**Reviewer #2**

General comments: This paper revealed the energy balance of a deep lake in Tibetan Plateau, one of the least studied regions on earth. Thus in general, the addition of newly obtained data and their analysis is welcomed and could be scientifically significant. However, I have a concern about the accuracy of energy balance determination in this study. Although the authors discuss uncertainty of lake evaporation estimates, I suspect that uncertainty is much larger than their estimate due to the items which authors did not deal with. Details are given in the following specific comments.

Reply: Thanks for the constructive comments. They are very helpful to improve the manuscript. We will revise the manuscript carefully according to these comments. In fact, your concerns are also our concerns. Further works are expected to set up an observing platform in the lake to improve the understanding of energy and water budget.

Specific comments:

1, Introduction: The authors should explain why lake level and hydrological processes in Tibetan Plateau (TP) are important. What kinds of practical and scientific contributions can be made by studying these components over there? Similarly, what are the particular importance of deep lakes TP in comparison with deep lakes in other regions (or other alpine areas)?

Reply: We will address these issues in the revision in more detailed. About the importance of this study, we will add one paragraph in the introduction. 'The Tibetan Plateau (TP) hosts the greatest concentration of high-altitude inland lakes in the world. More than 1200 lakes (>1 $km^2$) are distributed on the TP, with a total lake area of ~45000 $km^2$. Since the late 1990s, most lakes on the interior TP expanded dramatically, with increase in total lake area by >20% between the 1990s and 2010s. In contrast, lakes on the southern TP shrank dramatically during the past decades. These lake expansion or shrinkage indicates significant changes in the regional water cycle occurred on the TP in response to recent climate changes and cryosphere melting. Investigation of lake water budget at specific lakes is needed to understand changes in hydrological processes on the TP under climate warming.'

About the scientific contribution of this study (section 4.3): 'This study is important to understand the different lake level seasonality in high elevation region. Previous studies show that there were different amplitudes of lake level fluctuations even in similar climate regimes. For example, lake level at Nam Co and Zhari Namco, two large and deep lakes on the central TP, decreased considerably by 0.3-0.5 m in cold season (October to December), while lake level at two nearby small lakes, Bam Co and Dawa Co, decreased slightly by of 0.1-0.2 m during the same period. For deep lakes (e.g. Paiku Co, Nam Co and Zhari Namco), the latent heat flux (lake evaporation) over lake surface may lag the solar radiation by several months due to the large heat capacity of lake water. For this kind of lake, the lake level drop is most dramatic in the autumn and early winter when lake evaporation is high. For shallow lakes, the latent heat flux closely follows solar radiation, with high lake evaporation during pre-monsoon and monsoon seasons, and low lake evaporation during post monsoon season (Morrill et al., 2004). Meanwhile, the shallow lakes freeze up 1-2 months earlier than deep lakes. When the lake surface is covered by ice, lake evaporation is effectively prohibited. Consequently, lake level decreased at a much slower rate in shallow lakes compared with deep lakes.'

2. L76-84. The use of temperature and humidity measured at this location and by this instrument for the purpose of calculating Bowen ratio (Bo) is questionable.

(1) Location

- It is quite possible that this location is outside the internal boundary layer which develops over the lake's surface, particularly when wind direction is from land surface to lake. In order to obtain meaningful Bo values, it is necessary to use measurements within the boundary layer. Note also that Fig.2 should be replaced with a photo showing this location with the actual instrument installed.
- The surface temperature of massive rocks, above which instrument was placed, can be very high during daytime in comparison with air temperature. Thus, the instrument could have been exposed to strong infrared-radiation from rocks. This is a source of measurement errors if instrument does not have a good radiation shield and ventilation (see below).
- Also, given the size of the lake, it is likely that air temperature and humidity near the southern shorelines are different from other parts of the lake.

Reply: We agree that instrument should be installed in a right place. We will address the location of the instrument in more detailed in the revision. Fig.2 will be replaced by the Figure below, which shows more detailed information about the installation of the instrument. Paiku Co is a deep lake and has steep shoreline. It is difficult to install the instrument in the lake center. The logger was installed in an outcrop ~2 m above the lake surface at the north part of the lake. The instrument is just under a rock where there is a hole facing the lake. We believe that this is an ideal place to install the instrument. The meteorological condition over the lake surface can be well recorded.

