Manuscript number: cp-2012-177

Title: A Late Glacial to Holocene record of environmental change from Lake Dojran (Macedonia, Greece)

by A. Francke, B. Wagner, M.J. Leng, J. Rethemeyer

Thank you for sending me the manuscript entitled "A Late Glacial to Holocene record of environmental change from Lake Dojran (Macedonia, Greece)" to review.
The manuscript provides interesting information on climate variability in the Balkan region during the Younger Dryas and Holocene, which in my opinion is certainly worthy of publication in *Climate of the Past*. I recommend a moderate revision of the manuscript.

General Comments:

Use of language: the manuscript is written in a mixture of British and American English. For example, page 5747, line 18: analy**z**er, line 21: analy**s**es. Ensure that the manuscript is written in a uniform language. Furthermore, sentences are sometimes too long and include too much information, which makes them difficult to read.

5.3 Mid Holocene (7900 to 2800 yr BP)

This paragraph should be better structured, especially the first paragraph. It is sometimes unclear to which time interval your discussion related to. For example, to which time interval is your interpretion related, starting on page 5763, line 6? To the time interval between 7.9 kyr and 4.3 kyr or to the one between 6 and 4.3 kyr?

Scientific Comments:

5.1 Late Glacial (>11 500 cal yr BP)

Since your record reach to ca. 12.5 kyr only, I would suggest to change the paragraph caption to: Younger Dyras (12 500 to 11 500 cal yr BP).

You may describe it more clearer, that the first period represented by lithofacies 1, is characterized by cool and arid climate conditions, while the second period (lithofacies 2a) is characterized by sligher higher temperatures and more humid conditions. Furthermore, you compare this climate transition with marine records from the western Mediterranean region and the North Atlantic. There are different marine records from the Aegean Sea and Levantine basin as well as the Tenaghi Philippon record that also cover this time interval and are much closer to your study area. Do these records also reflect the climate transition at ca. 12.1 kyr?

5.2 Early Holocene (11 500 to 7900 cal yr BP)

The formation of sapropel S1 in the eastern Mediterranean Sea started around 10.2 and 6.4 kyr BP (calibrated age range based on the conventional ^{14}C AMS dates of

9.5-6 kyr by Mercone et al., 2000) and is related to particularly warm and humid climate conditions (e.g. Rossignol-Strick, 1985; Rohling, 1994; Emeis et al., 2000). Since the sapropel S1 formation was interrupted by the 8.2 kyr event (Rohling and Pälike, 2005), sapropel S1 is subdivided into S1a (ca. 10-8.2 kyr) and S1b ca. (7.9-7 kyr) (e.g. Schmiedl et al., 2010). Thus, I would suggest that the formation of your lithofacies 3a may coincide with the formation with the sapropel sub-unit S1a (page 5760, line 27).

5.3 Mid Holocene (7900 to 2800 yr BP)

The onset of a broad maxima in $CaCO_3$ at ca. 6 kyr appears to correlate with the end of the humid period in the Mediterranean region, and thus with the end of the sapropel S1 formation. The increased productivity and relatively stable conditions as indicated by your data persisted until ca. 4.3 kyr. Subsequently, this period is followed by a distinct decrease in $CaCO_3$ and a period of more unstable climate conditons. This should be described more clearer. What are the possible triggers for these more unstable climate conditions in the eastern Mediterranean region?

Page 5763, lines 6-11:
This is in contradiction to your discussion before, where you suggest that the climatic conditions change from more humid to more arid conditons. But here, you argue that your $d^{18}O_{carb}$ point to humid conditions and/or enhanced rainfall.

Minor edits and comments:

Page 5745
line 27: ... 500 m a.s.l., that is located in the ... Lake Dojran, where ...

Page 5746
line 16: between 3 and 4
line 17: changes
line 21: carstic

Page 5747
line 8: platform, using ...
line 14: In the laboratory, cores were ..

Page 5748
line 10: what was multiplied with 8.33 to calculate the $CaCO_3$ content?
line 15: CO_2, using
line 17: system based on
line 19 water, using

Page 5750
line 6: (Fig. 2, profile 2)
line 26: lake, and thus ...

Page 5751
line 14: as shown by the SEM picture given in figure 4

Page 5752
line 20: above and below 3a

Page 5753:
line 2: grain size (Fig. 2).
lines 6-7: $CaCO_3$ is generally low
line 11: OM allow
lines 12-13: is characterized by a massive or marbled structure, a dark olive brown color, a low $CaCO_3$ content, and decreasing trends in TOC content and TOC/TS.
line 23: While $CaCO_3$
line 28: which reflectors? ...profile (Fig. 2).
lines 24-25: High TOC points to high productivity, which is supposed to be triggered by high nutried supply than by (higher?) temperatures. Question: What are the indications for this assumption?

Page 5754
line 22: ... isotopic composition (Fig. 3).
line 26: changes

Page 5755
line 10: The age-depth model
line 10: correlations
line 12: Seven samples, composed of terrestrial plant material and charcoal,
line 27: offset

Page 5756
line 9: indicates
line 10: ..., suggesting that
line 14: ... BP). In addition, there was no ...

