Converting electron transfer rates of phytoplankton into daily carbon fixation rates in coastal waters of Ariake Bay and the East China Sea

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In the last 20 years, introduction of the active fluorescence technique, fast repetition rate fluorometer (FRRf), has opened up capability to measure instantaneous electron flow rate through phytoplankton photosystem II (electron transfer rate, ETR). However, in most of the early studies, the conversion factor (K_C) from ETR to primary production was assumed to be constant. Recent studies have shown that *Kc* can vary over a large range in nature and that understanding of the variability of K_C in relation to other physical and biogeochemical parameters is the crucial for accurately estimating primary production with FRRf. In this study, K_C was determined from parallel measurements of ETR and daily net primary production (NPP) and modeled as a function of key environments and phytoplankton community structure for the first time in Ariake bay and the East China Sea. In Ariake Bay study, we firstly confirmed that K_C varied considerably in nature and then demonstrated the strong correlation ($R^2 = 0.94$) between daily photosynthetically active radiation (PAR) and K_C; the novel and simple PAR-dependent relationship used for deriving K_C opens the possibility for directly FRRf based NPP estimating. In the East China Sea study, we confirmed that PAR was still the main controlling factor of K_C ($R^2 = 0.72$); moreover, this factor appeared secondarily influenced by dominant phytoplankton taxa present. Results showed that the correlation between K_C and PAR was improved ($R^2 = 0.78$-0.86) by considering two clusters of taxonomical groups, large phytoplankton (>20 μm) and small phytoplankton (<20 μm). Overall, we have developed a novel algorithm for estimating K_C from PAR and phytoplankton community composition and this algorithm can be applied to future FRRf-based high resolution studies of primary production.

Keywords: ETR, Primary productivity, Quantum requirement for carbon fixation, Phytoplankton composition, Fast repetitive rate fluorometer

