

## ***Interactive comment on “A systematic examination of the relationship between CDOM and DOC for various inland waters across China” by Kaishan Song et al.***

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Reviewer #1

General Comments: This study examines the linkage between CDOM and DOC in numerous types of water systems throughout China. As expected, this relationship is highly dependent on the type of environmental setting (e.g. river, lake, salt water, watershed types, etc). The study provides a large dataset that will be potentially very useful for future remote sensing studies in China. However, I would like to see more discussion of the broader relevance and how this fits into the global picture. For example, are the findings unique to Chinese water bodies or will these water body types have similar DOC/CDOM relationships globally or at least in similar latitudes? Response:

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the authors thank for the valuable comments. As we know that the relationship between CDOM and DOC is depending on the complexity of chromophoric components of CDOM, which is directly linked with DOC. Waters from different source may have different chromophoric components, the molecular weights and the chromophoric fractions are also varied in different water sources, which ultimately affect the relationships between CDOM and DOC. CDOM and DOC sources have strong effects on the relationship, the other two major factors that affect the relationship are photo-oxidation and microbial degradation on the CDOM components. This investigation covers different water types, particularly these from Tibetan Plateau, which represent an extreme environmental condition except the Antarctica continent, and water samples from this plateau can be very valuable to examine the relationship between CDOM and DOC. In addition, urban waters generally represent CDOM and DOC with relatively complex conditions and the components for CDOM is much complicated to that from natural water bodies, thus which also provide valuable information for the systematic examination the relationship between CDOM and DOC. Considering the various water types examined in this study, it would represent most of the water types at global scale, and forms into the global picture for examining the relationship between CDOM and DOC. The authors added this discussion in the revised manuscript, thanks again for the comments.

There was very little discussion of findings in the literature with respect to the findings of this study other than citing references to speculate on mechanisms. I would like to see more comparison of the slope results in the context of the above question. For example, do lakes generally fall within the same slope range? Response: the authors agree with the comments, comparisons were made between the slopes between this study and literatures from previous studies. However, it also should be pointed out that different reference spectral bands were applied, thus make the comparison very hard.

Another major aspect that's lacking from this study, which focuses on inland waters, is the role of hydrology on these findings. It is surprising to not see any attempt to char-

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acterize the rivers studied in terms of average annual discharge and/or the season that samples were collected. For example, I am curious whether spatial or temporal variability plays a larger role in shaping the observations made here. At a minimum there needs to be discussion of the role that hydrology may play (there was one sentence saying hydrology wasn't considered). Response: thanks for the comments. You are right that hydrology condition will definitely affect the relationship between CDOM and DOC. Originally we try to avoid this factor since a lot of factors need to be considered with respecting to different water types. Also most of the rivers only sampled once in our study, we have three sampling stations across the Songhua River, the Yalu River and the Hunjiang River, where time series samples were collected, these data were analyzed and provided in the revised manuscript. It also should pointed out that it is very hard to get hydrological data, and also the data is not released within two years, thus we did not collected current hydrological data in 2015 to examine the relationship between river flow and its impact on DOC and CDOM. Instead, we used some data we could collected over these rivers, and multi-year averaged flow data were used, that is the best we could do right now.

Another point of discussion is whether or not these systems can feasibly be studied via remote sensing. There is no indication of the spatial scales that are being discussed. For example, a small stream cannot be resolved from space, so the authors should explain why it's important that we know a CDOM/DOC linkage for these waters. Perhaps because CDOM is easier/cheaper to analyze than DOC so we can get better temporal resolution in the future to address variability with the hydrograph? I think that Table 1 would be more informative if some basic information was provided about the size of the water bodies that are being examined. For example, adding the range/average of the basin scale and or river channel width/lake diameter to table 1 along with discharge if available would be useful. This would also allow some discussion of where the CDOM/DOC linkage is most robust and whether those particular water body types would be feasible for remote sensing applications (e.g. discuss the resolution of different satellites with respect to basin scale). Response: the authors really thanks for

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these valuable and helpful comments and suggestions. Your comments were adopted and incorporated in the revised manuscript, which is really helpful to strengthen the manuscript.

In its current form the manuscript does not provide much information that would be useful to the broader scientific community. However, it is a strong dataset, and if presented appropriately, this could have some very useful insight for the community. Finally, the authors should carefully review the manuscript for grammatical errors throughout (not all were noted), and potentially consider hiring a professional editor if unable to make these corrections independently. Response: the authors really thank for the comments, we took great efforts in interpretation of the findings from this large dataset, and tried best to reach useful information for the broader scientific community. The authors have carefully reviewed the manuscript, and a professional editor was used for the grammatical corrections.

Specific Comments: Line 47: This sentence doesn't seem to add much and the citation of Raymond et al (2013) doesn't really speak to what the article was about. This paper estimated that inland waters outgas 2.1 Pg C/yr, further constraining the global carbon budget. Response: the authors thank for the comments. What the authors try to say here is that the current studies have a rough idea about the role of inland water play in carbon cycling; however, how much of carbon stored in lakes, reservoirs and also rivers is not clear. The citation of Raymond et al. (2013) was removed and Tranvik et al. (2009) was added in the revised manuscript.

