



EGUsphere, referee comment RC3
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Comment on egusphere-2022-403

Anonymous Referee #2

Referee comment on "Patterns and drivers of water quality changes associated with dams in the Tropical Andes" by R. Scott Winton et al., EGU Sphere,
<https://doi.org/10.5194/egusphere-2022-403-RC3>, 2022

General comments:

Overall the paper has strong scientific significance and quality as well as strong presentation quality. The authors show how Colombian dams drive changes in temperature, dissolved oxygen, and suspended sediment in rivers using monitoring data. They also show if and how stratification is observed in reservoirs, and how that relates to downstream impacts. They connect their findings with the drivers such as the upstream catchment properties and dam design, and thus make a strong practical connection. The impacts on aquatic ecosystems of the tropical Andes are also presented. The authors end with clear and concise recommendations to regulators and planners, which makes it potentially highly impactful and socially-relevant. The authors connected all of these themes seamlessly and made it an enjoyable and insightful paper to read.

The authors were working with a limited dataset due to the data scarcity in the tropical Andes, which is a common challenge in other parts of the world where dams are booming. Thus, this paper has implications beyond the tropical Andes. The figures communicate clearly important information and are helpful models for other studies to follow.

I have made minor comments which I hope will help make the manuscript even stronger, as outlined below. While the literature review is overall good, I believe the paper would benefit integrating information from other literature in other places, as I mention in the specific comments. I also believe that the authors have strong communication to regulators and planners, but could make some slight improvements for an even stronger impact. Lastly, I think that there could be a few more sentences towards the end that connect to the regional and global implications of the study (I didn't have any specific comments on this). I think it's pretty clear from the introduction, however would be interested to see more directly what the broader implications are for reservoir impacts on water quality from the perspective of the authors. Thank you for this important work!

Specific comments:

Lines 38-39: I question the use of “unintended”... it seems that consequences of dam construction now are well-known globally so I’m not sure that it can be generalized that consequences are unintended.

Line 55: A recent and relevant study that you may consider citing here is the following:

Flecker, Alexander S., Qinru Shi, Rafael M. Almeida, Héctor Angarita, Jonathan M. Gomes-Selman, Roosevelt García-Villacorta, Suresh A. Sethi, et al. “Reducing Adverse Impacts of Amazon Hydropower Expansion.” *Science* 375, no. 6582 (February 18, 2022): 753–60. <https://doi.org/10.1126/science.abj4017>.

Lines 55-58: It seems that some of these are specific to the Amazon, not global studies as the sentence implies. Consider using all global studies. Some examples to be considered are below:

Fragmentation:

Grill, G., B. Lehner, M. Thieme, B. Geenen, D. Tickner, F. Antonelli, S. Babu, et al. “Mapping the World’s Free-Flowing Rivers.” *Nature* 569, no. 7755 (May 2019): 215–21. <https://doi.org/10.1038/s41586-019-1111-9>.

Sediment:

Vörösmarty, C. J., Meybeck, M., Fekete, B., Sharma, K., Green, P., & Syvitski, J. P. M. (2003). Anthropogenic sediment retention: Major global impact from registered river impoundments. *Global and Planetary Change*, 39(1–2), 169–190. [https://doi.org/10.1016/S0921-8181\(03\)00023-7](https://doi.org/10.1016/S0921-8181(03)00023-7)

Syvitski, J. P. M., Vorosmarty, C. J., Kettner, A. J., & Green, P. (2005). Impact of Humans on the Flux of Terrestrial Sediment to the Global Coastal Ocean. *Science*, 308(April), 376–381.

Line 61: Flecker et al. (2022) (cited above) could also be a good example of a regional study. There are also several examples of strong regional studies from the Mekong river

basin, such as the following:

Kummu, M., X. X. Lu, J. J. Wang, and O. Varis. 2010. "Basin-wide sediment trapping efficiency of emerging reservoirs along the Mekong." *Geomorphology* 119 (3–4): 181–197. <https://doi.org/10.1016/j.geomorph.2010.03.018>.

Line 70: These parameters "are fundamental to the condition of aquatic ecosystems" seems vague. Perhaps it should be "are fundamental to understanding the condition".... Or discussion about how the parameters being in specific ranges is fundamental to maintaining healthy aquatic ecosystems.

