Responses to the comments on the Manuscript "High-resolution datasets for lake level changes in the Tibetan Plateau from 2002 to 2021 using multi-altimeter data"

Dear editor,

The authors would like to express thanks to the anonymous reviewers for their voluntary work and the constructive comments to improve this manuscript. All of the comments are of great benefit to us. During the past few days, we did much work to revise the manuscript according to the reviewer's comments. All of the comments have been addressed. Our revisions are as follows.

RC1: 'Comment on essd-2022-313', Anonymous Referee #1, 17 Nov 2022

This study provides the time series of water level for lakes in the Qinghai-Tibetan Plateau between 2002 and 2021 using altimeter data from Envisat, ICESat-1, CryoSat-2, Jason-1, Jason-2, Jason-3, SARAL, and Sentinel-3A. The water level data in 2002-2021 provided by this study is not new, and have been reported by couple of previous studies. This study did not present well such as time series of lake level and not story focused such as the mention the discharge without close relation with study study. Moreover, the authors did not know the background information of lakes over the Tibetan Plateau well. I can not recommend the publication of this manuscript (dataset).

Reply: Although the water level data provided by this study is not new, we provide the largest number of monitored lakes among the available studies. In the revised version, we added the analysis of the variation of lake level in different basin, while the discharge mentioned in the manuscript is mainly to illustrate the application of lake level data, which refers to the fact that we can explore the regulation of the rivers associated with the lake using lake level data.

1) Although this study provides the time series of water level of lakes in the Qinghai-Tibetan Plateau from eight altimetry products, this dataset is not new compared with published studies, especially in a limited period (2002-2021). Hydroweb and other websites have provided open access lake level data since 1992, which has covered the altimetry data used in this study.

Reply: These eight altimetry products are already used in published studies, but the number of lakes monitored based on them is very limited, as can be seen in the following table.

Reference	No. of Lakes	Period	Data Source	Dataset Public or not

Jiang et al. (2017)	70	2003-2015	IceSat-1, Cryosat-2	N
Zhang et al. (2017)	68	1989-2015	IceSat-1, Landsat	N
Li et al. (2017)	167	2002-2012	IceSat-1, Envisat	N
Hwang et al. (2019)	59	2003-2016	Jason-2/3, SARAL, IceSat-1, Cryosat-2	N
Li et al. (2019)	52	2000-2017	Jason-1/2/3, Envisat, Cryosat-2, IceSat-1	Y
Zhang et al. (2019)	62	2003-2018	IceSat-1/2	Y
Hydroweb (Cretaux et al. 2011)	36	1993-2022	ERS-2, Envisat, T/P, IceSat-1, SARAL, Jason-1/2/3, Cryosat-2, Sentinel-3A	Y
DAHITI (Schwatke et al. 2015)	62	2003-2022	ERS-2, Envisat, SARAL, Sentinel-3A, Cryosat-2, IceSat-1, Jason-2/3,	Y
This Study	361	2002-2021	Envisat, SARAL, IceSat-1, Cryosat-2, Jason-1/2/3, Sentinel-3A	Y

As we know, a large number of lakes exist on the Tibetan Plateau, and monitoring the water levels of these lakes is very important for understanding the water cycle on this plateau. Our study monitored the largest number of lakes with an area greater than 10 km^2 compared to previous studies. We believe that more monitored lakes will be useful to find more details driving mechanisms, and patterns of changes in the Tibetan Plateau. Therefore, this is also the objective of this manuscript.

2) The presentation of this study is not good such as Figures 3 and 4. Flowchart 1 and 5 should be combined together. For a scientific paper, the figures should be drawn by a scientific standard. Moreover, the offset among the different altimetry data was addressed? How?

Reply: Thank for your comments. We have combined the Figure 3 and 4, and drawn the figure again, please see the revised manuscript. Since Flowchart 1 and 5 represent different processes for altimetry data, Flowchart 1 is mainly the waveform retracking processing of altimetry data, while process 5 is mainly the fusion processing of water level data extracted from multi-source altimeters, which are different and not suitable for merging, so the two flowcharts are retained.

