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

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## OVERVIEW

This paper by Urrego and co-authors goes back to eight published pollen records from the tropical Andes (between 60°29'N and 16°20'S) and reinterprets them using both ecological groupings (with a particular focus on AP%) and ordination scores from DCA. The DCA axis scores are also used to estimate rates of change (RoCs). Except for the case of Llano Grande in Columbia, the authors have used the published age models. The paper is set out to look at millennial scale variability, specifically Heinrich stadials and what are called Greenland interstadials (D/O interstadials). In practice, however, the paper says more about the stadials (including the YD) than the interstadials, presumably because only three of the records actually extend back beyond 25 ka. I think

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that this is an interesting paper, but have concerns about the emphasis in the text on moisture sources when in fact most of the responses seem to be driven by temperature.

## MAJOR COMMENTS

Environmental setting. I found this quite confusing in places in terms of a) modern climatology (linking to Fig. 1) and b) setting. a) The description of this in section 2 and Fig. 1 need to be linked together more effectively. At a basic level Fig.1 has no latitudes or longitudes marked on it. It isn't clear whether the LLJ that is marked on the figure is the South American Low level jet referred to on p. 1707 (presumably it is). The Choco Jet referred to on p. 1706 isn't shown on the figure at all. The ITCZ is shown in only one location, with no indication of its seasonal shift and the label for the SASM seems to be located a long way to the east. The text on cold front outbreaks (p. 1705) is rather confusing as it refers to the impact of these fronts from both north and south, but then reports that cold fronts (from which direction?) can make a significant contribution to summertime (SH or NH?) precipitation in western Amazonia. It would be helpful to clarify this. P. 1706 line 9 – based on Fig. 1 it isn't clear how the Choco Jet affects the western flank of the Andes, this feature really needs to be added to Fig. 1. It will then make sense. In the text on Millennial scale variability, trends and climatic mechanisms it would be good to clarify the relationship between the ITCZ and the SASM (see top of p. 1704). The signature of stadials in Cariaco and the northern sites in this transect is dry. b) The text contrasts sites in the northern and central/southern Andes (p. 1706) but this categorisation isn't shown in Table 1 or Fig. 1. This could also be picked up in the first paragraph of 3 Methods. In this paragraph I would help the reader by inserting a bit more explanation in line 8 e.g. 'Lakes Chochos, Pacucha and Consuelo also lie on the eastern flank of the Andes, but further south'. What is meant by mid- to high-elevation in this context? (p. 1704 last line, 1705 top line).

Methods. I'm afraid that I am not convinced by the use of a ratio between aquatic pollen types classified as deep water taxa and shoreline/shallow water taxa, to reconstruct lake level change. The authors record that the Holocene D/SS is nearly zero for Lake

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Titicaca when it has been shown that there was a major drop in lake level in the early Holocene followed by recovery (e.g. Baker et al., 2001). Given their own caveats about the D/SS ratio at the top of p. 1719 and the fact that there are often more reliable lake level indicators for the sites discussed in this paper, I suggest that the authors think carefully about removing this element. Although lake level/moisture balance is referred to in Section 5.2 (Orbital scale environmental changes), it isn't referred to very much in relation to millennial scale change. If the authors do want to retain this, then they need a clearer definition of what is meant by shallow and deep (p. 1710, line 6) and make more use of other water balance indicators.

**Discussion.** The anti-phasing of responses (in relation to moisture balance) to both Holocene orbital forcing and to millennial events between the northern part of tropical South America and the southern part is quite well established. The possible east – west variation suggested by Cheng et al. (2013) based on their speleothem work is a newer idea. If the authors wish to continue to make this a focus of their paper, then these complex patterns warrant more discussion and could be linked much more closely to moisture sources (see above).

**Conclusions.** These say nothing about warm events (your Greenland Interstadials). I'm not sure there is that much to say given the records available, but they seem less consistent. See previous comments about moisture sources.

#### MINOR COMMENTS

**Abstract.** See comment above re moisture sources. I do not see this as the emphasis of the paper.

p. 1703 lines 13 and 14 add some non-ice core references

p. 1707 line 7 Do you really mean eastward transport of Amazonian moisture?

p. 1708 The text on age models isn't very elegant. Can you re-phrase?

p. 1709 line 1, insert 'the' before 'original authors'; line 7, insert 'a' before 'pollen taxon'

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- p. 1710, line 13 aimed
- p. 1713, line 2, study based on what?
- p. 1714, line 3 What do you mean by high resolution in relation to the Chochos record?
- p. 1716, line 19 difference; line 20 insert 'the' before La Cocha
- p. 1718, line 25 can you suggest some specific proxies? Leaf waxes? GDSTs?
- p. 1721 line 9, please check whether the YD has been mentioned previously; line 25 give the date for G1
- p. 1722 line 17 either 'directions differ' or 'direction differs'; lines 19-21 contrast with speleothem records from the east.

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Interactive comment on Clim. Past Discuss., 11, 1701, 2015.

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