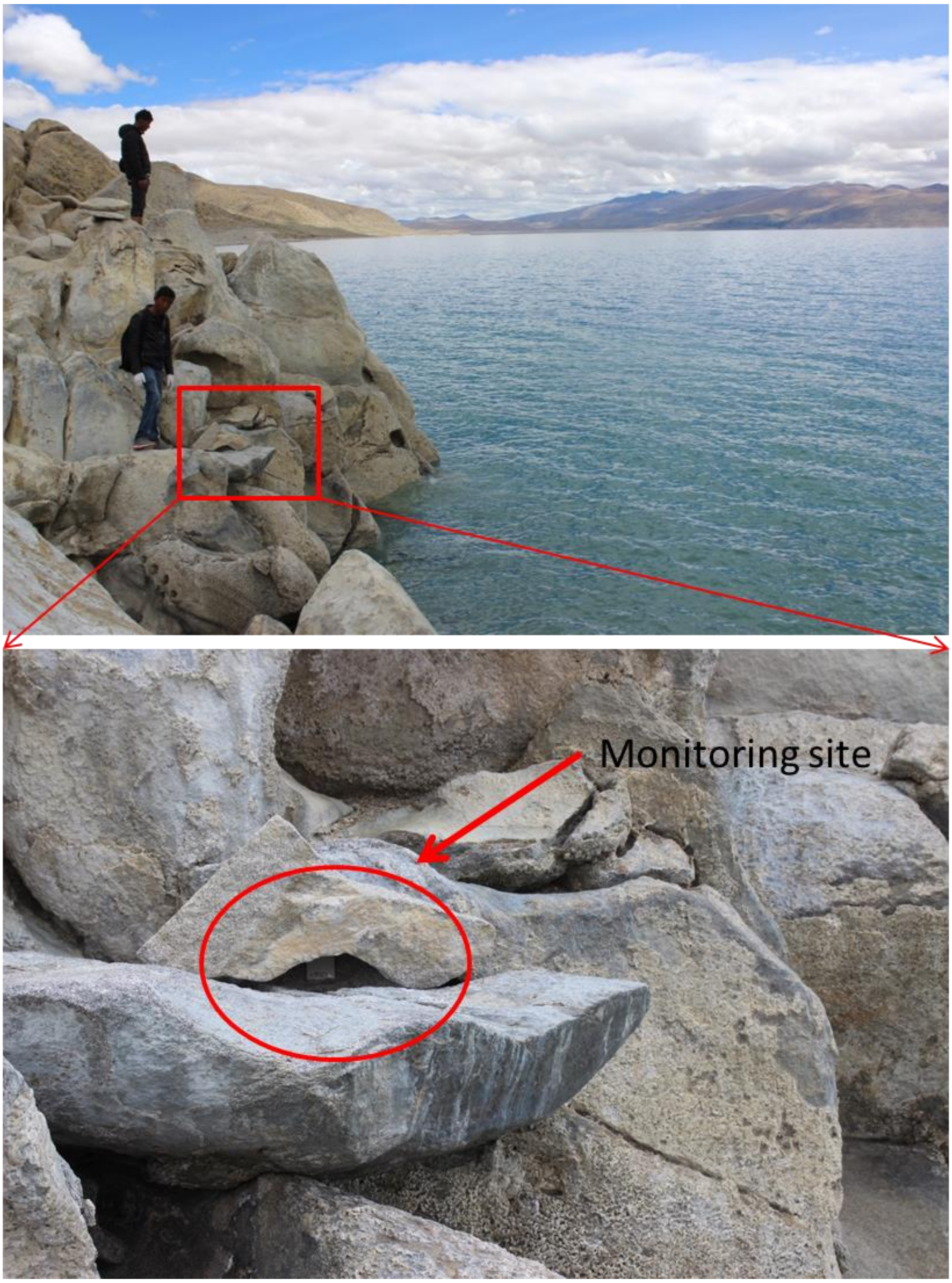



Figure 1. Location of the HOBO logger at the northern shoreline of Paiku Co.

(2) Instrument

- I have no experience in using a HOBO U12-012 logger, but the manufacturer states that this is designed for indoor use. It seems there is no ventilation of a sensor. Radiation shield (a data logger housing) may not be good enough to prevent effects from direct sunshine in a field condition. These could result in serious measurement errors when it is used outdoors. Authors should explain how (in) accurate their measurements are under their measurement condition and indicate resulting possible errors in flux estimation.