In this manuscript, the main merged method removes the offset between different altimetry data by subtracting the mean discrepancy obtained during the overlap period. Thus, we will pick the dynamic reference time series to make the mergerd time series as long as possible for each time in case there are no overlap period.

On the other hand, it also exists some lakes with no overlap period when merging ICEsat-1 and Cryosat-2. In this case, we will consider using a combined linear-periodic-residual model (Liao et al., 2014) to simulate and forecast lake-level time series in the no-overlap period, and then make it possible to obtain the offset between ICEsat-1 and Cryosat-2. These details are presented in section 3.2.

3) What is the difference of boundaries between Qinghai-Tibetan Plateau and Tibetan Plateau? How the comparison of time series of altimetry data and in-situ? Why the streamflow and discharge data are used, but the analysis of water level and advantage of your study are not clear?

Reply: There is no difference of boundaries between Qinghai-Tibetan Plateau and Tibetan Plateau. In China, people used to call Qinghai-Tibetan Plateau (QTP), but internationally, it is used to call Tibetan Plateau (TP). To avoid misunderstanding, we have revised as the Tibetan Plateau in this manuscript.

Due to the unknown datum of in situ data, here we consider comparing the water level anomaly between in situ data and lake level in this study by removing the mean value over the validation period. In the revised vision, in order to show the validate results of lake level in this study, we added a figure comparing the in situ data with the lake level in this study.

The streamflow and discharge data are used to show that lake levels can be used to explore the regulation of the rivers associated with the lake, and this is just one case of the application of lake levels. In addition, we added the analysis of water level changes in lakes in different basin, so it further indicates that our study is much clear in reflecting the spatial and temporal variability of lakes on the Tibetan Plateau.

RC2: 'Comment on essd-2022-313', Anonymous Referee #2, 26 Dec 2022

- Line 13: Here is for global climate change. But the text cannot discuss the relation between lake level change and global climate change.

Reply: Thanks for the suggestions, but here we are not discussing the relation between lake level change and global climate change. Just an introduction for the Tibetan Plateau and describe the importance of lakes in Tibetan Plateau.

- Line 16: What about the detail altimetry satellite missions?

Reply: Thanks for the suggestions, the altimetry missions we used in this manuscript is added in the revised version, please see the revised manuscript.

- Line 19: Here the time spans 2002 to 2021. Are all lakes' levels in this time span?

Reply: Thanks for the suggestions, not all the lakes staring from 2002, among all of this, 167 lakes water level staring from 2010. The details also added into revised version.

- Section 1: There are many literatures about the lake level changes in QTP, which should be further summarized and generalized.

Reply: Thanks for the suggestions, we added related literatures in past 5 years and summarized in the table 1.

Table 1 Comparison of this study with previous studies

Reference	No. of Lakes	Period	Data Source	Dataset Public or not
Jiang et al. (2017)	70	2003-2015	IceSat-1, Cryosat-2	N
Zhang et al. (2017)	68	1989-2015	IceSat-1, Landsat	N
Li et al. (2017)	167	2002-2012	IceSat-1, Envisat	N
Hwang et al. (2019)	59	2003-2016	Jason-2/3, SARAL, IceSat-1, Cryosat-2	N
Li et al. (2019)	52	2000-2017	Jason-1/2/3, Envisat, Cryosat-2, IceSat-1	Y
Zhang et al. (2019)	62	2003-2018	IceSat-1/2	Y
Hydroweb	36	1993-2022	ERS-2, Envisat, T/P, IceSat-1, SARAL, Jason-1/2/3, Cryosat-2, Sentinel-3A	Y
DAHITI	62	2003-2022	ERS-2, Envisat, SARAL, Sentinel-3A, Cryosat-2, IceSat-1, Jason-2/3,	Y
This Study	361	2002-2021	Envisat, SARAL, IceSat-1, Cryosat-2, Jason-1/2/3, Sentinel-3A	Y

- Line 72: Here there are 364 lakes. But there are 262 lakes in line 19.

