ABSTRACT

Title: Nutrient dynamics and production in the northern Lake Tanganyika

The northern Lake Tanganyika (off Bujumbura) has been less studied during the last decade (civil war period in Burundi and D.R. Congo) compared to other classically sampling sites of the ecosystem: off Kigoma (Tanzania) and off Mpulungu (Zambia). The main objective of this study was to describe and understand the seasonal variations of carbon and nutrient utilization by planktonic organisms in the northern Lake Tanganyika. The impact of Ntahangwa River as a nutrient supplier to the lake was also considered. The wind velocity constitutes the main control factor of the behavior of the ecosystem. Winds are weak in the wet season and strong in the dry season and each season showed two periods, the first period being a transition from the preceding season to the actual one and the second showing the specific characteristics i.e. high rainfall and very low wind for the wet season and absence of rain and strong wind velocities for the dry season. The wet season corresponded to a water column mostly characterized by a weak thermocline that implied an amply nutrient supply within the photic layer especially during the first period of the wet season (September to December). Afterwards, the very low wind stress during the second period of the wet season (January to March) seemed to progressively strengthen the water column stability and subsequently a low ambient DIN within the photic layer was observed. The dry season (April to September) showed mostly a strong thermocline that progressively deepened till the bottom of the sampled water column during July and then, it moved upward. This season has undetectable levels of DIN and corresponded to a first period (April to June) of increasing wind velocity and a second period (July to September) with strong wind velocity. In September the strong wind stress coupled with a shallow thermocline implied amply supply of nutrient within the photic layer due to mixing processes. Those features of the wet and dry seasons were reflected in the seasonality of the productivity of the ecosystem. September to December period showed peak POM biomass and productivity estimates contrary to low biomass and productivity features of the rest of the annual cycle. In addition there was showed a decoupling in the production of nitrogen and carbon during September-October period. Within the photic layer, ambient DIN levels were negatively correlated to silica levels

and this suggested that planktonic organisms using silica could be limited by nitrogen. However C/N-POM molar ratios suggested that nitrogen was generally sufficiently supplied for algal use. Further insights were obtained from C and N isotopic data. δ^{13}C-DIC emphasized the photosynthetic and respiration processes within respectively surface and sub-surface layers. Positive δ^{13}C-DIC values mostly around 0.5 ‰ but > 1 ‰ for the peak biomass period were observed for most of the annual cycle to suggest probably isotopic equilibrium with atmospheric CO_2. δ^{13}C-POC showed generally less variability within the water column but a seasonality within the photic layer was drawn on the annual cycle. The vertical distribution of δ^{15}N-PN suggested the occurrence of nitrification/denitrification processes mostly during the wet season. For one sampling day, highly depleted δ^{13}C-POC coupled with a high enrichment of δ^{15}N-PN was observed downward the water column and was probably linked to the occurrence of a methane based food web. The conditions that allowed this are however insufficiently understood. δ^{13}C-POC and δ^{15}N-PN variation within the photic layer distinguished specifically January to March period where δ^{15}N-PN around 0 ‰ and depleted δ^{13}C-POC values in the range -28 to -26 ‰ suggested the dominance of nitrogen fixing cyanobacteria and April to June period where negative δ^{15}N-PN values in the range -6 to -3 ‰ and enriched δ^{13}C-POC values in the range -23 to -21 ‰ suggested the use of recycled nitrogen with algal species that had high growth rates. For the rest of the annual cycle (July to December), δ^{13}C-POC values in the range -27 to -25 ‰ and δ^{15}N-PN values in the range 3 to 16 ‰ were mixed and the isotopic data failed to distinguish the two periods though characterized by contrasted limnological and production features.

The Ntahangwa River plume was characterized by undetectable DIN levels in the wet season and high ambient DIN levels observed in the dry season were linked to mixing processes. This DIN features seemed to imply quasi no DIN uptake in the wet season but high and preferential DIN uptake versus DIC was observed in the dry season. The absence of correlation between δ^{13}C-DIC or δ^{13}C-POC versus CO_2 pressure suggested less influence of photosynthetic processes within the plume. High δ^{15}N-POM values during the wet season suggested the influence of allochthonous matter within the plume but further research is essential before a firm conclusion could be established. The overall impact of Ntahangwa River on the lake is negligible.