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Biogeosciences Discussions

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

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Referee # 2 feels that the ecosystem simulation aspects of the study are not complete because the computed light fields do not feed back to the ROMS thermodynamics calculations. We certainly agree with this. It can be noted that several biological models have to date been coupled into the ROMS code, but none of those biological models have their (internal, for biological predictions) light calculations feed back into the ROMS thermodynamics calculations. We are working now to fully couple EcoLight into the ROMS-CoSiNE code (CoSiNE, Carbon-Silicon-Nitrogen Ecosystem; see Fujii et al., Biogeosci. 4, 817-835, 2007) including having the EcoLight-computed irradiances feed back to ROMS thermodynamics. That work will lead to more realistic 3D simulations, including optics effects on thermal stratification, than can be performed

with the idealized, periodic lateral boundary, ROMS-EcoSim code used for EcoLight development and initial testing.

Referee 2 also comments that the most interesting applications of EcoLight will be in simulations of Case 2 waters, but that only Case 1 simulations are shown in the paper. We fully agree that EcoLight's greatest value will be in simulations of Case 2 and/or optically shallow waters with reflecting bottoms for which no simple analytic light models are available. However, it was not possible to show any Case 2 simulations with the idealized ROMS-EcoSim code used here, because that code does not have components describing additional CDOM or sediment loads that would be found in Case 2 waters. ROMS-EcoSim is inherently a Case 1 water model.

Referee 2 also feels that we did not present an argument for the need for spectral irradiance vs. just PAR. Given the extensive literature on the different pigment suites found in different phytoplankton, it seems to us that the need for spectral irradiance is clear. Indeed, the reason EcoSim was developed was to model competition between phytoplankton functional groups having different pigment suites (which themselves evolve with time as light and nutrient conditions change), which means that they will respond differently to differences in spectral irradiances. Such spectrally dependent competition cannot be modeled with the use of PAR. The reviewer asks if we have done any PAR-only runs for comparison with the spectral Eo runs. The answer is no, because EcoSim inherently requires spectral irradiance, and other biological models (e.g., the CoSiNE model mentioned above) inherently use PAR. We do not have available any biological model that allows us to do parallel runs with PAR vs. spectral irradiance to see the differences within the same biological model.

The reviewer also asks if the differences in the simulations using analytic vs. EcoLight irradiances are really due to the spectral quality of the EcoLight runs rather than to differences in total irradiances. Both light models are spectral and are driven by the same external irradiances (so that the above-surface irradiance is the same for each model at any given time). The differences in ecosystem behavior result first from the differences

in the computed light fields for the same initial IOPs at time zero, and then later to how those IOPs then evolve with time and affect subsequent underwater irradiances. Both the spectral shape and magnitude of the in-water irradiances will thus be different and will influence ecosystem evolution.

We believe that the best way to address reviewer #2's suggestions is to submit a later paper on ecosystem modeling results, including effects of improved light calculations on mixed-layer thermodynamics, after results from the ROMS-CoSiNE-EcoLight simulations become available. This approach is consistent with reviewer #1's suggestion to split the original paper into two papers.

Interactive comment on Biogeosciences Discuss., 6, 10625, 2009.