Reply to anonymous reviewer #1

General comment:

The manuscript reports the result of semi spectral light attenuation, DOC and fluorescence/absorption properties for 27 stations during a 4 week cruise in 2009 from the Mackenzie River and out the Beaufort Sea. Overall the data appear to be of good quality and the measurements carefully and well conducted. The dataset are, however, limited and the data analysis lack originality and the presentation of data can be improved. Most of the weight in the data analysis and manuscript is on rather trivial matters like surface radiation, absolute values of Kd and relationships between CDOM absorption, Kd at different wavelengths and DOC concentrations, all issues there are well described in the literature already, and nothing new is found, except that the data is from a new cruise in an – I admit – interesting area. The most interesting part is the dynamics of the three fluorescent components, as this is a topic where information still is limited and scattered I suggest that the authors rewrite the manuscript, delete or down scale some of the trivial information (Fig. 3 (one panel is ok), Fig. 4, 5 and 6) and try to analysis the relationship between absorption and S, and between the three components C1-C3, and if possible their relationship to chlorophyll, primary production or another proxy for productivity, e.g. nutrient depletion.

Reply:

The manuscript was rewritten taking account the reviewer comment's

The structure of the paragraphs in the results and discussion chapter were deeply modified. Trivial information on Kd values were removed in the revised MS. The paragraph dealing with radiometric data was shortened and rewritten in the revised MS (pages 10-11 lines 241-265). Chapter 3.2.1. (pages 11-15) and 3.2.2. (pages 15-18) were shortened and reorganized. The conclusion chapter was changed for a Summary Chapter.

Please find below the detailed responses to the reviewer #1 comments.

The Figure 3 was simplified with only one panel (Kd at 325 nm) and the legend modified as follows:

"*Figure 3. Diffuse attenuation coefficient of light for K_d at 325nm as a function of surface salinity in the North East (circles) and North West (squares) sectors. Station 170 was characterized by high DOC (115 µM), Chlorophyll a (1.72 µg l^{-1}), primary procuctivity (37.9 mgC m^{-3} d^{-1}) and a_{CDOM}(350) (0.56 m^{-1}) content. Similar pattern was observed for 340 and 380 nm wavelengths and for PAR spectral domain..*"

The Figure 4 (surface DOC distribution in the studied area) of the submitted MS was removed, see new figures Fig. 4 (DOC and a_{CDOM}(350) = f(S)) in the revised MS.

Panel C of the Figure 5 of the submitted MS was removed in the revised MS (previous Figure 5 of the submitted MS is now Fig. 4 in the revised MS). We suggest to keep panel A and panel B, because relationship between DOC and a_{CDOM}(350) and salinity is discussed in the manuscript (pages 13-14, lines 313-322).

The Figures 6 and 10 of the submitted MS were removed in the revised MS.

With believe such new figure organization may provide appropriate information related to DOC and a_{CDOM}(350 nm).

Comment # 2: "I suggest the authors …..try to analysis the relationship between absorption and slope (S)" … Maybe a plot of S versus a would be interesting."

Reply: No clear relationship was found between $a_{CDOM}(350)$ and the spectral slope S (see Figure S1 below). Indeed, as indicated in the Table 1, spectral slopes remain quite constant over the studied area (±5 %) while $a_{CDOM}(350)$ exhibited large range of values (0-6.6). A new Figure 6 (spectral slope as a function of aCDOM350: Figure S1 below) was added in the revised MS.

This is now indicated in the revised MS (page 13, lines 307-311 of the revised MS)

"*We found no relationship between $a_{CDOM}(350)$ and the spectral slope S_{CDOM} as reported by Stedmond and Markager (2001). …… S_{CDOM} are difficult to determine, a result consistent with observations made by Matsuoka et al. (2012) for $a_{CDOM}(440$ nm).*"

The following reference was added in the Reference list.