Line 48: This would transition better if it was mentioned why remote sensing would be a useful tool, e.g. better spatiotemporal resolution. Response: the authors thank for the comments, and your kind suggestion was adopted in the revised manuscript.

Line 54: This sounds backwards. DOC is the larger pool, of which CDOM makes up a large fraction. Response: the authors thank for the comments, this sentence was rephrased in the revised manuscript.

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Line 54: DOC strictly speaking is not necessarily a “source of nutrients”. If you said DOM, this could be true, but we typically think of things like N and P (organic or inorganic) as “nutrients.” DOC is more aptly a “substrate” for heterotrophic bacteria, i.e. an energy source. Response: the authors really thank for the comments, this sentence was rephrased in the revised manuscript.

Line 55-56: This part of the sentence needs to be fixed for grammatical errors and clarity. Also, the Jaffe et al (2008) reference is not really relevant here. This paper looked at optical properties of CDOM, and any discussion of breakdown of allochthonous (i.e. terrestrial) DOC is inferential at best. Raymond et al (2013) also doesn't actually examine the mechanistic breakdown of DOC to CO<sub>2</sub>, they simply calculate global CO<sub>2</sub> outgassing rates. The conclusion that this CO<sub>2</sub> is from DOC breakdown comes from other studies. Some more suitable references that actually look at the breakdown of terrestrial DOC would be the following and references therein: Ward, N.D., Keil, R.G., Medeiros, P.M., Brito, D.C., Cunha, A.C., Dittmar, T., Yager, P.L., Krusche, A.V. and Richey, J.E., 2013. Degradation of terrestrially derived macromolecules in the Amazon River. *Nature Geoscience*, 6(7), pp.530-533. Mayorga, E., Aufdenkampe, A.K., Masiello, C.A., Krusche, A.V., Hedges, J.I., Quay, P.D., Richey, J.E. and Brown, T.A., 2005. Young organic matter as a source of carbon dioxide outgassing from Amazonian rivers. *Nature*, 436(7050), pp.538-541. Response: the authors really thank for the comments, these appropriate citations were added in the reference list in the revised manuscript.

Line 131: What pore-size, diameter and manufacturer were the filters? Was surface water collected for all of these analyses? What type of bottles were used and how were they cleaned? How were samples stored and for how long before analyses were performed? It seems as though bulk water was brought to the lab for filtration, so it's important to know how long samples sat and at what temperature. The decomposition processes alluded to in the introduction can occur quite rapidly. This appears to be noted on line 164: : I would prefer this to be more upfront assuming the timing was the

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same for all bulk analyses. Also describe if samples were stored on ice, etc. Response: the authors really thank for the concerns and valuable comments. These descriptions about water sampling, samples keeping and shipping, and preprocessing were added in the revised manuscript.

Line 134: It should at least be mentioned what type of filters were used. Response: the authors really thank for the concerns, the type of the filters were added in the revised manuscript.

Line 136: GF/F filters are typically 0.7um nominal pore size. Is this description accurate? Also, were samples preserved in any way? Response: the authors thank for the concerns, we checked with the technician and the correct brand of filters were used in the revised manuscript.

Line 192: This raises an important point. This manuscript does not consider hydrographic variability in its discussion of CDOM/DOC, which are tightly coupled to river discharge. For example, one could see large variability at one particular site throughout the hydrograph and even hourly during rapid events. It's not clear what amount of the variability observed in this study is due to site differences versus hydrographic differences. This should at least be minimally addressed in the discussion. The next sentence begins to address this, but the odd phrasing for both sentences don't adequately get the point across. Response: the authors thank for the concerns, as mentioned in the previous responses,

Line 203: There should be some level of discussion of why DOC was so variable in each river, i.e. hydrologic controls. There needs to be some level of discussion on hydrologic controls. For example, DOC has been shown to be tightly linked to discharge both seasonally and especially during rapid storm event. See these articles and the references therein: Raymond, P.A. and Saiers, J.E., 2010. Event controlled DOC export from forested watersheds. *Biogeochemistry*, 100(1-3), pp.197-209. Ward, N.D., Richey, J.E. and Keil, R.G., 2012. Temporal variation in river nutrient and dis-

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solved lignin phenol concentrations and the impact of storm events on nutrient loading to Hood Canal, Washington, USA. *Biogeochemistry*, 111(1-3), pp.629-645. Response: the authors really thank for the concerns. Some discussion on the variability of the DOC in different rivers, and also its connection with hydrology, please see the details in the revised manuscript. As mentioned in one of the responses to the reviewer's comments, we did not pay too much attention to the seasonal variation of DOC and CDOM from rivers since most of the samples from rivers were collected just once in this study. However, we do collect time series samples from Songhua River and Yalu Rive in Northeast China, some of the results were added in the revised manuscript. Line 322: It's not clear how this conclusion was reached. Is it speculation based on literature? Response: the authors thank for the concern, as you guessed, this conclusion was mainly based on literature. However, our own data set (which was not shown in the first version of the manuscript) also support this conclusion, and was added in the revised manuscript.

