Biogeosciences Discuss., 10, C8932–C8937, 2014
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Biogeosciences Discussions

Interactive comment on "A synthesis of light absorption properties of the Pan-Arctic Ocean: application to semi-analytical estimates of dissolved organic carbon concentrations from space" *by* A. Matsuoka et al.

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Anonymous Referee #2

This manuscript takes some in situ CDOM absorption and DOC data and attempts to use them to estimate Arctic wide surface DOC values, from Satellite retrieved aCDOM. With the high input of DOC into the Arctic and expected changes in carbon cycling, it is an important variable for us to monitor. The authors need to take more care in classifying this as a Pan-Arctic study when they have very little data from much of the Arctic

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and it is highly seasonal. The distinction between coastal and oceanic data seems a little arbitrary, I think the authors mean terrestrially influenced vs oceanic. It would like to see more time taken in discussing the difference between East and West DOC vs CDOM relationships. It appears that they have used the Western regional relationship between DOC and CDOM to estimate the Pan-Arctic surface DOC, however, these relationships have been shown to be quite different between Arctic sectors. The attempt to estimate Pan-Arctic DOC is commendable, however one is left wondering what the point of the manuscript is when the authors do not attempt to look at interannual variation, or changes over time. In Figure 11, we are only given averages, when standard deviations on those values would be useful. This paper should be expanded to include an analysis of the patterns seen in the satellite derived DOC.

Answer: Thank you for your comments. As in the title, this paper primarily focuses on examining optical properties using quality-checked and the largest datasets of the Arctic Ocean (please see Figure 1). Based on these properties, CDOM and DOC algorithms were logically and semi-analytically developed. As pointed out, "coastal waters" used in this study means waters influenced by river discharges. This term was corrected as "river-influenced coastal waters". To estimate DOC concentrations using ocean color data, following special cares were taken. First, DOC concentrations were estimated only for river-influenced coastal waters where tight relationships between DOC and CDOM are observed. Second, we applied published DOC versus CDOM relationships for Western (WAO; Matsuoka et al., 2012; references are shown at the end) and Eastern Arctic Ocean (EAO; Walker et al., 2013), respectively. Thus, we did not apply the Western regional relationship to EAO. To address spatial and temporal variability in DOC estimates, appendix A4 was added in the text.

Specific comments. Used different CDOM vs DOC for WAO and EAO?

Answer: Yes. For WAO, a DOC versus CDOM relationship published by Matsuoka et al.[2012] was used. For EAO, the one published by Walker et al.[2013] was used.

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Abstract: Line 1: Both absorption and scattering determine light propagation, not just absorption. Add scattering to this sentence.

Answer: Corrected as "In addition to scattering coefficients, the light absorption coefficients of particulate and dissolved materials are...".

Introduction: Line 16: Is the DOC in the base flow more refractory? I assumed that more refractory material is released in the spring and summer as permafrost melts.

Answer: This sentence means that DOC in the base flow in winter is more refractory relative to that in spring freshet, which is documented by Stedmon et al. [2011].

Methods: Page 17074 Line 12 to 25: I would not describe this as a Pan-Arctic dataset. There is no data from the Canadian Archipelago, Siberia is sparsely covered and data is mostly from the summer. I would like to see a discussion of the limitations of the data when describing Pan-Arctic patterns.

Answer: "Pan-Arctic" was corrected as "Arctic". Description about limitations of the dataset was added in the section 2.1 as follows: "Although data from the Canadian Archipelago, Greenland and Barents seas were not included, our dataset is well quality checked and the largest for the Arctic Ocean. Additional data will be included to cover wider areas in the future".

Page 17077 Line 17: When calculating SCDOM from NABOS data was it determined between each stated wavelength? Or across the range 412 to 510nm. Be a little clearer here.

Answer: For the NABOS dataset, SCDOM was calculated using aCDOM(λ) at 412, 440, 488, and 510 nm (please see Page 17077, lines 15-18).

Page 17078 Line 20: Were measurements made on the sunny side of the ship?

Answer: Yes. Please see the detailed measurement protocols by Hooker et al.[2013] and Antoine et al.[2013].

Page 17079 Line 2: fragment? at 443nm values based on" this the word values a fragment, as the sentence does not read well.

Answer: Corrected as "aCDOM(λ) values at 443 nm".

Page 17081 Line 9: How are you defining coastal and oceanic waters? The Chukchi really is coastal, as it is shallow and close to the coast. Do you mean riverine influenced versus oceanic? You may need different definitions here.

Answer: Corrected "coastal waters" as "river-influenced coastal waters".

Page 17081 Line 21: Where is the value 67 _19%, I cannot find it in Table 1.

Answer: This value, 67 $\pm$ 19 % was obtained only for WAO, not for all. To avoid misleading, the reference "Table 1" was deleted from the sentence.

Page 17083 Line 7: I would like to see a discussion of the low NAP absorption measured on NABOS, what is the contribution of NAP to ap is ap low or NAP?

Answer: Discussion regarding NAP absorption was added as follows: "SPM-specific NAP absorption at 443 nm (aNAP(443), m2 g-1) for WAO was significantly higher than for EAO (Table 2). This difference likely results from geological difference between the two areas [e.g., Amon et al., 2012]".

