Response to review #1 of Ekeroth et al., Egusphere-2026-707

Our responses are in blue text and the reviewer comments in black text.

RC1: 'Comment on egusphere-2026-707', Anonymous Referee #1, 08 Mar 2026

For marine biogeochemists the Baltic Sea is a world ocean fascinating part. Indeed, this semi-enclosed sea is not easily renewed by North Sea episodical inputs, and thus is submitted to perturbations generated from the land which indirectly impacts the evolution of the dioxygen content of the deep reservoir and of the nutrient cycles of the Baltic ecosystem as a whole.

In this study the authors implemented an ambitious program to estimate of the benthic silicic acid flux at the sediment-water interface for the different types of sediments that composed the Baltic Sea bottom (sand, mud-muddy sand, rock and boulder, mixed types). Using data acquired from benthic landers in the many sub-basins of the Baltic Sea and from ex situ measurements, thanks to GIS tools the authors spatially extrapolate from local to Baltic scale. They report silicic acid benthic fluxes ranging between 0.3 to 9.0 mol-Si m-2 d-1

Please note: 0.3 to 9.0 **m**mol Si m-2 d-1 (not mol).

with a mean of 3.7 mmol-Si m-2 d-1, which is consistent with analogous systems over the world. Then, extrapolating to annual scale the authors calculated a total flux of 8520 kt-Si yr-1 (304.3 Gmol-Si yr-1). This part of the article is without problems (however see comments below).

We thank the reviewer for this assessment.

Difficulties rise when the authors try to built an equilibrated budget of Si at Baltic Sea scale, integrating different fluxes and processus that are presently not well known, and/or not constrained.

The reviewer may have misunderstood our aim with this manuscript. Our aim was *not* to "build an equilibrated budget of Si at Baltic Sea scale". We aimed to show, by GIS upscaling on the Baltic Sea scale of a very large number of benthic dSi flux measurements, carried out during two decades, that the autochthonous export production from the photic zone was far from enough to match the sum of the integrated benthic dSi flux and the reported bSi burial rate. Therefore we suggested that other sources of rSi must exist, such as rSi of terrestrial origin. Our results should provide an incentive as well as facilitate upcoming investigations to construct a revised and more complete Baltic Si budget, as we wrote at the end of Conclusions: "*Results of this study should facilitate and stimulate the construction of a revised and more complete Si budget for the Baltic Sea. Future studies should in this regard include new estimates of burial of rSi (not only limited to BSi), of export of DSi and rSi to the Kattegat, of delivery of DSi and rSi via both rivers and groundwater, and continued observations of changes of the water column DSi standing stock.*"

1-Playing the authors'game, assuming steady state, to get a balanced budget of Si for the Baltic Sea, I build the below figure, inspired from Tréguer et al. (2021).

Figure 1 : A possible scenario for a steady state Si cycle in the Baltic sea

Thanks for this figure, which is a modification of Figure 4 in Tréguer et al. (2021). However, building a balanced silicon budget under a steady-state assumption for the Baltic Sea is beyond the scope of our study. Building a mass-balanced budget would require additional data that we do not have. Please also see our comment above.

This budget is built assuming that the benthic flux is generated by the amount of biogenic silica deposited in sediments that escapes long term accumulation (21.8 Gmol-Si yr-1).

21.8 Gmol-Si yr-1 equals about 612 kt Si yr-1. If "the benthic flux is generated by the amount of biogenic silica deposited in sediments", *and originating from the autochthonous export production from the photic zone*, "that escapes long-term accumulation", this number should be, based on the numbers we have presented in the manuscript, 2740 – 610 = 2130 kt Si yr-1. Not 612 kt Si yr-1. Hence, this benthic flux estimate by the reviewer does not agree with our upscaled direct measurements.

For an annual benthic flux of 76.1 Gmol-Si y-1,

This would be the benthic dSi flux if it was generated *only* by dissolution of the bSi originating from the Baltic Sea photic zone that is not buried.

the mean daily benthic flux is 0.56 mmol-Si m-2 d-1, which actually is in the range of the authors'measured fluxes (0.3-9.3 mmol m-2 d-1) but more than six times below the mean calculated by the authors.

This is one of the main points of our paper. Our results strongly suggest that the integrated annual benthic dSi flux is not only generated from the autochthonous export production from the photic zone, but that other sources of rSi must exist, such as deposition of riverine rSi and groundwater-derived rSi.

Assuming spatial extrapolation through GIS is correct, could the authors' annual benthic flux be over estimated due extrapolation of fluxes measured during a short period of time?

If the reviewer means short chamber incubation times at the sea-floor, the answer is no. We optimized chamber incubation times to match the reactivity of the sediment. Still some incubations became too long and in those cases the increase rate of dSi concentration in chambers slowed down at the end of incubations (see examples in our Figure S1).

If the reviewer means a short period of time of the annual cycle (for example mostly under the productive season), the answer is most likely no. Our flux measurements were carried out during 10 months of the year (January-November; but during many different years). The only months without measurements were March and December (Table 1).

If not, could the export of biogenic silica to depth be underestimated?

We assumed no dissolution of bSi during sinking through the water column from the bottom of the photic zone to the seafloor. Since the average depth of the Baltic Sea is relatively shallow, and the sinking rate of diatom debris is quite fast, this should only cause a minor underestimation.

Could the gross production biogenic silica in the surface layer be underestimated ?

We have used the most reliable estimate of primary production in the Baltic Sea that, to our knowledge, exists. Based on that and on well-known literature, we calculated the biogenic silica production in the surface layer. So our answer is that it is possible, but not likely.

2-It is clear that more data dealing with the biogenic matter fluxes and/or of the silicic acid fluxes (Si release from particulate matter transported by rivers, direct dissolution of lithogenic silica of sediments,…) are needed to build a realistic budget of Si for the Baltic sea.

We wrote that in the manuscript. So we do agree.

The authors' speculative Figure 6, a conceptual mass balance in the Baltic Sea, is not helpful given the uncertainties as regards the rSi sources which, according to the authors totalize 326 Gmol-Si.

Our aim in including Figure 6 was to illustrate the numbers we arrived at in the manuscript. Since this and the second reviewer seem to have misunderstood our intention with this Figure, we will remove it from the manuscript.

3-My recommendation would be that the authors try to built a « realistic » Si budget analogous to the above figure 1, expliciting their hypothesis regarding presently unknown fluxes.

It was never our intention to build a «realistic» Si budget. Please see our responses above.

Minor points :

-dSi and not DSi (which is ambiguous for a chemist).

Agree. We will change to dSi.

-bSi and not BSi (idem)

Agree. We will change to bSi.

-aSi and not ASi (idem)

Agree. We will change to aSi.