Reviewer#1

The authors quantified evaporation/sublimation (E) during ice-free (IF) and ice-cover (IC) periods for a large lake on the Tibetan Plateau. Field observations were collected between 2014 to 2019 and used to quantify evaporation/sublimation (E) and determine the main controls on E during the IF and IC period and annually. These results were then used to validate and assess three different types of E models (Mass Transfer, atmosphere dynamics and statistical model) to determine which model(s) would be adequate for simulating E during IF, IC and Annual (AN) conditions. The models were introduced to simulate E for the 2003 to 2017 period using reanalysis data to study climate change during IF, IC and annual lake conditions. This paper presents an interesting and innovative contribution to lake E by using 6 years of continuous high-resolution and precious observation datasets. There are not too much papers assessing evaporation from the Tibetan Plateau region or studying sublimation during the ice-covered period. The significance of the results is thus important for improving our understanding of the main controls of E during both IC and IF conditions on an alpine saline lake, and these results can be helpful to improve current hydrological models of alpine lakes. Thus, I recommend this paper for publication in HESS after a major revision. Besides, I did have some concerns about this paper as follows:

Response: Thank you very much for your positive comments on the significance of this study. Your comments do improve our manuscript, and we provide a point-to-point response to your comments in bold font below, and revisions were annotated in the manuscript in underline font.

Major comments:

(1) The objectives contradict some of the methods. In the second objective, the authors state that two models will be calibrated and verified, however, within the methods section three models are calibrated and verified and not just two models.

Response: Thank you for your insightful comments. Yes, the inappropriate expression in the second objective led to a misunderstanding which contradicts some of the methods. Actually, as you mentioned above, based on six years of observational data, we validated and assessed three different types of E models (Mass Transfer, atmosphere dynamics and statistical model) to determine which model(s) would be adequate for simulating E during ice–free, ice–covered and Annual conditions. And then, we select an optimal model for E simulation in ice–free and ice–covered periods (IFP and ICP) according to the maximum R^2 and the

minimum RMSE, respectively. The result shows that the mass transfer model simulates lake E well during the IFP, and the model based on energy achieves a good simulation during the ICP.

Thus, we have modified this expression in the second objective shown as follows: In addition, combined with reanalysis climate datasets, a mass transfer model (MT model), an atmospheric dynamics model (AD model), and a model based on energy, temperature and WS (JH model) were calibrated and verified, and then we choose the optimal model to simulate lake E and its response to climatic variability during the IFP and ICP from 2003 to 2017.

(2) Use summary tables for the observed data collection, Reanalysis of datasets, models, and variables. This will make it easier to understand the data collection, cleaning, and processing. Currently, the way these variables and their measurements are presented makes it unclear. For example, in Line 138 it is not clear if the gas analyzer is at the same height as the 3-D sonic anemometer. Besides, the observed meteorological data is in a 30 min timestep; but ERA-5 is in a 1-hr timestep. How was this addressed when assessing the fit between the observed data and the reanalysis data?

Response: Many thanks for your good suggestions and constructive comments. Following your suggestion, we added a summary table (Table S1 in this revision) which contains the instrument type, height from the lake surface or spatial resolution, time resolution and purpose of each variable from observed, reanalysis, model and remote sensing datasets.

The instruments of the measurement of the energy exchange flux and micrometeorological parameters were installed at the China Torpedo Qinghai Lake test base which has a height of 10 m above the water surface (Fig. 1), so most of the observed variables have a height over 10 m above the water surface the concrete height of variables was listed in Table S1.

In this study, all analyses are based on daily datasets, except for the analysis of diurnal variation of evaporation and energy by a time resolution of 30 min in section 3.1. Thus, we generated the daily EAR5 Ts by averaging the hourly temperature over 24 h per day. In order to make the methods clearer, we have added the following statement in the methods section of this revision: The analysis of partial least squares regression, random forest methods, and E simulation, calibration and verification were conducted at the daily scale.

Table S1. The information about variables from observed, reanalysis, model and remote sensing datasets.

