

Biogeosciences Discuss., referee comment RC3  
<https://doi.org/10.5194/bg-2021-156-RC3>, 2021  
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## Comment on bg-2021-156

Anonymous Referee #3

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Referee comment on "Modeling cyanobacteria life cycle dynamics and historical nitrogen fixation in the Baltic Proper" by Jenny Hieronymus et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-156-RC3>, 2021

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Jenny Hieronymus et al. Modeling cyanobacteria life cycle dynamics and historical nitrogen fixation in the Baltic Sea

This study incorporated a cyanobacterial life cycle model with phosphorus dependency, which improved the prediction of diazotrophic cyanobacterial blooms in the Baltic Sea. The research is quite interesting and challenging; however, I found the whole manuscript lacks a clear hypothesis, clear clarification of why phosphorus is important, and the interpretation of results is not deep enough. I could see that the authors were trying to explain the methodology as it is a complicated study, however I got lost easily as there is not a clear approach or conceptual diagram to lead the readers. I have also got a few major concerns as listed below.

### Introduction

From the manuscript it is not clear to me phosphorus utilization of the diazotrophic species is important in the Baltic sea, and what critical roles P plays in the dominance of the three species.

### Methods

Fig. 2 seems very complicated and busy to me, and I cannot tell what processes the authors have modelled and tried to test. What is your hypothesis? To someone who is not familiar with CLC model, I am suggesting the authors making Fig. 2 easier to follow, also by adding a conceptual diagram to illustrate what life cycle really means – what are the physiological processes, timescale, input conditions and output, etc.

Please also specify why CLC model needs to be modified to include P utilization. Did you

mean by superior P uptake, P storage or DOP scavenging strategies?

L100 – why some of the predicted temperature were much higher? Please kindly explain the reason behind it.

L110 – But you could already see cyanobacterial species vary in physiology from a great many publications. I wonder if it could be better to allocate a range or different C:N:P ratios for the modelled species, maybe a sensitivity analysis could help you find out whether this ratio really matters for the simulated outcomes.

L125 – I am sure the internal nutrient quotas also affect the growth and life cycle transitions; however, I cannot tell if you have included internal nutrient quotas impacts. A schematic including how processes involved in the model, alongside the methodology of this manuscript may help clarify the uncertainty here.

Results and discussion

L565 – There are some extreme biomass values that were not predicted, why is that?