"*Stedmon, C.A., Markager, S., Limnol. Oceanogr., 46, 2087-2093, 2001.*"

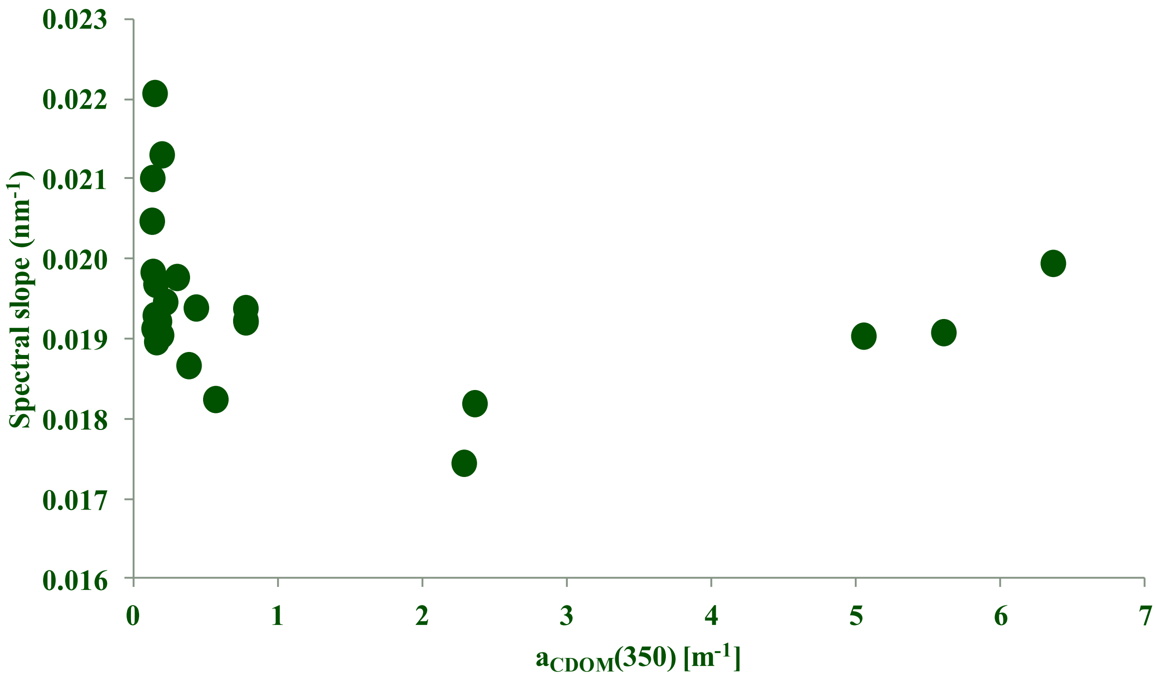

Figure S1. Spectral slope as function of $a_{CDOM}(350)$ content. This is the new Figure 6 in the revised MS.

An additional figure (Figure S2 below, Figure 5 in the revised MS) describing relationship between specific absorption coefficient at 350 nm ($a_{CDOM}^*(350)$) and $a_{CDOM}(350)$ and explicative text were added in the paragraph: 3.2.1. (page 12 , lines 288-293 in the revised MS).