- The sensor specification states the accuracy of _0.35_C for temperature and _2.5% for RH (from10% to 90%). They are not particularly high. The accuracy of the water temperature sensor is _0.2_C. What would be the resulting accuracy of Bo and fluxes? The final possible error of the estimated fluxes would be due to (1) plus (2).

Reply: It is true that the instrument we used in this study is designed for indoor use. We selected this instrument for measuring air temperature and humidity because it is cheap and easy to install. In fact, the instrument is installed just under a big stole where there is good ventilation, so the meteorological condition over the lake surface can be well recorded. The instrument has an accuracy of 0.35 $^{o}$C for air temperature and 2.5% of relative humidity. We will evaluate the accuracy of Bowen ratio caused by this error.

(3) Independent estimates: if there are wind speed data available, authors may try to apply bulk methods to estimate sensible and latent heat fluxes and compare them with those from the Bowen ratio/energy balance method.

Reply: From the beginning of this study, energy budget is designed to calculate lake evaporation. Wind speed in the study area is not available. A lot of experience is also needed if bulk method is also used to estimate sensible and latent heat fluxes. We will validate lake evaporation independently by comparing with lake level changes and runoff.

3. L93-94 “For large and deep lake, the components G and AV are small enough to be neglected”. This is not automatic, particularly for AV. Whether or not the statement is valid should depend on relative amount of inflow and storage, and respective energy advection and stored energy. For example, when a huge amount of melted snow near zero degrees discharge into a warmer lake late spring to early summer, this can be a substantial energy advection. To clearly indicate that they can be ignored, authors should give supporting evidence for that (e.g., amount of river discharge, river water temperature, etc.).

Reply: Paiku Co is a large and deep lake. Runoff only accounts for less than 2% of lake water storage. Water temperature and level are also recorded at the three largest rivers in Paiku Co basin (Figure 1). We can compare the water temperatures at rivers with lake water temperature. The heat input from rivers can be roughly evaluated. We found that the influence of Av on the lake heat storage is small and can be neglected. We will address this in section 2.2 in more detailed in the revision.

4. L103-106. Authors assumed Ts=Tw "because surface water can be mixed quickly by wind in the afternoon" and used Tw for their flux estimation. Please show the data to validate this statement. If no data are available, authors may want to add an argument that a small difference between Ts and Tw does not produce large estimation errors of Bo and fluxes. In general, Ts is not equal to Tw even under windy conditions (see., e.g., Prats et al., Earth Syst. Sci Data, 10, 727-743, 2018).

Reply: We agree that Ts is not equal to Tw. In this study, we do not measure the surface water temperature and lake water temperature at 0.4~0.8 m is used to represent the surface water temperature. However, there is small difference between them and this difference does not produce large estimation error of Bo and heat fluxes.

5. Eq.(5) to calculate heat storage change. What is the accuracy of this estimate? Error

sources could be (1) measurement error of water level, (2) accuracy of isobaths and water volume estimation, in addition to estimation error of mean water temperature of the lake. I assume water density and heat capacity are missing in this equation. _V is the lake volume (and not change), and therefore delta symbol is not necessary. To make the unit of S in W/m2, I think eq(5) needs to be divided by the lake surface area.

Reply: Thanks for pointing out this. The equation should be 'S = $\frac{\sum_{i=0}^{72.8} c_w \times \rho_w \times \Delta V_i \times \Delta T_i}{A_l}$'. Here $c_w$ is the specific heat of water (J $kg^{-1}$ $K^{-1}$), $\rho_w$ is water density (kg $m^{-3}$), $\Delta V_i$ is the lake volume at certain depth, and $\Delta T_i$ is water temperature change at the same depth, $A_l$ is lake area ($m^2$). Changes in lake heat storage are calculated at an interval of 5 m and therefore there are 13 layers in vertical direction. Lake volume is acquired according to the 5 m isobaths. Lake water temperature at each layer is taken as the average value between the top and bottom lay. We believe that there is no need to estimate the accuracy of lake heat storage because both the lake bathymetry and lake water temperature are all in-situ measurement.

6. L150-158. It is desirable to give comparisons with lakes other than those in TB, to highlight whether or not the thermal structure of lakes in TB is different from those lakes with similar dimensions in other parts of the world.

Reply: We will compare the thermal structure at Paiku Co with other lakes, not only from the Tibetan Plateau, but also from the other parts of the world, for example, the Great Slave Lake in Canada (Schertzer et al., 2003) and Issyk-Kul Lake in central Asia.

