

Interactive comment on “Rapid millennial-scale vegetation changes in the tropical Andes” by D. H. Urrego et al.

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OVERVIEW

The manuscript presented by Urrego et al. presents a reanalysis of eight fossil pollen records from the tropical Andes. The manuscript is significant because, for the first time, an attempt is made to reconcile two different approaches to interpreting fossil pollen data. The manuscript standardises, as far as is possible, the datasets from each record to examine them from the perspective of the abundance of expertly categorised pollen groups (e.g. arboreal pollen) and multivariate statistical analysis. The strength of the manuscript is in the collation of interesting and important pollen data sets from the tropical Andean region, and the standardisation of analytical approaches. The standardisation undertaken allows key features of the different analytical approaches

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and the palaeo-climate to be drawn out.

MAJOR COMMENTS

1) Choice of data set for Lake Fuquene. The data set analysed from Lake Fuquene is the “Fq-2” study that covers the last c. 46,000 years at an average resolution of c. 430 years (Table 2). However, a higher resolution record does exist from this lake “Fq-9c” (Bogota et al., 2011). Although the Fq-9c record does not reach the modern, given that this manuscript is trying to detect rapid climate change back to 60,000 years ago (Fig. 3) I wonder why this higher resolution record has not been used at least for the older part of the analysis. It would be good if the authors could clarify why the Fq-2 data have been used, or update the analysis to include the Fq-9c data (i.e. explain P. 1721, line 15-16).

2) Geographic relevance. The Figure 1 caption refers to “Northern and Central Andes” while the paper title is related to the “tropical Andes” (and elsewhere). The geographic region considered should be defined early in the paper and the manuscript would be improved if this were consistently used in the figures and text.

3) Focus on millennial scale variability. The title of the paper focuses on the millennial scale variability of tropical Andean climate. However, much of the paper discussion is related to the comparison of techniques, and the role of orbital forcing. The title could be altered to indicate the technique comparison element of the manuscript that would, I suspect, broaden the readership.

4) Figure 1. The concept of the 3D map figure is very nice and helps to show the altitudinal relationship between the study sites. However, the Lake Pacucha star appears to be in the wrong location and the orange circle representing the South American Summer Monsoon is unclear, maybe indicate that this is the extent of SASM for some months?

5) Can the authors get agreement from the contributing authors to deposit all data in

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the Latin American Pollen Database (LAPD)? If so this would be a good step forward. Even if not the case the authors should include DOI information, or LAPD data set ID numbers, so that it is clear to the reader which data have been used and which authors to contact to obtain data.

MINOR COMMENTS

1) General

- a. Check for consistency of capitalisation of names and acronyms, e.g. SASM South American Summer Monsoon (Figure 1 caption)
- b. Check references, e.g. Bogota et al. (2012) in Table 1, should read Bogota et al. (2011).
- c. Use “-“ after “sub” consistently, e.g. section 4.3 line 8.
- d. I think it would be correct to capitalise names of vegetation types, e.g. Paramo (section 4.3, line 13).
- e. The start of each site section within Results and Interpretation would be clearer if it started with the site name, rather than “This...”, i.e. replace “This site...” with “The Llano Grande site...” (P. 1711, line 12).

2) Abstract

- a. P. 1702. Line 8. Indicate what the millennial scale variability is in, i.e. “climate”

3) Introduction

- a. P. 1702. Line 13-14. The use of the word “adequate” is unclear. Do you mean that models are likely to predict future climate within a given uncertainty?
- b. P. 1702. Line 22-23. In what sense are “paleoenvironmental reconstructions” challenged? Are you talking about the challenge of sufficient resolution to identify past climate change events?

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- c. P. 1703. Line 10. The introduction of millennial scale variability should include a clear temporal definition of the events that are being discussed (e.g. a table to mirror the illustration on the figures and references). This would help the reader to judge the ability of the records to detect these events.

- d. P. 1705. Line 8-10. I agree that vegetation change is an “internal response of the climate system”; interesting additional discussion on this theme could relate to the different sensitivities of different vegetation types (at different locations) to climate change.

4) Environmental setting

- a. P. 1705. Line 22. Replace “unmarked set by Dunia” with a reference (or clarify what is meant).

5) Methods

- a. P. 1707. Line 26-27. Define what is meant by “mid- and high- elevations”.
- b. P. 1708. Line 18. Define what is meant by “relatively short”.
- c. P. 1708. Line 23. I am not sure what you mean by “operating mechanisms”? Please clarify.

6) Results and Interpretation

- a. P. 1711. Line 4. Changes could be synchronous and opposing.
- b. P. 1711. Line 16. The arbitrary direction of DCA z-scores should be explained so that the ability to reverse values is clear.

7) Discussion

- a. P. 1716. Line 17. The start of the discussion picks out an issue with the use of RoC analysis linked to a supplementary figure. As these results have not been presented then this is a bit of a surprise for the reader to suddenly come across a statement

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saying that they have not been used. I suggest that either this figure is moved into the main document if perceived to be important, or the discussion is moved to a less high profile section of the manuscript.

b. P. 1720. Line 3. Discussion of timings should include discussion of the robustness of chronologies. Especially where distinctions are made on relatively short events, e.g. cooling 13-11 ka (line 7) and short lived cooling 13-11.5 ka (line 10).

8) Figures

a. Figure 2. Plot on 60 ka timescale like Fig. 3 and 4.

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