Biogeosciences Discussions

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Comment on bg-2021-59

Huib E. de Swart (Referee)

Referee comment on "Evolution of the long-term and estuary-scale phytoplankton patterns in the Scheldt estuary: the disappearance of net growth in the brackish region" by Dante M. L. Horemans et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-59-RC1, 2021

Overall: this is a paper about an important topic. The paper is well structured and well written. The aims are clear and results are interesting. Clearly, this work is beyond a case study, as it also provides generic and useful knowledge for understanding similar phenomena in other estuaries.

My main comments concern the applied methods (to find the light extinction coefficient), the choice of the model and the formulations/assumptions used in that mode, the presentation of the results and the discussion (see comments below). Based on these, my recommendation is major revision.

Comments about the scientific content

Section 2

L101: Why only two measurement points, how useful is it in that case to apply an exponential fit? One would typically expect a number of points here at different distances and use these to make a fit.
Furthermore, it is not clear why the distance was chosen to be 40 cm, please explain.

L117: Why use this model instead of e.g. a state-of-the-art model like Delft3D?

Alternatively, the authors could have used the model of Arndt et al. (2011), why was decided otherwise? See also later comment: a discussion about the model limitations is missing.

L125: Why is salinity considered to be static and prescribed? That does not seem close to reality.
This comment also applies to the statement in l177 'to correct for the large temporal variability in the discharges'.

L126: Does the statement 'Scheldt…well-mixed' apply to the entire estuary, i.e., there no stratification anywhere? Please add a citation to support this.

L135-136: If being so precise here, then why not consider a dynamic salinity? The choices made seem a bit ad hoc.

Eq. 2b: Shouldn't the left-hand side be (H+\zeta), rather than H?

Eq. (3)

* Where does this come from, please add a citation here.

* The meaning and dimensions of the symbols g1, g2, Z… is not clear. It takes until Table 1 to conclude that g1 and g1 have the unit s^{-1} L and so the Z's are in L^-1. It then takes until l205 to find the unit of the Z's, but there ind. L^{-1} is used; but what is 'ind'?

* The text 'extension (section 3.2.4)' is not satisfactory: motivation should be presented here.

Eqs. (3) and (6): Please remove the 'dots' on the right-hand side of the second equation, they're not used in any other equation.

L155: Why a time-averaged growth rate?
And why is this about implementation, one would expect this to be about the choice for the formulation of \mu, which originates from biological literature.

L156: The argument to use Eq. (4) to save computational costs is a bit unexpected. There is no information about the time that a typical run lasts and how much does that costs, is that of the order of a week or more (as suggested by this statement)?

Note: this comment also applies to l170: please add quantitative information.

L160: It is suggested here that E has the unit PAR, but in Table 1 another unit for E is used. Please use either of them.

L162: Specify how the seasonal variation of E_00 is described in the model. Table 1 only contains one value (is that setting for the default setting?)

Eq. (5): The formulation is now such that E is only nonzero during one single day. This should probably be for all daytimes (multiple time intervals).

Eq. (6): Meaning and dimensions of the calibration parameters are not clear. In (6) \mu_01 is raised to a power with a (dimensional) temperature T (expressed in Kelvin?) as an exponent?

Table 1: Values for w_P, k_bg, k_P are expected to originate from biological literature.

Third line: there appear two parameters \mu_max and \alpha here?

Section 3

Figure 3 is very hard to read, because of the many curves with error bars and shading areas. Suggest to present Chl-a and calanoid abundance in different panels.

Consider adding 'suggestion lines' between the data points that correspond to a single event. That would help to 'guide the eye' of readers.

L237/Figure 6a: the unit seems not correct: from Eqs. (1) and (4) it follows that the unit of \mu_max is 1/s.

L240/Fig. 6b: Unit? From Eq. (4), it seems that the simplest way to write it is PAR^{-1} s^{-1}.

Fig. 7: Recommend to use a different color to plot the model results.

Section 3.2 (sensitivity analysis) is quite exhaustive and has a bit the style of a logbook. Suggest to shorten it and present less figures: not all seem to be necessary. Alternatively, move this section to an Electronic Supplement and only summarize the main findings of the sensitivity analysis in the main text.

Section 4

* L374: It is a bit unexpected that at this stage, two new state variables are introduced, viz. oxygen and fish abundance. If they are important, then why were they not considered earlier? And isn't oxygen affecting the phytoplankton as well (through respiration)?

L353/372/379: This paper is about verifying a hypothesis (L7). It is then a bit surprising that yet two other hypotheses are formulated that are not verified. The title of Section 4.2 is also unclear in the sense of 'reconstructions of concentrations'; what is the purpose here, to present a conceptual model?

* Section 4.2 is not really satisfactory. At the same time, important other information is missing, for example about the model limitations (what processes are neglected and how is that justified?) Recommendation: remove the current text of 4.2 and add text about model limitations and context (see next comment).

* What would add value to this study is to put the results in a broader context: in what way do these results of this study contribute to understanding phytoplankton dynamics in other estuaries? This would avoid readers to get the impression that this is a case study.

Appendices

The paper is long and it contains details that are of interest to only a small number of readers. To increase attractiveness and readability, please move all appendices to a separate electronic supplement.

Minors:

Overall:

Remove commas before ‘and’.

Add commas before ‘which’ (or replace ‘which’ by ‘that’).

L3: Why of ‘particular’ interest?
Note: this comment also applies to l27: the Scheldt is definitely interesting, but it not clear what is ‘particular’ about it with respect to other estuaries.
The comment also applies to l37.

L9-11: long sentence that is difficult to read. Please split.

L14: explain

L17-19: This text is almost identical to that of l1-3 of the abstract. Please rephrase.

L30: drastically, mainly

L32-35 long sentence, with several subordinate clauses. Suggest to rephrase/split it.

L38: What is meant by ‘we’ here, the authors? Clarify by means of a citation.

L42-44: a complicated sentence, suggest to split it.

L47: observations, to

L51-52: the introduction ends quite abruptly. It would help to write the last paragraph such that it provides an overview of what is in the remaining sections.

L54-55: suggest to move this to the last paragraph of the introduction (see previous comment).

L58: relatively small compared to what?

L66-67: why three citations needed?

L69-73: split.

L76: Is there an unofficial website as well? And perhaps provide the link here.

L87-89: difficult to read (too many subordinate clauses), please split/rephrase.

L134: dynamics, because

L139-148: this is one sentence. Please split.

L149-150: As a start? Further, the word 'simple' is rather subjective, the expression in Eq. (3) is already quite complicated.

L173: 'sensitivity study ... supported … observations' (? Not clear what is meant here, please rephrase).

L191-193: expected this in the last paragraph of the introduction (see earlier comment).

L242/261/330: please avoid the word 'conclude' while being in a section on results. Change e.g. by 'The long-term ..' , 'The results show..', The… thus shows..'.

L243: extent

L245 and hereafter: Present tense is used for activities that took place in the past. Compare with, for example, the text in Section 5.

L291: Not clear why a new symbol m_new is introduced here.

L304: k_c italic.

L309: Expected this motivation in Section 2, when designing the model experiments.

L336: If the reason is unclear then there is little to discuss. Suggest to write 'Possible reasons for… are discussed….'

L338-338: Suggest to move this to the last paragraph of the introduction (see previous comment).

L367: surprising, because