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Interactive comment on “Physical processes of thermokarst lakes in the continuous permafrost zone of northern Siberia – observations and modeling (Lena River Delta, Siberia)” by J. Boike et al.

Anonymous Referee #1

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General Comments: This paper presents data and analysis of the thermal regimes of five thermokarst lakes located on the Lena River Delta in Siberia over a three year period. This is a worthwhile contribution because 1) there is relatively few studies of lakes in Siberia despite their very high abundance and potentially rapidly changing condition, 2) many such lake studies only collect summer data from single years, whereas year round and multiannual data are presented in this work, and 3) the collection of water level and bathymetry data in addition to thermal data presents additional opportunities to understand these systems. Many of the observed aspects of thermal regimes such

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as release heat from the sediment following ice cover development and warming the water column prior to ice out appear correctly interpreted yet are not widely reported in other analyses of lake thermal regimes though I believe these are common processes. Good support for the value of year-round monitoring of lakes. This paper is very descriptive however and it seems there are many opportunities for comparison and analysis the authors elude to but never pursue. Some examples are comparison of thermal regimes by 1) landscape setting (river terraces vs. Pleistocene Ice Deposit Complex) or source waters (subject to river flooding vs. more isolated), 2) bathymetric characteristic, or 3) interannual variation in relation air temperature, radiation, or wind regimes. I think all of these potential controls on lake thermal regimes are qualitatively addressed to some degree but not analyzed in any meaningful way and thus the paper lacks potential understanding of these relationship that could be use predict changes in lake thermal regimes in time or space. The use of the FLAKE model is somewhat unclear as well. Some unmeasured parameters were simulated but it is not entirely clear what the value of these are to the analysis and questions of interest. Additionally the figures are mostly time series plots of different climate, water temperature or heat budget components and not always that insightful. I would simply recommend analyzing the collected data in a way that helps understand how these thermal processes vary in some meaningful way. I think that in addition to the importance of this lake type in this region would make this a valuable paper.

Specific Comments: Title: I would replace “Physical Processes” with either “Thermal Processes or Regimes” because it doesn’t seem like other physical processes were analyzed or considered. Abstract: 6639 L16 – might just say what Wedderburn number mean as many readers might not be familiar with this term. 6639 L19-20 – Not sure naming the model is necessary 6640 L30 – Seem abstract should follow with some treatment of ideas in the Summary and Conclusions section. Introduction 6641 L12 – Toolik Lake is a Long Term Ecological Research (LTER) station, not a Long Term Experimental (LTE) site (though the latter might be more fitting). Also, if there are long-term data from this site that are truly exceptional they should be noted here. 6642

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Last paragraph on aims; ii) doesn't appear to have been done, but it is a very good idea, and iii) it is unclear to what end this modeling part is for. Site Description 6644 L13-15 This statement that lake source water is ground ice has a reference, but this seems unlikely. More likely its snow-water which has a similar isotopic signature to ground ice (suggest removing this). Methods 6645 L25 – 6646 L6 – How were the buoys relocated and retrieved if they are located well below the water surface? Just curious as this seems challenging. 6648 L7 – This section is interesting, but seems more rational is needed as to why this is a good way to present lake thermal data. 6648 L19-20 – Since latent heat of freezing and thawing aren't the same, why should this necessarily be the case. 6649 – L19-21 – How certain are you that lakes are snow-free most winters? Have multiple lakes been observed throughout multiple winters? Are there other studies or observations to back this up? Results 6657 L16-22 – This lake sediment data is very interesting, but not from this study so why is it in the results. Discussion 6659 L2 – What is CALON? 6659 L10 – I believe that (lake depth > winter ice cover depth) should be (lake depth > maximum ice thickness) 6660 L22-27 – Not sure I follow the comparison of fall and spring thermal dynamics here. 6661 – L19-23 – I didn't see data presented to support this statement (may have missed it) but would be interesting to see this and focus more on such question with data presented in results (and figures) and discussed. All time series figures should have y-axis title in addition to units and x-axis dates are hard to read. Figure 6 – Which months are which and why the interannual variation? Lake bathymetry figures – Can you show where sensors were located in each?

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