Reply: Thanks for the suggestions, we have revised it, the correct number is 361. We also scrutiny the whole text, and revised this mistake.

- Table 1: One altimetry satellite can only pass some lakes. Some lakes can be covered by two or three altimetry satellite mission. How to process these conditions to precisely determine one level series for one lake? How to get the lake level series of all lakes from 2002 to 2021?

  Reply: Thanks for the comments.

  After constructing the time series for each altimetry over related lakes. We can follow the section 3.2 to fuse the multi-altimeter time series.

  Specially, we first merged the two products with the longest period for the time series and chose the altimeter-derived water level with the longer time series as the baseline. Then systematic biases between another altimeter and the baseline will be removed by subtracting the mean discrepancy during the overlap period compared with the reference series (Lee et at., 2011; Kropáček et al., 2012) according to Eq. (4). Then, the same process was applied to the remaining products and the merged products connecting the three altimeters.

  Additionally, some lakes cannot merge successfully (if just pass ICEsat-1 and Cryosat-2 before 2013), we will try to use a combined linear-periodic-residual model (Liao et al., 2014) to simulate and forecast the lake-level time series in the no-overlap period to merge the two altimeters with no overlap period.

  We added some details to make it easier to follow in revised version.

  Unfortunately, this manuscript only estimate lake level has valid observations from multi-altimetry, so not all the 361 lakes for time series from 2002 to 2021, only 194 lakes for the time series from 2002 to 2021, and 167 lakes for the time series from 2010 to 2021.

- Table 2: What unit is used for coordinate? 1985 should be the National Height Datum of China.

  Reply: Thanks for the suggestions, the unit for coordinate is degree. We revised the table notes for coordinates and 1985. Please see the revised manuscript.

- (1): How to get these corrections? How to improve these corrections?

Reply: Thanks for the comments. With the exception for retracking correction, all the corrections are included in the altimetry data product. We just need to improve the retracking corrections which is the most important to decide the accuracy of lake level. More detail can be seen in section 3.1.1.

- Section 3.1.1: How to verify the effectiveness and accuracy of the retracking method?

Reply: Thanks for the suggestions. Actually, the retracking method we used here is the automatic multiscale-based peak detection retracker (AMPDR), having a special paper for it (Chen et al., 2021). We try to compare several lake level time series from altimetry with in-situ time series and existing product time series. The effectiveness and accuracy of this retracker has already discussed in detail in the paper above.

- Section 3.1.2: Here is noise footprints. How about the abnormal footprint?

Reply: Thanks for the suggestions. The abnormal footprints are already detected in section 3.1.1, we call as unavailable off-nadir observation, which will be removed during retracking.

The lake level from invalid off-nadir observation usually shows a large bias with the DistanceThres. So, if the difference is larger than the half of the range window, it may not provide the signals from water surface and this observation will be regarded as an invalid off-nadir point (using Sentinel-3 as an example, it is 1/2*128*0.4684). (Chen et al., 2021)

- Section 3.1.3: How to process the gross errors in time series?

Reply: Thanks for the suggestions. Here we used a state-space model (Nielsen et al., 2015), the gross errors can be obtained from their models. The obtained time series are not easily averaging, they considering continuous time steps and a hypothetical error model. Then according to the Laplace estimation, the mean value and error will be calculated from the model. More detail can be seen in Nielsen et al. (2015).

- Section 3.2: Coordinate system transfer and coordinate frame transfer all should be made.

  Reply: Thanks for the suggestions. Coordinate system transfer and coordinate frame transfer are all made in this manuscript. All the data will be transferred into WGS84/EGM 2008.

