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Interactive comment on "Densified multi-mission observations by developed optical water levels show marked increases in lake water storage and overflow floods on the Tibetan Plateau" *by* Xingdong Li et al.

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Comment:

In this manuscript, the authors generated a dense (monthly and ever higher such as 10 days on average) continuous 18-year data set of changes in lake water level and storage for 52 large lakes on the Tibetan Plateau by combining multisource optical and altimetric information. Uncertainty in the optical water levels was evaluated by field experiments and rigorous uncertainty analysis, which is important to the generated data

sets. The UAV imaging of lake shorelines for evaluating Landsat-based lake shoreline detection and the derivation of the mathematic expression of the uncertainty in the optical water levels look really interesting and solid. The magnitude of the uncertainty was found to be around 0.1 m, suggesting that the optical water levels are often more efficient and less noisy than altimetry data when the altimeter footprints on the lake surface are insufficient, especially for small lakes.

I strongly believe that the data set is extremely valuable for the long-term and short-term monitoring of lake water level and storage changes on the Tibetan Plateau, and are also useful for lake water level and storage studies in other areas. Many studies on this aspect present long-term trends in these lake water storage. But the authors of this study have additionally explored the potential of these multiple remote sensing data sets in monitoring short-term variability in lake water storage and lake overflow floods that are really new and look fantastic to me.

Response:

We thank Dr. Xu for thoroughly reviewing the manuscript and making such encouraging comments. It is important for us to receive these feedbacks to further improve the data set and the manuscript. Comments and issues raised by Dr. Xu have been addressed and are illustrated as follows.

Comment:

Pg. 6, Line 8: "the systematic biases between different altimetry data were removed by either comparing the mean water level of the overlap period or comparing the two water level time series with changes in lake shoreline, depending on the length of the overlap period" would be discussed in more detail.

Response:

We agree that the original description of the method in Pg.6, Line 8 is not quite clear and needs further clarification. The basic idea of removing the systematical bias is to calculate the mean values of each altimetry-based water level time series from different sources during the overlap period. Then, the difference between the mean values of the two time series during the overlap period is removed from one of the time series to make both altimetry-based water level time series consistent and form a longer water level time series. This process was subsequently applied to all water level time series with overlap periods to merge them into a single time series for each lake.

However, the overlap period could be short between some altimeters such as Envisat and CryoSat (e.g., there are only one or two data points in the overlap period), or does not exist at all, such as ICESat and CryoSat. On these cases, optical water levels (i.e., changes in lake shoreline that need to be translated into water levels using linear regression with one of the altimetry water level series) are used to extend or create an overlap period that links the two altimetry missions. We chose a one-year or two-year optical water level series which has an overlap period with both altimetry water level series as the baseline, and calculated the differences between altimetry water levels and the baseline during the overlap period. Then the differences from altimetry water levels were removed.

Therefore, three water level time series (i.e., one optical water level series and two altimetry water level series) from different sources are merged together. The reason why we used one-year or two-year optical water levels is because a longer overlap period may introduce some unexpected errors, such as a rapid increase in water level, which may, however, not be detected by optical water levels (only if the lakeshore slope happened to be steep in the exact region of increases in water level, which, for most cases, can be avoided by checking Rˆ2 of linear regression when generating optical water levels). This part will be modified in the revised manuscript.

Comment:

Pg. 28, Lines 78: "where optical water levels can provide a near real-time monitoring of changes in lake water level and storage that are crucial to flood early warning and

risk management." However, I have not seen the results.

Response:

Thanks for this comment. The expression here is indeed a perspective as to the potential and advantages of optical water levels rather than a strong statement. In this study, we provided water levels of Lake Salt, which has limited altimetry information but mainly consists of optical water levels. Though we used Landsat ETM+ and OLI images, i.e., four observations were available in $\sim$ one month, more than half of the images were useless due to cloud contamination or gaps. Therefore, the temporal resolution of optical water levels in Lake Salt is still $\sim$ 1 month, which cannot be regarded as near real time monitoring at this stage. Nevertheless, the temporal resolution of optical water levels can be further improved by adding other missions such as Sentinel-2 that has a higher temporal resolution than Landsat series. A new data set termed harmonized Landsat and Sentinel-2 Reflectance Product has been generated recently, which we believe would improve the quality of optical water levels and make it near-real-time observation.

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