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Biogeosciences Discussions

Interactive comment on "Fast and accurate irradiance calculations for ecosystem models" *by* C. D. Mobley et al.

Anonymous Referee #2

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This paper makes two main points. The first is that it is computationally feasible to incorporate light fields calculated using the EcoLight program in a coupled physical/biological ecosystem model. The second is that the use of EcoLight significantly improves the performance of the model. The paper is clearly written, and addresses topics of considerable current interest which are appropriate for publication in Biogeosciences.

The strengths of the paper are as follows: i. The efficient use of Ecolight light fields within an ecosystem model is demonstrated. ii. Strategies are evaluated for tuning the Ecolight program to minimise computer run time, and modifications that could lead to further efficiencies are identified.

Possible weaknesses are: i. The job of integrating Ecolight with the ROMS/EcoSim

coupled model cannot be regarded as completed until the light fields calculated from radiance transfer theory are used to drive the physical components of ROMS (heating and stratification). ii. The most interesting applications of Ecolight light fields are likely to be in Case 2 waters with strong seasonal variations in the concentrations of non-phytoplankton particles and dissolved coloured substances. However only rather straightforward Case 1 scenarios are considered in the paper.

Issues deserving further discussion include: i. The need for spectrally resolved light fields rather than PAR profiles is repeatedly asserted in the paper, but no supporting evidence is provided. The model scenarios compare two different light field generation methods, EL and AL, but both are spectrally resolved: there is therefore no real test of the need for spectral resolution within the paper. Have any PAR-only runs been carried out? ii. The differences between the model results obtained with Ecolight light fields and those generated using the original AL method are not very great, and the general patterns at depths of both 1m and 15.7 m are rather similar. Have the authors checked whether the depth-integrated and seasonally-integrated primary production figures are significantly different for the two light field models? iii. The statement on p. 10644 (lines 6 and 7): 'We presume that the EL runs give a better ecosystem prediction than the AL run because the irradiances are computed more accurately.' raises a number of questions which the paper does not attempt to answer. For example, can the differences in Figs 6-8 really be attributed to the spectral quality of the EcoLight runs rather than to differences in total irradiances? Has any quantitative comparison of the light fields calculated by the two methods been carried out? Would it be useful to add one or two graphs illustrating light field differences to the paper?

In summary, I think this paper provides a worthwhile demonstration of the capabilities of Ecolight even though full integration into the coupled model has not been achieved. However the significance of the differences in model performance produced using radiative transfer theory should be more clearly evaluated before publication.

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