Zhang et al.

General comments:
This is a high resolution, palaeoecological study of a late glacial / Holocene sequence from Lake Ohrid, the oldest lake in Europe. The main focus of the study is on diatoms — silica-walled single-celled algae, which because they are at the base of aquatic foodwebs are important for ecosystem functioning of lakes. Given the importance of biodiversity and endemism in Lake Ohrid, understanding diatom variability over long-time scales and during periods of rapid environmental change is of considerable importance.

Overall, this is a well-written study that details methods and results clearly and succinctly. The quality of the data is excellent. I do have some thoughts on the interpretation of the data, which I invite the authors to consider.

(i)   The authors assume that high diatom concentrations = high productivity. However, diatom concentrations can be a rather poor indicator of productivity, and concentrations are often more related to cell size and biovolume (e.g. see Battarbee et al. 2001).

(ii)   The authors then assume that high diatom "productivity" (based on concentrations = high temperatures. But I'm not sure that "productivity" in itself should used to infer temperature, as productivity will also be influenced by nutrient inputs from the catchment, nutrient regeneration (through winds and turnover etc). Also, what does temperature mean in this context – water or air temperature? Summer or mean annual temperature etc? These are not clear.

(iii)   As diatom concentrations were so low prior to 10 kyr BP, is the dominance of *C. fottii* as portrayed by relative abundances in Fig 5, real? It would be interesting here to convert the principal species highlighted in Fig 5 to concentration data. It may be that numbers of *C. fottii* are actually very low and therefore one could draw different conclusions about the limnology of Ohrid during the early Holocene from high numbers of *C. fottii* during the mid Holocene.

I think therefore that aspects of the Discussion and Conclusions will need to be changed. My specific comments are detailed below.

Specific comments:

Introduction:
• I recommend adding an extra paragraph detailing important features of the climate variability during this period in the eastern Mediterranean, leading to what the aims or hypotheses are being addressed in this study.
• I myself would be cautious of ascribing diatom changes to temperature. It is the case that diatom productivity during glacials in many lakes is usually lower than during e.g. interglacials. Temperature is likely to be one factor linked to lower

productivity, but others will include extended snow and ice cover (if relevant), potentially fewer nutrients entering the lake from catchments etc.
- However, it is great to see the findings from this study be compared to previous work on the lake.

Site Description:
- This is excellent.

Materials and methods:
- Very good account of chronological framework, based on previously published studies, including authors of the current study.
- Very useful account of diatom taxonomies and their brief history in the context of Ohrid diatom research.

Results:
- It would be useful to start off the results with a statement of how many diatom samples were analysed, and their approximate resolution. Also, how many species were identified in total. Otherwise these are fine.

Interpretations:
- P11, Line11: during the Holocene, temperature changes are only very modest, and so unlikely to drive diatom productivity alone. Therefore, I would omit end of this sentence "...both in relation to temperature change" as changes in the mixing regime could also be brought about by changes in wind / storminess.
- P11, line 12-14: it is probably the case that dissolution is minor but as only one species was considered, the index used here might be of limited value for other, potentially more susceptible taxa.
- Fig 3: it's great to see so much care taken into characterising the different size classes for *Cyclotella fottii*, and for the ocelli number for *Cyclotella ocellata*. This makes Fig 3 look very busy therefore, and if these criteria are not showing anything ecologically meaningful, I think it would be better to just combine and present as one taxa for each.
    - Although I do see that this has indeed been done in Fig 4.
- Note that diatom concentrations by themselves are not terribly good predictors of diatom productivity because as diatom cells get smaller, their concentration often increases (Battarbee et al. 2001); Rioual and Mackay 2005), e.g. in Ohrid, concentrations look to be driven by changing abundances of the small-celled *C. ocellata*.
- For the F-index, why not change the x-scale, so that more variation in the data can be seen (e.g. 0.6 – 1.0).
- In Fig 4, diatom concentrations show v similar trend to TOC during early Holocene, but to c. 8 kyr BP, but look to have different trends between 8 – 3 kyr BP. Throughout most of the sequence, TOC looks to be negatively correlated with K (clastic input), so TOC is being governed to a certain extent by catchment in-wash?

- In Fig 5, it's pleasing to see that there really is very good correspondence between diatoms from different sites.

Palaeoecology interpretations:
- P12, Line 18: Reference to ice-rafted debris is made quite a lot (Wagner references) - would be good to provide more detail. Is there is a proxy for IRD in Ohrid that could be plotted on Figs 4-5.
- A couple of thoughts on K as an index of clastic material. I assume that this is being brought into the lake via fluvial input, and may therefore be an indicator of wetter conditions, or less stable soils in the catchment. But I note that in Wagner et al. 2012, K is also linked to tephra material – so this indicator actually has complex sources which will need to be highlighted sooner (although you do state this on P15, Line 12).
- It's interesting to note that K and TOC show quite negative responses, that is as K increase, TOC increases and vice versa. Does this mean that they are tied to a similar source? Do the authors have any indication from CN ratios (for example) that point to the origin of the TOC in the lake sediments?
- P13, Line 24: I don't think that it's correct to infer diatom productivity from concentrations alone – see comments above. Therefore link between temperature and productivity likely too simplistic. (Also see P15, lines1-4)
- P15, bottom off: interesting that diatom flora shows no response to potential 8.2 event
- P16, Line 6: again, stating that the mid Holocene was one of high temperature – you should really refer to a global consensus record (such as Marcott et al. 2013) for such a claim.

Conclusions:
- The conclusions are written in context of temperature forcing changes, but no temperature records are actually provided.

References used in review not already in manuscript

Marcott SA, Shakun JD, Clark PU, Mix AC (2013) A reconstruction of regional and global temperature for the past 11,300 years. Science, **339**, 1198-1201