***"**Plotting $a_{CDOM}^*(350)$ vs DOC (Figure 5) …… is a significant source of CDOM in the coastal area."*

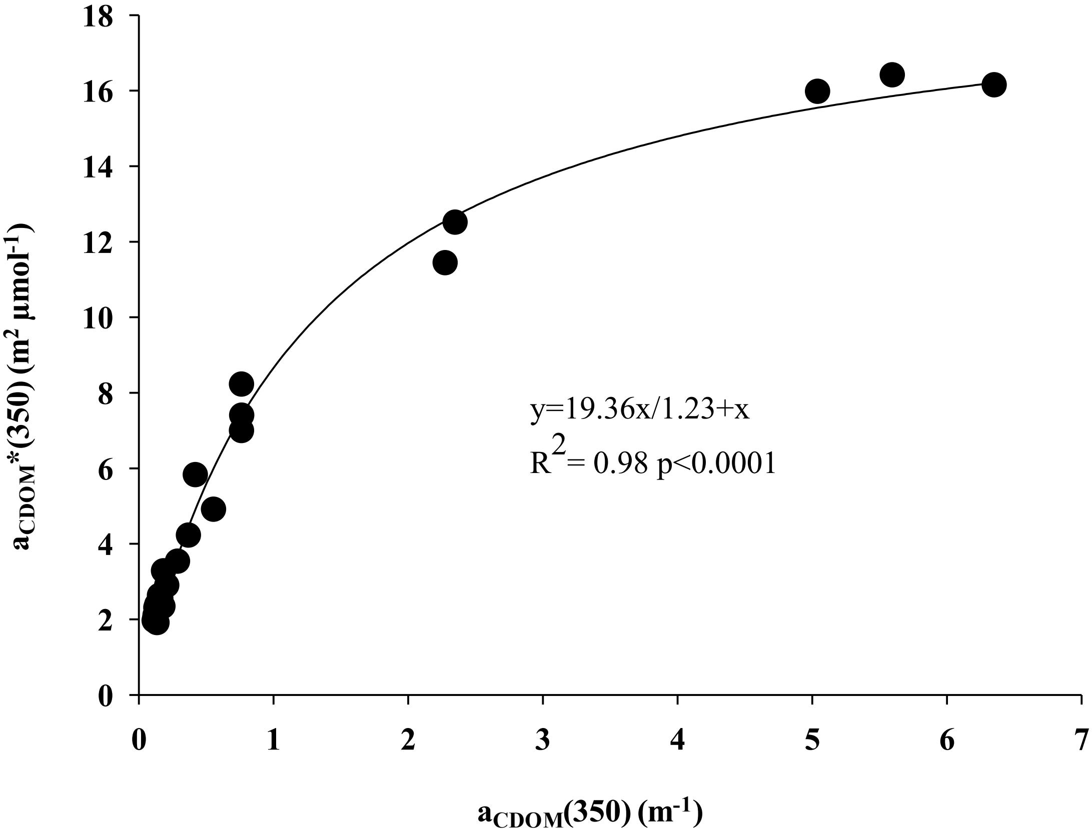

Figure S2. Relationship between specific absorption coefficient at 350 nm (a_{CDOM}*(350)) and a_{CDOM}(350) in the Mackenzie delta and North west sectors

Comment # 3: "I suggest that the authors…..try to analysis the relationship between the three components C1-C3, and chlorophyll, primary production or another proxy for productivity, e.g. nutrient depletion" …. where the authors suggest that inorganic nutrients fuels primary production and thereby also autochthonous DOM production along a salinity gradient similar to a terrestrial DOM component"

Reply: C1, C2 fluorescence *versus* Chl relationships were studied (see Figure S3 below).

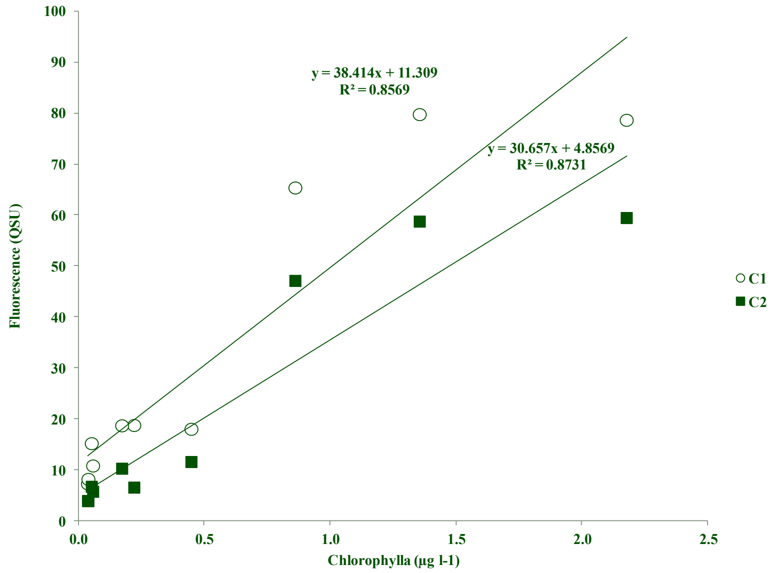

Figure S3. Correlation between C1 and C2 component with Chl *a* content (no significant trend between C3 and Chl a content was observed).

