Distribution of dissolved green-house gases (CO$_2$, CH$_4$, N$_2$O) in Lakes Edward and George: Results from the first field cruise of the HIPE project

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Inland waters (streams, rivers, lakes, reservoirs) are quantitatively important components of the global budgets of atmospheric emissions of long-lived greenhouse gases (GHGs) (CO$_2$, CH$_4$, N$_2$O). Available data indicate that a very large fraction of CO$_2$ and CH$_4$ emissions from rivers and reservoirs occurs at tropical latitudes. Data on GHGs at tropical latitudes from lakes however are much more scarce, and the relative importance of emissions, in particular in Africa, remains to be determined. Large tropical lakes are net autotrophic (hence potentially sinks for atmospheric CO$_2$) due generally low dissolved organic carbon concentrations, seasonally near constant light and temperature conditions, and generally deep water columns favourable for export of organic matter to depth. This sharply contrasts with their much better documented temperate and boreal counterparts, usually considered as CO$_2$ sources to the atmosphere sustained by net heterotrophy. Here, we report a data-set of dissolved CO$_2$, CH$_4$, N$_2$O obtained in October 2016 in Lakes Edward and George and adjacent streams and cater lakes in the frame of Belgian Science Policy (BELSPO) HIPE (Human impacts on ecosystem health and resources of Lake Edward, http://www.co2.ulg.ac.be/hipe/) project. Lake George and part of Lake Edward were sinks for atmospheric CO$_2$ and N$_2$O due to high primary production and denitrification in sediments, respectively, and modest sources of CH$_4$ to the atmosphere. Sampled rivers and streams were oversaturated in CO$_2$ and CH$_4$ and close to atmospheric equilibrium with regards to N$_2$O. Spatial variations within rivers and streams were related to elevation and vegetation characteristics on the catchments (savannah versus forest). Levels of CO$_2$, CH$_4$, and N$_2$O were within the range of those we reported in other African rivers. Crater lakes acted as sinks for atmospheric CO$_2$ and N$_2$O but were extremely over-saturated in CH$_4$, due to intense primary production sustained by cyanobacteria. These CH$_4$ levels were much higher than what we have reported in other lakes and reservoirs elsewhere in Sub-Saharan Africa.