References: -Amon, R. M. W., Rinehart, A. J., Duan, S., Louchouarn, P., Prokushkin, A., Guggenberger, G., Bauch, D., Stedmon, C., Raymond, P. A., Holmes, R. M., McClelland, J. W., Peterson, B. J., Walker, S. A., and Zhulidov, A. V.: Dissolved organic matter sources in large Arctic rivers, Geochim. Cosmochim. Acta, 94, 217-237, 2012. -Antoine, D., Hooker, S. B., Bélanger, S., Matsuoka, A., and Babin, A.: Apparent optical properties of the Canadian Beaufort Sea - Part 1: Observational overview and water column relationships, Biogeosci., 10, 4493-4509, doi:10.5194/bg-10-4493-2013, 2013. -Hooker, S. B., Morrow, J., and Matsuoka, A.: Apparent optical properties of the Canadian Beaufort Sea – Part 2: The 1% and 1 cm perspective in deriving and validating AOP data products, Biogeosci., 10, 4511–4527, doi:10.5194/bg-10-4511-2013.

-Matsuoka, A., Bricaud, A., Benner, R., Para, J. Sempére, R., Prieur, L., Bélanger, S., and Babin, M.: Tracing the transport of colored dissolved organic matter in water masses of the Southern Beaufort Sea: relationship with hydrographic characteristics, Biogeosci., 9, doi:10.5194/bg-9-925-2012, 2012. -Stedmon, C. A., Amon, R. M. W., Rinehart, A. J., and Walker, S. A.: The supply and characteristics of colored dissolved organic matter (CDOM) in the Arctic Ocean: Pan Arctic trends and differences, Mar. Chem., 124, 108-118, 2011. -Walker, S., A., Amon, R. M. W., and Stedmon, C. A.: Variations in high-latitude riverine fluorescent dissolved organic matter: A comparison of large Arctic rivers, J. Geophys. Res., 118, 1-14, doi:10.1002/2013/JG002320, 2013.

Figure captions

Figure A4. Satellite-derived DOC concentrations in the surface layer for selected MODIS-Aqua satellite data recorded in 2009 (top), 2010 (middle), and 2011 (bottom).

Interactive comment on Biogeosciences Discuss., 10, 17071, 2013.

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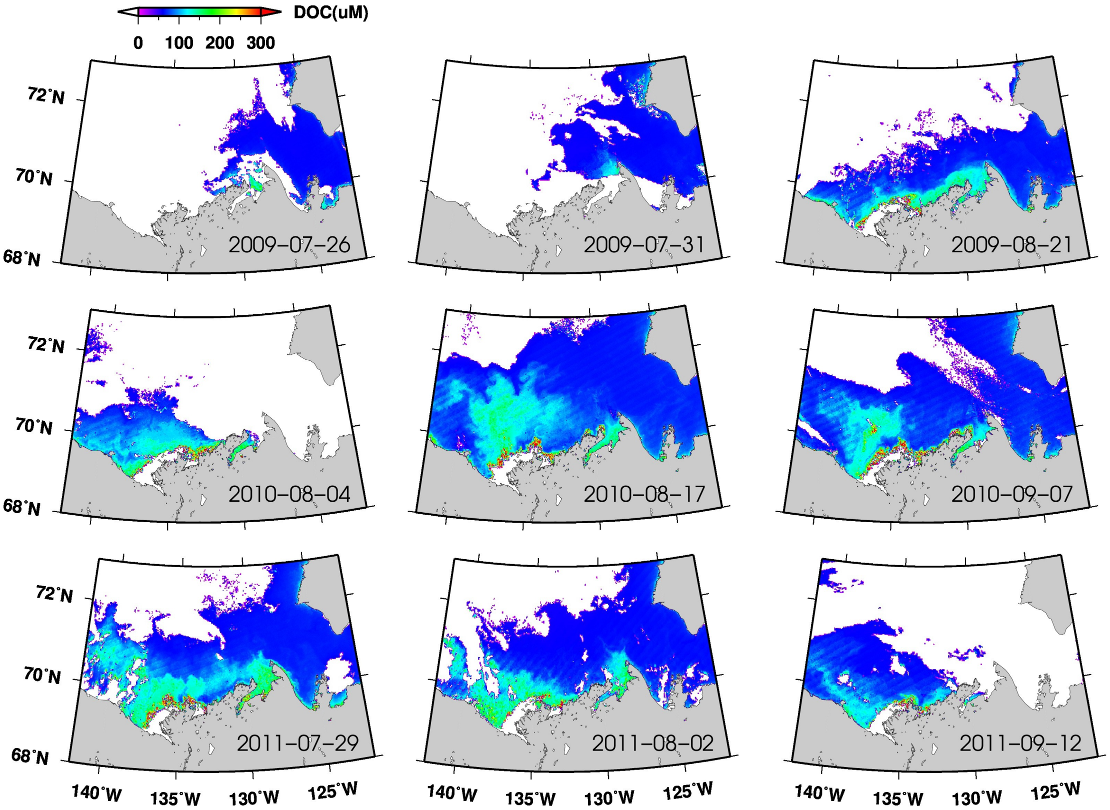

Fig. 1.

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