

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2021-398

Anonymous Referee #1

Referee comment on "Mechanisms and effects of under-ice warming water in Ngoring Lake of Qinghai-Tibet Plateau" by Mengxiao Wang et al., The Cryosphere Discuss.,
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Review of "Mechanism and effects of warming water in ice-covered Ngoring Lake of Qinghai-Tibet Plateau"

I think this paper is trying to understand how solar radiation influences thermal stratification under lake ice on a large lake on the Tibetan Plateau. This is an admirable goal, but it isn't clear what the novelty of this paper is. I would say aspects of this process are well known, and hence introduction needs to better review existing literature and make it clearer what new contribution in this work. I would say it is well known that over winter lakes warm up under ice. This is a key point in the highly cited 2012 review by Kirillin (Who is one of the co-authors on this paper!)

Kirillin, Georgiy, Matti Leppäranta, Arkady Terzhevik, Nikolai Granin, Juliane Bernhardt, Christof Engelhardt, Tatyana Efremova et al. "Physics of seasonally ice-covered lakes: a review." *Aquatic sciences* 74, no. 4 (2012): 659-682.

Specifically they introduce idea of Winter I and winter II as periods where heating is dominated by benthic heating (early winter) or solar radiation (late winter). I would say your lake is completely consistent with a long winter II dynamic.

Another paper to better review is the GRL paper by Yang et al (2021), who introduce idea of cryomictic and cyrostratified lakes. Based on Figure 4 the lake on TP is windier than lake on Nordic tundra. there is no information on size of Kilpisjärvi Lake, but I assume that is is much smaller than 610 km² Ngoring Lake (which is almost same size as 720 km² Lake Simcoe). Based on Yang et al (2021) you'd expect Ngoring Lake to be cryomictic and start winter near 0oC before it warms up, whereas the smaller less windy Kilpisjärvi Lake to start winter nearer 4oC as a cryostratified lake.

I think the novelty of paper needs to be discussed in context of these two papers - This would change statement in abstract about warming dynamics that "*The lake water temperature was observed to be generally rising during the ice-covered period from November 2015 to April 2016. This phenomenon appeared in the whole water column, with slowing in deep water and accelerating in shallow water before ice melting. The process is different from low-altitude boreal lakes. There are few studies on its mechanism and effects on lake-atmosphere interaction.*"

Specific comments

The section from lines 79 to 104 needs to be completely rewritten. There is no need to discuss Lake Kivu which is a tropical merimictic lake. If you want to talk about lake categorisations, I recommend starting with

Lewis Jr, W. M. (1983). A revised classification of lakes based on mixing. *Canadian Journal of Fisheries and Aquatic Sciences*, 40(10), 1779-1787.

Then discuss 2012 of Kirillin and 2021 GRL paper by Wang et al. The other papers on winter dynamics of TP need to be better reviewed including

Wang, J., Huang, L., Ju, J., Daut, G., Ma, Q., Zhu, L., Haberzettl, T., Baade, J., Mäusbacher, R., Hamilton, A. and Graves, K., 2020. Seasonal stratification of a deep, high-altitude, dimictic lake: Nam Co, Tibetan Plateau. *Journal of Hydrology*, 584, p.124668.

line 144 - is this lake salty like other TP lakes? this become important later when under ice temps go above 4C.

Figure 1. where is Nordic lake?

What is bathymetry of lake - we more interested in that than topography. Where is water temperature sampled?

line 168 - need to say specifically where profile was taken and add to figure 1.

Figure 2 --Use a continuous shading, not something with 1 oC steps, when whole range of interest is really 0 - 4 oC

Line 308 - "*Thereafter, the lake was mixed,..*" You need a discussion in intro about Winter II and solar driven convection for this statement to make sense.

Line 329 - DON't abbreviate Kilpisjärvi Lake as K lake. It might be better to refer to it as lake Kilpisjärvi, as jarvi just means lake in Finnish. There are also no details on this lake - how deep how wide ? Other publications on this data.

Figure 3 - use same x-axis formats for dates. Different data for temps is plotted so also hard to compare Y-axis of a and b.

Figure 4 - comment on differences in wind speeds in driving one lake to be cyrostratified and the other cyromictic. The long polar night above artic circle drives Fig 4 b, so timing of magnitude of solar raditions drives most of differences in under ice convection.

Line 370 - this queston on under ice heating needs to better motivated by a revised introduction.