Figures S3 showed some relationship between both C1 and C2 with Chl *a* that are less significant than those found for C1, C2 and salinity. It is important to notice that Chl *a* and primary production remained relatively low (values, Table 1 below). Indeed, Beaufort Sea is usually characterized by low primary productivity due to the very low nutrient concentration (3µM NO_3 at salinity 0 and 0.03 µM NO_3 at salinity 10 during MALINA cruise, Raimbault et al., per. com.), the high water turbidity and stratification caused by coastal erosion and river runoff (Carmack and Wassmann, 2006). This was confirmed by low primary productivity observed during the MALINA cruise (Table 1 below). Then C1 and C2 are very likely controlled primarily by mixing between riverine and marine waters, although local production can not be precluded. Another item of our paper is that "*in-situ* biological component" C1 is produced on land in the numerous lakes highly productive and not by primary production in sea. This paragraph was rewritten (page 17, lines 398-411, revised MS).

Table 1. Primary production during the MALINA campaign (P. Raimbault, unpublished data)

Station	Primary production ($mgC.m^{-3}.d^{-1}$)
150	
170	37.9
260	
110	2.7
240	3.5
130	
135	0.6
380	1.8
280	4.7
220	2.2
345	0.9
340	4.6
320	1.3
360	2.7
540	0.7
430	0.5
460	0.9
760	1.7
620	3.4
660	2.3
670	1.2
394	11.1
780	0.2
680	7.4
694	
695	
696	

Comment # 4: "Also an analysis of the residuals from the salinity-fluorescence component relationships (Fig. 9C and 9D) would be interesting."

Reply: As suggested, C1 and C2 residuals were calculated from the salinity-fluorescence relationships that we plotted with biochemical parameters such as Chl *a* content. Unfortunately this do not suggest significant explanation on the FDOM dynamic in Beaufort Sea (see Figure S4 below)

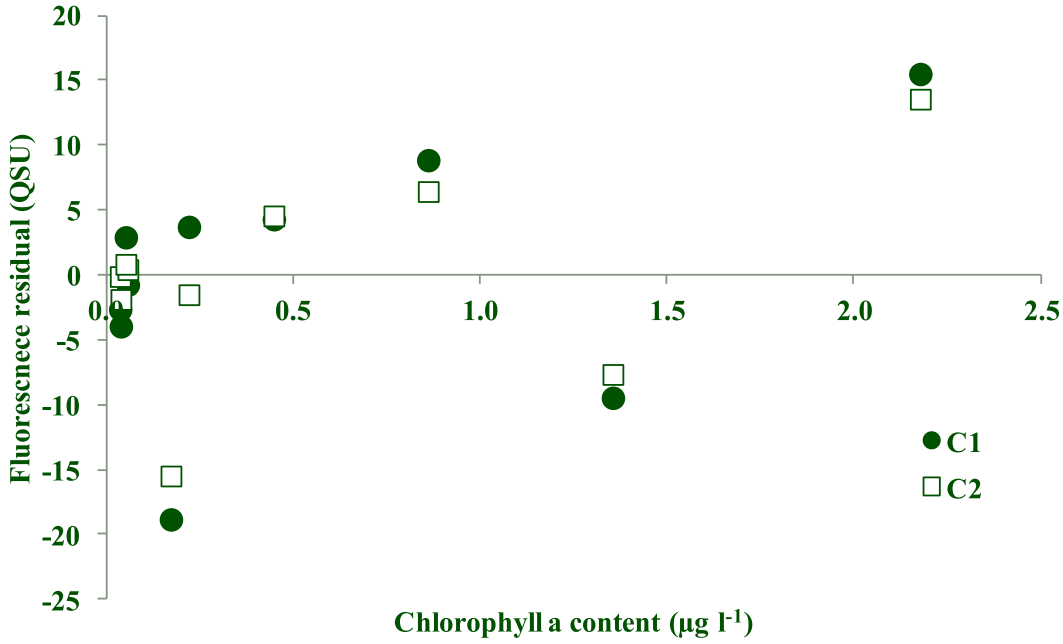

Figure S4. Residual fluorescence of C1 and C2 components versus Chlorophyll a content

We used residual from linear relation when gather interesting information. We added the following paragraph in the revised MS (pages, 13-14, lines 314-321):

"*DOC or a_{CDOM}(350) residuals calculated as the vertical …….. residuals correspond, except at station 696, to the lowest chlorophyll values (data not shown).*"

Comment # 5: "l. 32 Values of surface irradiance is irrelevant, particularly in an abstract, depends, as stated, on the weather conditions."

Reply: We agree, the surface irradiance values were removed from the abstract section of the revised MS (page 2).

