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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Large-scale impacts of hydropower development on the Mompós Depression wetlands, Colombia" *by* Héctor Angarita et al.

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We would like to thank the reviewers for their time and for their thoughtful comments. The comments led to some additional analysis and substantial improvements to the manuscript. Please find below our responses to each comment.

Note: updated version of the manuscript is included with the responses.

0. The only major caveat I encountered was the vague description of the Reservoir-Simulator model used, which has only been presented in conference proceedings and a thesis before. Author response: A description of the Reservoir simulator model has

been included as supplementary material. Changes in Manuscript: Added section SI-1

1. Page 1, line 14: please add the actual area (in km2) of the Mompos Depression wetland under study. Author response: Fixed Changes in Manuscript: Now reads: "one of the largest wetland systems in South America at 3400 km2"

2. Page 1, line 27: episodic inundation of the floodplain during dry periods? I presume this refers to dry years rather than dry season, please clarify Author response: We meant the seasonal oscillation of wetlands during dry years. Changes in Manuscript: the manuscript now reads: "similar magnitude to existing fluxes involved in the episodic inundation of the floodplain during dry years and"

3. Page 2, line 7: first reference should be Dynesius and Nilsson, not Nilsso. Author response: Fixed. Changes in Manuscript: Reference now reads Dynesius and Nilsson.

4. Page 3, line 3: when referring to the different hydrological characteristics of rivers that exhibit non-linear cumulative behavior, what does temporality refers to? Is it the same as timing? Author response: Yes, "timing" is what was meant. Changes in Manuscript: Now reads "changes in the magnitude, frequency, duration, and timing of river. . ."

5. Page 3, line 17: Please provide the hydropower capacity (in GW) associated with that 43Author response: Agreed, we adjusted the text to include that information. Changes in Manuscript: Now reads: "Medium and large hydropower plants in the Magdalena River basin (MRB) with a total capacity of 6.89 GW currently supply 49

6. Page 3, line 29: When mentioning "large-scale" impacts (here and throughout the text), I suggest that the authors are more specific as the audience of this journal can have different interpretations of what large-scale is (continental or global?). I think "basin-scale" is the most appropriate term. Author response: Agreed Changes in Manuscript: All instances of "large-scale" changed to "basin-scale"

7. Page 4, line 5: Mosaic is a more appropriate ecological term than patchwork, in

my opinion. Author response: Agreed. Changes in Manuscript: Manuscript now reads "The Magdalena River is located in the Northern Andes Mountains and drains a biodiverse mosaic of ecosystems. . ."

8. Page 6, lines 1-4: what is the source of this information? Author response: Data is provided by XM, company in charge of the operation of the Colombian energy market. Changes in Manuscript: The corresponding reference was included.

9. Page 6, lines 1-12: Here a general description of the ReservoirSimulator is provided, but given that such model has not been published in the international scientific peer-reviewed literature before, I wonder if this is a good opportunity to present in more depth some of the algorithms used. This could become part of the Supplementary data. Author response: Agree. Changes in Manuscript: A section "Supplementary Information" has been added with a description of the ReservoirSimulator routines

10. Page 8, line 4: What is the temporal resolution at which the Dendy's formula is used? Also, please make sure that all terms in the equation relate to the written description (capacity/inflow ratio, in particular). Author response: Dendy's formula is based on annual data. Capacity is C and Inflow I. Changes in Manuscript: Now reads "Dendy's method is a revised Brune curve, which uses an empirical expression to estimate the long-term average reservoir sediment retention efficiency based on the ratio between capacity (C) and average annual inflow (I). A higher ratio indicates higher sediment retention efficiency, TE, as described by the following equation: TE=100*(0.97)$^{(0.19^{Log(C/I)}}$

11. Page 11, line 16: please make sure that the use of the terms "ecodeficit" and "ecosurplus" is correct and consistent throughout the text and figures. Author response: Thank you for this note. Changes in Manuscript: We went through the document to verify consistency of the terms and made changes as necessary.

12. Page 13, lines 23-25: Here the authors state that they found a high inverse correlation between migratory connectivity and sediment trapping. Do you have a figure

to support this? Perhaps a separate frame in Fig 9. Highlighting this finding could be important as it might be very relevant to other large tropical rivers undergoing similar tradeoffs. Author response: We updated Figure 9, to include a more detailed display of trade-offs between the considered impacts. Changes in Manuscript: Figure 9 changed.

13. Page 13, line 33: please add the number of scenarios (5): "It should be noted that all 5 scenarios are plausible..." Author response: Change made. Changes in Manuscript: Manuscript now reads "It should be noted that all five scenarios are plausible. . ."

14. Page 14, line 18: here authors say the acceptance value for NSE is 0.65, but figure11 has NSE> 0.75 shaded. Please fix. Author response: Change made. Changes in Manuscript: Corrected figure.

15. Page 16, lines 25-33: in addition to this interesting discussion on sediment trapping, could you also comment on how that could affect the operation and longevity of hydropower dams in the Magdalena? Would there be any risks that the high rates of deforestation could make sediment accumulation much higher? Are there any measures or incentives from the hydropower sector to abate this potential issue? Author response: We do not have the full data needed to assess the rate of capacity loss of dams due to sediment trapping. In particular, we don't have data on sediment bedload transport. However, we added mention of the need to consider sediment trapping in the planning of site locations due to comparative rates of sediment inflow (see noted change below). As for the impact of deforestation, it would likely increase sediment accumulation, but such an analysis is beyond the scope of this project. Changes in Manuscript: We appended the results section with the following: "It is worth noting that in all the scenarios considered additional regulation in the Cauca has little to no additional effect on sediment transport reduction; this is due to the high sediment trapping of the baseline condition, and specifically due to the high sediment retention efficiency of Projects 2 and 21. As a result, those projects will be subject to high sediment input that will affect their longevity."

16. Page 17, line 5: I believe that this is the first time the term "reference period" is mentioned, although it is presented in figure 10. A quick explanation in the methods of what the authors mean by reference versus baseline periods would be helpful. Author response: Agreed. Changes in Manuscript: We indicated the reference period in section 3.1.1. The text now reads: “From the subset of scenarios that meet projected hydropower expansion by year 2050âĂŤan equivalent hydropower capacity of 15.25$\pm$0.5 GW, or +125

17. Page 17, line 31: please add the word “with” to “Hydrologic alteration in combination with over-fishing...” Author response: Change made. Changes in Manuscript: Manuscript now reads “Hydrologic alteration in combination with over-fishing and habitat conversion. . .”

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-544/hess-2017-544-AC1-supplement.pdf

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