Clim. Past Discuss., 10, C1435–C1442, 2014
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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.

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Received and published: 5 September 2014

This manuscript by Martin-Puertas and co-authors presents a substantial and original XRF dataset for one of the classical southern European Quaternary sequences (Lago Grande di Monticchio), focussing on the dynamic time interval of the early last glacial (MIS5d-5a). The manuscript incorporates the results of improvements to the absolute chronology for a composite core sequence through the addition of new varve counts and sedimentological characterisation. The study builds on the detailed decadal- to centennial-scale pollen record previously published for the site, by adding (sub)annual-

scale information from XRF scans. Overall, the most exciting contribution in my opinion is the well-constrained evidence for rates of change at transitions between different climatically-driven environmental states in this Mediterranean location. The findings highlight a very close coupling of vegetation and geochemical proxies and provide an important refinement of the classical pollen record by adding information on inter-annual environmental variability and the duration of different episodes within the well-controlled chronological context of an annually-laminated record. The study follows a strong track record of sedimentological investigation at the site, and the methods are carefully detailed and robust. The manuscript is generally clear, well written and the main messages are easy to follow, and the text is supported by useful tables and good figures (but see minor corrections and suggestions listed below). There are areas, nevertheless, where the manuscript requires further clarification and/or revision of some of the interpretations.

Ultimately, I would recommend revision of the manuscript for publication in Climate of the Past. Prior to publication, however, the authors should address the following issues:

» Climatic interpretation of the MON events

The climatic interpretation of the MON events (low arboreal pollen, thicker varves, high Ti counts) as cold and humid events does not agree with the previously published pollen-based climatic inferences at this site. For example, MON 2 corresponds to LPAZ 20 (Melisey 1) for which the pollen evidence has been reported to show: "conditions generally much drier, and with substantially more severe winter cold, than at present."(Allen and Huntley, 2009: 1532)

For LPAZ 18 (Montaigu) (corresponding to MON 3): "The very high abundance of Chenopodiaceae in the vegetation indicates a marked development of seasonal drought; it is also likely that winter conditions were more severe than previously, although summer conditions may have remained relatively warm" (Allen et al., 2000: 98)

And similarly for LPAZ 17d (MON 5), the pollen-based inference is of "steppe vegetation

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. . . indicating a return to a climate characterised by seasonal drought" (Allen et al., 2000: 98).

In the present manuscript, the authors draw attention to "slightly increasing Betula" as support for "cool and relatively humid conditions during these [MON] intervals" (p2605 Line 26). However, increases in Betula are not consistently shown in these intervals, and indeed the taxon is scarcely present in LPAZ 18, 17d, 17b (MON events 4-6). It seems odd to draw attention to this one minor taxon and not to consider any other aspects of the pollen spectra, especially the expansion of xerophytic and steppic taxa.

The interpretations in the present manuscript are at odds with the previous hydrological interpretations of the pollen data (at this site, and more widely in the Mediterranean - e.g. Milner et al., 2013), and the issue of seasonality (T or P) is not explored. The authors need to take onboard the previously published interpretations and either reconcile them or offer a reinterpretation, but they shouldn't be overlooked.

» Catchment dynamics

Linked to the above, the hydrological character of the events is critical for the interpretation of catchment-scale dynamics. At present the overall interpretation of enhanced detrital matter flux during MON events as "a result of increased catchment erosion likely in response to changes in both precipitation and vegetation cover" (P2606, lines 8-10) needs further development and discussion of the linking mechanisms. In broad terms, one would anticipate a reduction of vegetation cover and increased erosion under drier (not wetter) conditions, as evidenced by Mediterranean field studies (e.g. Kosmas et al., 2000). The strong parallels between the pollen and XRF records nevertheless point to important linkages operating at the catchment scale, and it seems a pity not to examine those in more detail here.