- (5): How to determine p in the Eq. ?

  Reply: Thanks for the suggestions. P stands for the number of periodic components. This can be determined by the reality. Such as considering 10 years periodic, 5 yeasr periodic, 2 years periodic, and 1 year periodic, then p equals to 4.

- Section 4: How about resolution?

  Reply: Thanks for the suggestions. Due to the complexity of fusion of multi-altimeter, it is hard to give a spatial resolution for the data set. The high resolution in title means high spatial coverage and large numbers of lakes.

- Table 3: RMS of Zhari Namco is 0.25m. But RMS is about 10.1cm in Sun et al. (Detecting lake level change from 1992 to 2019 of Zhari Namco in Tibet using altimetry data of TOPEX/Poseidon and Jason-1/2/3 missions. Frontiers in Earth Science, 2021, 9:640553, https://doi.org/10.3389/feart.2021.640553). Wang et al. (Robust, long-term lake level change from multiple satellite altimeters in Tibet: observing the rapid rise of Ngangzi Co over a new wetland. Remote Sensing, 11: 558, doi: 10.3390/rs11050558.) also shown the more precise lake levels.

  Reply: Thanks for the suggestions. For the RMSE of Zhari Namco, there is two possible reasons for this problem, one is that Zhari Namco is available on the eight altimeters in this manuscript, the data quality of Envisat is not stable, another is that fusion many different altimeter will also introduce noise. Actually, if we just consider Cryosat-2, Sentinel-3, Jason-2, and Jason-3, the RMSE is just 9.9 cm (as reported in Chen and Liao, 2020).

For the Ngangzi Co, no in situ gauge data are available in Ngangzi Co, so they are considering inter-compare with ICEsat and SARAL. In this manuscript, we just consider to compare with in-situ dada or existing product.

- Section 5: How about the physical mechanism? Why not the applications to climate change?

Reply: There are many factors influencing lake level changes on the Tibetan Plateau, including Precipitation, and glacier and snow melt and degradation of permafrost brought by temperature changes, etc. This manuscript, as a dataset paper, mainly shows the changes of lake level and provides the basic data of lake level changes, so the physical mechanisms of lake level changes are not explored here, which will be further explored in future work.

Lake level changes on the TP are an indicator of climate change in the region, which has been addressed in many papers (such as Gao et al., 2013; Hwang et al., 2016; 2019; Jiang et al., 2017), but here this manuscript does not expand on the application, but only points out the importance in the introduction.

RC4: 'Comment on essd-2022-313', Anonymous Referee #3, 28 Apr 2023

> The manuscript from Chen et al. presents the development and validation of a water elevation time series database for 362 lakes in the Qinghai-Tibetan Plateau from satellite multi-mission altimeters.
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> General comment:
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> The manuscript is easy to read and the methodology to derive water elevation is adapted, even if more information is needed (see specific comments below). However, I have the following main concerns:
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> - The database is validated only for 8 lakes over 362. No information on the area of these lakes are provided, nor their locations, nor their hydrological regime. So, it’s not easy to know if they are representative of many lakes within the 362 lakes in the database.

Reply: Thanks for the suggestions, the area, and locations of the lakes are included in the dataset. We will add an appendix table for including all the basic information (locations, areas, and also the hydrological regime info.

- For the remaining 354 lakes, no regional consistency analysis is done between neighbor lakes. It could be a way of cross-validating the database. Similarly, for each lake, no consistency between time series from different missions is done. It would also be a way to detect if some time series might be erroneous or not compared to measurements from other missions. The intermission bias is a good way also to check if the different missions are observing the same target (if one mission provide water elevations multiples decameters above/below other missions, then they are not observing the same target).

