

Interactive comment on “Quantifying late-Holocene climate in the Ecuadorian Andes using a chironomid-based temperature inference model” by Frazer Matthews-Bird et al.

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Quantifying late-Holocene climate in the Ecuadorian Andes using a chironomid-based temperature inference model

We wish to thank everyone who contributed to the improvement of this manuscript, specifically the comprehensive suggestions from the two reviewers. Outlined below is a detailed response to both the reviewers' general, and specific comments. The manuscript has been substantially changed as a result of the reviewer's general comments (see below; response to general comments) and minor edits have been corrected and recorded accordingly. All typos and minor formatting errors, highlighted in the annotated pdf have also been changed.

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Response to General comment: reliability of the reconstruction.

Whilst both reviewers, and an independent author who contributed to the online discussion, commented on the value of the study, all had major concerns relating to the final environmental reconstruction from Laguna Pindo and the subsequent interpretation. We would agree with all the reviewers that the development of a chironomid transfer function for the tropical Andes is an important contribution to tropical palaeolimnology and paleoclimatology. We also acknowledge, however, that chironomid studies from the tropics remain rare and little is known about the autecology of many of the taxa, namely their ecological tolerances relating to climatic variables. As a result, the environmental reconstruction from Laguna Pindo has some issues, namely unrealistically cold temperatures and significant inter sample variability. We would agree with all reviewers, and acknowledge in the original manuscript, that many of these fluctuations most likely relate to issues with the transfer function and/or the fossil record. These could include:

- The response of secondary variables, namely precipitation.
- Low head capsule concentrations in many of the samples.
- Un-even distribution of calibration lakes over the environmental gradient due to the steep topography of the Andes.
- Taxonomic issues (i.e different species between fossil samples and modern samples that currently cannot be separated using only larval head capsule material).

Many of these limitations are discussed in the manuscript. Indeed, we would argue a central point of this work would be the comparison of WA and Bayesian methods, in order to further explore these limitations. The application of the Bayesian model results in a less variable reconstruction, and an explanation for why the uncertainty associated with the reconstruction is greater than the climate variability we are reconstructing. The individual likelihood function of fossil taxa and the resulting posterior probability distribution for temperature sheds light on how the un-even distribution of calibration lakes, and subsequent skewed distribution of taxa, is affecting the inferred temperatures. Many taxa have unrealistically cold temperature optima due to the over

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representation of cold lakes in the calibration datasets and this has a significant affect on the reconstruction, most notably unrealistic cold Holocene temperatures. The error associated with both reconstructions is entirely consistent with a constant temperature of 20°C. We would agree with the reviewers that attributing the variability of the reconstruction to anything more than noise would be an overstatement at this point. This work does, however, suggest the way forward for improving temperature reconstructions, namely, improving the richness/sampling of the training set to enable the detection of smaller signals.

For this reason we would agree with the anonymous reviewer; “ These problems are honestly discussed in the text. It appears that L.Pindo was not the best lake to perform a reconstruction.”. The reviewer provides two options for rectifying these issues:

“(i) The TF is optimized, undergoes additional testing, the quality of the reconstruction is substantially improved (robustness of the TT amplitudes, robustness of the cold anomalies, etc.) and/or (ii) the profile of the reconstruction is lowered; given the pertinent deficits the reconstruction is qualitative and NOT quantitative, not overstating the results and conclusions.”

Unfortunately, we do not feel that the quality of the reconstruction can be substantially improved at this stage for many of the reason discussed previously and therefore we cannot meet first criteria (i). For this reason we propose to move forward with the reviewers second suggestion, i.e. lowering the profile of the reconstruction in the manuscript. We feel this option will allow the manuscript to make a meaningful contribution to the literature, whilst honestly representing the current sate of chironomid research in the area and addressing many of the concerns of all reviewers and online contributions.

The following major changes have been made to the manuscript in order to address the general comments of both reviewers:

i) The Introduction has been shortened (L.126-L132) in order to reflect the new fo-

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cus of the manuscript, i.e. refining the proxy as opposed to palaeoclimate inferences. This modification also addresses a concern of the anonymous review, which noted the introduction as being overly long.

ii) Sub section 5.4 Laguna Pindo temperature reconstructions has been removed. This subsection is no longer needed as the temperature reconstruction is presented as qualitative and only used to further understand the various models.

iii) Sections 5.6 (Cooling climate 3800-2800 cal yrs BP), and 5.7 (Recent cooling) have been removed. Based on the recommendations of the reviewers, we have changed the focus of the manuscript to center on proxy development not palaeoclimate interpretations. The Laguna Pindo reconstruction is used to understand the limitations of each model and is presented as a more qualitative interpretation of climate variability over this time period. The conclusions of the manuscript focus on our future recommendations for improving palaeotemperature inferences using chironomids. This addresses the current limitations of Neotropical palaeolimnology using chironomids, and provides a list of necessary criteria for future researchers wishing to explore this proxy further.

The attached PDF provides a detailed breakdown of how each of the reviewers specific comments was addressed.

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/cp-2015-186/cp-2015-186-AC2-supplement.pdf>

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2015-186, 2016.

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