

Preface

As authors of the manuscript egusphere-2022-1375, titled: "A DOM continuum from the roof of the world - Tibetan molecular dissolved organic matter characteristics track sources, land use effects, and processing along the fluvial-limnic pathway", we wish to express our gratitude to the anonymous reviewer No.I for thorough check and productive comments.

General Statement:

We will revise the manuscript to be more specific about the "central theme" missed. Indeed, we will highlight the differences along the fluvial-limnic continuum with more respect to endmembers as one part of the storyline (I) and transformation as the other part of the storyline (II).

As of Figure 6; from line 521 to 572 we dedicate a longer paragraph about the lake reactor and its transformations. Table 2 and Figures 3, 5 and 6 document parts of the transformation effects. However, we do see that the information should be better managed in the respective paragraph (i.e. 4.3) and will consider additional visualization such as "van Krevelen loss plots". Figure 6 shall be understood as an exemplary spotlight on one mass as a *pars pro toto* visualisation.

Detailed comments:

Abstract general comments: we will condense the abstract

26: We prefer to keep this statement because it is directly linked to the motivation and the research question. Pasture degradation is in part a climate change manifestation.

27: You are right, the comparison between glaciated and non-glaciated watersheds did highlight the specificity of glaciation as a determining factor. We will rephrase here.

30: Will be removed and rephrased

31: We will condense here

33: We will rephrase this and argue with the fluvial-limnic pathway that is already used in the title of the MS

33: Since degradation drivers are mixed and still under debate we will change this to more defined vocabulary

38: We will condense the introductory part of the Abstract, however not all readership can be considered to be well acquainted with the natural settings and

challenges of High Asia, so we argue that some introduction is necessary. There is debate if "endmember" is a standing term in hydrology, we will nevertheless explain it. The outcome that DOM differs is maybe expected, but we refrain from calling that weak. There was not much research done on High Asian DOM; and DOC loads are low, we think it is a strong finding that so much diversity is carried in DOM.

39-49: Will be rewritten

50: Thanks, we will put this in the forefront of the abstract

54-56: We will rephrase and keep this as a final statement

57: The definition of how water quality exactly is measured is of course open. DOM is an important part of the terrestrial-aquatic carbon and nutrient cycle and as this of OM cycling. We think that all changes in the riparian interface will impact on DOM characteristics. We will rephrase the sentence to reduce ambiguity.

59: We will add e.g. "DOM photooxidation" to state that it is a process and add graphical elements to distinguish from "pasture degradation"

Introduction

62-71: We will shorten this paragraph, however we argue that DOM and its characteristics translocated with the freshwater will be affected by pasture degradation (as we have corroborated) and that this in turn can affect freshwater quality.

69: peak-water is a standing term in socio-ecology and deeply related to "fossil" glacial water sources. Will be removed

70: Will be removed

74: Will be condensed to the end of the Introduction section

74-76: Will be changed; most likely to indicators/ indices. We will introduce the concept of a molecular fingerprint which is better depicting our experimental setup. The word "marker" will be removed throughout the manuscript

76-79: We will rephrase this accordingly and remove the "marker function"; We argue that the comparison of two glaciated watersheds, and one non-glaciated watershed which is highly degraded, is a functional comparison of anthropogenically altered vs. more natural systems.

85-86: Will be deleted.

91-99: We think that a general geographical introduction and an introduction into the study object (DOM) should prequel this section. We will expand on the introduction of the *Kobresia pygmaea* pastures and the Nam Co lake.

102-118: Both questions are indeed large and they represent two major research gaps. From this we deduct four hypotheses. We would like to keep four hypotheses, but we will rephrase the hypothesis since they appear not to be straightforward enough. We will formulate hypothesis that can be answered with "yes" or "no" and this will also imply clear statistical evidence, which we will present.

111: We perform a carry-over of the respective definition from the literature we rely on here. We will make that clear. We will omit to state some formulae as being recalcitrant. We will identify that recalcitrant in our study always mean intrinsic stability under certain environmental conditions. Also pointing to the fact that a change in condition will lead to different biogeochemical outcomes.

117-118: We will broaden the wording of this hypothesis. In general, we expect here an immense shift in DOM characteristics between a large endorheic lake and its terrestrial tributaries. There is indeed +20yrs of evidence that DOM of large lakes can differ from tributary DOM (https://link.springer.com/chapter/10.1007/978-3-662-03736-2_5), this makes it plausible to come up with this hypothesis ex ante. We will improve the hypothesis according to the comment in line 102-108 (see above; yes vs. no + clear evidence).