Dataset	Instrument type	Height from the lake surface/Spatial resolution	Time resolution	Purpose
Observed H and LE	EC system (Three–dimensional sonic anemometer: CSAT3, Campbell, USA, and open–path infrared gas analyzer: EC150, Campbell, USA)	17.3 m	30 min	Evaporation and energy calculation, and model calibration and verification
Observed Ta, RH and Pres	HMP155, Vaisala, Finland	12.5 m	30 min	Analysis of evaporation influence factors
Observed WS and WD	05103, R.M. Young, USA	12.5 m	30 min	
Observed Ts	SI−111, Campbell, USA	0	30 min	
Observed Tl	109L, Campbell, USA	−0.2 to −3.0 m	30 min	
Observed precipitation	TE525, Campbell, USA	10 m	30 min	
Observed four-component radiometer	CNR4, Kipp&Zonen, Netherlands	10 m	30 min	
ERA5 Ts	\	0.1°	hourly	Model input
ERA5 WS	\	0.1°	daily	
CMFD Ta, Pres, RH and Rs	\	0.1°	daily	
Lake ice coverage	\	\	daily	Lake ice phenology dividing

Notes: H, LE, Ta, RH, Pres, WS, WD, Ts, Tl and Rs are the abbreviation of sensible heat, latent heat, air temperature, relative humidity, air pressure, wind speed, wind direction, lake surface temperature, water temperature and downward shortwave radiation, respectively. ERA5 and CMFD mean the interim reanalysis dataset v5 and China Regional High–Temporal–Resolution Surface Meteorological Elements–Driven Dataset, respectively. Four-component radiometer is the incoming shortwave, reflected shortwave, and incoming and outgoing longwave radiation.

(3) E values for Antarctica are in mm/month during IC, Lines 346-347 you present the annual sum of E; but to draw comparisons to Antarctica can you put this value into monthly for the IC period? The total value does show it is larger but by showing it in the same units as Antarctica it will be easier to see how it relates monthly.

Response: Many thanks for your good suggestion! Yes, it would be clearer to draw comparisons at the same unit. Due to the ICP varied from 83 to 97 during 2014~ to 2018, we estimated monthly E of ICP by multiplying the mean daily E of ICP by 30, and added the estimated results as additional reference data in this revision shown as follows: <u>In this study, we found that E sum ranges from 130.59 to 262.45 mm during the ICP (approximately 51.60 to 81.3 mm month^{-1}, by multiplying the</u>

mean daily E of ICP by 30) from 2014 to 2018, which is higher than the previous observations from Antarctic ice sheets or lakes.

(4) In the key findings you state that wind weakening is considered a key finding; however, wind weakening and its relationship to E during the IC period is not discussed. As this is considered a key finding this should be discussed.

Response: Thank you very much for your constructive comments. We agree with referee at this point. It is very important to do some discussion of wind weakening and its relationship to E during the ICP. As we all know, E of lake driven by energy and is also a process of molecular diffusion which lends itself to mass transfer. Thus, the direct influences on lake E are energy, water vapor pressure difference and air stability above water. And wind stilling would enhance the stability of the atmosphere above the water surface, which in turn inhibits evaporation.

Following your suggestion, we have reorganized the discussion of the effects of climate variability on E, which described the studies of climate change on the QTP, discussed the effects of changes in wind speed and other climatic factors on E, and compared our results with studies of Selin Co and Namu Co.

We added the discussion in this revision shown as follows: Furthermore, the QTP is suffering surface air warming and moistening, solar dimming, and wind stilling since the beginning of the 1980s across the QTP (Yang et al., 2014; Kuang and Jiao, 2016), which affects the hydrothermal processes of the lake, such as increasing Ts and shortening lake ice phenology (Wan et al., 2018; Cai et al., 2019). Increase in Ts would enhance the diffusion of water molecule and enlarges the Δe between the water surface and the air, which in turn promotes evaporation (Wang et al., 2018; Woolway et al., 2020); while reduced in solar radiation would decrease the energy input of the lake, and wind stilling would enhance the stability of the atmosphere above the water surface, which in turn inhibits evaporation (Roderick and Farquhar, 2022; Guo et al., 2019). Our study found a decrease in E during the AN from 2003 to 2017, due to the steeper decrease in E caused by the solar dimming and wind stilling during the ICP than that increase engendered by the increase in Ts during the IFP. Compared with 2001, E decreased at an average rate of−6.17 ± 4.77 mm yr^{-1} (3.19%) and −18.92 ± 27.55 mm yr^{-1} (11.14%) due decrease in Rs and WS, respectively (Fig. 7; Table S2); while the increase in Ts increased E at an average rate of 10.19 ± 19.00 mm yr^{-1} (3.37%) during the IF (Fig. 7; Table S2). Previous studies have found the similar results in Selin Co and Namu

Co (Zhu et al., 2016; Guo et al., 2019). For example, Guo et al. (2019) found that E was mainly controlled by WS, decrease in WS lead to a decrease in E from 1985 to 2016 in Selin Co.

