Geoscientific
Model Development
Discussions

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comment

Interactive comment on "Radiation model for the Baltic Sea with an explicit CDOM state variable: a case study with Model ERGOM (version 1.2)" *by* Thomas Neumann et al.

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This paper uses satellite determinations of PAR-weighted CDOM absorption in the mouths of 69 estuaries / rivers as boundary conditions for a model tracer that represents the absorption of CDOM in a Baltic Sea configuration of the Modular Ocean Model (MOM). The authors find the absorption calculated with the new formulation improves on a simple CDOM-salinity relationship when compared to in situ absorption measurements, and it is shown that this change affects a biogeochemical model.

I found this an excellent and thought-provoking approach to take which will be of interest to coastal modellers. The manuscript itself has a significant number of problems

which I discuss below, and I have a few insights that might simplify / improve the approach.

Major comments.

1. The authors are occasionally loose with the use of CDOM vs. CDOM absorption and this becomes confusing. For example, p2 L17 is CDOM absorption; L26 'amount of CDOM'. Is this a load, concentration, rate of absorption?

2. While it is not entirely clear, the authors appear to attribute the improvement of their CDOM equation compared to the salinity relationship to the inclusion of non-conservative behaviour CDOM. Instead, I suspect the majority of the improvement is due to the use of the 65 stations to better set the inflow concentrations of CDOM. If they run a simulation with the non-conservative terms set to zero they would be able to quantitatively compare the importance of one over the other. The comparison should also include a complete description of the salinity-CDOM absorption parameterisation so that we understand the comparison. For researchers such as myself considering both options in a coastal model, this would double the value of the paper.

3. The authors use a neural network to determine the CDOM component of absorption at 440 nm at 65 sites. This is a key innovation. They then undertake a convoluted set of calculations, including choosing an arbitrary 75th percentile value, in order to turn the satellite-determined absorption into a CDOM concentration which is then multiplied by kcdom in Eq. 5 to obtain the component of vertical attenuation due to absorption CDOM. Is this complicated pathway even necessary? Absorption is inherently additive. Furthermore, the degradation rate is proportional to concentration, which is itself proportional to absorption. So, could you not simply have a model tracer CDOM absorption at 440, and applying the mixing and non-conservative terms to this tracer?

4. I presume the use of the 75th percentile is about trying to determine the CDOM absorption in the freshwater end member. Given that there is a hydrodynamic model, the authors could use salinity in the hydrodynamic model to determine the unique freshwa-

ter endmember for each of the 65 sites? I know you started with the feeling that salinity vs CDOM doesn't work, but I think this is because the Baltic has 65 different freshwater end members.

5. One of the key findings is the variability in CDOM absorption at the 65 stations. Fig. 4 illustrates this, but much more could be shown. I suggest splitting the two panels into 2 figures, and showing the map as large as Fig. 1, but with the 65 sites with symbols collected by mean absorption at 440. For some researchers this alone would be an important result.

Minor comments.

Title: "Radiation model" might imply a more sophisticated, directional model of light. Perhaps "Optical model" is less specific?

P1 L17 what does divergence mean in this context?

P2 L27 always have a space between a quantity and its units.

P2 2nd para. Paragraph goes from discussing non-conservative behaviour (2nd sentence), conservative behaviour (4th) to non-conservative again (5th). I understand what you are trying to say, and of course the point of the paper is in part the non-conservative behaviour. Paragraph just needs a more logical flow.

P3 EO processors – does this mean software, theory?

P3 L9 water leaving reflectance is a tautology.

P3 L12 coastal waters of Finland

P5 L15 'behaves conservatively',

P5 Eq. 8. Replace '2' in the equation with a parameter, the fraction of SWR in total solar radiation. What is the difference between PAR(z) and I(z)? Are you sure about exponential term in Eq 8. The K_PAR in front of the integral doesn't seem write. For

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equations, paper "Edwards, A.M. and AugerâĂŘMéthé, M., 2019. Some guidance on using mathematical notation in ecology. Methods in Ecology and Evolution, 10(1), pp.92-99." Is helpful.

P5 L10 K_CDOM is a parameter, not a statistical relationship.

P5 L10 CDOM absorption?

P5 L14. Isn't DON part of the DOM? In which case are the last two terms in Eq. 5 double counting?

P5, 2nd last line. 'depending on sun zenith angle, which is a function of latitude and time of day"

P6 L8 per m3

P6 L22 Whet is "Basis"?

P7 Title 3.3 Model configuration?

P7 A schematic of the biogeochemical model would help here.

Fig. 3b colorbar caption should be delta a(440).

P9 First paragraph – this discussion needs to be more quantitative.

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