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Climate of the Past Discussions

Interactive comment on "Annual proxy data from Lago Grande di Monticchio (southern Italy) contributing to chronological constraints and abrupt climatic oscillations between 76 and 112 ka" *by* C. Martin-Puertas et al.

Anonymous Referee #1

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Review of the paper by C. Martin-Puertas et al., CPD 2014

1- Summary and general comments:

This paper presents new high resolution sedimentological data from Lago Grande di Monticchio covering the time interval 76-112 thousand of years (hereafter ka). The new data allow refining the absolute chronology previously published by Brauer et al. (2007). Climatic oscillations at millennial scale are clearly observed while there are evidences for a superimposed sub-millennial scale climatic variability. These abrupt climatic changes are then compared to the climatic variability recorded in the Green-

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land NorthGRIP ice core and the European NAPLS speleothems.

This is an interesting study that provides new detailed insights on continental climatic variations in the Mediterranean region and it benefits from the fact that an absolute chronology can be derived based on the identification of annual varves. Within this context, the work of C. Martin-Puertas and co-authors should eventually be published in CP. However, it requires first some major modifications both on the form and the context. In particular:

- The introduction needs to focus more on the questions that will be addressed by their study and in particular on the chronology issues to date that prevent robust comparison between records originated from different paleoclimatic archives. In particular, the fact that for this time period it is difficult to get independent chronologies between archives should be highligthed).

- A better description and assessments of the age uncertainties associated with the event durations as recorded in the various paleoclimatic records should be presented.

- Figures 3 and 5 are too small when printed out. It would be good if the technical editor could ensure the largest possible figures for the final version. In addition, the authors need to provide revised figures with an increased vertical size compared to their current form. At the moment, the sedimentological records are too compressed to allow an easy visualization of some of the authors' statements. In addition, the authors should also produce additional figures which present zooms of their dataset on the transitions between the MON events and in particular on intervals highlighting sub-millennial scale variability.

Overall, the manuscript is clear but the authors should be careful to rewrite a few sentences that have some awkward formulations and to correct the remaining typos (listed in the "Minor and technical comment section"). I have detailed below the specific and technical comments that should be taken into account when preparing a revised manuscript.

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2- Specific comments:

Introduction: - The first paragraph of this section is informative, however in its current state (form and content), it is too descriptive. It is good that you introduce the context of your study but I would like to see it more focused especially at the beginning on abrupt climate changes and less on the Last Interglacial since your study does not really cover this interval) and on what your motivations and the issues that you want to address are. For instance you should mention on the fact that abrupt climate changes during the early glacial period is less studied than the rapid events of MIS 3: (i) because of the resolution of the records covering this time period but also (ii) because robust dating is more difficult since it is outside the interval covered by radiocarbon dating. - Also, you should mention that there are more and more evidences that sub-millennial scale variability is superimposed onto the classic millennial-scale variability during the glacial period but that only very high resolution records could enable to study both millennial and sub-millennial scale (and we don't have so many yet!). You should also insist more on the fact that you provide a high resolution continental record, this is rare for this time interval and this is a big added value to the paleoclimate community.

- More specifically, the paragraph P2598-line 13-line 20 about the dating issues should again emphasize better the limits at the moment in dating absolutely paleoclimatic records for time periods beyond radiocarbon dating. As for the ice core chronologies you should also say that beyond 60 ka, there is not annual-layer counting based chronology and thus absolute uncertainties are getting bigger. As for the speleothem record, you should mention that there are good dates but there are also other issues such as getting continuous paleoclimatic record and interpreting correctly the measured climate proxies.

- You mention dating differences of several millennial for ice core chronologies and you're right. However, you should be more precise: these differences exist between two different ice cores chronology (GICC05modelext and AICC2012) and then between ice core chronologies and speleothem chronology.

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To summarize, I think that a focused and precise introduction will help highlighted the value of your work.

Pollen record vs varve record (P2609) Line 9: What is the limit in age resolution? “Synchronous with “?” years” should be said or something similar. Can you give a quantitative estimate of this lag in term of age (together with an estimated uncertainty)? Lines 14-19: you should expand this paragraph. What does this observation imply? Is this something that you expect? Or not? Has this been observed in previous continental records?

Absolute dating, durations of climatic events and associated uncertainties - Section 4.2. In Figure 2d, you present error bars indicating the accumulative counting error and the maximum probability ranges without mentioning any details about it neither in the caption of this section nor in the text. I would like to see information and explanation on those and on what they represent. - What is the associated uncertainty on the duration of each event? The manuscript would benefit greatly from additional figures which zoom to clearly see the different transitions between cold and warm states for the Lago Grande di Monticchio record. Also, there are errors in the duration of events in speleothems and ice cores, how do you deal with them? I would like to see some estimates of them for so that we can see whether the differences in duration between the different paleoclimatic events highlighted with the comparison are significant or not.

Method section: P2600: lines 18-20. Please add a brief summary of the outcomes of this comparison between the two methods, e.g. how do the uses of these two methods compare?

P2610, line 10: This point needs to be more developed in this discussion as it only comes back in your conclusions (i.e. the fact that the differences observed between the different records may originate from different proxy responses). On one side, you should refer to previous works that have done comparisons of abrupt climatic variability in different archives and what we know about synchronicity/lead/lags. On the other

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side, you should also develop the fact that interpreting proxies from speleothems and whether recorded changes are synchronous with temperature changes e.g. above Greenland or Europe, is not always straightforward.