Line 355-369: Are there comparisons to other studies in the literature that can be discussed/compared to here? Response: the authors thank for the concern, as you may know that the second reviewer strongly suggested that this paragraph should be removed since the classification of CDOM based on SUVA<sub>254</sub> is not meaningful, thus comparison was not conducted in the revised manuscript.

Line 372-405: Are there comparisons to other studies in the literature that can be discussed/compared to here? Response: the authors really thank for the comments. Actually, this is the first study tries to establish the relationships between CDOM and DOC based CDOM absorption grouping, however, comparisons were still made and details can be tracked in the revised manuscript.

Technical Corrections: Line 17: Add "and" to end of list, also write "rivers and streams" if both were studied. Response: we corrected the sentence as suggested, many thanks. Line 18: Use the past tense, i.e. "ranged" Response: thank you, the tense was corrected as suggested. Line 20: It's not immediately obvious what is meant by

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"winter waters." Response: thanks, the authors change "winter waters" to "ice-covered waters". Line 23: "expected" Response: thanks, it has been corrected. Line 24: Replace "sunshine" with "daylight." Remove "the" from "In the contrast" Response: the authors thank for the corrections. Line 29: Make this sentence read more clearly. Response: the sentence is rephrased; please check it out in the revised manuscript. Line 58-59: Fix grammatical errors (i.e. add "and") Response: the authors thank for the suggestion, and the grammatical errors were fixed in the revised manuscript. Line 59: Choose more formal and grammatically correct wording than "A bunch of researches" Response: thanks for the suggestion, we used "numerous". Line 69: Fix grammatical errors Response: thanks a lot, the grammatical error was corrected. Line 72: Fix grammatical errors Response: thanks a lot, the grammatical error was corrected. Line 74: Fix grammatical errors Response: thanks a lot, the grammatical error was corrected. Line 80: "Relatively" Response: the authors thank for pointing out the wrong word, it was corrected. Line 86: Consider re-wording this sentence Response: the authors thank for the suggestion, this sentence was rephrased in the revised manuscript. Line 89: "Two forms of carbons" is not accurate. CDOM is a subset of DOC. Response: the authors corrected the sentence with accurate choosing of word. Line 90-92: This is somewhat redundant as the same argument was made on lines 62-64. Response: the authors thank for the suggestion, and the full sentence was removed. Line 95: Fix grammatical errors Response: thanks for the suggestion, the grammatical error was fixed. Line 103: Fix grammatical errors Response: thanks, the grammatical error was fixed in revised manuscript. Line 119: Use a word other than "data", i.e. dataset Response: your kind suggestion was adopted in revised manuscript. Line 122: Fix grammatical errors (i.e. "of") Response: the authors thank for the suggestion, and the sentence was rephrased in the revised manuscript. Line: 124-125: This sentence doesn't need to be included in the methods. Response: the authors agree with the reviewer's suggestion, and the sentence was removed in the revised manuscript.

Results and Discussion: Line 178: Perhaps add a subheading for "Bulk Geochemical Parameters" or something similar here. Response: the authors thank for the sugges-

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tion, we added a subheading of “bulk geochemical parameters characteristics” in the revised manuscript, and we really appreciated for the valuable suggestion. Line 179: This is an odd sentence. The goal was to study diverse water types. It would be more fitting to say that geochemical properties across the unique water body types were diverse. Response: the authors thank for the suggestion, and the sentence was rephrased. Line 181: Use the past tense when describing results here and throughout the rest of the manuscript. Response: the authors thank for the suggestion, and the past tense was used for describing results throughout the rest of the manuscript. Line 185: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 190: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 212-218: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 230: “wavelengths” Response: thanks for the correction, and the plural form was used. Line 243: Consider a different word than “endorsed.” Response: thanks for the suggestion, and the sentence was reworded. Line 289: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 303: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 309-313: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 315: Write (Chl-a = 7.3 ug/L). Also, this isn't an incredibly low value: : that still indicates decent amounts of primary production. Response: thanks for the suggestion, the authors adopted the suggestion in the revised manuscript, further, the sentence was rephrased to achieve an accurate description. Line 315: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 317-319: Fix grammatical errors Response: The grammatical errors were fixed, thanks for the suggestion. Line 337: Fix grammatical errors Response: The grammatical error was fixed, thanks a lot. Line 377: Fix grammatical errors Response: thanks for the suggestion, and the grammatical error was fixed. Line 383-386: Fix grammatical errors Response: the authors thank for the comment, and the grammatical errors were fixed in the revised manuscript.

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Line 397: Fix grammatical errors Response: the authors thank for the suggestion, and the grammatical error was fixed.

Figure 1: There is probably better terminology than “Winter water”, is this snow/icecovered lakes, for example? Response: thanks a lot for the suggestion, we reproduce figure 1 as suggested. References: The reference list appears to be incomplete. For example, Raymond et al (2013) is not present. Response: the cited paper was added in the reference list, thanks a lot.

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