

## Oleg Savchuk

Review of the revised manuscript by Stella-Theresa Stoicescu, J. Laanemets, T. Liblik, M. Skudra, O. Samlas, I. Lips and U. Lips: “Causes of the extensive hypoxia in the Gulf of Riga in 2018”.

1. I have intentionally started reading the revised version without looking first either in the extended Responses or “ATC1” file with all the corrections indicated in the text. I noticed some improvements in recommended streamlining of the Introduction with the addition of hypothesis and study questions, which, however, have not converted this local case study into something more attractive for the global audience of the Biogeosciences. Another positive improvement was an expansion analysis over 2012-2018 instead of focusing on 2018 only.

2. Unfortunately, two major faults are left hardly revised. Despite some restructuring, the style and length of Results section is almost unchanged: the same unnecessary lengthy, boringly detailed description of what is already clearly seen in Figures and Tables, which actually looks as “listing” rather than description. As a formal confirmation, the text length of Results became only slightly shorter, reduced from 17 to 14 pages, instead of recommended by all the reviewers, at least, halving it, for presenting to readers only most essential statements and conclusions drawn from these graphs and numbers. Perhaps, the Discussion has also slightly improved, however, again being expanded and diluted with some common places and trivial statements. Unfortunately, it has not been enriched much by considering also results and conclusions about hypoxia at the geographical locations other than the Gulf of Riga and the Baltic Sea.

3. To my mind, such superficial revision of the manuscript almost ignoring suggestions by reviewers, have not increased either scientific significance and quality of the manuscript or its presentation quality – it still looks as a Technical Report for the local funding authorities rather than a scientific “brick” into the knowledge about importance of hypoxia even for a very local Gulf of Riga. Therefore, although I could recommend the further Major revision, I will not revise the next iteration.

*We would like to thank Oleg Savchuk for his comments and suggestions. Although, we do not agree that we ‘almost ignored’ suggestions by reviewers. We tried to shorten and streamline the Results and Discussion sections once more during the second revision of the manuscript.*

## Anonymous

This is my second assessment of this manuscript and I believe the manuscript has improved. Nevertheless, there are still some issues that need to be addressed. Essentially, this is a relatively simple study, investigating the causes of the extensive hypoxia in 2018 in the Gulf of Riga. The authors have formulated three guiding research questions, leading to a general hypothesis. Given these clear objectives of the study, the storyline should be rather straightforward. The authors arrive at well-substantiated conclusions, and I agree with these, but I am wondering if 27 pages are really needed for this. Although I can see that the authors have reduced the text since the last submission, I still think that the manuscript could be made terser and more focused.

Whereas introduction, M&M and Sections 3.1 and 3.2 are well written, the manuscript starts losing focus from section 3.3 onwards. One problem is that the authors start mixing discussion issues into the results section from this point onwards. The authors need to present their results in an objective manner and keep their subjective assessment for the discussion. The discussion should focus on the research questions outlined at the end of the introduction, rather than repeating the results and giving general statements about causes of hypoxia etc. I suggest the authors to introduce subheadings for the discussion listing the key research question being addressed. This will help keep the manuscript focusing on answering the questions from the introduction. In doing so, I believe the text could be reduced considerably.

*We modified the results part (from section 3.3 onwards), keeping only objective descriptions of results. We restructured and rewrote the discussion, keeping in mind the study questions and removed the repetition of results. Although we did not introduce subheadings, we structured the discussion focusing firstly on the first study question (stating that 2018 agreed with the long-term trend, but pointing out that the reasons behind the extent of hypoxia need further elaboration). Then we move on to describe the factors influencing hypoxia, using 2018 as an example year and comparing it briefly with other analyzed years in regard of consumption estimates, meteorological forcing factors etc. (second study question - What were the reasons behind the observed hypoxia?). Next, there is a paragraph about future projections and what these could mean for the Gulf of Riga, plus the speculation on phosphorus trends (third study question - Was it a feature that could occur in the GoR and similar basins regularly and/or even more often in the future?). Finally, a short concluding paragraph was added.*

Another question that I would like the authors to consider is whether the increase in phosphate releases over time is directly linked to increases in hypoxia only, or if there could be an accumulation of phosphorus in the sediment pool as well over this period.

*We added some discussion on this topic (Page 21, l. 1-7).*

Thus, I believe the study is correct and deserves publication, but I would urge the authors to make it more focused on the specific research questions and to make a clear distinction between results and discussion.

### Detailed comments:

Page 2, l. 5-7: This sentence reads a bit like arm-waving. Please elaborate the mechanistic cause-effect relations between climate change and hypoxia.

*We supplemented this sentence.*

Page 2, l. 9-10: Maybe a better reference is the review by Reusch et al (2018) Sci.Rep.

*We added the suggested reference.*

Page 2, l. 12-13: See also paper by Carstensen & Conley (2019) Limnol.Oceanogr.Bull.

