Authors reply to Anonymous Referee #1 (RC1)
Text in blue corresponds to authors responses.

Holocene environmental and climate evolution of Central West Patagonia as reconstructed from lacustrine sediments from Meseta Chile Chico (46.5° S, Chile)
Franco et al., 2023

1. General comments

"A 3 m-long composite lake sediment record (LME-CP) was analysed from Laguna Meseta (LME-CP) in Central Western Patagonia at the eastern margin of the North Patagonian Icefield (NPI). Based on a multiproxy lake sediment analysis over the past ~10 ka, the authors discuss the sedimentation dynamic to reconstruct the glacial and environmental history of the area. The sedimentation dynamic was then correlated to environmental changes around the study area, specifically, regional glacial oscillation and paleoclimate proxies, with the objective of deriving insights into the Holocene climate variability in Central Western Patagonia. The authors discuss, infer, and conclude that the major environmental changes during the middle Holocene are mainly controlled by precipitation variability linked with the evolution of Southern Hemisphere Westerly Winds (SHWW).

The manuscript is well presented and structured, with fluent and precise language. Additionally, the problem, statement, and objectives are clearly explained. The manuscript provides results from a new location in the east of the NPI that contributes to improving the knowledge base concerning the evolution of the SHWW and adds relevant information to the understanding of past climate in the region. The evolution of the SHWW is a key component of the South American climatic systems. This manuscript contributes results that support a better understanding of the behaviour of the evolution of the SHWW through the Holocene and therefore, is within the scope of this journal. The title's manuscript clearly reflects the scope of the research, focusing on where the study was performed, the type of records found, and the period when is the environmental reconstructions were made. The abstract provides precise and complete information about the content of the manuscript, however, one suggestion for modification is, "3 m-long continuous sediment record" should be changed to "3 m-long composite sediment record" or just "3 m-long sediment record".

The methods area is clearly outlined and organised, and the description of the experiments is sufficiently complete and precise to allow for their reproduction. However, the construction of the "composite sediment records" is not totally explained in the methods sections, but this issue can be resolved with a brief explanation.

The manuscript's figures accompany the text well, and these have detailed descriptions, which allow for a better understanding of the problems in the study area context. The manuscript is well presented, and the article is very well structured. The problem statement is clearly explained, as are the objectives, area of study, and the method, the latter, permits the reproduction of the results. The manuscript presents a well pool of multiproxy results, which support the interpretation, and reaches adequate conclusions.

The interpretation of the geochemical data is clear and thoroughly discussed, and this allows the reader to appreciate how the authors constructed a discussion and reached the conclusion. The number of references is adequate; however, it is recommended that the authors check the format of the references. There is a minor change to make, for instance, the "Https://" is sometimes presented before the paper's doi and other cases not."

We appreciate the general positive review. The suggestion made by RC1 regarding the construction of the composite sediment record is addressed in the specific comments section.

2. Specific comments

"Line 132 mentions that three sediment cores were collected, and one of them will be used in the future for pollen analysis. Thus, the lector assume that two cores were utilised to construct the "3 m-long composite sediment record" (Laguna Meseta, LME-CP). Then, it is mentioned that the composite sediment records were constructed with additional help of six visible tephra as marker horizons for correlations between core sections. I understood (or I assumed) how the LME-CP was constructed after reading the results (Fig. 3) and Table 2 (AMS radiocarbon dates). I suggest adding a brief explanation in section 3.1 to clarify how the LME-CP was constructed, for example, mentioning how many overlapping drives of sediment (how long) were cored with a xxx corer from a depth of c xxx producing a composite lake sediment of 300 cm depth (Fig. 3), and that correlations of the overlapping core sections were based on (lithological changes?), and the correlation among sediments cores were made by…etc."

We will add supplementary material illustrating how we established the final composite sediment record.

In general terms, tephrochronology is the use of the tephra layers (volcanic ash) as "isochronous" (same time) connections or correlations of deposits from one place to another. It forms a widespread marker horizon or isochron in lake or marine sediments (among other sediments). The authors in this study detected six tephra layers using XRF scanning. This tephra layer detection is not associated with any geochemical quantified data, nor was the data compared with previous work. The authors mention that "the results show a non-uniform composition of these layer, reflecting different volcanic resources". There is not enough evidence to make that claim, and furthermore, this could perfectly be the result of a different eruption from the same volcanic resource. We don't know until the geochemistry is quantified. In brief, I suggest rephrasing the idea.

We agree, unquantified XRF geochemistry is not sufficient to address volcanic sources. We will rephrase this.

Only one tephra layer was geochemistry identified and compared with previous data from H1 (Hudson 1 eruption) and M1 (Mentolat 1). The results from this study show similar geochemical characteristics as T5 (H1, Hudson 1) (Table 1: Fig. 4). Then, the authors mention a mean age of 8,415 cal yr BP (Stern et al., 2016), which was drawn in figure 6 but was not included in the age-depth model display. My point here is to ask why the authors do not include H1 to display the age-depth model and completely apply the tephrochronology concept? I suggest writing a brief phrase explaining why H1 age was not included in the age-depth model. For example, an answer could be associated with any of the following: the limits of the tephra layer are not clear, the previous H1 age is too old/young compared with this study, or another motive. This explanation is very useful because tephrochronology is frequently not used in new data and/or in the other data we want to compare, and in my opinion, tephrochronology is underused."

The age of the Hudson 1 eruption is not included in the age-depth model because it has actually been dated for several locations, in both surface deposits and sediment-core samples from which different ages (within a reasonable range) have been obtained. For this reason, although we cite the age from Stern et al. 2016 (being the latest published chronology for this tephra), we do not include it in our age-depth model. Moreover, as RC1 states, the exact depth of the top boundary of this tephra within our records is not precise. Instead we compare the range of all available ages from other sediment cores with our age-depth model to highlight that published dates for H1 and our chronology are consistent with each other. A more detailed explanation of this matter will be included in the revised manuscript.

3. Format comments

All format comments will be considered for the revised version of the manuscript.