

# ***Interactive comment on “Sources, fluxes, and behaviors of fluorescent dissolved organic matter (FDOM) in an estuarine mixing zone: Results from the Nakdong-River Estuary, Korea” by Shin-Ah Lee and Guebuem Kim***

**Shin-Ah Lee and Guebuem Kim**

gkim@snu.ac.kr

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## Major comments

This manuscript by Lee and Kim set out to examine sources, fluxes, and mixing behavior of fluorescent dissolved organic matter in the Nakdong-River estuary in Korea. Time series samples were collected once a month during Sept 2014 – Aug 2015. In addition to humic-like and protein-like fluorescent DOM, the authors also measured bulk DOC concentration as well as its stable C isotopic composition to track DOM sources. They

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found both DOC and FDOM behaved conservatively, with concentration decreased with increasing salinity, showing the river as a major source for DOM. Values of DOC- $\delta^{13}\text{C}$ , on the other hand, increased with increasing salinity, demonstrating changes in DOM source along the estuary. In general, this is an interesting manuscript, presenting time series DOM data, including bulk DOC, fluorescent DOM and stable isotopic data, along the river-estuary transect in the Nakdong River Estuary. The authors show a strong seasonality in DOM export fluxes. In addition, different FDOM components seemed to contribute disproportionally to the bulk DOM pool between different seasons. These are new findings which provide insights into better understanding of DOM dynamics in estuarine environments. Therefore this manuscript is a welcome addition. I support publication after minor revision.

Having said that some of the data need more discussion. For example, while both DOC and FDOM concentrations decreased linearly with increasing salinity showing an apparent conservative mixing behavior, stable carbon isotope signatures did not show a linear mixing between riverine and marine DOC, as also shown in other estuaries (e.g., Guo et al., 2009, Mar. Chem). The concave mixing curve indicated preferential removal of fluvial/terrestrial DOM during estuarine mixing (Zhou et al., 2016, GCA) and source of DOC had been changed to more marine or autochthonous to maintain the somewhat linear mixing of DOC and FDOM, as shown in Figure 2 in the manuscript. These are very interesting results and the authors could add a few sentences in their discussion. In addition, if DOM sources had shifted in the higher salinity regions, is the FDOM in the estuary terrestrial or marine? Or what portion is from terrestrial DOM? Also, if portions of DOC and FDOM in the estuary are from in situ produced DOM, then, terrestrial DOM is not conservative, at least in the middle and higher salinity regions?

=> Thank you for your suggestion. The stable carbon isotope mixing curve was constructed based on the two end-member mixing equation (Spiker, 1980; Peterson et al., 1994; Raymond and Bauer, 2001). The curved mixing line for the conservative mixing was clearly explained previously by Spiker (1980) and Peterson et al. (1994). In

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general, the conservative mixing line for  $\delta^{13}\text{C}$ -DOC is “not curved” for a constant DOC concentrations, however, it is “curved” when DOC concentrations decrease as salinities increase due to the weighting effect of the endmember isotopic compositions by the DOC concentrations (Spiker, 1980; Peterson et al., 1994). This is also shown in the equation. Since our DOC concentrations decrease as salinities increase, our data are well fitted to the theoretical conservative mixing line. This suggests that DOC behaves conservatively in this system. However, we still see the variations of  $\delta^{13}\text{C}$ -DOC slopes against salinity for different months slightly, perhaps due to small changes in sources. We will mention about this in the revised version.

Minor comments for the authors:

1) Title: could be shortened to read: “Sources, fluxes, and behaviors of fluorescent dissolved organic matter in the Nakdong-River Estuary, Korea”.

=> will be corrected as suggested.

2) Line-24: add p values if available;

=> In the revised version, p values will be shown.

3) Line-28/29: “. . . . .due to higher fluvial production of humic-like FDOM”; This is not necessarily the case here. Data in Figure 3 show a constant slope for humic-like FDOM among different seasons although there is not a constant slope value for the protein-like FDOM.

=> We rephrased this sentence to be read as “higher terrestrial input of humic-like FDOM”.

4) Line-31/32: Are there any difference in export fluxes between the bulk DOC and different FDOM? This could be an interesting issue.

=> As shown in Figure 4, the fluxes of bulk DOC and FDOMH show similar patterns over the seasons (the highest fluxes in July and lowest in January and February), while

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FDOMP showed the highest fluxes in April and lowest fluxes in January. This will be mentioned in the revised version.

5) Line-89: Here the sampling date is October 2014-Aug 2015, which is different from the date shown in the abstract: Sept 2014 to Aug 2015. This should be fixed.

=> will be fixed.

6) Pg-7 on FDOM analysis: the extraction of FDOM-H and FDOM-P data from EEM-PARAFAC results should be mentioned briefly here.

=> More details on PARAFAC analysis will be added as suggested.

7) Line-180/181: Both QSU and \_M are used here for FDOM. How to convert QSU to \_M should be mentioned a bit here or in M&M.

=> will be corrected to QSU.

8) Pg-12: DOM fluxes are calculated from the integration of available time series data. Given the strong seasonality in DOC abundance and river discharge, how much difference will have in the fluxes if calculation is based on USGS LOADEST program although, in my opinion, showing the variability in DOM fluxes among sampling months, as provided in this manuscript, is very important. Maybe the authors can also plot data DOC vs discharge and show in Supplementary Materials.

=> We attempted to calculate the fluxes using USGS LOADEST program as suggested. However, we failed to obtain meaningful results since the river flow of this system is operated periodically by man and the concentrations were obtained from the slope between DOC and salinity correlations at the downstream of the dam. Also, our sampling period (monthly average) does not meet the number of data needed for this program (i.e., 12 months are needed...but we have 11-month data). The plot of DOC against discharge will be shown in Supplementary Materials.

9) Line- 251: add: "and specific river" after resolution.

=> will be added as suggested.

10) Line-254: add: “for the Nakdong River”, after 3 times.

=> will be added as suggested.

11) Line-257: “positive” should read “negative”

=> will be corrected.

12) Finally, are all the data, including DOC, FDOM, d13C, and discharge, documented in supplementary materials?

=> will add all data in supplementary materials as suggested.

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