referencing throughout the paper that this idea is not new. What **IS** new and exciting is that you can start to quantify this with the data presented in the current manuscript, showing that you have indeed significantly advanced the science while still giving sufficient credit to the vast quantity of existing literature that presents or at least references this framework. I have listed some references for you below, compiled from only a very quick search.

Second, you chose not to include basin depth as an environmental variable in your analysis, and you state that that is because the basin depth at the time of delta formation cannot be known from modern bathymetry. You have a similar statement regarding the last 26 years of sea level data. Unfortunately, this is also true for all of the variables you include. Many of these deltas are thousands of years old, at least. How can you take modern river discharge and relate it to delta formation without knowing if the modern river discharge is responsible for modern delta existence? I have two suggestions to remedy this because I still believe your analysis to be a useful one, despite the obvious problem of time. (1) Be abundantly clear in your language throughout the paper that you can map delta existence (not formation) in the modern state and you have some modern environmental variables, but provide the caveat that deltas were formed by past environmental conditions that are largely impossible to know. This is

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an easy partial fix, although somewhat unsatisfying, but absolutely needs to be stated up front. It is absent from the current manuscript in regard to all other variables. (2) For a **subset** of river systems, compile any and all regional historic climate data (may also include paleo reconstructions) to evaluate how the regional conditions were different in the past or perhaps even at the time of delta formation. This will at least give you a distribution of how conditions may have changed over longer timescales and will allow you to determine if some systems might be moving more towards constructive or destructive phases.

Third, I know that data on upstream and downstream variables is difficult to assemble, especially if you want all apples instead of a mix of apples and oranges. However, I find it surprising that you chose to use only one dataset of river discharge from 2011. Is there not any additional discharge data that can help you use more of your river/delta dataset in your statistical analyses? Have you checked the Global Runoff Data Centre or maybe even the Global Forest Information Service? Increasing your data usage can only make your own dataset(s) more valuable to the community.

Finally, the paper needs a bit more information on the datasets involved in this study. How did you map the rivers and deltas? Entirely by hand? Over what timeframes are your discharge data? I can go pull the MF2011 dataset myself, but this should be included in your manuscript, as it is for the marine data. Your supplemental table is helpful, but please also include in it your mapped river widths and the values of Qw, Qs, and Ab.

Minor:
The introduction would benefit from elaborating on what we DO know about the conditions that lead to delta formation. You state that they are not completely known, but you fail to really provide much information about what we do already know, either from a fluid dynamics perspective, sediment supply, or even things like effects of basin depth on delta formation.

Page 3 line 21: How do you determine (quantitatively) if the protrusion has a 'relatively smooth depositional shoreline?'

Why did you choose the 75th percentile of bathymetric slopes?

Page 10 Line 15-16: There is no apparent linear decrease.

Page 10 Line 21-22: Reserve this observation for the discussion, as it is elaborated on sufficiently there.

Figure 7: Is there a reason this can't be shown with all the data rather than binned data? At least include as supplemental, if not in the paper itself.

Page 15 Lines 3-5: But there is a concern with preservation in the rock record as well that makes this difficult.

Technical corrections:

Figure 1: Please provide the locations of the coastal environments shown in the caption.

Page 4 Line 15: 'representative of the river, devoid **of** significant downstream widening.'

Figure 2: Add to caption what the bounding boxes are or where they're discussed in the manuscript.

Page 7 Line 19 (and elsewhere basin bathy/depth is mentioned): Add appropriate references. Eg. Carlson et al., 2018, Wang et al., 2019

Page 10 Line 11: 'between the mean **or** median Qs/Qw values'

Page 11 Line 6: Your independent variables were not 'collected on all rivers,' as you state in the next sentence. Please reword.

Page 13 Line 4: If downstream variables are secondary, reword/reorder to reflect that.

References:

Destructive vs Constructive:

Edward J. Anthony, Wave influence in the construction, shaping and destruction of river deltas: A review, Marine Geology, Volume 361,2015, Pages 53-78, ISSN 0025-3227, https://doi.org/10.1016/j.margeo.2014.12.004.

Fisher W.L., Brown L.F., Scott A.J. and McGowen J.H. (1969) Delta systems in the exploration for oil and gas, pp. 78 + 168 figures and references. Bur. econ. Geol., Univ. Texas, Austin.

Liu, J.P., D.J. DeMaster, T.T. Nguyen, Y. Saito, V.L. Nguyen, T.K.O. Ta, and X. Li. 2017. Stratigraphic formation of the Mekong River Delta and its recent shoreline changes. Oceanography 30(3):72–83, https://doi.org/10.5670/oceanog.2017.316.

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Stanley, D.J. and Warne, A.G., 1998. Nile Delta in its Destruction Phase. Journal of Coastal Research, 14(3), 794-825. Royal Palm Beach (Florida), ISSN

Other:

Carlson, B., Piliouras, A., Muto, T., Kim, W. (2018). Basin water depth control on channel morphology and autogenic timescales in deltaic systems. Journal of Sedimentary Research, 88, 1026–1039.https://doi.org/10.2110/jsr.2018.52

Wang, J., Muto, T., Urata, K., Sato, T., Naruse, H. (2019). Morphodynamics of River Deltas in Response to Different Basin Water Depths: An Experimen-

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