Minor comments:

(1) Line 37: did the result for IC consider ice loss?

Response: Yes, E was observed by an eddy covariance observation system installed at the China Torpedo Qinghai Lake test base, which is based on the principle of eddy correlation, and can direct measure the water vapor flux, the latent heat, and the sensible heat of the lake surface in the spatial range of 100~1000 m in real time. Thus, E in this paper includes evaporation under ice–free and sublimation under ice–covered conditions mentioned in Abstract and Introduction section.

(2) Line 132: you should reference your site in Figure 1.

Response: We agree with this. Done.

(3) Line 166: Long time should be long-time.

Response: Thank you for your suggestion. Done.

(4) Lines 178-183: Qui et al 2019 is the referenced method for the ice phenology dataset, however, how do they account for the accuracy of the ice dataset you are using for your analysis? Using visible MODIS to ascertain freeze dates can be difficult, as the ice must be substantial enough to change the reflective properties. A few brief sentences to expand on the methods in this section would do well to provide context for the accuracy of the ice dataset you are using.

Response: Thank you for your insightful comments. Yes, it is important to ensure the reliability of dataset used in our paper. Actually, Qiu et al have selected six lakes (Qinghai Lake, Selin Co, Hala Lake, Dogze Co, Aksayqin, and Yaggain Co) with different locations, sizes and shapes on the QTP to verify and compare the ice coverage of this dataset and two other datasets based on passive microwave in their paper (Qiu et al., 2019). The result showed that the ice coverage obtained in their paper was highly consistent with that from passive microwave data at an average R^2 of 0.91 and an RMSE varying from 0.07 to 0.13 in the six lakes. And the R^2 and RMSE are 0.86 and 0.13, respectively in QHL, which indicates this dataset is very accurate and suitable for the division of lake ice phenology in QHL. Following your suggestion, we added the results of this data verification and comparison in this section to show that the dataset is suitable for the accuracy of our study: **This ice coverage has been compared with that from two other datasets**

based on passive microwave, and was found highly consistent with the each other at an average R^2 of 0.86 and an RMSE of 0.13 in QHL (Qiu et al., 2019). Thus, this dataset is very accurate and suitable for the division of lake ice phenology in QHL.

Table 2. Parameters of linear fit between the "ice-on" proportion and lake ice coverage of this paper.

Lake number	Lake Name	Slope	Shift	R^2	RMSE
1	Qinghai Lake	0.92,127	0.00871	0.86,335	0.13,808
2	Serling Co	0.9632	0.00077	0.9601	0.07438
3	Hala Lake	0.9763	0.00862	0.94,674	0.10,907
4	Dogze Co	0.93,485	0.00151	0.91,318	0.11,502
5	Aksayqin	0.90,571	0.0365	0.79,444	0.19,446
6	Yaggain Co	0.85,777	0.12,164	0.56,987	0.27,392

Figure V1: The linear fit of the ice coverage from Qiu et al. (2019) and two other datasets based on passive microwave in six lakes over QTP. This table is taken from Qiu et al. (2019).

(5) Fig S3: the x-axis should be the same for all 3 figures. They should all range from 0 to 60%; if you are to just glance at the figures and not read the axis label/units one would assume they all contribute the same during each period.

Response: Many thanks for your good suggestion. I think you're referring to Fig S4. And we have changed the range of x-axis to 0~60% in this revision shown in blow figure.

