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Dr. Gwenaël Abril
Associate Editor,
Biogeosciences

Attn: Review of the manuscript by Bennet Juhls, Pier Paul Overduin, Jens Hölemann, Martin Hieronymi, Atsushi Matsuoka, Birgit Heim, and Jürgen Fischer entitled: "Dissolved Organic Matter at the Fluvial-Marine Transition in the Laptev Sea Using in situ Data and Ocean Color Remote Sensing." submitted to Biogeosciences, , Manuscript No. BG-2019-70

Dear Dr Abril,

After reading the manuscript by Juhls et al., entitled: "Dissolved Organic Matter at the Fluvial-Marine Transition in the Laptev Sea Using in situ Data and Ocean Color Remote Sensing." submitted to Biogeosciences, Manuscript No. BG-2019-70, **I recommend this study for publication in Biogeosciences after minor revision.**

General opinion

Arctic Ocean receives 10% of fresh water inflow to the Global Ocean, although its volume is only 1% of the world ocean, likely resulting in an already greater load of CDOM in the Arctic than in other oceans (Stedmon et al., 2011). Majority Large Arctic rivers play an increasingly recognized role in regional carbon cycling by transporting a proportion of terrigenous material from land to the ocean. Significant quantities of dissolved organic matter (DOM) accompany this fresh water flux causing higher than average dissolved organic carbon (DOC) concentrations in the Arctic Ocean relative to other ocean basins (Hernes and Benner,2006; Mann et al., 2016). Combined discharge from six major Arctic rivers (Kolyma, Ob', Lena, Yenisey, Mackenzie and Yukon) constitutes up to 64% of the total fresh water discharge to Arctic Ocean. Therefore monitoring of terrestrial input of DOM from those rivers to the Arctic Ocean is necessary for understanding a carbon cycle in this region. Remoteness and harsh environmental conditions in the region severely reduces applications of routine field monitoring methods in the Arctic. The remote sensing could be a helpful solution, in spite of its regional limitations, as it offer a broad spatial coverage and provides a synoptic picture of many biogeochemical variables. Any new regional Arctic studies providing new algorithms for retrieval biogeochemical variables are very important and have great value.

Authors have presented an empirical model linking optical signatures of dissolved organic matter and dissolved organic carbon concentration, based on large data set of in situ measured CDOM absorption coefficient and DOC concentration collected in multiple expeditions in the Lena river estuary and Laptev Sea. Derived relationship was applied to CDOM absorption coefficients values estimated from ocean color remote sensing data from different processing algorithms. Authors have compared products from 3 neural network ocean color algorithms applied to MERIS data. The assessment of CDOM absorption coefficient at λ=440 or 443 nm, proved that the ONNS algorithm showed best performance in the extremely CDOM rich water of Lena river estuary and adjacent coastal Laptev Sea waters. The empirical relationship between $a_{CDOM}(443)$ and DOC was then applied to OCRS CDOM absorption coefficient retrieval and the surface maps of DOC distribution in the Laptev Sea were produced. The modelled DOC values were compared with DOC measured in situ showing moderate accuracy (R^2 = 0.53).

Author have undertaken a challenging task, due to overall difficulty in ocean color remote sensing in the high latitude polar areas due to persistent cloud cover and very low level of upwelling radiance, caused by low Sun zenith angle. Therefore their calibration/validation exercise could not meet rigorous criteria set for such studies by Gregg and Casey (2004). The principle requirement of calibration/validation of ocean color remote sensing is the maximum mismatch between time of in situ observation and time of satellite scene acquisition no longer than 3 hours. This criterion is almost impossible to achieve in Arctic coastal waters, characterized by high heterogeneity of spatial distribution of optically significant constituents, in riverine plume, which distribution is forced by winds, tides and frequent bottom sediments resuspension events in the presence of drift sea ice and high cloudiness. Authors have honestly acknowledged this being very conservative in their assessments of satellite imagery products. Personally I highly acknowledge their results, that have been achieved against all odds.

A manuscript presented me for review contains new and innovative approach to derive spatial and temporal distribution of important biogeochemical variable. I do not have any major critical comments on methodology applied by authors and presentation of their work and results. I have found some minor mistake that could be corrected during revision (listed in the detailed comments section), and I do recommend publication of manuscript by Juhls et al., in Biogeosciences after minor revision.

Detailed comments

Abstract

Page 1, Line 15.
Minor technical remark concerning use of optical symbols letter “a” in $a_{CDOM}(\lambda)$ shall be italicized. Please apply this format to all optical symbols in the manuscript.