» Introduction and aims

In the introduction, the overall research aims could be better defined. For example, the

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existence of dating differences of several millennia between different ice core chronologies (cf. p2598 lines 19-20) is not a problem that can be resolved with the new data in question; or is the emphasis here on differences between Greenland and the Mediterranean? The introduction suggests that the study aims at "proving or disproving possible regional differences between Greenland, the Alps and the central Mediterranean." (p2599 lines 3-4) While it is possible, as the authors do, to show explicitly and examine these differences, I do not see that there is scope to prove or disprove differences. Overall, in my opinion, the introduction sets up the impression that understanding teleconnections can be resolved by improvements to absolute chronologies – which isn't yet the case, as seen here. The introduction could raise more clearly the interest of co-registered environmental proxies in the same sequence and the potential insights afforded by annual/sub-annual resolution.

» Other corrections and comments

P2597 line 1. Change "shifting" to "shifted" – it is not certain that this will continue to occur!

P2597 line 7. Add reference for the marine timescale, e.g. Martinson et al., 1987

P2597 line 12. Spelling "Brauer"

P2597 line 15. I think the point about the broad correlation of the Eemian and MIS5e is a bit misleading – it was obviously a good observation in 1874, but this statement should be followed by reference to the studies that clearly demonstrated that the Eemian does not correspond exactly to MIS5e in either onset or duration (Sanchez Goñi et al., 1999, Shackleton et al., 2003).

P2597 line 23. Spelling "waxing and waning"

P2598 lines 2-12. At the end of this section the authors should cite the role of direct land-sea correlation on the Iberian margin in establishing the unambiguous correspondence between the Atlantic cooling and southern European vegetation events

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(Sanchez-Goñi et al., 2005).

P2601 lines 3-7. Report what percentage of the chronology is based on varve counting (i.e. method 1).

P2604 line 26. “A similar pattern is found for Ti and Fe” – and also Ti and Al, albeit less clearly?

P2605 line 26. “. . .relatively humid conditions” – compared with what, interglacial or full glacial conditions? (See first main point above, too.)

P2606 line 9. “changes in both precipitation and vegetation cover” – specify directionality of changes, i.e. increased precipitation and reduced vegetation cover? (See also second main point above.)

P2608 lines 6-8. This is a very interesting observation, supporting the view of closely located refugia for the arboreal taxa at Monticchio (not a new idea, but a nice confirmation!)

P2609 line 10. Can the authors suggest a reason why varve response should lag vegetation changes in contrast with the other events? Could this relate to changing geographical sources? Is the case for a lag clear, given gradual changes in both proxies (and taking into account different sampling resolutions).

P2610 lines 7-9. “We specifically avoid any kind of wiggle matching. . .” I don’t agree that this broad-brush statement is really relevant here, and think the statement should be deleted or refined. Throughout the remainder of the discussion, the interpretations depend on the correlation of MON events with the Greenland stratigraphy, as illustrated in Figure 5 and implicit in many statements such as “MON 4 correlates with GS 22”(P2611 Line22). Ultimately, the concluding assumption of “a bias in the varve chronology” (P2612 Line 19) suggests that the authors have more confidence in proposed event-for-event parallels between the Mediterranean and Greenland than in the absolute age attribution of the varve chronology. I appreciate that the authors

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do not make any assumptions about the ages of events in their record in light of other chronologies, or assume that any of the four compared absolute chronologies is more "right" than the others. The statement should be refined to indicate more specifically what type of analysis is prioritised and/or avoided.

P2613 Conclusions – Point 1. The authors might examine this point further in light of the proposed ideas about how and when millennial-scale variability emerges at the glacial inception, specifically with reference to Landais et al. (2006), who report how DO 25 shows a small Greenland temperature change being preceded by a very weak cooling episode.

P2613 Conclusions – Point 3. The authors make some qualitative observations here about the MON and Greenland curves, but should go further in positing some explanations or hypotheses about the differences in terms of climatic configurations. The relatively modest vegetation response associated with event MON3 (Montaigu) was previously highlighted also by Sanchez Goñi et al. (2005) and this should be incorporated in the discussion of this event. The authors also hint at orbital controls on the amplitude of variability ("...interestingly, this cold interval occurred during a period of lower global ice volume") but this idea has not been previously introduced and is not fully explained or referenced here. The view that the amplitude of millennial-scale shifts in vegetation cover in the Mediterranean is greatest during intermediate ice volume states is fairly well established (Tzedakis, 2005, Margari et al., 2010, Fletcher et al., 2013).