Comment # 6: l. 30-35 The depth for 10% light does not depends on surface irradiance. It is better to state the Kd-values, and then the reader can calculate the depth for any percentage of surface irradiance"

We agree. The following text was deleted in the revised MS (page 15577, lines 1-7, submitted MS):

"*Regardless, the 10% irradiance depth, ($Z_{10\%}$ (λ) in m), …….. depth for photochemical reactions in this riverine setting*"

Comment # 7: "151-157. "How is α calculated, and is it correct that Chl. concentration is a factors in the equation for albedo or is it only if the equation on the web site is used to calculate the light attenuation in the water? It is not clear form the web-site reference given. Why is Chl. conc. set to 0.1 µg l-1. I can hardly believe that Chl concentrations were not measured on a cruise like this, at least a CTD with a fluoremeter must have been on board?."

Reply: The web site was used to calculate the Fresnel reflection albedo (α) for irradiance from sun and sky using Chlorophyll a content, solar zenith angle, wind speed and aerosol optical depth. This value was then used to calculate $Ed0^-$ (i.e. irradiance just beneath surface)

The complete data set of HPLC pigments Chl *a* was not initially available and initial fluorescence data suffered of uncertainties and were closed to 0.1 µgl^{-1}. This explained that the chlorophyll content was initially set to 0.1 µgl^{-1} for all stations. HPLC pigments (unpublished data) are now available and were now used in the revised version of the MS (for comparison with DOC and CDOM as well as for the albedo factor (α) calculation). However, the results changed only slightly: For instance, α calculated for the station '170' (highest Chl *a* content of the radiometric stations) with Chl *a* content at 0.1 µg l^{-1} is 0.064 (Figure S5) whereas α is 0.059 for Chl *a* content at 1.72 µg l^{-1} (Figure S6).

α factor is also used for $Ed0^-$ calculation ($Ed0^- = Es/(1+\alpha)$). The Es measured at 325 nm at this station was 10.41 µWm^{-2}, thus $Ed0^-$ = 9.78 µWm^{-2} (for Chlorophyll concentration of 0.1 µg/l) and 9.83 µWm^{-2} (for chlorophyll concentration of 1,72 µg/l) which is only 0. 3% lower. Thus this difference doesn't induce significant change in the Kd calculation (< 0.1 % lower than difference between duplicate profiles i.e. 3%). However, to avoid any misunderstanding and be more accurate the text was modified accordingly as follows:

Page 7, Line 158 of the revised MS: "*where α is the Fresnel reflection albedo for irradiance from sun and sky determined using a 'look up table' (Jin et al., 2004; http://snowdog.larc.nasa.gov/jin/getocnlut.html) based on the validated Coupled Ocean-Atmosphere Radiative Transfer (COART) model. Because…*"

Figure S5. Result for the calculation of the Fresnel reflection albedo (α) for irradiance from sun and sky using the "look up table" by Jin et al. (2004) for Station 170 with Chl *a* concentration set at 0.1 µg l-1 at wavelength 325 nm.

Figure S6. Result for the calculation of the Fresnel reflection albedo (α) for irradiance from sun and sky using the "look up table" by Jin et al. (2004) for Station 170 with Chl *a* concentration set at 1.72 µg l-1 at wavelength 325 nm.

Comment # 8: line 188. This technique was first published by Stedmon et al (2000). It is most correct to refer to the original paper.

Reply: the suggested reference was added in the text (page 9, line 197, revised MS) and in the reference list of the revised MS.

Comment #9: lines 228-234 Surface irradiance is weather depended and therefore of little interest. Consider to delete this, or argue why it is important.

Reply: We agree, however we think it is important to give such information. We added the following sentence in the revised MS (page 10; lines 243-246):

"*These mean daily doses were low ……… in the Beaufort Sea"*

Comment # 10: 235-258 The absolute values of Kd for wavelengths are hardly of interest to the reader, particularly since they, as stated, fall within expected values. Values are given in Table 2 so no need for further comments.

Reply: We agree. The text was simplified as following (page, 11, lines 254-262):

" *$K_d(\lambda)$ values determined in both the UV-A and PAR spectral domains…. attenuation of both UV-A and PAR almost as strongly as the river plume*".

The authors acknowledge the anonymous reviewer for the constructive comments on the paper