Page 5757
line 4: ... BP (Figs. 3 and 7).

Page 5758
line 2: water, while
line 6: ... BP (Figs. 3 and 7).
line 14: is also indicated by ...
line 14: suggests
line 15: inflow of what?
line 22: in which relation are the given temperatures and annual precipitations rates – are they related to modern conditions?
lines 28-29: ... Ohrid. This is probably due to lower winter ... deficits, that have ...

Page 5759
line 3: changes
line 11: ... BP (Figs. 3 and 7).
line 12: period from
line 15: southward movement ... during winter seasons.

Page 5760

lines 1-5: this sentence is unclear
line 5: What are the indications for increased humid conditions during this time interval? Is this assumption based on your own data or derived from the literature? And are this humid conditions seasonally or anually?
line 13: , however, ... by a ... by an ...
line 20: ... is less variable. The lack of ...
line 27: ... eastern Mediterranean Sea (add references: Emeis, et al., 2000; Schmiedl et al., 2010).

Page 5761
lines 3-4: this sentence is unclear
line 4: This is corroborated by ...
line 21: , however,
lines 24-25: this sentence is unclear

Page 5762
line 11: add reference: Rohling and Pählike, 2005
line 12: While
line 13: which corridor?
line 19: ... BP (Figs. 3 and 7). (insert new paragraph after the first sentence)
line 21: delete , after conditions
line 23: data (Fig. 2).
line 25: add paragraph after ... Holocene.
line 27: , a slightly

Page 5763:
lines 1-5: this sentence is unclear
line 16: a environmental

Page 5764
line 5: ... the latter one is a ...
line 13: today (Figs. 3 and 7).
line 18: ... parts (Fig. 2).
lines 19-20: delete: including Lake Prepa
line 28: eastern and northeastern

Page 5765
line 2: may also have
line 4: ... action. This assumption is supported by high abundances of shell and shell fragments, occurring the in upper parts of ...
line 7: This shift is likely caused by...
line 10: ... stratification as suggested

Page 5766
lines 5-6: We suggest that during this period the lake hydrology and ... is may have been significiantly affected by human...

Page 5767
you may mention somewhere at the beginning of your conclusion, that your interpretion is based on analyses of core Co1260.

line 11: During the early Holocene... temperatures increased, though nutrient...
line 14: ... BP. This is likely due to ...
line 15: coinincides with the formation of sapropel S1 (S1a)
line 22: The formation of sapropel S1 (S1b) persisted until approx. 7 kyr (see comments above).

Figure captions:

Fig. 1 (B): Satelite image of Lake Dojran ... location Co 1260 (red square) and the ...

Fig. 3: ^{14}C samples (black dots), ... , Potassium (K) (black line) and Iron (Fe) (...line)

Fig. 5: Modern isotope ... Lake water samples ...

Fig. 7: ... Potassium (K) (black line) and Iron (Fe) (...line)

Figures:

Fig. 1 (A): Add country names of Macedonia and Greece.

Fig. 1 (B): Add country borders and names of Macedonia and Greece.

Fig. 2: The figure and the fond sizes are too small and difficult to read.

Fig. 3: This figure is also too small. Possibly add ages of ^{14}C datings.

Fig. 4: Characters used in the figure are a bit difficult to recognize.

Fig. 6: Symbols should be a bit bigger (like they are in Fig. 5)

Fig. 7: This figure is too small. *y*-scale title: age (cal yr BP)

Fig. 8: *y*-scale title: age (cal yr BP)

References:

Emeis, K.-C., Struck, U., Schulz, H.-M., Rosenberg, R., Bernasconi, S., Erlenkeuser, H., Sakamoto, T., Martinez-Ruiz, F., 2000. Temperature and salinity variations of Mediterranean Sea surface waters over the last 16,000 years from records of planktonic stable oxygen isotopes and alkenone unsaturation ratios. Palaeogeogr. Palaeoclimatol. Palaeoecol. 158, 259–280.

Mercone, D., Thomson, J., Croudace, I.W., Siani, G., Paterne, M., Troelstra, S., 2000. Duration of S1, the most recent sapropel in the eastern Mediterranean Sea, as indicated by accelerator mass spectrometry radiocarbon and geochemical evidence. Paleoceanography 15, 336–347.

Rohling, E.J., 1994. Review and new aspects concerning the formation of eastern Mediterranean sapropels. Mar. Geol. 122, 1–28.

Rohling, E.J., Pälike, H., 2005. Centennial-scale climate cooling with a sudden cold event around 8,200 years ago. Nature 434, 975–979.

Rossignol-Strick, M., 1995. Sea–Land correlation of Pollen records in the eastern Mediterranean for the glacial–interglacial transition: biostratigraphy versus radiometric time-scale. Quat. Sci. Rev. 14, 893–915.

Schmiedl, G., Kuhnt, T., Ehrmann, W., Emeis, K.-C., Hamann, Y., Kotthoff, U., Dulski, P., Pross, J., 2010. Climatic forcing of eastern Mediterranean deep-water formation and benthic ecosystems during the past 22 000 years. Journal of Quaternary Science Reviews 29, 3006-3020.