

Review Biogeosciences

This paper compares and uses the signals provided by multiple biogenic proxies to interpret the hydrologic evolution in the western Baltic Sea region during the past 8000 years. Inter-comparison of the proxy-data and quantitative reconstructions allow for robust reconstructions and time constraint of the major regional hydrological transitions (salinity and temperature). This paper is a good contribution and I suggest it is accepted with minor modifications.

General comments

The information provided in this paper is highly relevant and the interpretations are well justified. However, although I understand it is difficult to be concise when reporting on so many proxies, the manuscript is long and should be thoroughly reviewed to remove repetitive sections, and to restructure certain sentences and paragraph sections (particularly lines 532-556 present one long section in which the reasoning is jumping around a bit between proxies and from one time interval to another). Furthermore, there are a lot of abbreviations and this makes the reading unnecessarily challenging.

- I would be cautious with the discussions concerning the performance of the different proxies. Although many proxies are used, only a very few amongst them are used in an optimal way (e.g. not statistically robust dinocyst counts; a non-calibrated foraminifer species used for Mg/Ca-based estimates, contamination of foraminifer test used for Mg/Ca ratios, and assemblage and geochemical analyses on foraminifera that are suspected to be affected by dissolution - which probably also is the same for the ostracodes, etc) – this is okay if trying to answer a scientific question, but I would have some reservations when the authors evaluate the performance of these proxies. Their applicability can be evaluated, but not their performance (question of using the right term).

Specific comments

Figure 1. The « Little Belt », « Great Belt » and « Öresund » should be added to this figure so the readers that are not familiar with the region can refer to this map. Perhaps also « Lake Flarken », also mentioned in the text.

Figure 3. What species of diatoms were considered F, BF, BM, etc?

Figure 3. Add dinocyst concentrations.

Replace “non-heterotrophic dinocysts” by “phototrophic”.

Introduction

Lines 54-59. These sentences are somewhat unrelated to the remainder of the manuscript and the objectives of this study.

Line 77. Can you be more specific here? What conditions can influence the application of

Mg/Ca in the Baltic Sea?

Lines 78-83. Include references here.

Lines 86-87. You introduce the TEX_{86} proxy, but the text further down mentions the TEX_{86}^L proxy; please clarify what the TEX_{86}^L is.

Line 89. What does LDI stand for?

Line 94. The term biogenic should be used instead of “biotic”.

Line 99. The length of the core is not important, it is the sedimentation rates and temporal resolution (it is not because it is long, that the sedimentation rates and temporal resolution are high).

Line 103. [...] moreover to Greenland ice core records and marine records from the North Atlantic □ this sentence seems out of place, since this is not done later in the manuscript.

Line 103. replace “records” with “cores” (drilling provides cores, analyses provide records)

Methods

- The thickness of the samples is only given for forams, but not for other proxies.
- For many proxies, the same amount of samples was analyzed (36). Presumably, these represent the same samples/levels in the core (although this is not that obvious from the manuscript). Instead of repeating this information every time, perhaps a short introducing paragraph can be added to provide this information (same-sample analyses for which levels, which ones in higher resolution, etc)

2.1. Lines 114-115: is the latitudinal span (numbers) relevant? So why not the longitudinal span, too? But both would not seem relevant to the study, which focuses on a specific, smaller region. The coordinates of the core would seem to suffice.

2.2.3. What mesh sizes were used for sieving?

- Did you add marker grains for calculating the concentrations?
- Zonneveld and Pospelova, 2015 is not an appropriate reference here – it is a determination key. Perhaps you can refer to de Vernal and Marret, 2007 [de Vernal, A., Marret, F., 2007. Organic-walled dinoflagellates : tracers of sea-surface conditions, In Hillaire-Marcel and de Vernal (eds.) Proxies in Late Cenozoic Paleoceanography, Elsevier,pp. 371-408.]
- What does “rarity of counted types” mean?

2.2.4. Line 201: “selected depths”: do you mean the same 36 depths, or a selection of these 36?

2.2.5. The use of heavy liquid separation is understandable, but is this common practice? Could you provide a reference that illustrates the influence - or, ideally, the lack of it - on

assemblage composition (selective removing of certain species because of sediment infilling, fragmentation of fragile species, etc.). Ideally, in order to really test the power of the proxy, all samples should have undergone the same preparation method...

2.2.6. Line 230. A total of 75 ~~30cm³~~-sediment samples were processed for ostracod analysis (confusing otherwise).

Results

Line 455. *Operculodinium centrocarpum* (?), *Spiniferites* spp., *Lingulodinium machaerophorum* (?)

Line 460. When using “*Gymnodinium* cf. *nolleri*”, it is implied that a cyst type was found with a morphology that **looks like** *G. nolleri*, but at the same time very clearly **is not** *G. nolleri*. Is this what the authors mean: cysts whose morphology cannot be attributed to a known species? Or, if different species of *Gymnodinium* are meant (i.e. *nolleri*, *catenatum*, *microreticulatum*), then “*Gymnodinium* spp.” should be used.

Discussion

Transition from line 492 to line 493. Somehow a circular reasoning, as the variations themselves are inferred from the proxies. The first two sentences of this paragraph could be removed.

Line 502. How do the ostracodes indicate low primary production?

Lines 501, 504, 506. These sentences could be restructured to avoid repetition. In addition, the sentence “these factors indicate that EZ1 presents a low productivity freshwater environment” should be moved downward, as (the more convincing) arguments are given following this sentence; the low concentrations of *marine* palynomorphs does not indicate that the setting was one of low total productivity.

Line 526. Add reference after “[...] may indicate more saline conditions”.

Lines 543-556. This entire section needs a bit of restructuring and rephrasing; now it is sometimes confusing and unclear what periods and water masses (bottom, surface) are compared and discussed.

- bottom water = increasing salinity (Line 545-546); surface water = decreasing salinity (Line 549-553), correct? This contrasting evolution (if I understood correctly) is worth stressing and discussing further?
- L553: ...regard **this** as the most... what period exactly (early Littorina, entire Littorina,...)? “most marine” seems in contradiction with decreasing salinity...
- L554: increased with respect to what? Modern? EZ1?

Lines 559-601. please rephrase, there seems to be something not entirely correct about this sentence.

Line 600. The use of “juvenile (percentages)” comes out of the blue here. Also, given the

low ostracod counts, how significant are such percentage/relative changes? How many specimens are we talking about here?

Line 611. Inorganic and inorganic proxies are not the best terms here – perhaps “geochemical analyses” and “biomarker”

Line 637. Not everybody is familiar with the Boreal and Atlantic terminology and timescale; please introduce properly or replace with/add actual dates.

Line 651. When do these eustigmatophyte algae bloom?

Line 656. LCD would seem a good candidate to be left out as abbreviation and be written out in full instead (as is done just a few lines above). Other good candidates, since used only very rarely, would surely be BIT (line 679), MWP and MHP (685; the latter only used once, i.e. where the abbreviation is given!?), HTM (line 691), and BWT (line 697).

Technical corrections

Line 43. [...] changes in salinity, but **often do not** allow quantitative

Line 44. [...] is associated with **particularly** large uncertainties [...]

Line 248. Due to poor **preservation**

Line 290. A total of 40 sediment **samples** collected [...]

Line 351. [...] was divided into four **overall** environmental zones.

Line 397. *A. beccarii*

Line 456. *G. nolleri*

Line 465-467. This information belongs to the method section.

Line 501. “biological” should be replaced by “biogenic”.

Line 647. Same as above. Change different inorganic and organic for “biogenic proxies”.