121-141: In this study we follow a description-scheme from hilltop to lake, we think it is easier this way, since it follows the hydrological cycle.

169: Wetland water will be highlighted by a halo. Figure 1 d(c) -> bottom left will be replaced by a more straightforward version.

274-277: Thanks 😊

279-367: We will go through the section and thoroughly revise the content. Section will be shortened.

344 - Figure 2: We used the Viridis colour palette of R that ensures good readability also for larger amounts of classes; after double check with the colour blind tool provided by EGU we found the combination of colours in connection with the clear orientation of bars to suffice for this issue. We will add descriptive information to the x axis labels and populate this through the text where possible

and useful (i.e. once per paragraph)

367: If the reviewer does not object, we would like to keep the right end label of the X-axis, to populate "sample category" throughout the text.

369-393: In section 2.5 we describe the application of external environmental predictor variables that were obtained from a prior investigation. For the external variables, we will introduce these variables so that the readership is not left empty-handed. The internal predictor variables are extensively described in this text, under 2.4.

408: We agree that this section needs clarification, and we will improve it. For clarification: *Indeed, the main point is that DOM of Qugaqie (strongly glacial-fed system) is influenced by terrestrial DOM to a large extent, visible e.g. by I_{Terr} values (Table 1). Nevertheless, the negative CHO and the composition-shift towards larger relative contribution of O-poor compounds indicate a lower microbial breakdown of terrestrial-borne compounds, corroborated by D'Andrilli (2019): In their study, mostly O-rich molecular formulae were produced after incubation of DOM substrates, while substrates initially had more O-poor formulae*

413-422: Spacing will be corrected.

427: Right, we were missing "mass", sorry

439: We do share your understanding of recalcitrance as a non-functional concept Especially when the impression is evoked that certain components are ultimately stable. We will disclaim the concept of recalcitrance more clearly as indicated in the comments of **line 111**

446-449: We will further elucidate on this and we think that the terminology of land-use control is not as suitable as e.g. "influenced by land use". Further, we will revise the MS to increase connection between results and discussion.

449: We will remove the expression.

483: The indicated in **comments 111 and 439**

488-490: Under this definition our study setup does not support a marker application indeed, because we cannot control all (or even most) of the external effects. We will refrain from the marker wording and rephrase accordingly.

497: We will further clarify the mechanism of wetland degradation and how they can become endangering for downstream ecosystems by nutrient subsidies.

498: We will use "cumulate" or "group together" instead.

512: We will enhance the visibility of ledger and regression lines, but we would like to keep the figure in its current form apart from that.

535: connected to comment of "**General statement**": This range is a representative selection of a relative high molecular mass area (max. was 2000 Da). This area is representative of the processes that DOM undergoes in the lake reactor especially for aromatic compound groups. We will clarify and elucidate on this and we will prepare a van-Krevelen plot highlighting the diminished and disappeared molecular formulae when comparing lake DOM to stream/brackish DOM. We will further clarify that Figure 6 is a representation of the results already discussed. We will further zoom into a more narrow nominal mass areas and clearly depict formulae, so that readability is increased for this figure.

545: Will be clarified in accordance with **535**

564: Will be removed

565-566: "millennial-scale" will be removed

566: We will remove the citations and statements concerning arctic rivers and open ocean systems. To our knowledge there is only limited application of FT ICR MS in High Asia so far, but we will inquire for systems that are more suited to be compared (e.g. Lake Qinghai <https://doi.org/10.1021/acs.est.0c01681>; or other alpine lakes)

570-571: You are right that with the 30 m sample we see very processed DOM compared to watershed influences. We will rephrase the statement to what it is, i.e. we see altered and differing signatures in lake DOM compared to streams asf., which likely result from processing in the lake.

To state a lake uninfluenced from inflows we would need a time perspective that we currently do not have, so we corroborate your statement.

573-626: We will make the conclusions more concise and synchronize with the revised abstract.

609: You are right, should not be stated here in the conclusion; Will be removed

621: All "open-ocean" comparisons will be removed throughout manuscript

625: We will remove all these statements throughout the manuscript and name this

"a high-resolution investigation"

626: In this study we have, in large parts, identified the effects of the local sources on stream and lake DOM characteristics. From this aspect the Nam Co watershed can still stand as a case study representing the general inventory and processes of wider parts of the southern TP which have comparable natural features. We will rephrase this part.