Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-616-RC1, 2019

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Modeling experiments on seasonal lake ice mass and energy balance in Qinghai-Tibet Plateau: A case study" *by* Wenfeng Huang et al.

Anonymous Referee #1

Received and published: 22 January 2019

Reviewer comments on

Modeling experiments on seasonal lake ice mass and energy balance in Qinghai-Tibet Plateau: A case study by Wenfeng Huang, Bin Cheng, Jinrong Zhang, Zheng Zhang, Timo Vihma, Zhijun Li, Fujun Niu

This paper summarises a wintertime observation-modelling study in a small lake on the Qinghai-Tibet plateau. The thermodynamics of the lake is analysed in an air/ice/water column by using in-situ measurements and thermodynamic model HIGHTSI, earlier applied for several studies on lake and sea ice all over the Northern Hemisphere. Energy balance at the top and bottom of the lake ice shows features typical for the conditions

of the "third pole" but unusual elsewhere on the globe.

The manuscript presents unique observations and modelling results in the unique environmental conditions of the Qinghai-Tibet plateau. I have enjoyded reading it, meeting a lake whose thermodynamics seem to differ crucially from all other lakes I have met in earlier studies. In my opinion, the manuscript has potential to become an outstanding paper that can point a way to future studies for understanding the impact of changing climate on the cryosphere and its feedbacks to atmosphere over this area of global importance. In the manuscript there is sufficient material, good methods and well posed research questions and the structure of the manuscript is good. However, this rich material deserves better presentation in order to be understood by researcher colleagues and general reader.

Several questions arise when reading the paper, concerning not only details but also more general aspects of the impact of lakes on the "third pole". There is both general background information and details about the studied lake but it might be possible to better tie these together at the regional (QTP) level. Unfortunately, it is not always possible to understand what the authors want to say, due to poorly formulated, too general or unfinished statements and problems of English language. The paper should be rewritten in a more focused way by removing material that is not essential to the study.

Next, I will present some general comments on how I understood, based on your manuscript, the unique properties that determine the lake thermodynamics and mass balance over the plateau and in the studied lake. More specific comments are written into the manuscript pdf using Adobe reader. I also hope the authors will have a possibility to request linquistic support in order to improve the English in the paper.

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General comments or how I understood the unique properties that influence the lake thermodynamics and mass balance

A small lake with the surface area of 1.5 hectars, shallow with mean depth of 2.5m at high altitude of ca. 4000m. At the bottom: talik and permafrost.

Strong, gusty wind prevails during winter. Clear sky conditions, strong solar radiation with the daily maxima up to 1140 Wm-2. Strong LW cooling to space at the surface.

In the air, small humidity on average 34%. Yearly precipitation is 353 mm but potential evaporation is 1613 mm. No rivers flow to/from the lake. Subsurface inflow/outflow?

Sublimation of lake ice - up to 40 % of lake ice disappears to air during winter. Small ice surface melting in spring. Melting at the ice bottom due to penetrating solar radiation.

Possibly falling snow is blown away from ice surface. Dust gathers on ice in the end of winter. These lead to 1) smaller albedo 2) no thermal insulation by snow

Penetration of SW radiation into the (transparent?) ice and water below, absorption in ice and water. Melting of ice from bottom in interior ice layers. Convection under ice. Diurnal cycles of freezing and melting, ice temperatures.

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Did I understand correctly the main features? Would you consider developing this kind of summary a bit further, perhaps presenting a comparison (Table, Figure?) with an Arctic lake you have been studying earlier? This would illustrate the unique nature of lakes in your study area and perhaps highlight open questions that call for further research. Such a comparison might suit the concluding section. Also it would be interesting see comments on what is required from a model to correctly simulate lake thermodynamics in these conditions. HIGHTSI works but would for example the bulk lake model FLake be able to simulate the QTP lakes?

According to the Global Surface Water Explorer, global-surface-water.appspot.com, during the last decades there is a tendency to new permanent and seasonal small lakes and ponds to appear, not disappear, over the plateau. In their maps, Lake BLH-A has got permanent, new permanent and new seasonal pixels. How do you explain

the dynamics of your lake (over the whole year, not only in winter conditions that you discuss here), that evidently looses yearly a significant amount of water by evaporation/sublimation but still stays well alive? Large-scale permafrost melting, something else? Would be interesting to discuss the related aspects from the point of view of the possible impact of the (new) small lakes in the weather and climate of QTB and connections to even larger areas. Anyway, the area and mass of water in the lakes and ponds is currently relatively small?

Specific comments ——————

- written into the manuscript pdf.

You may have forgotten one reference to your own studies, possibly relevant for this manuscript:

Yang, Y., Cheng, B., Kourzeneva, E., Semmler, T., Rontu, L., Leppäranta, M., Shirasawa, K. & Li, Z. J. 2013: Modelling experiments on air–snow–ice interactions over Kilpisjärvi, a lake in northern Finland. Boreal Env. Res. 18: 341–358.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-616/hess-2018-616-RC1-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-616, 2018.