Biogeosciences Discussions

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Comment on bg-2020-473

Anonymous Referee #2

Referee comment on "Radiative transfer modeling with BGC-Argo float data in the Mediterranean Sea" by Elena Terzić et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-473-RC2, 2021

This manuscripts presents a radiative transfer model that uses BGC-Argo float data to derive profiles of the underwater light field. This is a thorough, comprehensive study which tested different inherent optical property models/parameterizations, and validated them on float-measured downwelling irradiance and satellite observations.

Given the increasing use of BGC-Argo floats and autonomous gliders, methods to connect their biogeochemical measurements to optical properties/underwater light fields are important – this study is one of few attempting to fill that gap, and as such, is of interest to the wider community.

Ultimately, I think this manuscript could be a valuable contribution, however in its current form, I have some concerns/comments and areas that I think need a bit of clarification.

1) Some of the method details and corresponding results are a bit hard to follow. Sometimes it's unclear what exact IOP parameterization is used where, and what parameterization the different results in the text are referring to. I think this could be simplified with a table or two summarizing these details.

2) Maybe I'm missing something in your methodology completely, but it is unclear to me why you test the individual OSM (optically significant material) constituent IOP models separately. You know that for your float data, you're never in pure water or pure water + 1 OSM. You're almost always going to be in your 6th IOP model group (i.e. all constituents). So you need to test your different individual OSM-IOP model parameterizations within this 6th IOP model group because it is the total IOPs that are important. For example, when testing your a_NAP model parameterizations (your 2nd IOP model group), you may get a better result (i.e. an irradiance that is closer to the measured value) for one of the parameterizations that is actually less correct. This is because that parameterization could be less correct in a way that is more correct in terms

of the actual total IOP e.g. in this NAP case, perhaps your NAP model is incorrect, but it accurately captures CDOM, and CDOM is the dominant OSM in that sample, so overall, the total absorption is more correct.

Further comments are detailed below.

Specific comments

L7: Lefering et al (2020) used model, satellite and glider data for the type of three-platform comparison done here. [Development of bio-optical model for the Barents Sea to quantitatively link glider and satellite observations, Philosophical Transactions A: Mathematical, Physical and Engineering Sciences https://doi.org/10.1098/rsta.2019.0367]

Fig 1 & 2: units missing on the colour bar – number of floats? Number of days with profiles present over the 5 year period?

L75: you haven't defined Kd yet

L75: The details on the Kd calculation are not clear. It seems like you are doing a depth averaged Kd rather than taking the derivative of the Ed profile (to get a profile of Kd). If so, what depth are you averaging over? Why do you need to have the first Ed measurement shallower than 1m?

L78: Are you saying that you tested all your different model parameterizations but then just removed the results that had an Ed difference of greater than 30%? What's the justification for this?

L95, 99: missing backscattering coefficients

L142: What is the "this" at the start of the sentence "This is however present…" Can you please reword to make it clearer?

Eq 16 / L177: I don't understand this. Why are you estimating aCDOM using Pope and Fry when you are using Mason et al elsewhere?

L178-179: in the text you have a_{ORIG}, but in Eq 16 you have a_w^{ORIG} – can you please make it consistent?

L195: No other OSMs affecting Kbio(380)? Can you expand on this in the text please.

Section 2.3.4: How do the min and max Chl values affect the results? You didn't see any features/performance issues at the low and high ends of your data?

Eq 20: using chl as a bp model – what about NAP?

Are all IOP models derived for the "surface" and then extrapolated? What's the "surface"?

Fig 6 & L310: what configurations are used for each of the OSMs here? The best aNAP and aCDOM results from Figs 4 and 5? You described a range of different scattering models – which one is shown in this figure?

L311-312: Suggest including that these decreases in RMSE and bias are in reference to the pure water simulation.

L323-326: what run is this paragraph referring to? I'm assuming the run with water + all OSMs. If so, what configurations are used for each of the OSMs? Can you please include those details?

Fig 7: The y-axis label isn't defined anywhere

Fig 8 – 10: what is the depth bin or range for the model and float data shown in these figures?

I'm not sure I'm following the aNAP argument presented in section 3.2. You state the Kd comparisons improve when you remove the aNAP component – this makes sense because of your assumption that Kbio was only CDOM driven. Then you say you need the aNAP component to get the best Rrs retrievals, but offer no explanation. What's going on here? It seems your Rrs model is inconsistent with your Kd model?

Technical corrections, typos etc

L10 “also incorporated” rather than “incorporated also”

L15 “also enabled the estimation of” rather than “enabled to estimate also”

L27 Suggest reordering, the second part of the sentence is fragmented. “To achieve this, and in order to follow up with the pace… in-situ platforms, the implementation…remains essential.”

L49-50: Same as above, suggest reordering “With their high vertical resolution profiles and high spatial coverage, BGC-Argo…”

L125: Haven’t defined PFT

L135 and a few other places: you have an indent after the equation where there shouldn’t be one.

L141 “of conveying” rather than “to convey”

L163 the Babin et al ref should be in parenthesis

L195-199: This sentence is slightly confusing. I think you’re saying the IOPs used for pure water are an upgrade because you use Mason et al and include a T-S correction. Suggest rewording along the lines of “Given the fact that the IOP models used here for pure water absorption are the new measurements of Mason et al, and a T-S correction is applied, …”

Eq 12 and 22: use bb’ and bb-tilde for backscattering ratio, please make it consistent throughout.

Fig 3: In the caption the formatting of the xlabels is different from the figure.

Fig 5 Caption: “twe” should be “the”