Reply: Thanks for the suggestions, the regional consistency analysis is a very useful tool for this dataset, at least we don't have so many gauge stations to evaluate, so we added the cross comparison with DAHITI (46 lakes), Hydroweb (40 lakes), G-REALM (8 lakes),and in Section 5.1, we added the trends analysis for the changes in the water levels of the lakes in different basins of the TP. This also a regional consistency analysis between neighbor lakes. At the same time, we don't think this could check whether the different missions are observing the same target. There exists a system bias between different missions.

- The comparison with other altimetry database is pretty weak. Lake trend is compared between the proposed database and the Hydroweb database. Why not comparing directly water elevations? Other altimetry databases (like DAHITI and G-REALM) should also be considered.

Reply: Thanks for the suggestions, we added the comparison with DAHITI (46 lakes), Hydroweb (40 lakes), G-REALM (8 lakes), and also direct with water elevation changes. Our initial purpose in comparing lake trends is because of various products have different errors. But the interannual trends obtained from these products should exhibit consistency. From your suggestion, we will also add the comparison with water elevation changes.

- Multiple satellite missions are used, which have different type of sensors. For example, ICESat is a lidar altimeter, which is quite different from nadir radar altimeters (both in vertical accuracy, sensitivity to clouds…). It is never explained, nor discussed. Pros and cons from lidar and nadir radar altimeters should be provided. For example, I would expect more accurate, but less measurements in time, from ICESat than from nadir radar altimeters.

Reply: Thanks for the suggestions. The different correction for ICEsat and nadir radar altimetry is in 3.1 section, ICEsat should consider the saturation correction, and radar altimetry should consider retracking correction. In this paper, our main goal is to generate a dataset, the different between lidar and nadir radar is not an important part.

> - Besides, there are some errors from nadir radar altimeters that are not discussed, but could have a huge impact on the database. This type of altimeters, in closed-loop tracking mode or with erroneous onboard DEM value in open-loop tracking mode, could lock their tracking window on the top of the surrounding topography near the lakes. If this topography is quite high compared to the lake (>tracking window size), the waveform will not sample the lake surface elevation. So, no matter how efficient is the retracking algorithm, it is not possible to retrieve the lake surface elevation. This point should be discussed in the manuscript. In addition to this type of error, when the lake is frozen, nadir radar altimeter could provide erroneous data. How is it delat with in the database?

Reply: Thanks for the suggestions. The OLTC was also considered in this study when we try to retrack the waveform. Due to the influence OLTC, the waveform will show without any peaks (just like the noise signal), this could be distinguished by using the data quality flag and waveform classification. When the lake is frozen, this will be processed using retracking, actually AMPDR has the ability to obtain the water level in winter which has already be discussed in Chen et al., 2021.

> - There are more and more published papers using satellite lidar data (ICESat, ICESat-2 and GEDI), see for example Luo et al. (2021) who studied 221 lakes in the QTP. How does your database compare to these studies?

Reply: Thanks for the suggestions. Comparing with other published papers sound like a good situation, but we suggest to compare with Legos and Dahiti dataset, Luo et al. (2021) has a gap losing 7 years. And our dataset is mainly using nadir radar altimetry.

> - Very few lake water elevation time series are presented (only three time series are shown, respectively in Figure 2, 3 and 4). They have rather a poor temporal sampling (figure 4) or strange elevation dynamic (figure 2).

Reply: Thanks for the suggestions. This should be the figure looks not good, we have already revised the figure to make it looks good. About the temporal sampling, this is the normal situation because some small lakes can only be monitored by the geodetic mission

Cryosat-2 without enough points, but we still add this inside, because these small lakes are also very useful for analyzing, which has been proven in Chen and Liao (2020).

- At the database repository, it is written that '196 lakes have the series from 2002 to 2021 in the 02-10 folder and 168 lakes have the series from 2010 to 2021 in the 10-21 folder'. This information should also be provided in the manuscript.

Reply: Thanks for the suggestions. This has already been included in the revised version.

- In the title, I don't understand why the term "high-resolution" is used. I would suggest to remove it.

