

## Comments to the author by the Associate Editor Richard Gloaguen

First I commend the authors for the attention to details and their careful implementation of the reviewers comments.

Secondly, I apologize for the delays. It was extremely difficult to find experts willing to assess this submission. I can not find any reason for this. Fact is: I can not further delay the processing of this submission.

I have 2 remaining issues that I would like the authors clarify.

1- I can not understand why ground water levels can be discarded as culprit here. It seems that this a very complex situation and in many lake regions, groundwater flows have a huge impact on lake levels. Is there a way to assess groundwater levels in the region (wells?) .

2 - The conclusions are very regional. It would be important to make statements on 1- the portability of the method to other regions (assess the limitations) and 2- If this single lake is representative of the situation in Sahel.

## Report by Anonymous Referee #3

This paper extensively presents a very useful method to infer area, height, erosion/deposition balance of an African lake. All data and methods are well presented and discussed in depth. The paper underwent a first round of reviews, which very carefully went through the text, figures and legends (especially reviewer 1). As a result, the revised paper has been corrected form what appeared to me as minor errors/typos. Both reviewers and authors should be commended for this. Some interpretations are closer to hypotheses than to firm conclusions (the lake bottom is not observed), but this is completely normal (discussion) and the paper fully reaches its objectives of presenting a widely applicable method, drawing relevant conclusions and pointing possibly important impacts. Not being a native english speaking person, I will not comment the language, which seems to be more than OK to me.

Therefore, I recommend to publish the paper as is.

## Response by the authors

We are grateful to the Associate Editor Richard Gloaguen for his decision to publish the paper subject to minor revisions. We also thank Anonymous Referee #3 for his/her suggestion to publish the manuscript as is, and for commending the “*relevant conclusions*” and “*possibly important impacts*” of the study.

The two remaining issues raised by the Associate Editor we have addressed as follows:

1- Groundwater levels are not discarded as a culprit per-se, and the water balance indicates a possible decrease of net inflow to the lake during the dry season (Figure 9). Inflow during the dry season happens exclusively through groundwater exchange. Falling groundwater could therefore have contributed to the lake level decline. However, other factors such as increasing evaporation from the lake and in particular the decrease of the base level at the outflow have a more significant negative impact on the lake water levels. The uncertainty range of the calculated net inflows indicates that groundwater levels could also be stable. Data from wells are not available in the region. We have therefore endeavored to assess groundwater level trends by using as proxy the surface water extent of Lac Kononi, a small groundwater-fed lake in the vicinity of Lac Wégénia. For this lake there is no

evidence of declining lake areas over the last 22 years (now shown by Figure A1). We think that with this additional analysis and given the results of the water balance we can convincingly show that groundwater levels are indeed not the main culprit here. The additional analysis is discussed on lines 457 to 564 of the revised manuscript. The following text has been added:

*“However, the uncertainty range of the calculated net inflow indicates that groundwater levels could also be stable (Figure 9). Indeed, a general decrease of groundwater levels should also affect the levels and extent of other water bodies in the area, but the surface water areas of Lac Kononi in the vicinity of Lac Wégna do not show a decreasing trend over the last 22 years (Figure A1). Lac Kononi is a groundwater fed lake that is not directly connected to a river channel, and its water level can therefore be used as a proxy for local groundwater levels. Unfortunately, the bathymetry of Lac Kononi is not available, and we could therefore not reconstruct its WSH such as we have done for La Wégna. Its constant lake areas, however, are an indicator for stable groundwater levels.”*

2. We have revised the Conclusion section to address the portability of the method and the representativeness of our results for the situation in the Sahel. Regarding the portability of the method we have added the following sentences (lines 524-528):

*“The method is portable to all water bodies with strong fluctuations of the water level over periods where optical satellite imagery are available. In case of persistent cloud-cover, the method could be extended to surface water mapping using Synthetic Aperture Radar data (e.g. Markert et al. 2020). No in-situ measurements are required to apply the method, provided that a high-resolution DEM of the bathymetry is available.”*

Please note that a more detailed discussion of the portability and limitations of the method is provided by Section 7 (lines 491 - 504).

Regarding the representativeness of our results for the situation in the Sahel, we now clearly state that the decreasing lake level trends cannot be taken as representative of the situation in the Sahel, but the main cause is the local management of the lake. On the other hand, we have identified several issues that are also highly relevant elsewhere in the Sahel (dynamic sediment movements, increasing direct evaporation from water surfaces, groundwater levels, increasing rainfall). No general conclusions can be drawn regarding the importance of each of these factors for other lakes in the Sahel, but the present study represents a showcase for how to unravel their hydrology and sediment balance given the constraints on in-situ data availability. The corresponding paragraph in the Conclusion section has been revised as follows (lines 533-539):

*“The present study also indicates a possible decrease of net inflow to the lake during the dry season, and an increase of direct evaporation from the lake. Both factors could also negatively impact the persistence of other water bodies in the region. However, a small groundwater-fed lake in the immediate vicinity of Lac Wegna does not reveal a negative trend in water area, and other water bodies in the Sahel are likely benefiting from the positive rainfall trends. The obtained results should therefore not be taken as representative of the situation in the entire region, but the present study can be a showcase for unraveling the hydrology and sediment balance of other Sahelian lakes using remote sensing.”*