

Comments on the paper by Schouten and co-authors entitled. *Lake anoxia, primary production and algal community shifts in response to rapid climate changes during the Late-Glacial.*

This paper investigates the sediments of a small lake on the Swiss plateau to reconstruct anoxia and algal communities from the Late-Glacial until the Early Holocene. The idea is to understand the response of a small lake to warming and its potential recovery afterwards. This kind of information is useful to better understand if the current warming has irreversible effects. The authors use numerous, complementary and cutting-edge methods to carry out a very high-resolution analysis of this 90 cm long sediment section. The methodology is well described, allowing to reproduce what has been done. The work is meticulous, and the analyses were carried out with rigour. A special congratulation for the use of the sequential extraction of P, Mn and Fe, something that should be done more often when it comes to interpreting these elemental profiles. Although the sedimentary section is very short, the amount of data produced is impressive. The presentation of this mass of data is sometimes difficult to follow, although the manuscript is generally pleasant to read. The right amount of information has been moved to supplements. Please note that I am not competent to assess the interpretation of pigment analyses by HPLC.

### **General comments**

**Abstract:** the introduction to the topic is quite long and could shorten.

**Figures and call to figures.** While the figures are well drafted, it is often quite difficult to find the information described in the text.

For instance, the text of sections 4.2, 4.3 and 4.4 refers to the chronozones H1, Bølling, Allerød, YD and Holocene, but none of the figures called for (Figs. 3-6) contains that information. I understand that you have established three different stratigraphies, (litho-, cluster-, pigment-) and that you also use the chronozones, but the text is not easy to follow for the reader that is not familiar with the study.

I know that these figures are already very busy, but would it be possible to add these chronozones to Figs 3-6? It would make the paper easier to follow.

Along these lines, section 4.4 is hard to follow, because it is not clear what figure the text is referring to: is it 6 or is it 7?

To make things even more complex, you also use the NGRIP stratigraphy (e.g., (GI-1d)). I understand why you do that, but is it really necessary, since you are not really discussing the potential leads and lags of your lake with NGRIP?

Another example is at lines 492-493: one needs to switch from one figure to the other to follow your discussion. Here, you refer in the same sentence to PZ-2a, described in fig. 7, and to features outlined in fig. 9i.

In brief, please make sure that what is described in the text is easy to find in the figures.

**Calibrated dates.** All the dates have been calibrated using Intcal20, but none of the dates mentioned in the text and the figures indicate “cal”. Please add “cal” before all occurrences of BP.

**Chronozones.** It is not clear how the chronozones have been defined. You write on lines 126-127: *We combined  $^{14}\text{C}$  dates with well-dated regional biostratigraphic markers (Ammann et al., 2013; Rey et al., 2017, 2020)*, but I’m not sure to understand what you have done practically. Are you just relying on your age model, and use the dates of the chronozones defined by Ammann (or the NGRIP chronology) to set the boundaries used here? Or do you use the changes in one of your indicators to set the boundaries of the chronozones? Along those lines, is your age model accurate enough to briefly discuss the timing of these chronozones? (This is probably another paper, but maybe somebody will want to do that.)

**Section 4.2.** At the end of the description of each lithofacies, there is an interpretation. I’m not against including interpretations of the lithofacies here, but one needs to make sure there is no repetition in the discussion section.

**Discussion.** Why the onset of the Holocene is not discussed? It was announced somehow in the introduction by saying that your study would help to understand the response of lacustrine systems in a quickly warming climate. Yet, the early Holocene is usually considered to have a very fast warming. If it is the recovery to warning that is of interest, please write it down in the text of the discussion.

**Section 5.5.1.** You are discussing AO, GZ, YD in this section dedicated to the description of H1. This is not logical. Maybe should you add a “dust record section” that covers multiple time slices.

#### **Other minor comments**

L47: one understands you are talking about species only later. I suggest writing : “(...) promote generalist species competitiveness (...)”.

L105: I think you should specify that the DOE-1 corresponds to the Bølling because I’m not sure that the readership of Biogeosciences is familiar of the DOE stratigraphy.

L132-135: I'm not sure to understand what you have done here? You XRF scanned the core three times and measured the standard deviation of your measurements? Was this performed on clr-transformed data or on raw data?

L215: I have not seen the R codes on Github.

L228: here you should use kyr instead of ka, because it refers to some duration.

L237: only XRF data are shown in S5.

L249: how was water content measured? This is not in the method section.

L251: “*of low aquatic primary production (PP) and high accumulation rates of fine clastic sediments (matrix effect).*” belongs to a discussion section not a result section (see comment about section 4.2 in the general comments).

L301: please spell out what LT means in the caption.

L315: not all transitions align with lithotype changes.

L369-370: could the degradation of chlorophyll also be due to anoxia?

L413-415: what I understand from these lines is that the degree of degradation (PC3) is due to high grazing pressure during anoxic events. I don't understand this, as anoxia should prevent the presence of grazing organisms. Is there something I'm missing here?

L439: I suggest the following: "(...) *show that environmental changes on the Swiss Plateau responded **very closely** to large-scale climatic shifts (...)*".

L441: try to be more specific about how you have done that.

L458: I don't see anywhere a curve with sedimentation rates. This "sharp" decrease is not visible in the age model presented in Fig. 2. Actually, you have no date before 16.2 ka BP, and there is just the assumption that the lake formed around 19 ka. The sedimentation rate you infer is quite uncertain, even if it makes sense. I would be more cautious here.

L462-466: your interpretation makes a lot of sense, but you don't have the smoking gun. A stronger argument would be if you could show that the rounded grains in your sediment are Ti, K, Si and Zr-rich and the angular ones are from carbonate rocks.

L469: how this correlation has been calculated to cope with their different resolutions. Also, it is not easy to tell if the Ti curve in Fig 9g is the low resolution one or the opposite. More contrasted colours would help.

L481: I'm not sure this statement is true and useful.

L489: in my view, turbid waters are not compatible with low clastic sedimentation rates, or maybe there is something I don't understand here.

L497: this fluctuation is barely visible. Is it a question of scale?

L514: I do not see the 80% in this Bølling/Allerød interval. It starts near 0% and ends around 60%.

L537: "drought" is quite a strong word. In this small closed lake, a drought would have a more spectacular impact. Maybe should you simply say that the climate was drier, and that it produced a lowering of the lake level.

L541: one should expect high rates of changes between phases, but not during phases, right?

L568: Fig. 9g does not show Si.

L569: this idea of Si-fertilization has already been presented earlier. Try to avoid repetition

L571: what do you mean here? How the LST could Si-fertilize the lake before the eruption even occurred?

L618: replace the two occurrences of "ky" by "ka", as they are dates and not durations (and add "cal" of course).

I enjoyed reading this very interesting paper, and I hope these comments and questions will help to improve the manuscript.

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