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Interactive comment on "New insights into mechanisms of sunlight-mediated high-temperature accelerated diurnal production-degradation of fluorescent DOM in lake waters" *by* Yijun Liu et al.

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Anonymous Referee #2 Interactive comment on "New insights into mechanisms of sunlight-mediated high-temperature accelerated diurnal production-degradation of ïňĆuorescent DOM in lake waters" by Yijun Liu et al.

Dear Prof. Dr. Koji Suzuki, Associate Editor, Biogeosciences, We are very grateful to Reviewer #2 for the valuable and constructive comments on our manuscript. We are submitting the manuscript revised according to the Reviewer comments. Thank you.

Itemized responses (R) to Reviewer comments are below: Note: all line numbers refer to the revised manuscript.

General comments: The paper "New insights into mechanisms of sunlight-mediated high-temperature accelerated diurnal production-degradation of fluorescent DOM in lake waters" has the potential to investigate the diurnal daytime-photoinduced production of FDOM components and their associated cascade night-time-microbial degradation processes as affected by temperature in two closed lake systems. However, the work is complicated to read. Although the importance of knowing the process in the context of global warming (GW) is mentioned, it is not explained because it is important to study it in two lakes located inside the campus of Tianjin University. Also, it is suggested to leave the objectives well stated and framed, as well as to order the texts according to the section of the article (do not mix objectives with methodologies, and methodologies with results, for example). The figures presented are not of good quality and are also difficult to interpret. Finally, it is suggested to do an in-depth review of the work structure with emphasis to achieve a better transfer and interpretation of the results to a reader interested in this research topic.

R. Thank you for your valuable and thoughtful comments. As suggested, we have revised the manuscript and some Figures at our best. We have comprehensively revised and re-discussed the identification and characterization of fluorescent components by PARAFAC modeling, also according to comments of Reviewer#1. We have also comprehensively discussed the sources of FDOM. The "Global warming issue" has been discussed extensively in the new subsection "4.4 High-temperature followed production of FDOM from phytoplankton and their sequential entire degradation in 24-h diurnal scale" 4.4. High-temperature production of FDOM from phytoplankton and its sequential entire degradation at 24-h diurnal scale The complete degradation of FDOM after its formation from phytoplankton can be ascribed to the gradual increase in SI (from 1.36 to 2.97 MJ/m2 for a total of 15.26 MJ/m2) at the highest WT (30.2-33.7 °C) and AT (35.4-41.8 °C) (Fig. 2). These environmental conditions are directly responsible of the rapid production of FDOM from phytoplankton and its corresponding rapid degradation by day-time sunlight-induced and night-time microbially-induced processes. Such entire sequential diurnal degradation of FDOM was not observed in October, May and June samples (Figs. 3-5) when solar intensity, AT and WT were relatively low compared to July samples (Fig. 2). As discussed previously, the production and degradation of FDOM are related to simultaneous significant fluctuations in the contents of NO3−, NH4+, NO2−, DON, PO43−, DSi and DOC (Fig. 6; Table S2). Photochemical and microbial processes can transform EPS into various forms of FDOM (Shammi et al., 2017a, 2017b) that are related to field observations, which show that different components of EPS vary over different timescales and temperatures (Shammi et al., 2017c; Sheng and Yu, 2006). Many studies provided evidence that photochemical and microbial degradation processes increase with increasing temperature and light intensity (Matsumoto et al., 2007; Weston and Joye, 2005; Malinverno and Martinez, 2015; Whelan and Rhew, 2015; McKay and Rosario-Ortiz, 2015; Grannas et al., 2006; Farias et al., 2007). In turn, these results would indicate that high SI, WT and AT would accelerate the complete transformation of autochthonous FDOM into LMW DOM and other mineralization end-products on a 24-h diurnal cycle, which could be further increased by the influence of future GW. Such changes can to be reasonably expected to occur in the future on the basis of increasing water temperature, extended summer season and increased water stratification in response to the predicted GW from 1.5 to 2.0°C (Huisman et al., 2006; Watanabe et al., 2011; Rogelj et al., 2019). In essence, rapid diurnal mineralization of HMW FDOM components under conditions of high WT can be related to a further rapid mineralization of DOC and nutrients (Fig. 6), which subsequently would impact on biogeochemical functions and processes, including C, N and nutrient cycling. These effects are expected to have an ultimate impact on trophic levels of water ecosystems as a whole, which could represent a crucial indicator of the potential GW implications for surface water ecosystems. Finally, the rapid mineralization of DOM in aquatic ecosystems under conditions of high water temperature can be used as a useful indicator to predict the potential impacts of GW."

As suggested, we have also modified some Figures (Fig. S1, Fig. 2 and Fig. 6).

We have also checked and revised the manuscript for a better understanding to readers.

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Whelan, M. E., Rhew, R. C.: Carbonyl sulïňĄde produced by abiotic thermal and photodegradation of soil organic matter from wheat ïňĄeld substrate, J. Geophys. Res. Biogeosci., 120, 54 –62, 2015, doi:10.1002/2014JG002661

Some specific comments are mentioned below as an example of the lack of organization in this work.

-page 5, lines 116-120: "Water samples were collected along 24-h in each season from the lakes Jingye and Qingnian in China, on which water temperature, solar intensity (SI), dissolved organic carbon (DOC), dissolved organic nitrogen (DON), NO3-, O and N isotopes of NO3-, NO2-, NH4+, PO43-, dissolved silicon (DSi), pH and electrical conductivity (EC) were determined at hourly intervals together with scanning electron microscopy imaging of phytoplankton variability between day and night". Reviewer's comments: It should be in the materials and methods section.

R. We agree. These issues are already in the Mats & Meths section, so this sentence has been deleted in the revised manuscript.