Reply: Thanks for the suggestions. We will delete the high-resolution in title.

Specific comments:

There is an issue concerning the way ICESat-1 is presented in the text (firstly mentioned in the text at p.2 l.48). It is never mentioned that it is a lidar altimeter and not a nadir radar altimeter, like other satellite missions mentioned in the manuscript.

Reply: Thanks for the suggestions. The related information of ICEsat-1 has already been added in the revised version.

p.2 l.61-62: why not adding Icesat-2, as it covers the last part of the studied time span (2002-2021)?

Reply: Our aim was to generate a long time series dataset, and Icesat-2 was not considered since the time period covered by Icesat-2 was also covered by Sentinel-3. We will increase the use of Icesat-2 in subsequent studies.

p.3 l.83-84: Jason-1/2/3 were not only CNES mission, please edit (see for example https://www.eoportal.org/satellite-missions/jason-1, https://www.eoportal.org/satellite-missions/jason-2, and https://www.eoportal.org/satellite-missions/jason-3). These three missions have the same orbit, so why they do not observe to the number of lakes ? Besides, Jason-1 is well known for not providing much data over continents (e.g. see at the end of section 14.2.1 in Cretaux et al., 2017). Why do you have more data from Jason-1 than from Jason-3? I am very surprised by the low number of lakes observed with Jason-3 (and the high number observed with Jason-1).

Reply: Thanks for the suggestions. Jason-1 will not provide much useful data in inland part, but this should be compared with Jason-2, because Jason-1 and Jason-2 all experience an interleaved orbit (Jason-2 from Oct. 2016 to June 2017, Jason-1 after February 2009), increasing the number of observed lakes. While Jason-3 does not experience an interleaved orbit during 2016-2021.

Reference:

Cretaux, J.-F., K. Nielsen, F. Frappart, F. Papa, S. Calmant, J. Benveniste (2017). Hydrological applications of satellite altimetry: rivers, lakes, man-made reservoirs, inundated areas. In: Stammer, D., Cazenave, A. (Eds.), Satellite Altimetry Over Oceans and Land Surfaces, Earth Observation of Global Changes. CRC Press, 2017.

Table 1 lacks some important information or have dubious information:

- You should add a column with the orbit repeat cycle for each mission (i.e. time sampling).

- The column with the duration is misleading. For example, if Envisat mission lasts from 2002 to 2012, in October 2010, its orbit changed (see https://www.aviso.altimetry.fr/en/missions/missions-passees/envisat.html) and therefore did its ground tracks and repeat cycle. The same goes for most missions cited in the table. Such information should be provided in the table or in the text. Besides, you should provide the time span over which you used the data. For example, for Envisat, you could only have used data from 2002 to 2010.

- I have some doubts concerning the diameter footprint provided in the last column of the table. For example, the AltiKa antenna footprint on the ground could be considered to be ~4 km (considering it corresponds to the 3-dB aperture angle of 0.6°) according to Steunou et al. (2015). Footprints of Envisat, and Jason-1/2/3 altimeters, because of Ku-band used is even coarser. Please edit the table and provide the references you used to derive information provided in Table 1.

Reply: Thanks for the suggestions. The orbit repeat cycle for each mission has already been added to the table. For the duration of the mission, we revised it according to different orbit, such as Jason-1/2/3 reference orbit, Jason-1/2 interleaved orbit (2009.02-2012.03 for Jason1, 2016.10-2017.05 for Jason2), Envisat reference orbit (2002.05-

2010.10), and Envisat extension orbit (2010.10-2012.04). All the antenna footprint has already been revised.

> Reference:
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> Steunou N., J.-D. Desjonqueres, N. Picot, P. Sengenes, J. Noubel, and J.C. Poisson (2015). AltiKa altimeter: instrument description and in flight performance. Mar. Geodesy 38 (sup1), 22–42. http://dx.doi.org/10.1080/01490419.2014.988835
>
> Table 2: What does the column 'Reference' and 'Mode' mean and correspond to? You should add a column with the yearly mean area (or something similar) of each lake.

