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Biogeosciences Discussions

Interactive comment on "Tracing the transport of colored dissolved organic matter in water masses of the Southern Beaufort Sea: relationship with hydrographic characteristics" *by* A. Matsuoka et al.

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Dear Reviewer #2, Responding to your comments, the text has been revised. Please find below our detailed response to your comments and suggestions.

Tracing the transport of colored dissolved organic matter in water masses of the Southern Beaufort Sea: relationship with hydrographic characteristics, A. Matsuoka et al.

General Comments: The paper investigates light absorption properties of colored dissolved organic matter (CDOM) in the Southern Beaufort Sea. The paper adds to a

growing body of CDOM and DOC studies in the Arctic Ocean and the impact of Rivers such as the Mackenzie discharging into the Arctic. This is an excellent study of CDOM optical properties (absorption and spectral slope) and DOC in relationship to hydrography and linkages to the various Arctic water masses; the study also supports the potential use of CDOM as a tracer of water masses in the Arctic. Further, observed CDOM-salinity and CDOM-DOC relationships in surface waters could be used to study carbon budgets using ocean color remote data in the study region. This is a well written manuscript; my concerns with the manuscript are listed below by a few comments or questions that can be addressed in the revised version:

Specific comments: i) A surface layer of river plume water with a conservative CDOM-salinity relationship is observed to be dispersed over a large area of the Southern Beaufort Sea. However, this large riverine CDOM footprint in the shallow surface layer (0 – 20m) of the Southern Beaufort Sea would likely be impacted by variable river discharge, wind field and circulation features in the region. Summer variability in the intensity and frequency of the northeasterly (upwelling-favorable) winds that generally prevail in the region (MacDonald et al., 1999) would most likely impact the horizontal extent of the dispersal, surface mixing and the sea-ice melt conditions that would likely change the dynamics of the relationship between CDOM, DOC and salinity (Figures 1, 8). With a large fraction of the data points obtained at stations along transects with greatest influence of the Mackenzie River plume (Figure 1), a conservative CDOM-salinity relationship in the UPML is more likely (Figure 5). However, it is possible that the fraction of freshwater due to ice-melt in surface waters could change under variable physical influences thus biasing ocean color derived estimates of CDOM or DOC using the relationships derived in this study. It is pertinent to address this issue in the revised paper.

We added two sentences mentioning this possible error at the end of discussion (lines 540-543): "Note that the relationship between aCDOM(440) and DOC might be influenced by changes in the fraction of freshwater due to ice-melt conditions. Thus, estimates of DOC concentrations could be biased in these waters and should be considered with caution"

ii) Page 11012, line 25: "At salinity < 28 (in the UPML) aCDOM(440) values showed a strong and negative correlation with salinity except for some stations where waters were influenced by sea ice melt (dotted circle in Fig 5a)." It would helpful to know what % of data points were influenced by sea ice melt.

From an optical point of view, 21 % of our samples in the UPML were influenced by sea ice melt waters. We added this description in the results (lines 312-313).

iii) Page 11020, line 16: "In this study, we found that DOC concentrations were highly correlated with aCDOM(440) in the UPML (r2=0.97). This result suggests that when aCDOM(440) values are obtained using ocean color remote sensing, DOC concentrations can be also estimated from satellite." Please provide the number stations used in obtaining the correlation shown in Figure 8. Do the data points used also include stations influenced by sea ice melt?

In total, 34 data points were used in obtaining for both DOC vs. salinity (Figure 8) and DOC vs. aCDOM(440) (Figure 9) regressions. Because DOC concentrations for sea ice melt waters were not obtained in this study, these data points were not used to obtain those regressions. We added this description in the results (lines 370-372).

iv) An additional source of CDOM/DOC in the Arctic Ocean is likely due to biological processes associated with polar phytoplankton blooms within the Arctic Ocean. Figure 3 shows a substantial phytoplankton fluorescence peak. This bloom would likely be much stronger earlier in the spring in the near surface waters. It might be worth commenting on the potential for autochtonous CDOM contribution associated with the large phytoplankton production generally observed during the early stages of the polar blooms or the subsurface phytoplankton peaks observed in the water column during the field campaign.

Phytoplankton bloom occurs in the near surface waters in early spring, and a deep chlorophyll maximum is developed around 60-80 m depth (defined as PSW in this study) in summer in our study area [e.g., Tremblay et al., 2008, JGR-Oceans]. During our observations, there was a significant and positive correlation between aCDOM(440) and chl a concentration in this study (r2 = 0.35 and 0.32 for surface and PSW, respectively; $p < 0.05$ and < 0.001, respectively). This result suggests that autochthonous CDOM could be produced as a result of phytoplankton degradation in these layers, and contribute to the CDOM pool. We added these sentences in the discussion (lines 440-447).

Interactive comment on Biogeosciences Discuss., 8, 11003, 2011.