7. L170-174. "water circulation"; this is an interesting point. Are there any supporting data for the presence of such circulation?

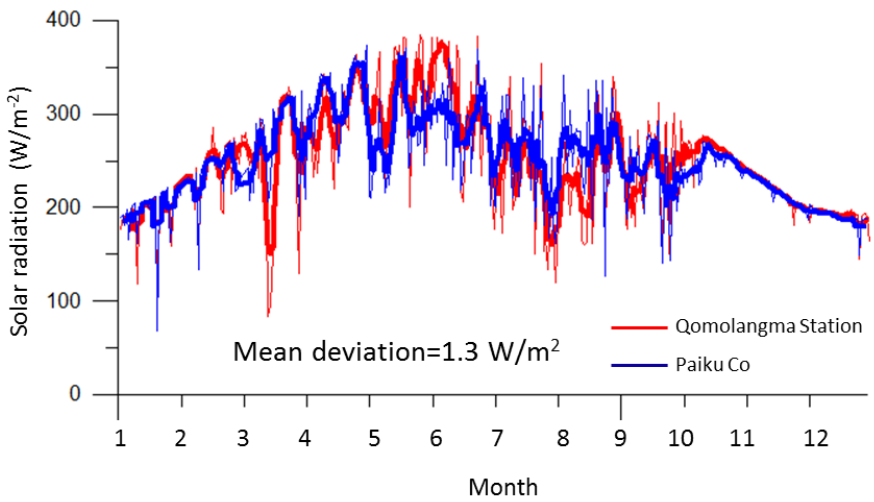
Reply: We will discuss this in more detailed in the revision. 'This contrasting pattern of water temperature between the surface and bottom layers occurs in early autumn when the bottom water temperature reaches to its highest. This indicates that deeper water convection occurs in the northern basin than the southern basin when the water temperature gradient on vertical profile also starts to decrease during this period.' However, more evidence is needed to confirm this.

8. L180-183. "large error...if water temperature data collected at the shoreline are used..."; It is also true that some errors can result if only water temperature measured at a central part of the lake is used (and ignore shoreline areas having different temperature) to estimate evaporation of the whole lake.

Reply: We agree with this that both have their representativeness. But Paiku Co is a deep lake with an average water depth of 41 m. Lake water temperature at the center of lake can more represent the average state of lake water temperature.

9. L269 "mean deviation of 1.3 W/m2."; this is a surprisingly small difference. The authors may want to add information on the accuracy of the estimated daily solar radiation by the Himawari-8 satellite data to enhance the credibility of the small difference. By the way, if there are estimates of daily solar radiation at Paiku Co, why not use them for estimating evaporation?

Reply: In this study, we do not have in-situ observations of solar radiation at Paiku Co, so we have to use the solar radiation and long-wave atmospheric radiation at Qomolangma Station, which is about 150 km away from Paiku Co. Both sites are in dry environment.Solar radiation at the two sites exhibited very similar seasonal fluctuations ($R^2$=0.55, P<0.001) with standard deviation of 23.9 W/$m^2$ and mean deviation of 1.3 W/$m^2$. In order to reduce the error caused by regional difference, weekly averaged radiation was used to calculate lake evaporation. The satellite short wave radiation derived from Himawari-8 satellite is not used for the lake evaporation estimation in this study because this dataset can not provide downward longwave radiation.




A comparison of solar radiation at Paiku Co and Qomolangma Station derived from Hamawari-8

10. L272-L277 "The actual solar radiation at Paiku Co can be considerably overestimated due to the blocking effect of the surrounding mountains around the lake"; I think this type of effects can be estimated by using GIS software such as ArcGIS with DEM as an input.

Reply: As a large lake, we do not consider the blocking effect of the surrounding mountains in this study because it mainly occurs in shoreline.

11. L277-278 "5.4 mm/day.... 3.8 mm/day"; this is a large difference. In fact, the difference (1.6 mm/day) can be translated into 192 mm/(4 months). I suspect that this is closer to actual errors of evaporation estimates than the estimated error given in L295.

