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Biogeosciences Discussions

Interactive comment on "Satellite-detected fluorescence reveals global physiology of ocean phytoplankton" *by* M. J. Behrenfeld et al.

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General Comments

The paper presents the first global scale analysis of phytoplankton fluorescence detected by satellite based sensors. Most of the variability in the fluorescence signal is demonstrated to be associated with changes in 1) phytoplankton biomass, 2) 'pigment packaging', and 3) phytoplankton physiology (non-photochemical quenching, NPQ). The quantum yield of fluorescence (the ratio of photons fluoresced to those absorbed) calculated after accounting for three dominant factors is shown to spatially co-vary with a modeled Growth Constraint Index that distinguishes iron-limited waters. Higher quantum yields are associated with increased iron stress due to changes in stoichiometry of PSI and PSII reaction centers. This paper represents a truly significant increase in the

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understanding the phytoplankton fluorescence variability with potentially great impact on the understanding of phytoplankton physiology on a global scale and consequently estimates of oceanic primary productivity.

Specific Comments

The work presents a novel analysis of the satellite derived fluorescence line height and provides a detailed derivation of the approach in the Appendix. The new aspects are the recognition of the contribution of the excitation irradiance (iPAR) in the FLH product derived from the normalized water leaving radiances that has been missing from many previous satellite based studies and the normalization for the NPQ using the inverse of the iPAR. (Biomass and pigment packaging effects have been parameterized previously). With these corrections the authors produce a product they term the 'satellite fluorescence quantum yield'. This might not be the best terminology for this product as the quantum yield is the ratio of photons emitted to those absorbed which would include the effects of NPQ. A better term might be the NPQ-normalized fluorescence quantum yield.

A review of requested aspects of the work

1) Does the paper address relevant scientific questions within the scope of BG? - Yes 2) Does the paper present novel concepts, ideas, tools, or data? - Yes 3) Are substantial conclusions reached? - Yes 4) Are the scientific methods and assumptions valid and clearly outlined? - Yes 5) Are the results sufficient to support the interpretations and conclusions? - Yes 6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? - Yes 7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution? - Yes 8) Does the title clearly reflect the contents of the paper? - Yes 9) Does the abstract provide a concise and complete summary? - Yes 10) Is the overall presentation well structured and clear? - Yes 11) Is the language fluent and precise? - Yes 12) Are mathematical formulae, symbols, abbreviations, and

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units correctly defined and used? - Yes 13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Not really, but the color scales on the global distributions of the quantum yield (e.g. Figure 4A) appear to use only half the range given in the legends (i.e. all appear to be dark blue to cyan). Expanding the range of the color scale (0 to 1.2?) might give a better presentation of the global scale variability of this product. 14) Are the number and quality of references appropriate? - Yes 15) Is the amount and quality of supplementary material appropriate? - Yes

More specific comments

Page 4239 Line 3: By accounting for NPQ the fluorescence quantum yield is not really derived, rather a NPQ normalized fluorescence yield product (see note in section above)

Page 4240 Line 11: What was the atmospheric correction used (citation would be useful)

Page 4240 Line 15: Were there water leaving radiances at 748 greater than zero for the non coastal areas included? If not would this simplify the derivation of Fsat.

Page 4245 Line 9: Some details (citation) of the light utilization model might provide some useful information. What was the iPAR value at the equator used? What fraction of the absorbed light energy was emitted as fluorescence?

Page 4245 Line 25: See previous comment about the terminology of the quantum yield product.

Page 4252 Line 22: The FLH approach 'approximates' the removal of the non-fluorescence contributions to the normalized water leaving radiance as the baseline is not linear.

Page 4256 Line 17: See previous comment about the terminology of the quantum yield product.

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Interactive Comment

Technical Corrections

I found no typing / spelling problems.

Interactive comment on Biogeosciences Discuss., 5, 4235, 2008.