Reply to interactive comment on "Role of rainwater induced subsurface flow in water-level dynamics and thermoerosion of shallow thermokarst ponds on the Northeastern Qinghai–Tibet Plateau" by X. Pan et al.

Received from anonymous Referee #2

(1) *The article 'Role of Rainwater Induced Subsurface Flow in Water-Level Dynamics and Thermoerosion of Shallow Thermokarst Ponds on the Northeastern Qinghai-Tibet Plateau' addresses the hydrology of two ponds of the Qinghai-Tibet Plateau. The paper presents interesting ideas which could potentially contribute to understanding hydrological and thermal processes related to aquatic ecosystems in permafrost setting. However, the paper is very poorly written and, in my opinion, doesn't meet the minimal requirements for a publication in The Cryosphere. In many instances, it is not possible to clearly understand the concepts proposed because they are not properly explained in the text.*

We would like to thank the second referee for here/his valuable comments that will definitively help to improve the original manuscript. Particularly, several imprecise terms and concepts were pointed out. A major change in the revised text is that we narrowed our research topic to pond water mechanism and its thermal impacts, and the topic of thermoerosion was moved out. Based on 3-year observations, we identified the water mechanism at the shallow thermokarst ponds, and also showed its impacts on the pond thermal regime. Over a long period, the water mechanism will affect the thermal evolution of the talik, as well as thermo-erosion. However, given limited observations, the relationship between water mechanism and thermo-erosion was not hard to say. Therefore, we just focused on water mechanism and thermal regime of the pond in the revise manuscript, and their implications were just simply discussed at the end. So, the word "thermo-erosion" in the title was also replaced with "thermal regime". In addition, some excessive speculations were dropped in the revised text (See details in the following answer (5)).

Limited by available observations in the harsh environment, our results are not perfect but still quite solid. We thoroughly revised the manuscript and tried to make it easier for understanding. Answers for specific comments are given in the following.

(2) *2) Scientific quality.*

"This paper lacks scientific rigour. The methodology is not always clearly explained. In fact some parts are sound while other sections really lack details to evaluate the strength of the results produced. "

We tried our best to fix the problems suggested by both reviewers. Major changes in methodology were (1) a detailed introduction of the methodology

(evapo-transpiration-evaporation equations); (2) the assumption of negligible seasonal vertical seepage at both ponds was clarified. Detail explanation is given in the answer (6). (3) Improper speculations were removed in Subsection 4.5.

(3) *"The concepts of thermokarst and thermo-erosion are not always used in a proper way or in the proper context."*

We acknowledge that the concepts of thermokarst and thermo-erosion were imprecise in the original text. These terms were revised in the text. Thank you for reminding.

(4) *"The authors also discuss about conductive heat transfers while it should be convective heat transfer (in relation with thermo-erosion). The evidences of thermo-erosion are anecdotal and have not been demonstrated clearly. "*

Given the definition of the thermo-erosion - the combined thermal and mechanical activity of running water in periglacial conditions (See Etzelmüller (2000)), we agree that the thermo-erosion is conducted by convective heat transfer. Given the reason in answer (1), we removed the results about thermo-erosion in the new text. Thanks for your suggestion.

Reference:

Etzelmuller, B. 2000. Quantification of thermo- erosion in proglacial areas - examples from Svalbard. Zeitschrift fiir Geomorphologie N.F., 44, 343-361.

(5) *"It is not clear if the water level data measured using U20 sensors have been corrected for atmospheric pressure. If not, then the results in figures may contain significant noise. "*

The water level data measured using U20 sensors had been corrected for atmospheric pressure in the original text. The technique details were added in the revised text.

(6) *"The authors assume that there is no infiltration of water into the mudstone below the pond. However. the 'waterproof' character of the mudstone hasn't been demonstrated clearly. Fissures in the rock could contribute to infiltration of water from the talik and thus to pond water level. This could severely impacts the conclusions of this study. "*

We agree that the assumption is very important for the conclusions. We carefully made this assumption based on the following three points. Firstly, fissures are not expected to exist in this kind of small thermokarst ponds. Different from tectonic lakes, thermokarst ponds are usually originated by permafrost thaw. Secondly, drilling samples show that the underlying thick lacustrine deposits of the upper Tertiary is mudstone, which is usually thought as aquitard if no fissures. Finally, a rough calculation shows that the amount of vertical seepage through the thick mudstone would be just a few millimeters per year given a low hydraulic conductivity of 1.0×10^{-10} m s^{-1} (e.g., Aplin et al., 1999).

Further explanation was given in the revised text.

(7) "There is not enough rationale or background information given in the evapo-transpiration-evaporation equations. it is not specified where those equations are coming from (not enough referenced)."

Background information of the method and missing references were added in Subsection 3.2 in the revised text.

(8) Basically, I consider that this paper is not well-articulated, that the evidence presented are vague, the discussion is often anecdotal (no clear scientific proof) and therefore the conclusions are weakly supported.

