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Interactive comment on "Partial coupling and differential regulation of biologically and photo-chemically labile dissolved organic carbon across boreal aquatic networks" *by* J.-F. Lapierre and P. A. del Giorgio

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Response to review #1.

We would first like to thank the reviewer for the detailed comments on the photochemical aspect of the manuscript and for taking the time to explain at length what is considered as a critical flaw of the present study; the figure provided by the reviewer will be useful in the response.

We really need to point out right from the start that we are perfectly aware of the point

raised by the reviewer, and that the appendix was added to the manuscript precisely to take that point into account. It is important to note that in Figure A2 we did not normalize by a constant light dose (130.2 W m-2), as stated by the reviewer, but that each sample has been standardized by its own average light dose. We acknowledge that the sentence at p.6696 L1-5 may induce confusion: "We tested the significance of this self-shading effect on the reported patterns by comparing the uncorrected Pd-DOC values to light-standardized concentrations, which were obtained by dividing Pd-DOC by the average light energy available in the experimental tubes.". What we actually meant here is that each single Pd-DOC value was divided by the average light dose (i-e volume-weighted average based on the exponential loss of light going through the milieu) within the tube in which the experiment was conducted. This calculated light dose is a function of 1) the absorption of the incoming light by the vial (same value for all samples) and 2) the absorption by CDOM, this having been measured for each sample. This is what explains that the average light dose within the vial varied from 118.4 to 140.4 W m-2 (10th and 90th percentile, respectively), as stated in the manuscript at p.6680, L19-23; it is the individual average light dose for each sample that was used in Figure A2. This represents roughly 20% difference in the light dose between high and low CDOM samples, much along the lines of what Figure 1 in the Reviewer's document suggests: Quick visual examination of the figure suggests a total photon dose of roughly 140 mol m-2 d-1 (from 300 to 500 nm) at high CDOM, compared to 180 mol m-2 d-1 for low CDOM. This difference represents roughly 20%, and would be slightly higher if expressed in W m-2 rather than mol photons m-2. That difference, in turn, would be attenuated by the fact that what is presented in the Reviewer's Figure 1 is the maximum difference between the light dose at the surface and at the bottom of the vial, whereas what we have reported here is the average light dose within the vial (see below).

Concerning our Figure A2, if a constant light dose had been used, as the Reviewer interpreted, the relationship would not only be 1:1, but it would a perfect relationship (r2 = 1) where the values on the x axis would always be 130.2 times lower than the values

on the y axis. What Figure A2 shows instead is that there is indeed a certain amount of variation around the line, especially at very high CDOM, precisely because we accounted for the differences in light dose within the vials, but this variation is negligible relative to the gradients in the amounts of Pd-DOC covered. The roughly 20% difference that exists between the average light dose for the lowest and highest CDOM environments cannot in any way alter the overall patterns in the concentrations of Pd-DOC that span over three orders of magnitude among the very diverse sampled systems: Standardizing for either 118 or 140 W m-2 (10th and 90th percentile average light dose within the vial, respectively) changes almost nothing when comparing concentrations of Pd-DOC ranging from 0.05 to 10 mg L-1 Pd-DOC. Below we explain in more detail how we made those calculations, as the Reviewer's comment makes it clear that there was perhaps lack of clarity and some ambiguity in the manuscript concerning these technical issues.

As the Reviewer points out, the average light dose within the vial will depend on the CDOM concentration due to self shading across the vial diameter, as is well illustrated in the Figure 1 of the Reviewer's comment. What the reviewer illustrates is the difference in the light dose at z = 24 mm for high and low CDOM sample. At z = 0 mm (when light enters the vial) the light dose is the same for both, the available light decreasing with vial depth differentially for high and low CDOM samples, generating the difference that is illustrated in that figure at z = 24 mm. What we have done, for each sample, is to calculate the average light dose by dividing the vial in 10 layers of equal thickness. For each of those layers we have calculated the remaining fraction of light based on the CDOM absorbance spectrum for the corresponding sample, then we have calculated the weighted-average of the light dose across the 10 layers based on the respective volume that each of those layers occupy.

In summary, we were well aware of the technical issues raised by the Reviewer and had in fact proceeded exactly as suggested. The whole point of the calculations presented in the Appendix was to directly address this issue, and explore to what extent it could

influence our results. On the basis of these calculations we had concluded in the manuscript, and we re-affirm this conclusion here, that the patterns in Pd-DOC that we describe in our manuscript are robust and are neither generated or even significantly influenced by this particular issue raised by the Reviewer. However, we acknowledge that we need to further clarify both our approach and our arguments concerning this point in the manuscript.

Interactive comment on Biogeosciences Discuss., 11, 6673, 2014.