Climate
of the Past
Discussions

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Interactive comment on "Multi-century lake area changes in the Andean high-elevation ecosystems of the Southern Altiplano" *by* M. S. Morales et al.

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The paper presents a calibrated lake level reconstruction from southwest Bolivia and northwest Argentina. The reconstruction of lake level changes over the past 600 years is of outstanding resolution and worthy of publication. The paper also includes high-quality and meticulous data analysis and statistical treatment that enhance the value of the dataset. Discussion is somewhat weak and leaves the climatic interpretation somewhat underdeveloped. For instance, what is the most likely climatic mechanism responsible for the links between the reconstructed changes in lake surface areas in the region of interest and ENSO and PDO? On the format side of things, careful proof reading is needed, as the paper contains quite a few typos, plural/singular inconsistencies, missing words, and tense inconsistencies.

In summary, the data and statistical manipulation are remarkable, however the discussion could be largely strengthened and the description of the methodology could also be made more clear. My recommendation is that the paper be considered for publication in the Climate of the Past after incorporating major revisions. I provide more specific comments below.

Specific comments: Title should be modified to capture the interest of the readership of the journal who are mostly interested in past climate change. The term 'ecosystems' seems inappropriate here. As phrased it reads as if the lake area changes happen in the ecosystems, instead of in the lake.

Abstract should highlight the main findings: In my opinion, the main findings are the decrease in lake levels in the 20th century compared to the past 600 years, and the link between this and SST in the tropical and subtropical Pacific (ENSO, PDO). The last sentence of the abstract should be stronger and should relate to the implications of the reconstructed climate changes. What do these findings mean in light of current global warming and IPCC predictions of increase aridity in this region?

While the quantitative data analyses presented in the paper are outstanding and very robust, the description of the approach in the methodology is difficult to follow. Please add a flow chart showing the different steps involved in the data analyses. This is important because it is likely to improve the reproducibility of the methodology.

Please justify why non-overlapping averages over 5, 25 and 50 years are worth calculating with this dataset? If the purpose of the paper is to identify the signal of ENSO or PDO, it does not seem appropriate to take the high-resolution data (annual) and average them. For instance, what longer term climatic variability do you intend to identify with a 50 year average?

Please add the composite chronology from P. tarapacana mentioned in P 1830 L 20-25 as a Figure in the Supplementary Information.

In the Results section, subsection 3.1 you mention that the reconstruction accounts for 60% of the total variability in lake level changes. Someone could argue that consistency below 90% is not good enough. Where does this 60% threshold come from or what is it based on? R2, p-values? Please justify

The discussion presents several interesting statements but falls short at piecing the climatic history together. Please elaborate/clarify the following ideas: 1. Tree rings and surface areas of lakes in arid environments (P 1835, L 7-10). This sentence needs rephrasing, it is not clear what is meant 2. Correspondence with Altiplano records (P 1835, L 15-19). What is the linking climatic mechanism? 3. What is the atmospheric – low or high-pressure system – that links observed changes between Andean glaciers and the reconstruction presented here? (P 1836, L 24-27) 4. Longest interval with reduced lake levels recorded in the second half of the 20th century (P 1839, L 10-14). What is the climatic mechanism proposed for this observed change? 5. How is this new reconstruction complementing other studies discussing the regional manifestations of PDO and ENSO? This is one of the most important findings of the paper but the idea is only introduced but very poorly discussed. 6. The last paragraph of the discussion is somewhat weak. As stated, it sounds as if the aim of the paper was to produce a reconstruction, instead of shedding light on the climatic mechanisms responsible for the observed changes.

Minor comments Please define the term 'endorreic' for the non-specialist readers P 1824, L 5. Please add a reference to the first sentence in this paragraph. At the end of this paragraph, do you mean to reconstruct lake level fluctuations and moisture balance? Please tweak P 1824, L 15. Please add comma after word " periodicities" P 1826, top paragraph, please add "the" before "supplement" P 1825, L 5. Please clarify sentence on "trend distortion in index series" P 1829, L 5. First sentence, is this annual averaged precipitation or temperature? Please clarify P 1831, L19-20. Please consider rephrasing. . . "The fifteenth century high lake level stand was characterized. . ." P 1834, L 3, Consider replacing "show" with "showed" to keep the paragraph in the same tense

Table 2. Please modify Figure caption: As phrased it sounds like the numbers are moving averages but they seem to be z-scores of annual lake area. Z-scores and anomalies are presumably not the same thing, please verify terminology. Is rank 1 more important than 5? Please clarify this in the caption. Figure 1. Please make markers larger so they are more visible