We acknowledge that several discussions of observations were speculated too much. Particularly in Subsection 4.5 in the original manuscript: (1) extraordinary warming phenomenon at the bottom during the late ice-cover period; (2) the deduction of the relationship between water regime and underlying permafrost thickness at the pondshore. They were dropped in the revised text, and only some straightforward evidences were demonstrated.

(9) "The graphical quality of the figures is not always good and explicit (e.g. fig. 3) and the figure caption is not detailed enough to interpret/understand the figures."

New data were added for the blank area in the Fig 3 (Fig. 5 in the revised text). Figure captions were revised.

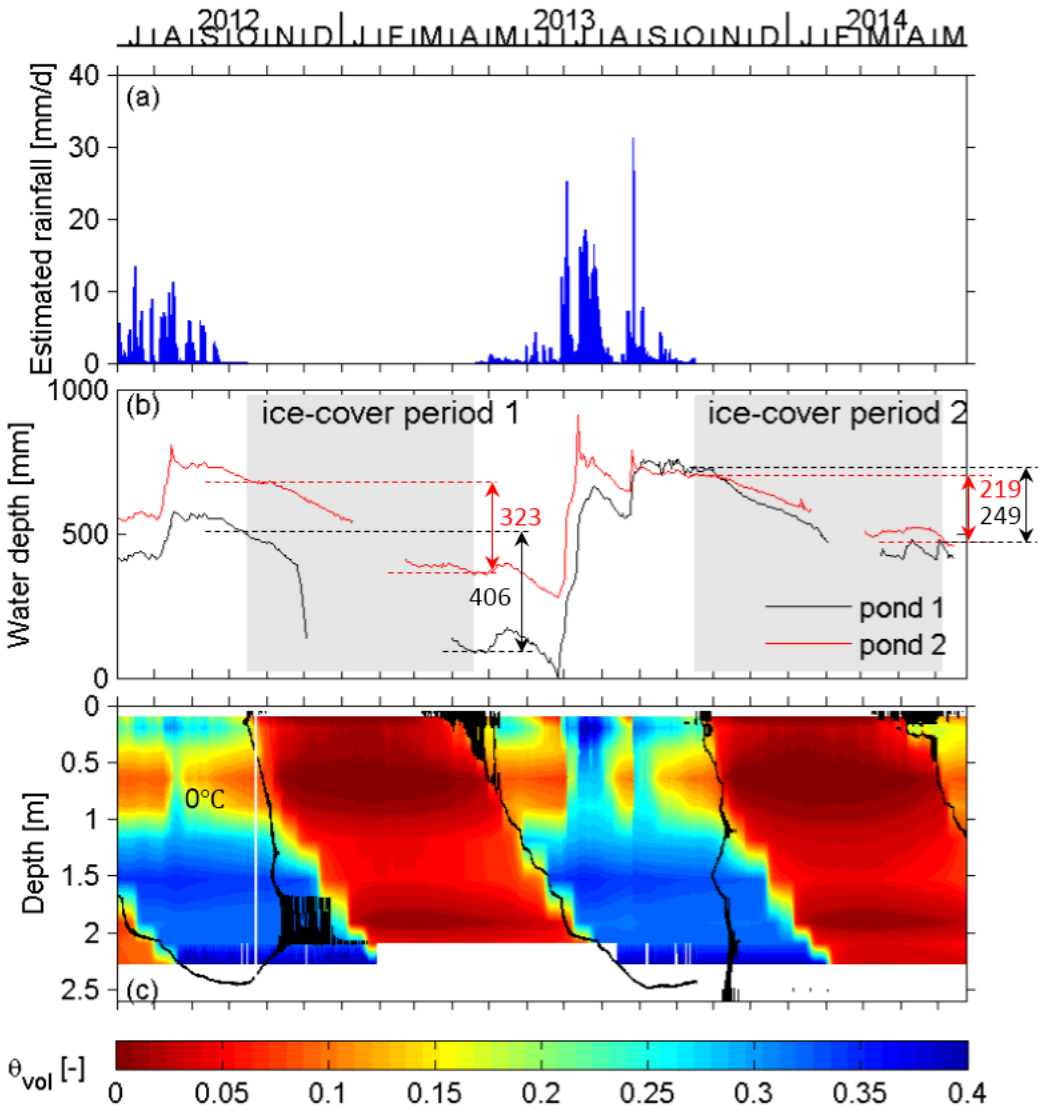

Figure 5. Response of pond water storage to precipitation and freeze and thaw of adjacent active layer during the period from July, 2012 to May, 2014. (a) Rainfall excluding solid precipitation. (b) Pond water dynamics in the Pond 1 and the Pond 2; dashed lines show the drop of water-level during ice-cover periods. (c) Soil water dynamics and thawing front (0℃, black curve) in the monitoring profile at the weather station (Fig. 1b). θ_{vol}: Volumetric water content.