P2614, line 18: you should develop this last sentence. Also, what are the perspectives resulting from your work and what are the broader implications? The conclusion should be developed to answer those questions, while the summary of your results can also be less detailed.

Throughout the manuscript, you mention oxygen isotopic records from the NGRIP ice core and also from the NALPS speleothem. It is necessary to be more rigorous and clear on the terminology. You should be careful when you refer to these records so it is clear to the reader that you refer to the water isotopes measured on the ice of NorthGRIP (ice δ18O), while for the NALPS speleothems you refer to the calcite δ18O record.

Figures 3 and 5 need to appear in a much bigger size in the revised manuscript. Also, the vertical size should be made much bigger to ease the visualisation of variations both in the sedimentological curves and the climatic curves.

3- Minor comments and technical corrections:

Title: I find the formulation of the title awkward. Here is a title suggestion: “New annual proxy data from Lago Grande di Monticchio (southern Italy) between 76 and 112 ka: New chronological constraints and insights on abrupt climatic oscillations”.

P2596 -lines 1-6: you should make two sentences out of this one. You need also to mention the fact that the pollen assemblage record has been previously published. -line 3: “ka” should be defined also in the abstract. -line 9: “based on independent...”: you should say instead that you propose an absolute timescale and if you want to keep the fact that it is independent, precise what it is independent from (e.g. marine and/or ice core chronology). -line 13: “GS” should be defined in the abstract. -line 20: “with

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their counterpart IDENTIFIED in the ice and speleothem records.

P2597 -line 9: “(MIS 5d and 5b) and reduced (MIS 5c and 5a)” -line 12: “BRAUER et al.” -line 18: replace “oxygen” by “water” -line 26 to P2598, line 2: Information is redundant within those two sentences; this paragraph needs to be rewritten. In particular “rapid temperature changes superimposed on millennial-scale” needs to be reformulated.

P2598 -line 28: “the Mediterranean CONTINENTAL climate variability...”

P2599 -line 1: “COMPARISON -lines 1-2: “the isotope records from Greenland (NGRIP, ice δ18O) and from the northern Alps (NALPS, calcite δ18O) -line 8: refer to Figure 1 at the end of the sentence

P2600 You should present in the “Material and Method” section, the pollen record together with associated basic information (e.g. about the analysis and the resolution) and mention that this has been previously published in Brauer et al. (2007).

P2601 -lines 26-27: “For most intervals....r=0.999”; can you give an order of magnitude in years for the divergence for the studied period (e.g. what is the maximum divergence?).

P2602 -line 22: “from last interglacial to glacial deposits (112-76 ka)” rather than “76-112 ka”.

P2605 -line 20: the headline should be changed to be more precise.

P2606 -line 28: need a space between “1” and “and”.

P2607 -line 23: this sentence needs to be rephrased. The cold event MON3 is not very pronounced in the pollen record as you mentioned in the text and I was wondering if there any other paleoclimatic evidences for this sort of regional differences in Europe? Do you have any potential explanation for such a regional feature? The resolution of the pollen record doesn’t seem as high as for some other parts. You should discuss more this particular feature and propose hypotheses to explain this particular feature.

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P2608 -line 5: “the pollen-defined Montaigu EVENT” instead of “the pollen defined Montaigu”.

P2610 -lines 3-4: replace this sentence by “The NGRIP record is displayed both on the updated GICC05 modelext (Wolff et al., 2010) and the AICC2012 timescales (Bazin et al., 2013; Veres et al., 2013). -line 14: “succession and evolution of cold climatic fluctuations that occurred during ....” : it seems to me that because of the uncertainties due to the dating of the different paleoclimatic archives, it is very difficult to propose a “succession” of the climatic conditions and this is not what you actually do. Thus, you should reformulate this sentence. -line 20: add unit after 217. -line 22: Rephrase the sentence starting by “Interestingly, ...” by “No counterpart is identified in the water isotopic profile from NorthGRIP.” About the end of this statement, why would MON 1 be associated particularly to the end of the GI25? You need to be clear on the fact that this is speculation.

P2613 -line 27: CALCITE d18O -line 11-line 14: this sentence needs to be reformulated -line 23: MON3 not only shows the least pronounced changes in sediment varve thickness but also the pollen-based environmental reconstructions highlight a least pronounced cold event; this should be added to the sentence.

P2614 -line 5: precise the fact that it is ice d18O values -line 14: “...in BROAD agreement...” -line 16: remove “the”; add an “s” to the second “record”

4- Tables and figures

-Table 2: In the caption and in the table, replace “GICC05” by “GICC05 modelext”; Add a note in the caption to explain that you give the duration of GI23 together with GS23 because the gradual transition in the NorthGRIP ice d18O (rather than the usual sharp decrease) makes it very difficult to define a clear transition between the two. -Figure 1: Naples, Rome, Mont Vulture are mentioned in the section 2 of the paper describing the regional setting but do not appear on any of the maps shown in Figure 1. They should be added. Also, the map in (d) needs to be introduced in the caption too. -

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Figure 2: you should add the uncertainty envelope on figure 2c. In the caption, replace “error bars” by “blue envelope”. -Figure 4: Add the units on the x and y axis. -Figure 5: reference is missing below “NGRIP d18O (permil) AICC2012” label. In the caption replace “GICC05” by “GICC05 modelext”.

5- References:

- line 15: you should refer to this paper using the expression “NorthGRIP project members” and not “Anderson et al.”. - line 18: NaTuRe.

Interactive comment on Clim. Past Discuss., 10, 2595, 2014.