Responses to L. Li' Comments

Dear reviewer,

Thank you very much for your valuable suggestions and comments on our manuscript. Those comments are of great assistance to me for improving and revising our manuscript. We have studied comments carefully and have made correction in line with the suggestions made by you. Revised portion are marked in blue in the paper. The main corrections in the paper and the responds to the reviewer's comments and remarks are as flowing.

'This manuscript describes a study on characterization of colored dissolved organic matter (CDOM) of 63 lakes across the Tibet Plateau. These 63 lakes were divided into brackish and fresh groups, and the differences between these two groups of lakes in water quality and CDOM absorption and fluorescence were addressed using CDOM optical absorption and fluorescence, and the selected absorption and fluorescence indices. PCA was applied to the normalized excitation-emission matrix (EEM) and fluorescence regional integration (FRI) to investigate how brackish and fresh water samples are different/correlated and RDA to CDOM optical absorption and florescence signals or derived indices for their correlation to water quality parameters, particularly to CDOM. At last, the effects of salinity, solar radiation and land cover on the fate of CDOM in these brackish and fresh lakes are elaborated.

The most obvious strength of this work is its large size of water samples collected from representative lakes in the Tibet Plateau as well as its focus on how solar radiation has impacts on the decomposition of CDOM these brackish and fresh lakes. The work is well done, the result is solid and expected to draw much attention from scientists in this area after being published. This reviewer also feels that there is room for this manuscript to be improved, and the following general comments should well serve for this suggested improvement. Meanwhile, specific comments from this reviewer can be found in the annotated manuscript.'

1) Introduction: the listed objectives are too broad and some of them were not fully achieved (e.g. objective 4) or not at all (objective 2). The acronym should be used consistently and explained when first used, e.g. FDOM vs. FCDOM.

Response: Thanks for your patient review, and the revised portion is 'The study objectives are to: (1) characterize the similarities and differences in CDOM absorption and components among the 63 lakes with similar climatic, hydrologic and geological conditions using EEM-FRI technology; (2) link FDOM by EEM-FRI to CDOM absorption and fluorescence parameters, and to water quality; and (3) assess the effects on FDOM (fluorescent dissolved organic matter) by EEM-FRI caused by salinity, solar radiation and land cover.' In the revised manuscript, we explained FDOM (not FCDOM) when first used in this study. We hope that these revisions and the improved text will be satisfactory.

2) The overview of lakes in the Tibet Plateau is too general to be as helpful as it should be. This overview should focus more on how the solar radiation received by

the lake in the Tibet Plateau differs from those in low elevation regions of China, and how the elevation range of these lakes looks like. It is too late that elevation is described in section 3.1.

Response: Thanks for your instructive comments and suggestions. We have revised our manuscript according to your comments carefully as following 'The high elevation of Tibet Plateau was driven by the collision of Indian Ocean plate and Eurasian Plate. Lakes on the Tibet Plateau are typically formed by erosion and melting of glaciers, geological tectonic activity (fault and depression), barriers present on the land-surface, or due to melting on hot spots. More details about lake elevation can be found in Figure S1. Due to the low latitude and high altitude of the Tibet Plateau, there was a higher solar altitude resulting in a short optical path length before solar radiation reach the ground through the atmospheric layer. By comparison with other regions in China, Tibet Plateau is provided with some special characteristics, e.g., low atmospheric density (air is thin), low solid impurity content and water vapor, less cloud, good atmospheric transparency and low ozone concentration, etc. These make the refraction, scattering and absorption of solar radiation are greatly weakened, and solar radiation is enhanced. It also has more prolonged sunshine duration and sunny days in summer than other regions in China. Li et al. (2011) reported that Tibet Plateau has abundant solar energy resources, and the average annual solar radiation intensity reaches 6000-8000 MJ/m^2, the highest in China and second worldwide after the Sahara Desert.' We hope that these revisions and the improved text will be satisfactory.

3) In the method and material section, some symbols are present abruptly without giving sufficient background e.g. SUVA, S, M, and HIX. Some indices are fully described, but the description is mingled with that of spectral measurement, e.g. FI. Field sampling and lab measurement should be described separately, e.g. section 2.2.

Response: Thanks for your patient review. We revised the section 2.2 according to your suggestion, and the field sampling and lab measurement are described separately. Likewise, we added background of symbols (SUVA, S, M, HIX and FI), and separate the sections of measurement and parameters according to your suggestion in section 2.6 as following '

Helms et al. (2008) and Weishaar et al. (2003) showed that the absorption coefficient *a*(350) is seen as a proxy to characterize CDOM concentration. Weishaar et al. (2003) showed that UV absorption at 254 nm which was normalized to DOC concentration could be seen as a parameter called specific UV absorbance ($SUVA_{254}$). $SUVA_{254}$ correlated strongly with CDOM aromaticity (r^2=0.97) when it was determined by 13C-nuclear magnetic resonance. Higher $SUVA_{254}$ values are related to allochthonous-dominated sources, having a higher percentage of DOC aromaticity and microbial-dominated substances in DOC; lower $SUVA_{254}$ values indicate the opposite (Spencer et al., 2012; Weishaar et al., 2003). M (E_{250}:E_{365}) defined by the ratio of CDOM UV absorption at 250 nm and 365 nm could provide further insights into the average characteristics (chemistry, source, diagenesis) of CDOM than absorption values alone. Increasing M (E_{250}:E_{365}) values indicate a decrease in