Reply: Thanks for the suggestions. Reference means the geoid reference, Mode corresponds to the water level is a water level or water level anomaly. We have added the table footnotes to make it easier to follow. The yearly mean area we will add all lakes' area in the appendix table.

> You should provide a map with lakes sampled with altimeters presented in section 2.2.1 and validation in situ data presented in section 2.2.2.

Reply: Thanks for the suggestions. The figure has already drawn with the location of the in situ data using the star symbol, and also the altimeters overpass orbit are also included, the satellite image map is regarded as the background.

> Section 3.1: What is the 'satellite centroid correction'? Why do you need to consider 'ocean tide corrections' for lakes that are among the highest on Earth?

Reply: Thanks for the suggestions. The 'satellite centroid correction' has already been removed, because this correction has already been added in L1b processing chain. Actually, the ocean tide corrections are all zero in Tibetan Plateau lakes, we mentioned it here is for making this formula more complete.

> p.4 lines 110-120 are almost a copy/paste of Chen and Liao (2020)

Reply: Thank for your suggestions. We have modified this part.

> p.4 l.122 and following references to Chen et al. (2020): Chen et al. (2020) is not provided in the References section.

Reply: Thanks for the suggestions. This reference has been added.

Chen, J., Liao, J., Wang, C. (2021). Improved lake level estimation from radar altimeter using an automatic multiscale-based peak detection retracker[J]. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 14: 1246-1259. doi.org/10.1109/JSTARS.2021.3035686.

> Section 3.1.1 assumes readers are familiar with the AMPDR retracker, which is not a commonly used retrakcer. So, more information on this retracker is needed and you should define the acronyms and variables mentioned (like HDEM, DistanceThresh…). As written in lines 124 to 126, it seems that you don't have any bias using AMPDR with Jason-2/3, Sentinel-3A/B and Cryosat-2, contrarily to other missions. I have observed bias between J2/3 and S3/B over many lakes and rivers using OCOG retracker. I am therefore more surprised that you don't have bias with these missions, rather than you observe bias with other missions (and according to section 3.2, it seems that you have biases between each consecutive mission).

Reply: Thanks for the suggestions. Actually, this is a dataset description, so we don't include too many retracking methods, as it was already published. But we also added the acronyms and variables mentioned to support this method can be easy to follow.

AMPDR is the retracking suitable for Jason-2/3, Sentinel-3A/B and Cryosat-2, both these four satellites can get good results, which has been proved in Chen et al. (2021). This is related to the OLTC and SAR technique but still has some observations not good resulting in the bias you see, this will be finally removed from the processing of merging multi-altimetry. But for the other missions, the data quality is not so much good in inland, so we make some improve for AMPDR to make the statistics threshold more reasonable.

> p.6 l.162: How the training set of 300 waveforms have been selected? What type of lakes do they cover?

Reply: Thanks for the suggestions. Waveforms are uniformly selected with various types of lakes, and also various locations of the lakes. Not for some type of lakes.

> p.6 l.167: Why excluding tracks with fewer than 5 observations?

Reply: Thanks for the suggestions. This is coming from the AMPDR, this retracker are considering the statistics of the along-track water level, fewer than 5 observations will not be enough for giving stable statistics and also mean the observation is easier be polluted at terrain signals.

> Section 3.1.3, I don't see what is the purpose of using tsHydro (equations 2 and 3). You should explain in more details what is the purpose of this tool, what it is supposed to do, why it is needed and all the parameters used

(sigmaRW is not explained for example), why specifically equations 2 and 3 have been selected (why this model has been chosen). Providing this information in the manuscript is important, even if they are present in Nielsen et al. (2015).

