Three-stream modelling of radiative transfer for the simulation of Black Sea biogeochemistry in a NEMO framework

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Author's response - 2nd revision round:

Please find below our reponses to comments from the reviewer. Figures 8, 9, 10, 12, 13 and 14 have also been updated to adjust the color scheme, as requested.

Report 1: by Anonymous referee #2, 16 Jul 2026

Author's response:

We thank the reviewer for this new review of our paper and for the remarks and suggestions. Please find below our replies in blue.

I am generally happy with how the authors addressed my previous comments. Perhaps with some of my points more discussion reflecting on those could have been added to the manuscript, but for most part I happily leave it to the authors. I also appreciate that the authors expanded the Discussion section and overall I think the paper is an interesting contribution which should be published in GMD.

I have only few last minor comments:

- In addressing my comment 3 you added "PISCES model (Aumont et al. 2015) and other configurations such as Hordoir et al. (2019)." This sounds to me quite ambiguous and unclear. I.e. "configurations" of what, of PISCES model? Or do you mean other models? If so, these are separate models rather than configurations, i.e. I understand under "configuration" a detailed set-up of a specific model (with some model version) that can be run somewhere… Can you please clarify?

We decided to simplify this part and simply list references to Aumont et al. and Hordoir et al. without detailing it here, as it is not the main focus of the paper. The idea is to list here previous implementations of radiative transfer schemes within NEMO, that led to the model we are presenting in this paper. To avoid confusion, since Hordoir et al. (2019) does not use PISCES, the sentence was changed to: " Lengaigne et al. (2007) proposed to add a third band, separating the visible range between blue (400-500 nm), green (500-600 nm) and red (600-700 nm), as applied in Aumont et al. (2015) or Hordoir et al. (2019) for instance".

- As per answer to my point 8., I appreciate there is now sentence in the discussion mentioning SPM, but maybe you could go a bit deeper and discuss what is the expected impact on model skill by leaving SPM out? Less attenuation in certain (which?) areas at certain wavelengths? Or has the absence of SPM somehow been mapped into the parametrization of other variables? Although you said something in your response letter, perhaps it would be good to discuss this more also in the manuscript?

We added the following sentences in the discussion: "We could also imagine the inclusion suspended minerals (SPM) that could be particularly relevant in the sediment charged waters close to river mouths. SPM aggregates suspended particles of organic and inorganic origin, and we would expect its contribution to be larger in longer wavebands (Grégoire et al., 2023). In the current formulation, model parameterisation is made such as the organic part of SPM is accounted for in the optical properties of non-algal particles. The missing contribution is also compensated in the optical properties of CDOM, as they are derived from other contributions. The explicit addition of SPM would require further model parameterisation; including aggregation, and recalibration of the non-algal particles and CDOM contributions." SPM would matter more close to river mouths as already mentionned in the text. Model skill could improve in this areas by adding SPM explicitly and not accounting for it only though other constituents.

- I’m still not 100% clear about the normalization addressed by my comment 15. Is irradiance in observations and models normalized relative to surface layer value of observations and models respectively, or surface value of only one of them (e.g. observations)? If the former why the lines don’t meet at 1 at the high end? This wasn’t answered..

Irradiances are normalised relative to the surface layer values of observations and model, respectively. On the plot, and in the analysis the surface values are not shown or considered, as these values would simply match 1 with 1. The regression lines therefore do not meet at 1 as regressions are calculated based on deeper values.
We updated the description on these plots to: “In this figure, downwelling irradiances are normalised by their surface values, respectively from observations and model, to focus on radiation absorption independently from potential surface radiation biases. Regressions are computed to evaluate the agreement between sub-surface datasets.”