Review of the manuscript „Estimating the seasonal impact of optically significant water constituents on surface heating rates in the Western Baltic Sea" by Bronwyn E. Cahill, Piotr Kowalczuk, Lena Kritten, Ulf Gräwe, John Wilkin and Jürgen Fischer

The study presents estimates of changes in the Western Baltic Sea water heating rates due to presence of particulate organic matter (including phytoplankton and detritus) and colored dissolved organic matter. The authors emphasize the importance of considering this biogeochemical impact on the solar radiation penetration and related changes in the physics, possible biological-physical feedbacks, and interactions between sea water and atmosphere when predicting weather or climate by numerical modelling. The study is based on a 3 dimensional (3D) coupled physical-biogeochemical model augmented by a spectrally resolved sea water optical module. This optical module allowing for explicit calculation of the shortwave radiation penetration, which is used in the physical model. The model performance w.r.t. simulated CDOM for 2018 (the considered time period) is evaluated with MERIS satellite based CDOM retrievals (averaged over the time period 2003 - 2012) and seasonal means of CDOM absorption at 443nm derived from in situ time series (1994 - 2017) observations at Oder Bank, Darß Sill, Arkona Sea and Bornholm Basin. The simulated temperature is evaluated with temperature observations in 2018 at the aforementioned four stations (Oder Bank, Darß Sill, Arkona Sea and Bornholm Basin). The estimates of heating rates obtained with the introduced 3D coupled physical-bio-optical model are assessed against similar estimates provided by more sophisticated in terms of physics but 1D coupled ocean-atmosphere radiation model.
With respect to the subject of ocean physical-biological feedbacks, the study would fit nicely within the journal scope. I would like to support this kind of studies. Generally, the text is well written. However, I have got some concerns, and suggest to consider a number of clarifications and edits before publishing the manuscript (please see my general comments below, followed by specific comments with reference to the Line number as Lxxx).

General comments

1) Very nicely and very much in details written general (published) and theoretical information but much less in details the actual information. In particular, this novel bio-optical module the authors introduce, use and evaluate is currently described in words with references to equations in the Theory subsection. Even though the Theory section is nicely written, it would be more straightforward to explicitly formulate the model equations with proper citations in the subsection 2.3 (as a separate subsubsection) and remove then subsection 2.2 (Theory). Especially if this "Bio-Optic" module is presented for the very first time. If it was already published and evaluated, please provide the related reference.
   Looks like the ROMS-BioOptic model code used in this study is not easily accessable (is not easy to find) given the provided general link `https://www.myroms.org` (Is it within EcoSim?)

2) Some more details could be given w.r.t. setting the radiation model MOMO used for the evaluation of the heating rate estimates (see specific comments).
3) Temperature observations at the "Oder Bank", "Darß Sill", "Arkona Sea" and "Bornholm Basin" stations provided by the German Maritime Agency (BSH) and

Denmark Meteorological Institute (DMI) could be presented in the "in situ observations" subsection. Please provide the related references.

4) Are there actual satellite CDOM, phytoplankton total chlorophyll, Kd products available for the year 2018 (the year of your interest)? What about using Sentinel 3 observations?
5) I would recommend changing the format of the result visualization from 3D (as it currently Figures 4 -8) to 2D. The 3D representation does not add anything in comparison with 2D one but hides some information. Hovmöller diagram might suit better for the results depicted in Figure 9 (I agree with the first reviewer)

Specific comments

L17-18: please double check and correct if required: currently it reads as both phytoplankton and CDOM effects dominate in summer.
L120: you could cite also Fasham et al., 1990
L126: I would suggest removing Equation 2 as not used in the current study.
L137: Could Equation 3 be removed? Do you use this equation?
A related equation used in the current study could be shown in the subsection dedicated to the "Bio-Optic" module.

Figure 1: Were the observations marked as red dots used for evaluation or only the observations from the four stations (marked green dots)?

The material from Subsection 2.2 Theory could be adjusted in the subsection dedicated to the "Bio-Optic" module.

L287: reference is required if exists
L303-304: what is assumed/used as information on "clouds, water vapour and aerosols, the surface roughness"
L311: provide information on how *a* and *b* for phytoplankton, detritus and CDOM are explicitly calculated, show also the function used to calculate the average cosine (L309)
L347: you could list the observed characteristics here explicitly

Table 1 reads somehow repetitive to the text. While you could still extend the table by information related to "Bio-Optic" module setup, including information on spectral resolution. Information used for evaluation can be summarized in a separate table (if required, it will support the subsection 2.5). There you could also provide the details on satellite data used.

L357-359: please provide the setup details on the MOMO simulations
L393: I suggest removing "using Eq. (11)" as the equation follows
L402: I suggest removing "using Eq. (12)" as the equation follows

Section 2.5.1 could be shortened. The sampling details (e.g. L384-391) if not used for the discussion can be moved into Supplementary material).
In this section, BSH and DMI observations could be presented.

What about data from Meler et al. 2016?

Subsection 2.5.2 Remotely sensed data:
Are there products available from other satellite missions (e.g. Sentinel3) for the year of your interest 2018?

Could Figure 2 be moved to the Supplementary or Appendix since not presenting results of the study, although supporting the discussion? Instead, in the Result section the authors could show and discuss the CDOM (TChla, Kd) distribution simulated by the model.

L446-448: please provide references to the BSH and DMI observations
Figure 3 captions: detail the legend (abbreviation used in the Legend)

Table 2: Please extend the title to clarify that the goodness of fit statistics is provided for the simulated sea surface temperature.

Figure A1: please provide related labels (a, b, c, d) to be consistent with the figure caption.

Figure A1 could be moved to the main manuscript as model evaluation results and could be extended (or revised 2 upper panels) by comparing with more collocated with MERIS (or Sentinel 3) surface matchups (not only for the four stations).

References

Fasham, M. J. R.; Ducklow, H. W.; McKelvie, S. M. (1990). "A nitrogen-based model of plankton dynamics in the oceanic mixed layer". *Journal of Marine Research*. **48** (3): 591–639. *doi*:*10.1357/002224090784984678*