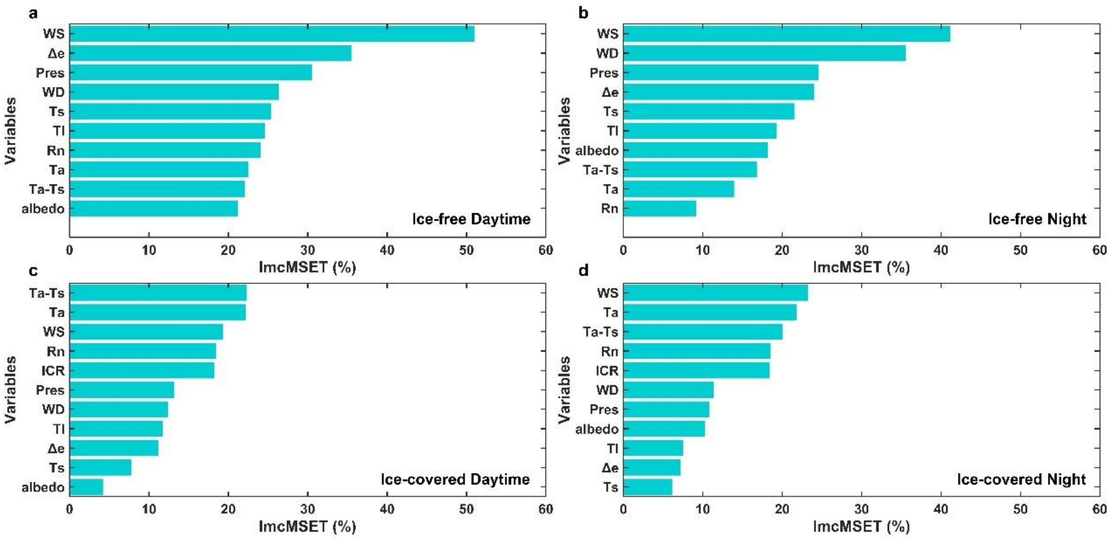

Fig. S4. Importance of the daytime and nighttime climate factors to the evaporation (E) rate of Qinghai Lake during the ice–free and ice–covered periods (IFP and ICP). Rn, Δe. WS, WD, Pres, Ta−Ts, Tl and ICR denote the net radiation, vapor pressure difference, wind speed, wind direction, surface air pressure, difference between the air and lake surface temperatures, average temperature of the lake body from 0 to 300 cm and ice coverage rate, respectively.

(6) Fig S5: the y-axis should have the same scale for all figures. Why is the x-axis for ice cover 1 year? Whereas the IF and AN showing 3 and 4 years respectively? Your caption states they are showing the results from 2014-2018.

Response: Thank you for your suggestion and elaborate comments. I think you're referring to Fig S6. We have unified the y-axis to be the same scale in this figure. All x-axis in this figure are the results from 2014~2018 (four years). Because the average length of AN, IFP and ICP are approximate 368, 278 and 90 days for a cycle year (AN: from the begin of IFP and the end of ICP), respectively. Thus, the sum days of AN, IFP and ICP during the four years (2014~2018) are 1472 (368×4), 1112 (278×4) and 360 (90×4) days shown as the y-axis in this figure.

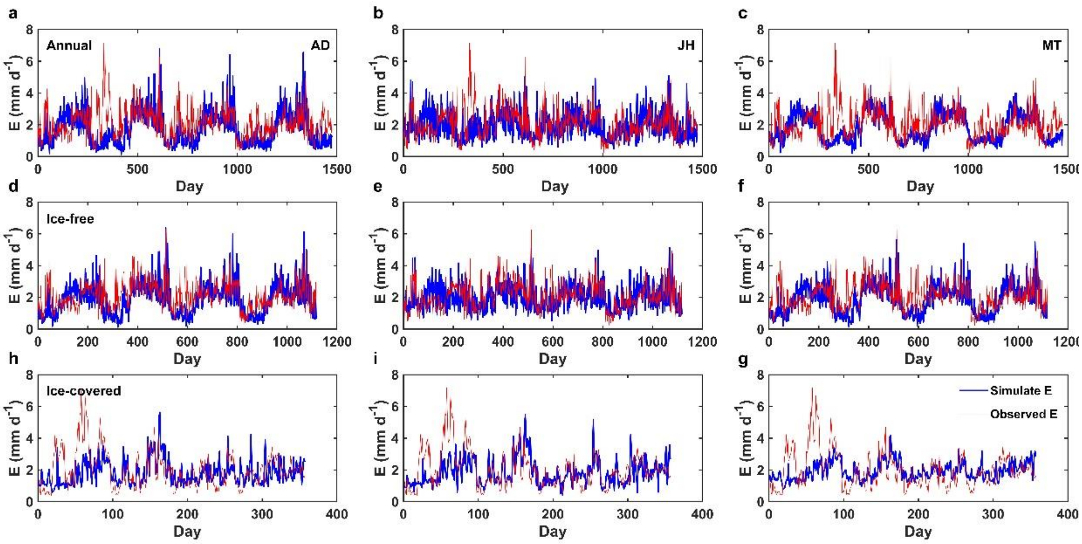

Fig. S6. Daily observed and simulated evaporation (E) with the atmospheric dynamics model (E_{AD}), mass–transfer model (E_{MT}) and Jensen–Haise model (E_{JH}) in the cycle year (annual: AN, a−c), ice–free (IF, d−f) and ice–covered (IC, h−g) periods from 2014 to 2018.