*We added the suggested reference.*

Page 3, l. 3: This sentence reads awkward. Assuming what? Do you mean 'Considering the ...'?

*We changed the sentence as per the suggestion.*

Page 3, l. 9: Use either 'deep layer' or 'deep waters', not both. It is verbose.

*Noted and changed.*

Page 3, l. 15: Same comment as above.

*Noted and changed.*

Page 4, l. 16: Suggest to use 'speculate' rather than 'predict'. This is what will be discussed, right?

*We changed the sentence as per the suggestion.*

Figure 1: Pärnu River is marked by white square, should be green as for the other rivers.

*Figure changed.*

Page 6, l. 27: better to write 'assuming an even horizontal depth distribution for the occurrence of hypoxia'.

*We changed the sentence as per the suggestion.*

Page 7, l. 6: What about Pärnu River? Weren't there any discharge data available? From Estonian monitoring authorities?

*In the previous versions we did not include discharge data from Pärnu river, because the data available was not representative of the flow estimates in the river mouth (measurements are taken some 30 km inland from the mouth). But, upon learning that these exact same data are used in the PLC calculations, representing the whole Pärnu river runoff, we have now included these data in our calculations as well. It did not change the presentation and results, but dataset used is more complete now.*

Page 7, l. 26: Extracted from where?

*Added specification.*

Page 7, l. 31: 'We introduced a coarse method for estimating ...'

*We changed the sentence as per the suggestion.*

Page 10, l. 7: 'the lower sampling frequency'

*We changed the sentence as per the suggestion.*

Page 10, l. 8: 'since 2012, except for 2016 and 2017'.

*We changed the sentence as per the suggestion.*

Page 11, l. 2: 'did not at ..' Remove 'exist'.

*We changed the sentence as per the suggestion.*

Page 11, l. 13: 'was apparent'

*We changed the sentence as per the suggestion.*

Page 11, l. 15: Do you mean 'The lowest oxygen concentrations were observed ...'?

*We changed the sentence as per the suggestion.*

Page 11, l. 17: Replace with 'The first occurrence of the seasonal hypoxia was observed in July in 2014, August in 2018, ...'

*We changed the sentence as per the suggestion.*

Page 11, l. 18: Replace 'border' with 'boundary'.

*We changed the sentence as per the suggestion.*

Page 11, l. 23: 'dominated'. Check for consistent use of past tense.

*We changed the sentence as per the suggestion.*

Page 11, l. 27: 'were'. Use past tense consistently.

*We changed the sentence as per the suggestion.*

Page 12, l. 3: Replace 'related to' with 'were associated with'.

*We changed the sentence as per the suggestion.*

Page 13, l. 19: Insert 'previous' before 'year'.

*We changed the sentence as per the suggestion.*

Page 13, l. 21-22: 'in vertical stratification during spring between these two years'.

*We modified the sentence keeping in mind the suggestion.*

Page 19, l. 3: 'during destratification in autumn' rather than 'in the stratification decay in autumn'

*We changed the sentence as per the suggestion.*

Page 19, l. 5-11: These sentences are more discussion than results.

*These sentences were removed from the results.*

Page 19, l. 15-16: Rephrase this sentence moving the verb forward.

*We modified the sentence.*

Page 20, last paragraph: This paragraph reads more like discussion than results. Please keep a clear distinction between results and discussion, also to avoid repetition in the discussion.

*Noted. We removed all discussion-like sentences from the results.*

Page 21, l. 13: 'respiration' is better than 'consumption' here.

*We changed the sentence as per the suggestion.*

Page 24, l. 9: 'If oxygen consumption exceeds oxygen supply ...'

*We changed the sentence as per the suggestion.*

Page 24, l. 28: 'have accelerated recently'.

*We changed the sentence as per the suggestion.*

Page 25, l. 11: What about the degradability of the organic matter. In autumn, much of the labile organic matter has already been degraded and more refractory organic matter remains.

*Aigars et al (2015) suggested, that higher consumption in spring-early summer could be related to the availability of degradable organic material is available (settling of spring bloom, although the impact is smoothed over time). We added word "degradable" into this sentence (Page 19, l. 22).*

Page 25, l. 30: 'summer deoxygenation was higher compared to other years'.

*We changed the sentence as per the suggestion*

Page 25, l. 32: 'uplift of the almost oxygen depleted near-bottom waters'. 'boundary' instead of 'border'

*We changed the sentences as per the suggestion*

Page 25, last paragraph: Isn't this paragraph a repetition of the results?

*Removed.*

Page 26, l. 4: Is this where the discussion really takes off, by addressing the research questions?

*We restructured the discussion, keeping in mind the study questions.*

Page 26, l. 18-19: 'Lower wind speed reduces vertical mixing and enhances stratification'.

*We changed the sentence as per the suggestion.*

Page 26, l. 19-21: What is the main message here? What is the difference between have a more steady (constant) exchange relative to having a more variable?

*Removed*