

Earth Syst. Dynam. Discuss., referee comment RC1  
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## Comment on esd-2021-33

Donald Boesch (Referee)

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Referee comment on "Baltic Earth Assessment Report on the biogeochemistry of the Baltic Sea" by Karol Kuliński et al., Earth Syst. Dynam. Discuss.,  
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### General Comments

This is an excellent assessment on the current state of biogeochemistry of the Baltic Sea. It is comprehensive, thorough, up-to-date, and effectively synthetic. The assessment considers past, present and future biogeochemical dynamics and how they are affected by human activities and the changing climate. It will be a standard, stock-taking reference for future research and science applications in the Baltic Sea, but will also be of significant interest outside of the region because of the diversity of environmental conditions and biogeochemical processes in the Baltic.

### Specific Comments

I have no substantive criticisms of the sections summarizing and synthesizing the current state of knowledge. They are uniformly thorough and sound. The section of knowledge gaps and future research could be sharpened if it is meant to be useful beyond a wish list of scientists. This section is replete with characterizations of poorly quantified and uncertain, poorly understood, poorly characterized, great knowledge gaps, hot topics, significant gaps, correct estimate, not understood, and not sufficiently clear. But, do these unknowns and uncertainties matter equally, either in achieving robust understanding or for practical utility in sustainable development in the face of climate change. Some level of prioritization as to the most critical knowledge gaps and research opportunities to narrow them would be helpful

All scientists want more data and the next critical experiments and refined models, but what difference will these make. For example, it is not at all clear how better quantification of the nutrient loads and their geographical distribution and changes in the catchment can better quantify baseline conditions before 1970 (lines 1349-1353). Is a baseline even a relevant concept for characterizing good ecological status when, because of changing climatic and other conditions, it is no longer an achievable state?

### Technical Corrections

Perhaps give a more complete name for BONUS such as BONUS: Science for a Better Future of the Baltic Sea Region (line 49).

It would be helpful, for context, to mention the other Grand Challenges that Baltic Earth is dealing with (line 60).

A reference is required here to support the statement about the decrease in nutrient loads and briefly some indication of the proportional amount of the decrease would be helpful. I realize this is discussed in more detail later, but the statement needs some support on first mention (lines 99-100).

Misplaced, open parenthesis (line 150).

The RCPs are pathways greenhouse gas concentrations and their radiative forcing, not global warming, per se. (line 158) The authors should make clear that the CMIP5 projections are those used in the IPCC AR5. Updated projections will be included in AR6 that will be released this year.

Clarify the sentence: "The results generally show a greater variation among climate models . . . for projections until the mid-21<sup>st</sup> century, but greater variation among RCPs towards the end of this century". (lines 161-164)

Make clear that these projections are for air temperature. (lines 165-167)

Are the SSPs for climate derived from CMIP6 model ensembles? (lines 172-173)

Doesn't all carbon enter the Baltic Sea in either inorganic or organic form? (line 221)

Is this TOC increase for the northern Baltic or an average for the entire Baltic? (line 228)

The caption for Figure 2 should explain the color coding in the histograms. (lines 344-345)

Clarify what is meant by "71% (89%) of the phytoplankton nitrogen and phosphorus uptake." (line 520)

Misplaced, open parenthesis (line 728).

Do mid-80<sup>th</sup> and late 90<sup>th</sup> refer to the mid 1980s and late 1990s, respectively? (lines 1052 and 1054)

The three long sentences on lines 1059-1066 are confusing and should be more clearly stated.

Non-stoichiometric uptake may not be clear to the non-specialist reader. I suggest that this should be reworded more plainly. (line 1461)