P2614 line 14. Spelling "broad"

P2619. Table 1. Add PAZ numbers 18 and 20 and any others to column 4?

P2619. Spelling "Montaigu"

P2620. Table 2. The caption says that the MON durations have been rounded but the values (2592 yr, 1681 yr, etc.) don't seem to reflect that – please change or clarify?

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Figure 3. This figure (parts a,b,c) should be separated into three separate figures. Even printing it out to fill a full A4 page the text is barely readable, and as such the figure doesn't do the data justice.

Figure 4. The caption here should indicate the significance of the different ellipses, or at least link to the text section where they are discussed.

» References

Allen, J.R.M., Huntley, B., 2009. Last Interglacial palaeovegetation, palaeoenvironments and chronology: a new record from Lago Grande di Monticchio, southern Italy. Quaternary Science Reviews 28, 1521-1538.

Allen, J.R.M., Watts, W.A., Huntley, B., 2000. Weichselian palynostratigraphy, palaeovegetation and palaeoenvironment: the record from Lago Grande di Monticchio, southern Italy. Quaternary International 73/74, 91-110.

Fletcher, W.J., Müller, U.C., Koutsodendris, A., Christanis, K., Pross, J., 2013. A centennial-scale record of vegetation and climate variability from 312 to 240 ka (Marine Isotope Stages 9c–a, 8 and 7e) from Tenaghi Philippon, NE Greece. Quaternary Science Reviews 78, 108-125.

Kosmas, C., Danalatos, N., Gerontidis, S., 2000. The effect of land parameters on vegetation performance and degree of erosion under Mediterranean conditions. CATENA 40, 3-17.

Landais, A., Masson-Delmotte, V., Jouzel, J., Raynaud, D., Johnsen, S., Huber, C., Leuenberger, M., Schwander, J., Minster, B., 2006. The glacial inception as recorded in the NorthGRIP Greenland ice core: timing, structure and associated abrupt temperature changes. Climate Dynamics 26, 273-284.

Margari, V., Skinner, L.C., Tzedakis, P.C., Ganopolski, A., Vautravers, M., Shackleton, N.J., 2010. The nature of millennial-scale climate variability during the past two glacial periods. Nature Geosciences 3, 127-131.

Martinson, D.G., Pisias, N.G., Hays, J.D., Imbrie, J., Moore Jr, T.C., Shackleton, N.J., 1987. Age dating and the orbital theory of the ice ages: development of a high-resolution 0 to 300,000-year chronostratigraphy. Quaternary Research 27, 1-29.

Milner, A.M., Müller, U.C., Roucoux, K.H., Collier, R.E.L., Pross, J., Kalaitzidis, S., Christanis, K., Tzedakis, P.C., 2013. Environmental variability during the Last Interglacial: a new high-resolution pollen record from Tenaghi Philippon, Greece. Journal of Quaternary Science 28, 113-117.

Sanchez Goñi, M.F., Eynaud, F., Turon, J.L., Shackleton, N.J., 1999. High resolution palynological record off the Iberian margin: direct land-sea correlation for the Last Interglacial complex. Earth and Planetary Science Letters 171, 123-137.

Sanchez Goñi, M.F., Loutre, M.F., Crucifix, M., Peyron, O., Santos, L., Duprat, J., Malaizé, B., Turon, J.L., Peypouquet, J.P., 2005. Increasing vegetation and climate gradient in Western Europe over the Last Glacial Inception (122-110 ka): data-model comparison. Earth and Planetary Science Letters 231, 111-130.

Tzedakis, P.C., 2005. Towards an understanding of the response of southern European vegetation to orbital and suborbital climate variability. Quaternary Science Reviews 24, 1585-1599.

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