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Interactive comment on "Optical community index to assess spatial patchiness during the 2008 North Atlantic Bloom" *by* I. Cetinić et al.

Anonymous Referee #2

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The authors propose that the ratio between chlorophyll fluorescence (ChlF) and the particulate backscattering coefficient (bbp) is a proxy of relative contribution of diatom in plankton biomass and it can distinguish diatom community from pico- and nanophytoplankton community. This proposal is based on in situ measurements of a series of variables related to phytoplankton, taken by glider, float and ship. The authors discuss mechanisms of the co-variability between ChlF/bbp and diatom, to conclude that variability in ChlF/bbp is caused by the taxa-specific chlorophyll-to-carbon ratio of phytoplankton and that the observed highest values of ChlF/bbp are indicative of Si-limitation to diatom.

Main comments The manuscript summarizes extensive measurements of phytoplankton and associated variables relatively well. Especially, the authors' findings that

the optical index can be a useful proxy of relative carbon biomass of diatom has a great potential to advance understanding of phytoplankton ecology of their study region because the optical index can be determined from in situ measurements taken by commercially-available instruments and therefore a load of measurements would easily be taken. As a result, the paper has a good potential to be published in Biogeosciences. The authors discuss mechanisms controlling variability in ChlF/bbp, to conclude that the variability is due to (1) taxa specific differences in the cellular Chl-to-autotrophic carbon ratios (2) a fraction of the planktonic carbon due to diatom (Section 4.1, L 6, P12849) and (3) Si–limitation to diatom is responsible for the highest values of ChlF/bbp (Section 4.2, L8, P12852). Firstly, I am surprised that (1) and (3) (as well as (2)) are rather explicitly concluded in the main text, but not mentioned in both Abstract and Conclusion. These conclusions should be mentioned there. Secondly, although the conclusion (1) is exciting, it was drawn from their observation that Chl-to-autotrophic carbon ratio is higher by factor of two for diatom-dominated samples (L4, P12850). I am not really convinced as to how the authors were able to conclude the above (1) just because of that. No detailed discussion was given as to how difference in Chl-to-carbon ratio among different plankton community can be translated to variability in ChlF/bbp (only discussion on high Chl-to-carbon ratio for diatom was given). Please explain/clarify this, since it is crucial for readers to understand how the optical index proposed by the authors works. Thirdly, the significant scientific finding in this manuscript is, as concluded by the authors, that ChlF/bbp is an optical index of a relative abundance of diatom community. Meanwhile, the authors also introduce rather immature analysis on patchiness of the optical index, but failing to draw a significant scientific finding, as the authors themselves admit it by stating "analysis on patchiness did not manage to resolve the primary drivers of the observed patchiness in community composition in the Conclusion section (see L19,P12854)". As a result, description of patchiness does not add a value on this paper, and the section describing "patchiness" distracts the overall story of this paper. The main story and points of this paper (i.e. the optical index is a proxy of %diatom) would be much clearer without the discussions of

the patchiness.

Other comments

Title The optical index is developed here, actually to estimate a relative carbon biomass of diatom. The title needs to be revised to be more precise.

Introduction Please re-consider the phrase “in situ remote optical sensing . . . as well as from space”, since Reader can easily confuse it with “optical remote sensing”. (Is “autonomous optical sensing” better in the present context?)

Section 3 There are quite many variables and observation platforms appear in this section. Also different instruments, platforms, and/or data processing were applied even for a same variable (e.g. Chl, diatom carbon etc.). All measurement items, instruments, platforms and data processing methods could be better summarized, for example, in a table.

Subsection 3.2 Please plot Si concentration, in one of the plots in Fig. 3, since it would be useful information for Reader to understand a latter discussion about Si-limitation in Section 4.2 (as well as it is an evidence for your statement L20 in P12844).

Subsection 3.3 Scatter plots (otherwise a table showing correlation statistics) between (1) %diatom and ChlF and (2) %diatom and bbp would be much simpler than Fig.5c and 5d to latter discussions in subsection 4.1.

Subsection 3.4 L4-8 in P12847: Do you mean score instead of loading here? L9: I can’t see, from the information in Fig. 7, (1) that PC 2 shows no significant difference in the %diatom_c product among stations for the two types of diatom communities, i.e. Group 2 and 3” and (2) that PC1 can separate them as a function of nutrient concentrations, since which data points (stations) correspond to what group is not shown in the figure.

Subsection 4.1 L9-12: Would the author please explain, step by step, why they refer to “relationship between POC and bbp as a function of plankton community composition” here, rather than a relationship between bbp and the community composition? I

guess the latter makes more sense in the present context here. Since the authors have measurements of bbp and %diatom, they should be able to check by their own measurements whether or not bbp varies with plankton community composition(see also my comment for subsection 3.3). If bbp does NOT have correlation with community structure, the authors may want to look at a relationship between ChlF and %diatom (e.g. scatter plot) to check if ChlF alone is correlated to %diatom (i.e. ChlF alone is sufficient to explain %diatom), especially when the authors believe that effects of solar quenching and nutrient limitations on ChlF are minor or minimized in their dataset (L4-L6, P12849). The authors may also want to explain (i) what is an advantage(s) to normalize ChlF by bbp as an optical index for %diatom and (ii) whether the normalization actually enhance a signal of community composition, or weaken the signal, especially if bbp have correlation with community structure. I made comments above, because a comparison between ratios is sometimes not straightforward since numerator (or denominator) of a ratio is not a direct translation of that of another ratio, even though they may have a certain degree of correlation.

L13: “making a change in particle optics an unlikely explanations” Don’t particle size and refractive index vary with particle concentration in natural environment? (In other words, there is no correlation among them?)

Subsection 4.2 The author found that Si-limitation is associated to “highest values” of the optical index. While this is a good finding, can the authors give a quantitative guidance on how “high” the values should be to imply Si-limitation, because I am currently unsure how this finding can actually be useful for users of the authors’ science.

Subsection 4.3 I am not sure if this section (hence, Fig.9 also) is needed, since no significant conclusion was drawn from here, as the authors admit it by stating “our analysis did not manage to resolve the primary drivers of the observed spatial patchiness” in Conclusion section. If patchiness were to be discussed, more extensive analysis would be needed to draw a conclusion. In any case, discussions of patchiness without a significant conclusion distract a story of the manuscript.

Section 5 The authors should include their conclusion such as (1) Chl/C ratio is responsible for ChlF/bbp and (2) the highest values of ChlF/bbp is an indicative of Si-Limitation to diatom, since they are keys to interpret how the optical index the authors propose works.

Fig. 3 Please increase a font size. Please describe what DM, E, S, M, Ed and P means in figure caption, too.

Fig.6 Please consider merging Fig. 6 into Fig. 3.

Interactive comment on Biogeosciences Discuss., 11, 12833, 2014.