Reply: We will evaluate the difference between lake level changes and lake evaporation in more detailed in revision (section 4.1). The runoff measurement at the three large rivers (Fig. 1) makes it possible to compare the lake evaporation with lake level decrease. In pre-monsoon season (mid-April to mid-May), lake evaporation (1.7 mm/day) was quite similar with the decreasing rate of lake level (1.8 mm/day). The high consistency between lake evaporation and lake level decrease confirms the reliability of lake evaporation estimation. In post-monsoon season (October to January), lake evaporation (5.4 mm/day) is considerably higher than the rate of lake level decrease (3.8 mm/day). This discrepancy may be due to the contribution of precipitation and surface runoff (Tab. 3). As shown in Tab. 3, runoff at the three large rivers can contribute to lake level increase by 0.7~1.6 mm/day in October. The impact of lake evaporation on lake level changes can be partially offset. According to this difference of 0.9 mm/day in post-monsoon, the error of lake evaporation is estimated to be 82.8 mm/year.

12. Chapter 4.2, Again, it is desirable to give comparisons with lakes other than those in TB, to highlight whether or not the thermal structure of lakes in TB is different from those lakes with similar dimensions in other parts of the world.
Reply: We will compare the thermal structure at Paiku Co with other lakes in other parts of the world, e.g. the Great Slave Lake (Schertzer et al., 2003) and Issyk-Kul Lake.

13. L333-335. "In-situ observations of runoff at the three main rivers indicate that the surface runoff had weak impact on lake level changes.....(Table 3)"; Discharge values in Table 3 are only for short durations. Are those periods during baseflow? What would happen in case of rainfall-runoff events, or snow melting discharge?
Reply: The runoff measurement was mainly conducted in late May or early October when the water level is still low. Besides discharge measurement in the three rivers, water level is also records by using HOBO water level loggers. We found that this discharge can approximately represent the average state in spring and autumn. It can still not represent the baseflow because there is almost no surface runoff between January and March.

14. L373 "Bird B.W. polished the language." I am not familiar with the author's guideline for HESS, but personally, I do not think this is a good reason to make Bird B.W be a co-author.
Reply: We believe that Bird BW should be included because he also contributed a lot to data analysis, besides language polishing.

15. Fig.9; Why there are a large fluctuation when calculation was made with weekly averaged data? Do peaks correspond with week-long sunny periods between rainy events or cloudy conditions?
Reply: The large fluctuation may indicate a different climate condition, such as air temperature, humidity, solar radiation and changes in lake heat storage. The 5 point running average exhibits less fluctuation (Fig. 10). We notice that lake evaporation derived from eddy co-variance method also shows large fluctuation.

Technical corrections:
L62: Correct degree sign.
Reply: Thanks for pointing out this. We have corrected it.

L95: Eq. (2); this equation is confusing. Ra is stated as "downward longwave radiation" in L 97 while Eq. (3) specifies Ra as upward longwave radiation from lake. Downward longwave radiation should be Ra, part of which (0.03Ra=(1-")Ra) is reflected by the surface and the surface also emits upward longwave radiation ("_Ts^4). So the final equation of longwave radiation balance should be Ra-(1-")Ra+"_Ts^4="Ra+"_Ts^4. L96: "Rsr.... which is taken as 0.07"; this does not make sense. Could it be 0.07Rs?
Reply: Thanks for pointing out this. We have changed Ra to Rw in equation (3) and address

this sentence more precisely. ‘$R_s$ is downward shortwave radiation, $R_{sr}$ is the reflection of solar radiation from lake surface, which is taken as 0.07 $R_s$ in this study (Gianniou and Antonopouls, 2007), $R_a$ is downward longwave radiation to lake, $R_{ar}$ is the reflected longwave radiation from the lake surface, which is taken as 0.03 $R_a$, and $R_w$ is the longwave radiation from the lake surface. The units of the items in Eq (2) are $W/m^2$’.

L97-98 "Rar...., which is taken as 0.03"; this does not make sense. Could it be 0.03Ra?
Reply: Thanks for pointing out this. $R_{ar}$ is the reflected longwave radiation from the lake surface, which is taken as 0.03 $R_a$.

L103 "atmospheric emissivity"; the word "atmospheric" is not needed if it indicates water surface emissivity.
Reply: Thanks for pointing out this. It should be ‘water emissivity’.

Fig.1; Is a black polygon surrounding Paiku Co a watershed divide? Add this information in legend. Show more clearly where incoming rivers are. Also, add information on the elevation of surrounding areas.
Reply: We will add locates of the three main rivers and the elevation information in Fig.1 in revision. The information about the catchment boundary will be addressed in the legend.

Fig.9: Explain what dashed blue lines indicate, please.
Reply: The dashed blue lines do not have scientific meaning. They are mainly used for the convenience of readers. We will delete some in the revision.