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Biogeosciences Discussions

Interactive comment on "Pollen-based paleoenvironmental and paleoclimatic change at Lake Ohrid (SE Europe) during the past 500 ka" *by* L. Sadori et al.

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First of all we would like to thank Thomas Litt for his positive and constructive review on our manuscript.

1) Taking into account the comments already made by P.C. Tzedakis concerning the chronology, I agree to make some additional explanations regarding the way of identifying control points which have been used for correlation/synchronization, even if it is described and discussed in another manuscript/paper. To avoid all the problems dealing with the relationship between insolation maxima and expansion of woodland or correlation with the benthic $\delta^{18}O$ and terrestrial signal, it is, indeed, more practical to

use mainly the $\delta^{18}O$ curve of Mediterranean planktonic foraminifera as reference scale for synchronization because the correspondence especially between pollen record and MEDSTACK is obvious. Make clear that the age-depth model is mainly based on tuning, however, confirmed by tephra stratigraphy. At least for the last glacial-interglacial cycle the NGRP curve can also be used to synchronize tie points.

Answer: Please see our reply on the age model changes and integrations above.

2) Regarding *Pinus* curve: I am uncertain whether it is really an advantage for the interpretation to exclude the pine values from the total pollen sum related to 100% (or AP). There is no doubt that pine played an important role in the region during past glacial-interglacial cycles. However, this tree does not belong to the a-zonal vegetation such as swampy woodland with high percentages of Alnus. Therefore, the latter tree has been often excluded from the basic pollen sum (AP + NAP) in pollen diagrams from NW Europe caused by local over-representation. In addition, based on pollen traps, other wind-pollinated trees also produce a comparable high amount of pollen as pine (i.e. oak, see Andersen). Therefore, I would prefer to include *Pinus* into the pollen sum. It would also be easier to compare the pine percentages from the Ohid record with those from other long continental records in the adjacent Greece.

Answer: We fully agree with the reviewer that pines played an important role in the region during past glacial-interglacial cycles. The overwhelming % of pine pollen could be due to both long distance transportation (even reinforced by taphonomical issues in large and deep basins such as seas or big lakes - see our response to the comments of C. Tzedakis) in a wasteland or to pine populations close to the lake. To achieve maximum clarity for the readers, an AP/NAP curve will be added with pine included in the sum and we will elaborate on this issue in the discussion of the revised manuscript. It has to be noted here, that in more than 50% of samples *Pinus* pollen percentages are higher than 60%. The inclusion of *Pinus* in the total arboreal pollen (AP) sum would preclude an in-depth view of the vegetation dynamics, both during glacial and interglacial intervals. The very good correlation of the Ohrid AP% curve with Tenaghi

Philippon when excluding *Pinus* from the basis sum also supports that this is more representative of regional conditions.

3) An interesting aspect of the whole pollen record is the general trend between wetter older and dryer younger glacial-interglacial cycles. I agree with the view of P.C. Tzedakis that pine percentage value is not the best argument in this respect. If you would include *Pinus* into the total pollen sum, I guess that the picture will change a bit. A strong argument, however, is the steadily increase of the Artemisia curve. I see the point mentioned by P.C. Tzedakis that the pollen concentration during the 2nd part of MIS12 has the lowest values. I highly appreciate his opinion and argumentation, however, I would not over-exaggerate this proxy, because pollen concentrations per ccm are not only influenced by vegetation density, but also by sedimentation ratio (low concentration caused by high sedimentation rate: dilution effect). Pollen influx cannot be calculated from the Ohrid record to measure the vegetation cover (lack of annually laminated sediments). The climate characterization of MIS 12 (rather cold and wet or cold and dry) is difficult to disentangle. The contradiction between the interpretation by Sadori et al. (cold and wet) as well as the concerns by P.C. Tzedakis (problem to assume extreme cold but not extreme aridity at the time of the largest Pleistocene ice sheeds) could be solved: In northern Europe (The Netherlands, Germany, Poland), the first maximum extend of the ice sheet in this area was reached during the so-called Elsterian, which seems to be correlative to MIS 10 (see review Litt et al., Chapter 20: Quaternary; in McCann (ed.) The Geology of Central Europe, 2008). In any case, maximum global ice volume (benthic $\delta^{18}O$) does not necessarily mean coeval maximum extent of inland ice in northern Europe. We see the general trend in north-central Europe that inland ice was present only from the younger part of the Middle Pleistocene onward. This could support the steadily increase of steppe components in the pollen diagram.

Answer: Thank you for this comment. We will keep this in consideration, but, given the stratigraphic uncertainties of the fragmented pollen records from central Europe,

we would rather prefer to make comparisons with marine and terrestrial records from southern Europe (with a special focus on the eastern Mediterranean). The age of the Elsterian glaciation is broadly discussed because the glacial itself is not well defined. Glacial phases (i.e. North Sea tunnel valleys) are correlated both to MIS10 and MIS12.

4) I would also prefer to use Pollen Assemblage Superzones-PASZ (see Litt et al. 2014 for Lake Van long pollen record). In the meantime, we defined Pollen Assemblage Zones-PAZ based on a higher resolution for the last glacial-interglaical cycle, which are embedded into the PASZ (see Pickarski et al. 2015a,b).

Answer: We thank the reviewer for the suggestion; we will try to use PASZ to prevent future problems with high-resolution pollen data.

Minor remarks: p. 15463, l. 2: explain FYROM (it appears for the first time) p. 15463, l. 22/23: the interglacial phase MIS 11 is not correlative to PAZ OD-12 (488-455 ka BP), also OD-19 (367-328 BP) is wrong, you mean probably OD 9, which, however, corresponds to MIS 10. Only OD-10 correlates with MIS 11! p. 15465, l. 25 pp: add Liepelt et al., 2009, Review of Palaeobot. Palynol. (Abies) p. 15470, l. 13 pp: see comment chronology above p. 15470, l. 22 pp: 1) You should include pine into the pollen sum (see comment above). 2) Who was really involved in the pollen analyses, who was responsible for what? p. 15474, l. 10 pp: OD-3 and OD-1: really increase C6883 BGD 12, C6881–C6884, 2015 Interactive Comment Full Screen / Esc Printer-friendly Version Interactive Discussion Discussion Paper in aridity and increasing trend in temperature? Misleading, because in between MIS 5 (from 5e to 5a) we can assume decrease temperatures. In addition, it is probably better to use the term “continentality” instead of “aridity”, because an interglacial or interstadial is not arid in Europe. p. 1574, l. 14/15: OD-6 is not correlative to the time interval 106-81 ka BP, what do you mean? p. 1574, l. 19: shows (not show) P. 15476, l. 1 pp: OD-6 is not an interglacial, it is an interglacial/interstadial complex interrupted by stadials! p. 15476, l. 21: OD-3, 126-70 ka (sf. MIS 5) is not an interglacial, only 5e is an interglacial, 5a and 5y are interstadials interrupted by stadials! p. 15478, l. 10: . . .interglacials that are. . . (not interglacial) p.

15479, l. 12: “During the interglacial period occurred between 245 and 189 ka, a very high interglacial variability is found.” Is misleading (see above regarding OD-6)! Better: During MIS 7, a very high interglacial/interstadial variability is found.

Answer: We will elaborate on these minor/technical suggestions in our revised manuscript.

Interactive comment on Biogeosciences Discuss., 12, 15461, 2015.