aromaticity and molecular weight of CDOM (Helms et al., 2008; Wen et al., 2016). In addition to the above parameters, CDOM absorption spectral slopes (*S*) was used to semi-quantitatively describe the ratio of fulvic acids to humic acids in a sample (Weishaar et al., 2003). It was noted that *S* correlates strongly with molecular weight (MW) of isolates of fulvic acids but not humic acids (Helms et al., 2008). The spectral $S_{275\text{-}295}$ (275–295 nm) was used to represent DOM molecular weight, with higher values signifying lower average molecular weights of DOC (Helms et al., 2008). Then $S_{275\text{-}295}$ can be regarded as an indicator for terrestrial DOC percentage (Gonnelli et al., 2013).

The humification index (*HIX*) was calculated from fluorescence EEMs, as indices for the humification degree and DOM sources (Huguet et al., 2009; Zhang et al., 2010). Then the fluorescence indices FI_{370} and FI_{310} introduced by McKnight et al. (2001), were used to characterize CDOM source. More details of fluorescence parameters could be found in Table S2.'

We hope that these revisions and the improved text will be satisfactory.

4) Section 2.7 is weak, correlation analysis of EEM-FRI and regression mentioned in the result section should be briefly mentioned. The description of PCA and RDA should be provided, including what variables these methods were applied against, why PCA and RDA were used and what outputs were generated. Was PCA based on the variance-covariance or correlation matrix of EEM-FRI?

Response: Thank you for your valuable comments and suggestions. We have revised our manuscript according to your comments carefully, and then the details about Statistical analysis were added in revised manuscript.

'Statistical analyses were performed using the SPSS 16.0 (Statistical Program for Social Sciences). Regression and correlation analyses were conduct to examine the relationships between variations (φ_i of EEM-FRI, FI_{370} and *a*(350), *HIX* and *a*(350), DOC and *a*(254), DOC and FI_{370}, DOC and φ_V) among lakes. Statistical differences between variations were assessed with an independent samples *t*-test. Significance levels are reported as non-significant (NS) ($p>0.05$), significant (*, $0.05>p>0.01$) or highly significant (**, $p<0.01$).

In order to assess variations in normalized cumulative volume φ_i by EEM-FRI among lakes, principal components analysis (PCA) based on correlation matrix of EEM-FRI was undertaken using CANOCO 4.5 (Microcomputer Power, Ithaca, NY, USA). Relationships between the CDOM absorption, EEM-FRI fluorescent components, the fluorescence indices (FI_{370}, FI_{310} and *HIX*) and the water quality parameters were determined by redundancy analysis (RDA) in CANOCO 4.5 for window. CDOM spectroscopic indices (*a*(254), *a*(350), $S_{275\text{-}295}$, $SUVA_{254}$, M (E_{250}:E_{365}), FI_{310}, FI_{370}, *HIX* and φ_i (*i*=I, II, III, IV, V)) were selected as explanatory variables, and water quality parameters (DOC, Chl-a, TN, TP, salinity and turbidity)were were defined as species variables. φ_I was deleted due to large inflation factor (>20).' We hope that these revisions and the improved text will be satisfactory.

5) The result section is a bit long, some sentences should be placed in the method section and others should be in the discussion section. The description in this section should be straightly focused on the results, and the following order of the description could be considered when the authors revise the manuscript: Water quality parameters, CDOM absorption, fluorescence indices, EEM-FRI and its correlation analysis, PCA of EEM-FRI, and RDA of CDOM absorption and fluorescence parameters along with water quality parameters.

Response: Thanks for your patient review. We have revised our manuscript according to your comments carefully. The following order of the description was revised as Water quality parameters, CDOM absorption, fluorescence indices, EEM-FRI and its correlation analysis, PCA. Then we revised the result section, and some sentences were modified in method section and others were moved to the discussion section according to your suggestion. To make this revised manuscript flowing to read, we have requested an editing company to modify the language in this manuscript. We hope that these revisions and the improved text will be satisfactory.

6) The discussion may just focus on the effects of salinity and solar radiation. The effect of land cover is relevant but it is not as important as the effects of salinity and solar radiation.

Response: Thank you for your valuable comments. we have revised the discussion section about the effect of land cover. The influence of land cover is relevant according to our results, and it not as important as the effects of salinity and solar radiation. Then we added these discussions in 4.3. We hope that these revisions and the improved text will be satisfactory.

7) The conclusion section should summary the major findings which are supported by the results and in line with the research objectives stated in the introduction section. Obviously, the conclusion section needs more effort to improve.

Response: The authors really thank for your instructive comments. We have revised conclusion section in line with the research objectives according to your comments carefully. We hope that these revisions and the improved text will be satisfactory.

8) As above mentioned, some specific comments relevant to the general comments can be found in the annotated manuscript along with some editorial comments. Most importantly, the language of this manuscript needs to be improved, particularly a lot of repeated and similar statements take too much space.

Response: Thanks for your patient review. We have used an editing company to modify the language in revised manuscript. We hope that these revisions and the improved text will be satisfactory.

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