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Climate of the Past
Discussions

# *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 chironomidâĂŘbased temperature inference model Matthews-Bird et al. Climate of the Past

Summary The training set developed by Matthews-Bird et al., based on surface sediment recovered from 59 Andean lakes in tropical South America, is used to: 1) determine the distribution of subfossil midge remains; 2) identify environmental variables that can account for a statistically significant amount of variance in the distribution of the midges; and 3) produce a midge-based inference model for mean annual temperature (MAT). In addition, the inference model, which is applied to the subfossil midge assemblages preserved in a sediment core recovered from Laguna Pindo, a small, shallow



lake in the eastern Andes of Ecuador, is used to develop a quantitative midge-based reconstruction of late Holocene temperature change for region.

The development of a midge training set and the associated inference model for this region is notable and important. This study provides much needed insight into the biogeography of midges in tropical South America and also serves to improve our understanding of the modern midge-environment relationship. I believe that this paper makes an important contribution and should be accepted for publication with some revisions. My major concerns are outlined below with minor issues following.

Major Concerns

1. The range in midge-inferred MAT values at Laguna Pindo during the late Holocene is ∼ 6oC. In addition, there are intervals where the change in midge-inferred MAT is of a large magnitude and quite rapid (e.g. the ∼ 5oC decrease in MAT that occurs between 400 and 100 cal yr BP). MAT is inherently less variable than seasonal or monthly temperature estimates; this is especially true in the very low latitudes where MAT does not vary appreciably through the year. I believe the authors should include a discussion of the potential drivers of tropical climate during the late Holocene given the large magnitude fluctuations in inferred temperature documented at Laguna Pindo. What is driving a 5oC change in MAT during the Little Ice Age (LIA)? Is the magnitude and rate of this change in inferred MAT reasonable? Polissar et al. (2006) is cited to suggest that the change in MAT at Laguna Pindo during the LIA is comparable to other records from the topical Andes; however the reconstructions in Polissar et al. (2006) are based on sites located at ∼ 4200 m asl (∼ 3200 m higher in elevation than Laguna Pindo) and likely influenced by vertical amplification of warming in the tropics (Thompson et al. 2011).

2. Are there alternative explanations/site specific drivers that can account for the shifts in the midge assemblages at Laguna Pindo? For example, could changes in lake level and/or the composition of aquatic vegetation influence the midge assemblages

and thereby, confound downcore interpretations and the midge-inferred temperature reconstruction.

3. A number of studies identify ENSO-related shifts climate in the eastern tropical Pacific (e.g. Conroy et al. 2008) and the western margin of tropical South America (e.g. Moy et al. 2002) during the late Holocene. What role does ENSO variability play in influencing the midge assemblages at Laguna Pindo? The Medieval Climate Anomaly (MCA) is also well expressed in the low latitudes (Mann et al. 2009); however, no mention of the MCA is made in the manuscript. Is the influence of MCA-related solar and volcanic forcing evident at the study site? The authors should more explicitly connect the downcore reconstruction to known drivers of late Holocene climate change in the region.

4. The following concerns relate to the robustness and reliability of the MAT reconstruction. The reliability if the reconstruction is assessed using a number of standard approaches including modern analogue technique and a goodness-of-fit measure. These approaches document that the downcore samples are not well represented in modern training set and many of the samples have a poor-fit to temperature. In addition, there appears to be a correspondence between samples with low head capsule counts and samples that have a poor fit to temperature. Lastly, there is a fairly large discrepancy between the midge-inferred estimate of modern MAT ($\sim$ 17oC) and the observed MAT for the study site (20.2oC). The above highlight some of the issues related to the quantitative reconstruction. A more detailed discussion on the paleoecological information captured by variations in midge assemblage composition would help to strengthen the paper. In addition, elaborating on the results of the DCCA would provide interesting qualitative information on the timing and magnitude of faunal turnover.

5. L. 542 : Is the primary control on the subfossil midge assemblages temperature or precipitation? The assertion that taxa associated with higher sites are migrating down slope in response to changing climate can be substantiated by passively plotting fossil assemblages against the modern training set samples (coded/classified by elevation)



in ordination space.

Minor Issues

1. l. 349: I do not think that that lakes located between 1000 and 300 m asl can be considered to be similar in elevation to Laguna Pindo ($\sim$ 1200 m asl). Applying a standard lapse rate to this elevation range suggests that MAT for the lowest and highest lakes would vary by 12-20oC.

2. l. 415: reporting the RMSEP as a % of the total MAT range captured by the training set would be useful.

3. Fig. 1: requires a N-arrow

4. Fig 2: “PH” should be corrected.

5. It is not clear why non-limnological variables such as latitude were included in the exploratory analysis. Latitude, longitude and elevation are not directly controlling the distribution of midges; the analyses should be re-run with only environmental variables that have the potential to directly control the distribution of midges included.

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Please also note the supplement to this comment:
http://www.clim-past-discuss.net/cp-2015-186/cp-2015-186-RC1-supplement.pdf

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