-page 6, lines 139-142: "The diurnal results measured on FDOM components in July and October samples showed that the most important changes occurred in the afternoon at around 14:00 due to day-time sunlight-induced production and degradation and at early morning before sunrise (6:00) by night-time microbial processes." Reviewer's comments: this text belongs to results.

R. We agree. The sentence has been moved to the "Results and Discussion" section at the early of the section "4.1.3. Water samples collected in May and June from Jingye lake The diurnal results measured on FDOM components in July and October samples showed that the most important changes occurred in the afternoon at around 14:00 due to day-time sunlight-induced production and degradation and at early morning before sunrise (6:00) by night-time microbial processes. Therefore, water samples in May and June were collected only twice-a-day, i.e. in the afternoon (14:00) and early morning (6:00). Three FDOM components were identified in water samples collected in May at 14.00, after a 6.00-14.00 time . . .."

-page 6, lines 157-158: Microscopic images of phytoplankton were obtained by the intelligent identification and counting instrument for algae (Algacount S300-3614025). Reviewer's comments: The authors should explain how the sampling was carried out.

R. Sampling was carried out with guidance of Prof. Wang Baoli (coauthor: sample

collection, processing and measuring in the same biological laboratory). The text has been revised as suggested by addition of "Approximately 400 ml of each water were collected in 500 ml brown glass bottles at each time for measurement of microscopic images of phytoplankton. To stop the growth of phytoplankton 1.5 ml 10% formaldehyde solution was added to each water sample. After standing for 36 h, the water sample was concentrated to 40 ml for night samples and 25 ml for day-time samples. To identify the phytoplankton species microscopic images of phytoplankton at 40×10 magnification were obtained by the intelligent identification and counting instrument for algae (Algacount S300-3614025) (Hu and Wei, 2006).".

-page 17, lines 467-478. Reviewer's comments: Part of the first paragraph of the conclusions section has already been presented in the introduction.

R. As suggested, the sentences repeated have deleted from conclusions. The deleted sentences are: "Although photoinduced degradation has been proved to be mediated by âŮŘOH radicals generated from photo-Fenton reaction or direct dissociation of H2O2 under sunlit surface waters (Wang et al., 2017; Vione et al., 2006; Mostofa and Sakugawa, 2009; Mostofa and Sakugawa, 2016; Zhu and Kieber, 2018; Gligorovski et al., 2015), the diurnal transformation mechanisms of complex mixtures of FDOM of diverse composition existing in surface waters are not yet well understood.".

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2020-145/bg-2020-145-AC1-supplement.pdf

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-145, 2020.

Figure S1. Sampling sites and their locations on the map

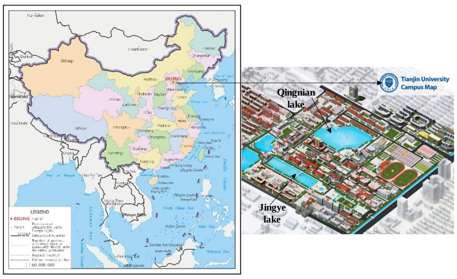

Fig. 1. Figure S1. Sampling sites and their locations on the map

Fig. 2. Variation of air temperature (AT), water temperature (WT) and solar intensity (SI) in the ambient environment of Jingye lake as a function of diurnal sampling time in July 5 and October 12, 2018 (a), and May and June, 2018 (b). Data were provided by Tianjin Meteorological Agency, Tianjin, China.

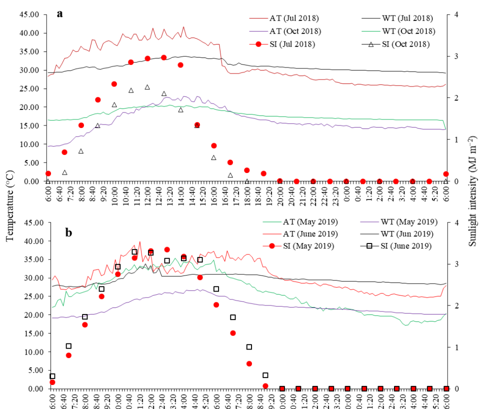

Fig. 2. Fig. 2. Variation of air temperature (AT), water temperature (WT) and solar intensity (SI) in the ambient environment of Jingye lake as a function of diurnal sampling time in July 5 and October 12, 20

Fig. 6. Changes of nutrient concentrations in diurnal samples from Jingye lake: (a) nitrate (NO_3^-), ammonium (NH_4^+), nitrite (NO_2^-) and dissolved organic nitrogen (DON), and (c) phosphates (PO_4^{3-}) and dissolved silicon (DSi) collected in July; (b) NO_3^-, NH_4^+ and NO_2^- and (d) PO_4^{3-} collected in October; and (e) dissolved organic carbon (DOC) collected in July and October.

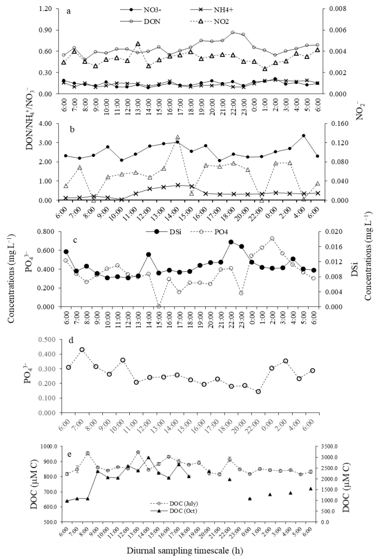

Fig. 3. Fig. 6. Changes of nutrient concentrations in diurnal samples from Jingye lake: (a) nitrate (NO3−), ammonium (NH4+), nitrite (NO2−) and dissolved organic nitrogen (DON), and (c) phosphates (PO43−) and