Plankton diversity and metabolism in the Congo River during high waters (December 2013) and low waters (June 2014)

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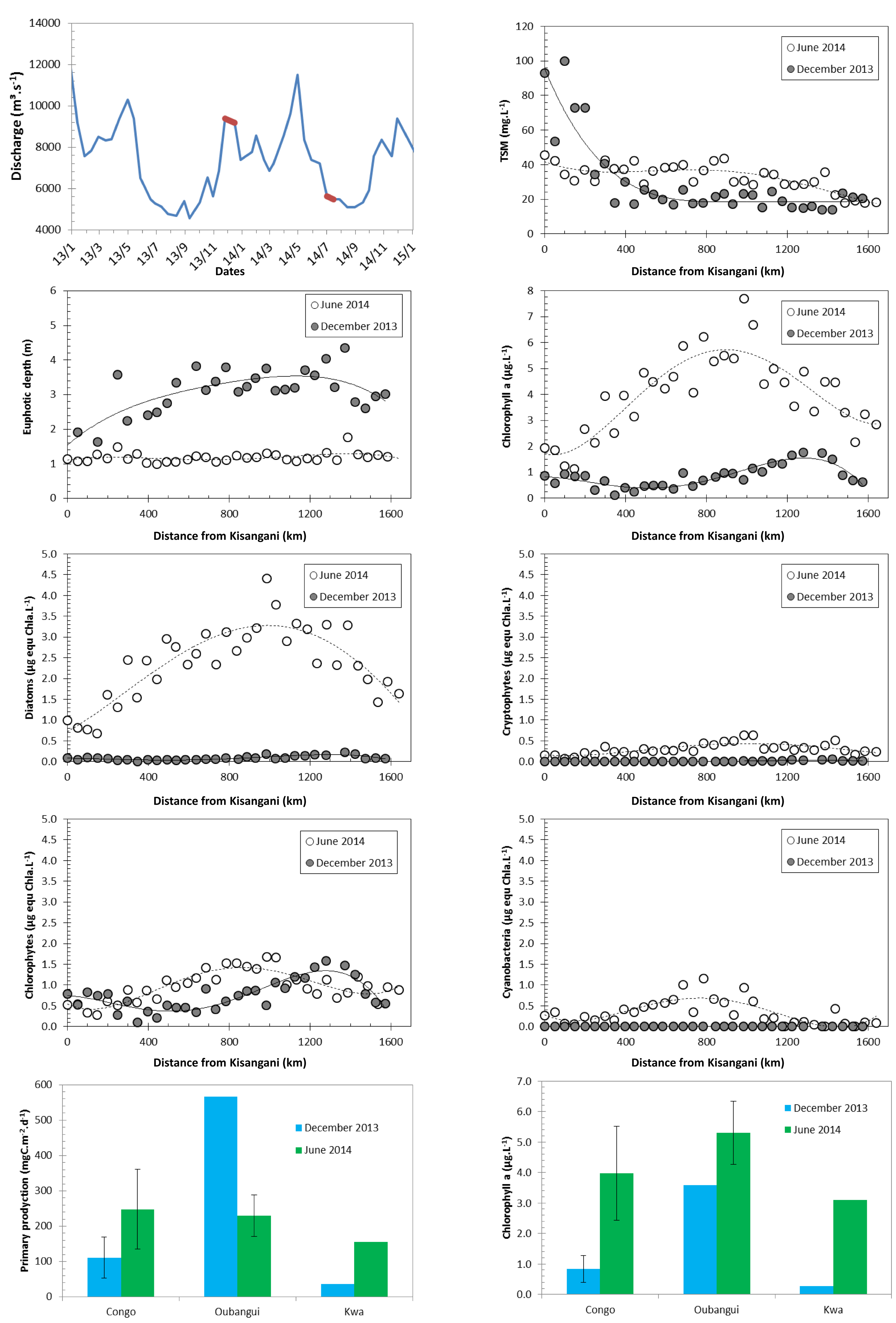

Ecological functioning of large river systems is described by several conceptual models which stressed the importance of allochthonous organic matter and autochtonous production from upstream sources to downstream. These concepts were challenged along a 1700-km stretch of the Congo river. The Congo river is the second largest river in the World in terms of freshwater discharge (1457 km^3 yr^{-1}) and in terms of drainage basin (3.75 10^6 km^2). In sharp contrast to its biogeochemical and ecological importance, studies on metabolism and ecological functioning in the Congo river are entirely lacking.

Here, we report a data-set of phytoplankton richness, diversity, abundance and plankton metabolism (respiration and photosynthesis) (total of 164 samples) in the mainstem of the Congo river, along the 1700 km stretch from Kisangani to Kinshasa, and in its main tributaries during the high water (December 2013) and low water (June 2014) periods.

During high water periods, turbidity was low, with a mean euphotic depth of 3.1 m in the mainstem. Phytoplankton biomass was low (mean Chlorophyll a = 0.8 µg L^{-1}). During low water periods, turbidity was higher, with a mean euphotic depth of 1.2 m in the mainstem. Phytoplankton biomass was higher (mean Chlorophyll a = 4.0 µg L^{-1}). Light penetration in the water column was statistically significantly explained by total suspended matter (TSM) and phytoplankton biomass (Chlorophyll a) (Multiple Regression Analysis, $p < 0.001$, $R^2 = 0.65$).

The areal integrated primary production of the Congo River mainstem ranged between 48 and 252 (mean, 111) mg C m^{-2} d^{-1} during the high water period and between 52 and 405 (mean, 248) mg C m^{-2} d^{-1} during the low water period. Primary production (estimated by ^{13}C incubations along a light gradient) was directly related to Chlorophyll a ($R^2 = 0.72$).

Only chlorophytes were significantly observed, but in low concentrations, during high water levels. They were desmids, coccal greens and Euglenophycaeae (*Strombomonas*). Diatoms were nearly absent during high-water periods but developed well during low-water stages. They presented a hump-shaped longitudinal evolution with a maximum biomass in the lowland Cuvette Centrale.

Environmental conditions encountered during the low-water period clearly favored the phytoplankton development and especially diatoms. We may hypothesize that lower water levels and higher residence time promote phytoplankton growth as water discharge decreases.

In December 2013, the Oubangui river (2nd largest tributary of the Congo river) presented a higher biomass (3.6 mg m^{-3}) and a higher primary production (566 mg C m^{-2} d^{-1}) than the mainstem, and the Kwa river (1st largest tributary) showed a lower biomass (0.3 mg m^{-3}) and a lower primary production (36 mg C m^{-2} d^{-1}). At the inverse, in June 2014, biomass and primary production were comparable between the Congo river and its first 2 largest tributaries.

In conclusion, the comparison of high and low water periods shows a general increase of phytoplankton biomass and productivity during low water periods.

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