Page 1 Line 16,

“Observed changes in a_{CDOM} and its …”
Please specify wavelength of CDOM absorption coefficient at which this quantity was measured, referred.

Introduction

Page 2 Line 2,

“Large volumes of fresh water and dissolved organic matter (DOM) are discharged by Arctic rivers into the Arctic Ocean …”

Please give number estimated of fresh water and DOC discharge to Arctic Ocean based on cited literature.

Page 2, Lines 8-9

“ …from the Lena River, which delivers around one fifth of all river water to the Arctic Ocean …”

Based on cited literature, please give number estimated of Lena River fresh water discharge.

Page 2 Line 13,

“… the Lena River has the highest peak concentrations of DOC of all Arctic rivers …”

How much is peak DOC concentration – please give a number.

Page 2 Line 31,

“… focused on optically deep (Case 1) waters …”

Wrong citation, Kutser et al., 2017, did not developed the optical classification to optical Case 1 and Case 2 waters. When referring to optical Case 1 water type, please cite original paper by Morel and Prieur, (1977), where this concept was formulated. Alternatively you can cite paper by former students of prof. Andre Morel, who has given an updated interpretation of Case 1, Case 2 water classification, in the paper by Antoine et al., 2014 (Annu. Rev. Mar. Sci. 2014. 6:1–21). The citation to paper by Mobley et al., 2004 is correct.

Page 3 Lines 6 – 14

A paragraph on relationships between $a_{\mathrm{CDOM}}(\lambda)$ and DOC. You should mention a paper by Massicotte et al., (2017) who has presented a consistent global relationships between $a_{\mathrm{CDOM}}(\lambda)$ and DOC based on more than 12000 in situ measurements from variety of fresh, estuarine, coastal, marine and oceanic environments.

Page 3 Lines 19-21

“Spectral characteristics of $\mathrm{a}_{\mathrm{CDOM}}(\lambda)$ and their correlation to the DOC specific absorption coefficient …”

I could not find any relationship between spectral characteristics of $a_{\mathrm{CDOM}}(\lambda)$ (spectral slope coefficient) and DOC specific absorption coefficient in the paper by Stedmon at al., (2011). I found a table that presented a SUVA(254) values of Siberian and North American Rivers, which indicated slightly lower DOC specific absorption for Yukon River in comparison to Siberian Rivers. The relationship mentioned by Authors has been published by Matsuoka et al., (2012) in the Western Artic Ocean, by Makarewicz et al., (2018) in European section of Arctic Ocean and by Norman et al., (2011) in Antarctica. Most of relationships between those variables were published for tropical/subtropical and temperate estuaries e.g. Mississippi River (Fichot and Benner, 2011, 2012) or Red River Delta, French Guyana and English Channel (Vantrepotte et al. 2015). Please rewrite this sentence specifying exactly which type of spectral characteristics you mean, and refer to paper, where correlation between defined variables could be found.

Material and Methods

Page 5 Line 6

"Spectral slopes of $a_{CDOM}(\lambda)$ were calculated fitting Eq. (2) for the individual wavelength range."

Please, specify which wavelength range you used to calculate spectral slope coefficient *S*.

Page 5 Section 2.3 Satellite data

Please specify which satellite algorithms has been used to derive total suspended matter concentration values that have been used for analysis in Discussion. This information is missing.

Results

Page 8 Line 7-8

"Most samples from this study are located below the $a^*_{CDOM}(440)$ limits of oceanic water reported by Nelson and Siegel, (2002) …"

It would be good if global data distribution of DOC specific CDOM absorption coefficient presented in thepaper by Massicotte at al., (2017) would be used here for comparison.

Page 8 Sectiobn3.3

I think that first paragraph of this section is an introduction to subsection 3.4.

References

Hansell Carlson and Amon,

Wrong citation. I assume that you referred to book edited by Dennis A. Hansell and Craig A. Carlson. I quickly browsed through both editions on line and could not find any chapter authored by Hansell Carlson and Amon. Please give exact bibliographic citation, which chapter and which edition you have cited.

Hieronymi et al 2016 – this is a conference paper, listed as submitted to ESA special publication. I am not sure if this is a peer reviewed publication and shall be included in references lis.
Please give . Please give exact bibliographic citation of the paper you cite not the link to the web site. If it is a web journal you should use DOI citation.

Best regards,

Piotr Kowalczuk