(7) Fig 1: DEM needs units, missing the line for rivers in the legend, is the scale the same for the inset map?

Response: Many thanks for your useful suggestion. We have added the units of DEM and line for rivers in the legend. And the scale is not the same for the inset map. The inset map is intended to show the relative position of the study area, so we did not add a scale to it. And we added a note of the scale in the Figure 1 shown as following: <u>The scale is just for the Qinghai Lake Basin.</u>

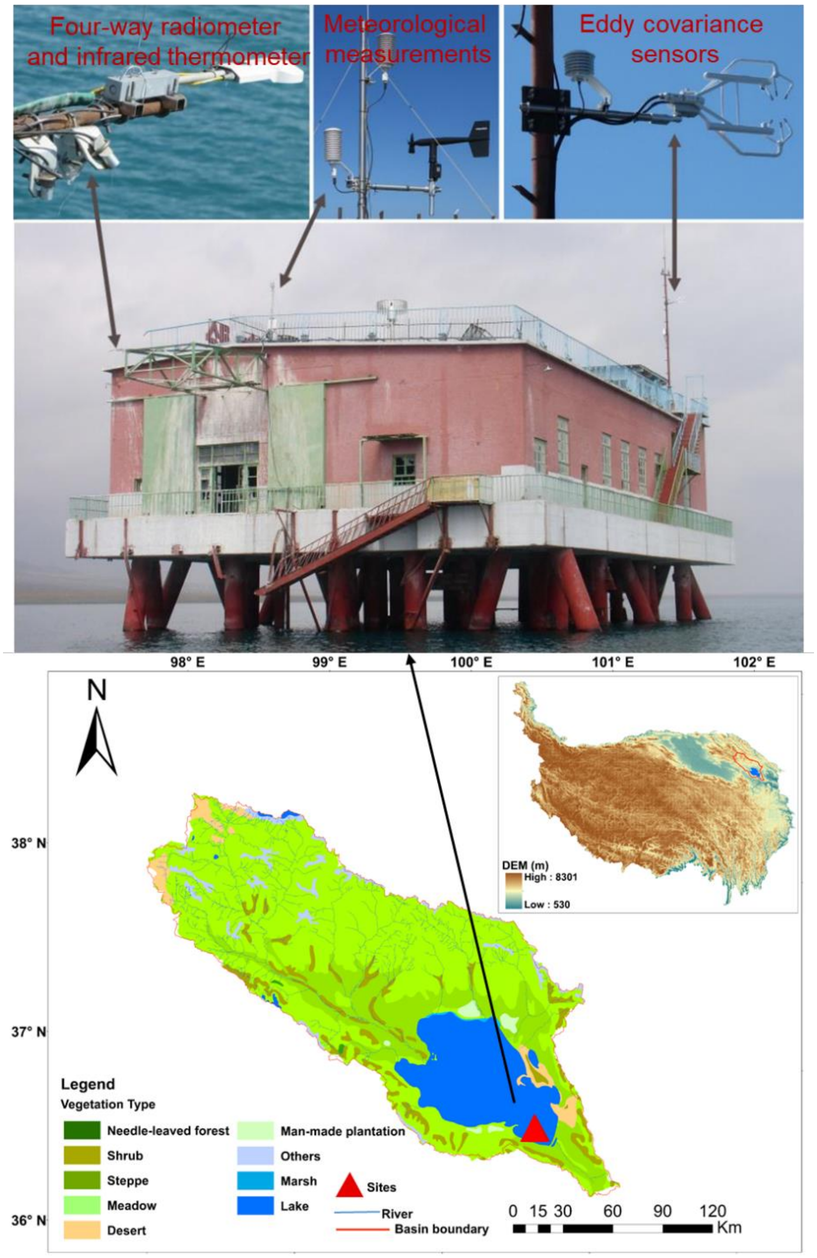

Figure 1. Location of Qinghai Lake (below) and the measurement site of the Chinese Torpedo Qinghai Lake test base (upper). The insets in the upper picture are photos of the four–way radiometer and infrared thermometer (left), meteorological variable measurements (middle), and eddy covariance sensors (right). **<u>The scale is just for the Qinghai Lake Basin.</u>**

(8) When using the abbreviations for ice-covered (IC) or ice-free (IF), they are missing context (or a word) such as conditions or periods.

Response: Thank you for your insightful comments. To make it clear, we have changed all IC and IF to ICP and IFP as the abbreviation of ice-covered period and ice-free period in this revision.

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