

## ***Interactive comment on “UV effects on the primary productivity of picophytoplankton: biological weighting functions and exposure response curves of *Synechococcus*” by P. J. Neale et al.***

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The authors used spectrally resolved exposures to irradiance to develop biological weighting functions for photoinhibition of photosynthesis in representative marine *Synechococcus* strains. They use establishing modelling procedures but incorporate a physiological reasonable extension by modelling repair processes as a rising but saturating function of photoactivation, so that at low irradiances/degrees of photoactivation repair rises to counter photoactivation, but above a threshold, irradiance-dependent photoactivation outruns repair. This nuance improves the fits of the models.

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The strains are important, the biological weighting functions are important, the work is carefully done and statistically rigorous.

I have comments and suggestions that might improve the readability of the manuscript, particularly for physiologically-oriented readers.

I also encourage the authors to continue to reach out to some of the relevant physiological literature, which is starting to provide mechanistic and even kinetic support for their repair threshold model. best regards, Doug Campbell

Introduction: Good, clear.

Figure 1: Nice conceptual figure. But there is a fairly extensive literature from the physiological/molecular side on the different response curves of repair rate and primary photoactivation (damage). I understand that Biogeoscience is not a physiological/molecular journal, but it would be good to refer to some of the work of ex. Tyystjarvi 2013 International Review of Cell and Molecular Biology, Vass 2011 BBA, Takahashi & Murata 2008 Trends in Plant Science, Edelman & Mattoo 2008 Photosynthesis Research, etc. on the environmental effects on photoactivation and repair. Murata's group in particular has a long string of papers on model cyanobacteria showing that UV provokes both direct photoactivation, but also inhibits the repair process. Edelman & Mattoo 2008 give a good overview of the long tangled history of light response curves of repair and photoactivation. The mechanistic people now, finally, have some ecophysiological relevant insights to offer, that could help explain and even parameterize some of the higher level integrated responses. The Fragoso et al. 2013 paper is a good step towards integrating physiological kinetics. I know (mea culpa) there has been a long history of dialogue of the deaf and missed citations between the biological oceanographers & the physiologists. Collaborators and I have been groping towards the Emax model from the bottom up by estimating rates for key rate limiting processes in the repair process, and comparing them to photoactivation rates.

Fig. 2 good data, but I think the rather cryptic panel titles should either be expanded, or

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explained in the legend. I am reading the figures first and inferring that the figures pool data from inhibited and relatively uninhibited culture samples, but it is confusing to see some panels (GG395) looking like classic P vs. I curves, and other panels (WG280) jumping up and down (even though the model is working well). I am wondering if the data from Table 1 could be presented as shaded bars on a spectral range above each panel (not trying to be meddlesome, just thinking of ways to clearly convey each treatment).

Fig.4: On my screen there is not enough distinction between the light and heavy lines; I am not sure which is full and which is part.

Figure 8: Very nice. Good to compare to diatom. Is the strain of *Thalassiosira pseudonana* a reasonable choice for co-occurrence with *Synechococcus*?

Materials & Methods: Two temperatures are tested. Might I suggest that a successor paper could test different nutrient levels? I think in this paper cultures were under nutrient repletion; Milligan et al. show big photophysiological effects of nutrient limitations.

Results: p. 19461; GRB; this term Gamma Ray Burst only occurs a few times and is peripheral to the main thrust of the article. Might I suggest writing out Gamma Ray Burst, to have some mercy on readers coping with many abbreviated terms already?

Discussion: p.19465 weights misspelled (wieghts)

“Fragoso et al. (2013) suggest that this could be related to increased expression of a more UV resistant isoform of the PSII reaction center core protein, D1.” Yes, maybe, and/or induction of expression of the key protease FtsH involved in clearly photoactivated PsbA/D1. Or pre-induction of levels of mRNA encoding PsbA/D1. or. . . .

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