

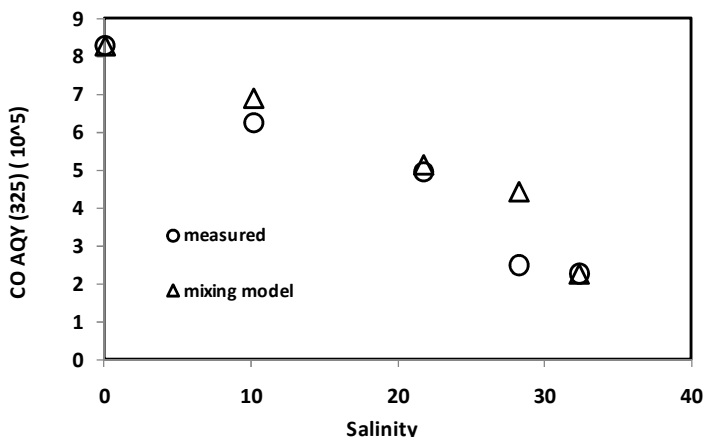
General comments:

This paper presents interesting data of CO photoproduction and marine CDOM photoreactivity in an estuarine environment. The data lead to an important incremental progress in the field of marine photochemistry and organic carbon cycling and thus merit publication. However, some essential methodological details are lacking and recent important progresses made in this area are not acknowledged. Furthermore, there might be a fundamental calculation error in the mixing model, which, if confirmed by the authors, could substantially change their conclusions. I recommend the acceptance of this manuscript for publication after the following issues are addressed.

Major comments:

I recalculated CO AQYs predicted from the mixing model (eqs 1 and 2) using data shown in Tables 1 and 2 and found that the predicted AQYs mostly well agree with the measured ones (see table and figure below). I realize that in principle aCDOM at 325 nm should be used (not provided in the manuscript) to calculate the fraction of Tyne River CDOM. However, this probably should not make a big difference as I tried CO AQY at 365 and 423 nm and found similar agreements between the predicted and measured. I suggest that the authors re-check their calculation. If this error is confirmed, the major discussion and conclusions should be rewritten.

Stn	salinity	aCDOM (412)	Fraction of TR CDOM	CO AQY ($\times 10^5$) (325 nm)	
				measured	predicted
1	0.08	18.1	0.9993	8.3	8.30
9	10.2	7.1	0.7694	6.25	6.91
12	21.8	6.7	0.4778	4.96	5.15
13	28.3	7.1	0.3603	2.5	4.44
14	32.4	5.2	0.0000	2.27	2.27



P7432, eq 3 is inappropriate for the water column. The factor $[1 - 10^{-A_{CDOM}}]$ should be replaced by $[1 - R]$ where R is the irradiance reflectance (see eq. 6 in Bélanger et al 2008 JGR). Also, it does not make sense to integrate up to 800 nm since there is essentially no CDOM absorption above 700 nm. In addition, A_{Total} should be the summation of A_{CDOM} , particle absorption (A_p), and water absorption. A_p is an important light absorption term in estuaries. The manuscript, however, lacks methodology of A_p measurement. To my knowledge, this is part of the first author's doctoral thesis. According to the thesis, only was light attenuation (absorption plus scattering) measured but not A_p . Scattering is important for particles. The authors should explicitly point out this approximation and the associated uncertainties in their CO photoproduction estimates (both for CDOM and CDOM plus particles).

CO AQYs are significantly temperature-dependent (see Zhang et al. 2006). The CO photoproduction estimates in this manuscript are based on CO AQYs determined at 25°C. However, in-situ temperature in the Tyne River estuary may greatly deviate from 25°C on a seasonal basis. What uncertainties could be caused by neglecting the temperature effect based on published T-dependence data?

Minor points:

Some recently published papers are very relevant to this study and should be referenced (e.g., White et al. 2010, Mar Chem 118, 11-21; Fichot and Miller 2010, Remote Sensing of Environ, 114, 1363-1377; Xie et al. 2009, L&O 54, 234-249).

P7424, line 12, please add Fichot and Miller (2010).

P7424, line 3, please add White et al. (2010) and Xie et al. (2009).

P7424, line 16-20, please acknowledge that similar approaches have been employed by Fichot and Miller (2010) and Xie et al. (2009).

P7425, line 8, 0.5-0.7 or 5-7 m?

P7426, line 26-27, Tygon tubing is notorious for CO contamination (Teflon tubing is much better). Please report pre-irradiation CO concentrations in the irradiation cells.

P7428, line 21-24, please also compare with White et al. (2010) and Xie et al. (2009).

P7429, line 26-27, Fig. 6, however, does indicate additional input of CDOM at salinity >20.

P7430, line 16-17, Fig. 6 does not indicate significant photobleaching across the freshwater-salty water transition zone if there was no additional input of CDOM as suggested by the authors.

P7431, line 5-7. In fact, Xie et al. (2009) did already report a significant correlation between CO AQY and aCDOM(412) and discuss its implication for space-based evaluation of CDOM photochemistry.

Table 1. Define surface areas and volumes. Their meanings are unclear. $10 \times 6 \text{ m}^3$ or 10^6 m^3 ? Add water temperatures if available.

Fig. 1. Add station numbers.

Fig. 6. How did you measure particle absorption coefficients (see major comments above).

Fig. 3. Where is the modeled AQY for the North Sea seawater (salinity 32.4)? Is this point hidden by the filled squared symbol? If so, please change filled symbols to non-filled ones.