Line 99: Consider providing the link to the data source

Lines 101-102: Were you only able to access/analyze 2017-2018 data, and not other years? Or did you only select those years? Perhaps it would help to clarify so that readers better understand accessibility.

Line 124: I think "We feel that" should be removed as it dilutes the recommendation and makes it seem like an opinion that can more easily be ignored by regulators

Lines 212-215: This is an important point- perhaps it can be stated earlier in the paragraph as a topic sentence.

Line 264: See Dunn et al 2019 as another relevant (and more recent) study

Dunn, Frances E, Stephen E Darby, Robert J Nicholls, Sagy Cohen, Christiane Zarfl, and Balázs M Fekete. "Projections of Declining Fluvial Sediment Delivery to Major Deltas Worldwide in Response to Climate Change and Anthropogenic Stress." *Environmental Research Letters* 14, no. 8 (August 1, 2019): 084034. <https://doi.org/10.1088/1748-9326/ab304e>.

Lines 278-311: This section is strong, however mainly focuses on the need to increase monitoring frequency. There were other regulatory implications discussed throughout the text, such as the need to change the temperature regulation from 5 deg C to 2 deg C. I think it would help to briefly reiterate those various items in this section. It's possible a regulator would skim the rest of the paper and look closely at this section—what would be the most important things to reiterate?

Line 302: Would satellite remote sensing be another viable option for monitoring some of the parameters, for at least a first-order approximation? Since in situ monitoring in the Andes is challenging, it seems to be a practical option to consider. There would be several limitations to consider, of course. I am aware of studies in the Mekong River basin where satellite data is used to monitor impacts of dams on sediment and temperature—see citations below (you don't necessarily need to cite them in your paper, but perhaps they could help your investigation)

Bonnema, Matthew, Faisal Hossain, Bart Nijssen, and Gordon Holtgrieve. "Hydropower's Hidden Transformation of Rivers in the Mekong." *Environmental Research Letters* 15, no. 4 (April 1, 2020): 044017. <https://doi.org/10.1088/1748-9326/ab763d>.

Beveridge, Claire, Faisal Hossain, and Matthew Bonnema. "Estimating Impacts of Dam Development and Landscape Changes on Suspended Sediment Concentrations in the Mekong River Basin's 3S Tributaries." *Journal of Hydrologic Engineering* 25, no. 7 (July 2020): 05020014. [https://doi.org/10.1061/\(ASCE\)HE.1943-5584.0001949](https://doi.org/10.1061/(ASCE)HE.1943-5584.0001949).

Figure 1: Consider labeling the hydropower reservoirs on the map, since you refer to them by name in the text/figures, and the relative location seems to be important. Or, at least label the eight reservoirs in Table S3. I understand that labeling the reservoirs might make the figure too busy, but you could also use numbers to label in the map and add a table. Could also consider adding major cities, such as Medellin and Bogota (since urban effects are discussed in the text)

Figure 3: Consider adding horizontal lines for + 2 degrees and - 2 degrees (they could be in another color like gray?), since that's an important threshold that you mention. Could also indicate the regulatory limit (5 deg) to emphasize the difference (which could help with messaging to regulators)

Figure 4: Consider adding line for -2 mg/L since this is the threshold that makes the downstream waters below the regulatory limit.

Technical corrections:

Line 128: "we are unlikely to [be] capturing"—need to add "be"

Line 180: Grammar is awkward— perhaps say “while other reservoirs” or “and other reservoirs”

Line 247: Here you say “the authors” but in other parts you say “we” – edit for consistency

Line 258-259: Need comma after “delivery” for consistency. Also, would be good to clarify that “downstream” refers to reaches downstream of the dam but upstream of the delta. Consider breaking this into two sentences to clarify these things as they might be confusing for people not familiar with the concept.

Line 299: should be “justifies” and no comma is needed before that

Figure 1: In legend for hydropower reservoirs, it should be $>70 \text{ km}^2$ (not $<70 \text{ km}^2$).

Figure 4: Y-axis on left side should be “DO” not “OD”

Table S2: “Reserervoir” should be “Reservoir”