

The Cryosphere Discuss., referee comment RC1  
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## Comment on tc-2022-232

Anonymous Referee #1

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Referee comment on "A field study on ice melting and breakup in a boreal lake, Pääjärvi, in Finland" by Yaodan Zhang et al., The Cryosphere Discuss.,  
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The study presents detailed observations on variations of lake ice properties during two melting periods in a boreal lake. The observations encompass ice structure, porosity, density, biogeochemical characteristics (pH, electrical conductivity, Chlorophyll a) and were performed at daily to weekly intervals covering the latest stages of the ice-covered period. The study design and the approach are relevant to the state-of-the-art of the lake ice studies. The newly collected data have a potential to make a valuable contribution to the current knowledge on the mechanisms of the seasonal ice cover melt.

The presentation of the results is however extremely hard to follow, too lengthy and poorly structured. Description of methods pops up in the middle of results presentation, while new introductory information and collateral results, which are only loosely connected to the subject of the study, unexpectedly start the discussion part. The authors should analyze, synthesize, summarize and---finally---present scientific results in a concise, well-structured way.

Endless recitation of dry unbound numbers throughout long paragraphs, repeating the information presented in tables, without an integrated analysis of the field information is redundant and superficial. Last but not least: the poor language and style make the study hard to read. Overall, the style reminds that of a plain field report rather than a research paper. Many sentences are barely understandable because of poor English use. Reworking of the text with significant shortening, restructuring and language improvement is strongly recommended. The length of the ms should conform to the amount of the reported results, which suggest shortening it by 1/3-1/2. Below are some specific comments aimed to provide guidance on the revision. The comments are aligned with the text flow. The remarks on language and style are not exhaustive and serve just as the most evident examples.

L49 "structure" -> "structures"

L56: "physics of climate sensitivity..." poor wording

L61: "seasonal" -> "seasonally"

L67: "productive" -> "production"

L69: remove "the extent to"

L72: "protects the ice.." from what? Remove "by its presence"

L73: "immediately when" -> "immediately after"

L79: "difficult conditions": difficult for what?

L80: "melt rate" -> "rate of melt" or "melting rate"

L86: "has reached" -> "reaches"

L171: "unfiltered" -> "unfiltered" (?)

L173: "high accuracy" -> provide the accuracy values.

L176: "long wavelength" -> provide the wavelength range

L192: add the spatial scales and explain the color scale in Fig. 2

L195-196: remove "As we can see from Fig 3a-f", add "(Fig 3a-f)" at the end of the sentence.

L200: "became more and more" -> "increased"

L207-208: "rachis-shaped" revise wording

L212: Remove "Then"

L213: "temperature rose..." Temperature of what? The same for L217

L226-236: Fig 3 is not comprehensible and should be shortened to present the essential information only.

L244-254: The paragraph mostly repeats information from Table 2 and should be shortened to 1-2 sentences.

L262: Equation 1 is wrong.

L264-265: revise the style of the sentence

L277-279: awkward phrasing. Revise the sentence

L303 and elsewhere: " $S \text{ cm}^{-1}$ " Is it " $uS \text{ cm}^{-1}$ "? Check the units across the entire text.

L307: remove double "in"

L315: shorten Table 5, remove information repeating Fig. 5

L339, Section 4: The section represents the rare attempt to analyze the observed data

beyond their straightforward listing. However, the heat budget model, as presented here, is rather crude and lacks support by background physics of the heat exchange between air and ice surface. The monthly climatic means of solar radiation are too rough for such a model and can be replaced by data from reanalysis or nearby weather monitoring for the actual dates. Assumption of constant albedo is also weakly supported for the melting periods, especially with snowfall and rain events. Several approaches exist for albedo parameterization, with the simplest ones based on air temperature. Still, one could expect even more sophisticated albedo parameterizations, taking into account the detailed information on ice properties and drone images of the surface conditions. There is no clear model described for the long-wave radiation budget in the ice-air system and for the sensible/latent fluxes at the ice surface. By this, the inconsistency of the oversimplified model with the data (L376-378) is not surprising. The approach should be deeply revised based on the current knowledge on the surface heat budget.

L388, Section 5.1: This section appears absolutely unexpected and does not fit in line with the general flow of the study. Section is an odd mix of newly presented data lacking a thorough analysis of their relevance, statistical significance and processing methods (Figs. 6-7) with unnecessary common places (L411-412), and information on ice phenology from other lakes irrelevant to the subject of the study. The whole section reads inorganic and should be either removed or deeply revised with proper redistribution between methods, results and discussion, including adequate analysis of data reliability.

L430, Section 5.2: "comparisons with ice melting" - comparisons of what? The section title is senseless.

L453: "if further generalized..." This generalization is actually what the reader expects from the authors at this point: generalize your results and put them into the context of the present knowledge on the subject. The whole section should be deeply revised. Move Fig. 8 with the accompanying data to Results and write a new, more focused discussion.

L526-527: "...a surge of phytoplankton..." - Do you mean a phytoplankton bloom? If yes, can you demonstrate a correlation between pH variations and Cl<sub>a</sub> content? This passage reads too speculative and unsupported. Revise it, demonstrating support by data analysis, or remove completely.

L555-556: Awkward sentence, should be revised or removed.