**Reply to RC1: reviewer comments in blue, and our reply in black.**

This paper presents a valuable new hydroclimatic record derived from varved sediments in a deep fjord lake at the western edge of the Atlantic Ocean, offering insights into climate variability over the past 1500 years. The authors emphasize the potential of the GL-13 lamination sequence as a proxy for regional hydroclimate and suggest that their findings align with broader teleconnections, particularly with the North Atlantic Oscillation (NAO) and the Atlantic Multidecadal Variability (AMV). While the paper makes important contributions to our understanding of long-term hydroclimatic dynamics, there are several notable gaps in the analysis that warrant further attention. The interpretation of this high-potential record is undervalued.

Thank you for your good words about the high potential of this site and our study.

**1. Lack of Seasonality Analysis:**

One missing issue is the absence of a detailed evaluation of seasonality within the varve record. The authors assert that the varves are annual in nature, with thicker varves indicating higher precipitation and thinner varves associated with drier periods. However, the seasonal distribution of precipitation within the year (e.g., whether the wetter periods are associated with specific seasons such as winter or summer) is not discussed. Given the potential sensitivity of the region's climate to changes in seasonal patterns, a deeper understanding of seasonality could offer important insights into how different climatic factors may influence precipitation timing and intensity throughout the year. It could have important implications for the interpretation of historical hydroclimatic changes and the impacts of climate variability on local ecosystems.

There seasonality of the varves proximal to the main tributaries is more pronounced and was detailed in the paper by Gagnon-Poiré et al. (2021): varve thickness is mainly driven by the spring discharge. However, as supplementary figures S4 and S5 show, the spring discharge is driven by snow melt, the latter being controlled by winter precipitations. On line 184, we clearly indicate that snow precipitation is the main driver of the varve thickness record, that means that varve record a winter signal. Yet, all the teleconnections subsequently discussed (Figs 8 and 9) are focusing on the winter month (JFM). Therefore we are not sure what we need to do to get a "deeper understanding of seasonality."

**2. Teleconnection Mechanisms:**

I appreciate the attempt to come up with spacial patterns. While the authors suggest that Greenland blocking and NAO plays a central role in modulating precipitation in the study region, they do not provide a comprehensive evaluation of how this teleconnection operates within the context of proxy record. Also the associated time and spacial scale is not considered.

The precipitation data from Goose A shows a sensitivity to North Atlantic Oscillation (NAO) changes, impacting both temperature and precipitation variability. The significant correlation between the varve thickness series and precipitation suggests that this proxy record is, to some extent, responsive to NAO fluctuations. As illustrated in supplementary figures S4 and S5 and as mentioned above, spring discharge is primarily influenced by snowmelt, which is directly connected to winter precipitation. Therefore, we can associate the atmospheric patterns linked to increased precipitation with more pronounced negative NAO phases.

Furthermore, understanding whether the relationship between the record and the pattern is constant across different phases would be valuable for refining the interpretation of the varve record.

Evaluating the persistence of this teleconnection over time and across various scales is challenging, as the different reconstructed NAO indices lack correlation before the instrumental period. This discrepancy is likely influenced by seasonality; tree-ring records are more closely associated with summer temperatures, suggesting that earlier reconstructed NAOs using tree rings may be more relevant to summer conditions. In contrast, the NAO is primarily an atmospheric pattern linked to winter variability, making our proxy record a unique resource for understanding past winter NAO dynamics.
We believe our record will be invaluable for future NAO reconstructions within a spatial network of sensitive winter NAO proxies. The scope of this study is to present the first 1,500 years of hydroclimate variability in northeastern Canada, detailing the age model, local comparisons, and potential teleconnections. An additional manuscript is in progress that will further explore the record across time and scale, as well as the underlying mechanisms.

**3. Implications for Hydroelectricity and Future Climate Trends:**

The paper makes a useful connection between past climate variability and potential drivers. Nnoting that the trend of decreasing varve thickness over the past 50 years is consistent with long-term variability, it would be interesting to make the link to climate model output.

Yes, making the link with climate models input would be very useful indeed, and we have the plan to look into this in a subsequent paper, but this is beyond the goal of this paper.

**4. Further Data Validation and Comparative Analysis:**

The paper claims that the GL-13 varve sequence is robust and confirms its annual character over 1523 years. The authors briefly mention similarities between their record and others, but a more in-depth comparative analysis would strengthen the argument that the GL-13 sequence is a reliable proxy for regional hydroclimate and enhances the credibility of their interpretation.

There are not that many records out there that are geographically close enough to be under the same hydroclimatic influence and they don't have the same resolution as ours.
The eastern Canadian tree-ring record (Figs 1 and 6) is a summer temperature record, so not directly comparable to ours. Moreover, the hydrological regimes in western Quebec are different from those close to the Labrador coast (Nasri et al. 2020).
The Norman's Pound record in Newfoundland is a complex stable isotope record that is influenced by precipitations and temperature, both with a seasonal effect on the isotopic values. We outline that the LIA and the MCA were recorded in Norman's Pound as it is the case at Grand Lake, but it seems it is the only link that we can do.
Nevertheless, we agree that such suggested comparison would strengthen the credibility of our interpretation but we are not aware of any record that would be appropriate for that, except the ones already used in the paper. Any suggestion is, of course, welcome.

**Conclusion:**

While this paper presents a valuable new hydroclimatic record and offers interesting insights into long-term hydroclimate variability in eastern North America, it would benefit from a more nuanced discussion of the seasonality of precipitation and a deeper evaluation of the teleconnection mechanisms driving the observed changes in the varve thickness. By addressing these gaps, the authors could provide a more comprehensive understanding of the region's hydroclimatic dynamics and enhance the broader implications of their work, particularly with regard to future climate change and its potential impact.

We will modify the final revised paper to add more details about the mechanisms between varve thickness, the seasonality of precipitations and their teleconnections with the major modes of climate variability.

**References**

Nasri B.R., Boucher E., Perreault L., Remillard B.N., Huard D., Nicault A. & Projects A.-P. (2020). Modeling Hydrological Inflow Persistence Using Paleoclimate Reconstructions on the Quebec-Labrador (Canada) Peninsula. ***Water Resources Research*** 56, 5: e2019WR025122.