Reply: Thanks for the suggestions. We have added the explanation for the tshydro, such as the dynamic model formulation and its explanation.

p.7 l.182: I guess the 'reference plane' is the geoid or ellipsoid used to reference water. It would be good to provide explicitly the definition in the text.

Reply: Thanks for the suggestions. Yes, the 'reference plane' is geoid, we have added it in revised version.

Section 4.2 and Figure 6: Why comparing trend and not directly water elevation time series? I would prefer to see a comparison between time series. There are other altimetry water elevation databases like DAHITI (https://dahiti.dgfi.tum.de) or G-REALM (https://ipad.fas.usda.gov/cropexplorer/global_reservoir/ and https://blueice.gsfc.nasa.gov/gwm/lake/Index). You should also add these databases in your comparison

Reply: Thanks for the suggestions, we will add the comparison with DAHITI (46 lakes), G-REALM (8 lakes), and also direct with water elevation changes. Our initial purpose in comparing lake trends is because of various products have different errors. But the interannual trends obtained from these products should exhibit consistency. From your suggestion, we will also include the comparison with water elevation changes.

Section 5.2 is too qualitative, some assertions are not really supported by the figure (discharge seems to raise before the lake level, which is not coherent with the fact that discharge is regulated by the lakes; no information on the used precipitation is provided; there is some connection between precipitation and lake level variation and discharge; discharge time series might not be fully validated, given its 'stair steps' shape over some periods) and does not provide anything to your database. I suggest to delete this section.

Reply: Section 5.2 focuses on a case of lake level application, the purpose of which is to show that lake level changes can reflect river regulation. Without the influence of rainfall, the water level changes of the two lakes are consistent with the discharge changes along the Yellow River, while the downstream rivers, which are not subject to the regulation of the lakes, have uneven discharge changes. Since the discharge data from gauge stations were applied, mainly qualitative relationships were derived in this study.

> p.15. l.320: Why does your database could be labeled as 'high-resolution datasets'?

Reply: Thanks for the suggestions, the high-resolution datasets is for spatial, but maybe not unclear here, we will delete it.

> I download the full database and plotted all time series. Some time series looks really good, but some other raise some questions. I have not been able to load the plot on the server, but the following time series illustrates some of my observations:
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> - Buergacuo_Lake_Water Level.txt has a clear different behavior before and after 2011. Is it realistic?

Reply: The lake was originally recharged by a spring. It can only be inferred that the water level tends to rise steadily after 2011 because the groundwater recharge from glacial melt is greater than the spring recharge after the temperature rises.

> - Co_Ngoin1_Water Level.txt has a clear annual cycle after 2011, which is not the case before and it seems strange to me.

Reply: Thanks for the suggestions, before 2011, it is very hard to see this situation because only ICEsat can observe it. But after 2011, Cryosat-2 and Sentinel-3 could.

> - Kusai_Lake_Water Level.txt has an 8m water elevation increase in less than a month. Could it be due to an intermission bias?

Reply: Thanks for the suggestions, this is not the intermission bias. Kusai Lake experienced an abrupt expansion in 2011, resulting from the dike break of an upstream lake, named Lake Zhuonai. Li et al. 2019 also reported this situation.

> - Laorite_Co_Water Level.txt, for some time series beofre 2011 when there are few points, time series seems to have a smooth curvy shape, which is not the case for time period with more data. Could it be due to a smoothing form the tsHydro processing?

Reply: Thanks for the suggestions, but we think this is not the case, before 2011 looks smooth mainly because the tempoal resolution is not enough for ICEsat overpassing this lake.

- Gyesar_Co_Water Level.txt has too few measurements, is it worthwhile to provide this time series and compute trend?

Reply: Thanks for the suggestions, although it has a few points, but still can be very useful for estimating the lake level annual change rate.

- Xiaoquan_Lake_Water Level.txt has a 80m increase for few time steps, which does not seem realistic

Reply: Thanks for the suggestions, this lake has some problems when generating time series, some big bias observations was considering, we will consider remove this lake.