This is a very detailed and extremely useful review of current research on thermokarst thaw effect on aquatic ecosystems (and potential effects on climate). The few comments I have as an editor are on the terminology and structure (see below).

General comment:

Using the feedback term is confusing throughout the text. The feedback is a loop between two components (processes), e.g. between permafrost thaw and warming:
Increased **permafrost thaw** (due to some initial forcing, eg warming due to deglaciation or anthropogenic emissions)-> increased GHG release to the atmosphere -> increased **warming** -> increased **permafrost thaw**

In general, it is ok to talk about feedback, especially in introduction, however, the GHG feedback is global, and warming due to thermokarst CO2 affects GHG emissions from the other regions on the globe. This complication is neglected in a simplified formulation above. In most cases in the text, you discuss a climatic effect of the thermokarst thaw, not the feedback:

Increased **permafrost thaw ->** increased GHG release to the atmosphere -> increased **warming**

Please revise the text and use the term feedback only where it is appropriate (see comments below).

Abstract, l.33: Following Julia Boike's comments, I think that the statement of 16% makes a wrong impression that we know this number with precision of 1%. There is a strong disagreement between different datasets on the area of wetlands and inundated areas. My suggestion is to write "about 16%" to indicate uncertainty in the data.

L59: "an urgent need to address the key gaps in understanding" – could you give here an example what are the key gaps you are talking about? The text above tells nothing about knowledge gaps. Do you mean gaps in understanding, ie there are processes we do not know well, or do you mean absent quantification of these processes, ie to closes the gaps we need to put numbers at the processes which are already known?

l. 179-188: I struggle to get a clear message that could be drawn out of the lake depth discussion. From the first 2 sentences, it follows that they are rather shallow (0.4 to 3.5 m), regardless of the geographical origin. The third sentence tells that they could be 10 meters or deeper. In addition, Walter et al., 2014, wrote "When these ice wedges melt under the warmer Holocene climate, the ground subsides (thermokarst), forming deep lakes (10–30 m)." I assume that Walter et al. exaggerate the lake depth, but for some reason you have not referred to this paper. Could you rewrite these sentences telling eg that most of the thermokarst lakes are rather shallow (0.4 to 3.5 m), but some could be 10 meters or deeper?

l. 1084-1086: “direct evidence for a positive permafrost carbon feedback to climate in thermokarst lakes is found…” I do not see how you can find an evidence for a feedback which is global. Can you actually quantify it based on this evidence? Is it 10% of global warming amplification or 0.1%? I think what the data tell is that warming promotes CH4 emissions due to thermokarst (but could reduce CH4 emissions coming from other regions, eg in subtropics if they become drier), the rest is a qualitative conclusion. At maximum, what is found is an evidence that CH4 emissions due to thermokarst increase in warmer climate, at least temporarily.

l. 1095: see above.

l. 1109-1111: Here, you discuss climatic effect of thermokarst lakes, not a feedback. Feedback strength (factor) is constant since it is independent of temperature change (additional change in dT per original T change). What are your feedback units? Is it feedback factor (amplification/dampening) in dT/T units (dimensionless) or radiative feedback units (W/m2/K)? Please rewrite the whole paragraph preferably avoiding the feedback term.

l. 1182: What do you mean by a long-term trend in feedback potential? Again, feedback in terms of W/m2/K is almost constant. Should it be climatic effects, not feedback?

l. 1381: “Summary, feedbacks, and future research needs”
I do not understand the section title as it mixes up different categories. If feedbacks are discussed, this is appropriate for discussion section prior to the summary section. Besides, it is unusual and confusing to have other sections after the summary (5.1). Could you please specify (the summary of what?) I would move the feedback section prior to the summary.

l. 1415: “The fate of released constituents and their feedbacks to climate…” GHG-climate feedbacks, eg CO2-climate feedbacks are a big theme which is not discussed in this paper.

l. 1447: Climate feedbacks – again, these are climatic effects of permafrost thaw, not feedback. Please rename and move above, before the summary.

l. 1470: “Future needs for research”. The content of this section rather fits a title “Gaps in understanding and future needs for research”. In most cases, it identifies gaps but does not tell what are methods to use, what are the primary research questions and what is the roadmap to address them.

l. 1633: Section “Inclusion and prioritization in models”. The section is not very specific, and it does not tell much about priorities. For example, is the land surface heterogeneity essential for getting the permafrost thaw into the models? Should it be stochastic or deterministic model? What is a proper spatial and temporal resolution? What are the data necessary for calibrating/evaluating models? Since there is no discussion of models in the main text, I wonder whether it makes sense to have it at the end of the manuscript.