

First report on greenhouse gas emissions from African rivers

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Credit: IRD/ Bruno Le Ru

Twelve scientists from the University of Liege, the KU Leuven and the

Research Institute for Development (France), have just completed a large-scale research project conducted over a five-year period on the African continent. The aim of this study was to compile the first greenhouse gas budget of African rivers. The data from this project both complement and challenge previous knowledge of the overall carbon budget for the continent.

Covering 12 rivers spread across the entire continent of Africa including the Congo, the second largest river in the world, the study shows that [greenhouse gas](#) emissions from the rivers are very significant. This data constitutes essential information with regards to the management of forestry resources in Africa. An article is due to appear on July 20th 2015 in the prestigious journal *Nature Geoscience* .

A team of scientists led by the oceanographer Alberto Borges (University of Liège) and Prof. Steven Bouillon (KU Leuven) has just completed a five-year large-scale research project financed by Europe (ERC starting Grant), the FNRS, FWO and BELSPO, the aim of which was to compile a previously unknown budget of greenhouse gas emissions (GHG) by the rivers of the African Continent . Under the guidance of Alberto Borges, who is head of the Chemical Oceanography Unit at the University of Liege and who specializes in the GHG of aquatic environments and in close collaboration with Professor Steven Bouillon of KU Leuven, the researchers trawled the African continent in order to analyze the streams of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), the three main GHG.

The results and analyses, which have now been finalized, are the subject of a publication in *Nature Geoscience* . This data represents a major contribution to existing knowledge about [carbon emissions](#) to the atmosphere from African [inland waters](#) . In a broader sense, this data-set contributes to better understand the role of rivers in greenhouse gas global budgets.

"Due to the fact that rivers link continents to the ocean by carrying organic matter that is partly degraded by bacteria, they play a major role in the production and emission of CO₂ and CH₄", explains Alberto Borges. "Research concerning GHG emissions in inland waters – rivers, lakes, and reservoirs – began in the 1990s in various developed countries, supported in part by the hydro-electric industry, and supplied valuable information about boreal (Scandinavia, Canada), and temperate (Europe, United States) inland waters. Concerning the tropics which hold 60 % of the freshwaters of the planet, studies were carried out almost exclusively in Brazil, on the Amazon the largest river in the world. But can the data collected in Brazil be applied to the world's second largest river, the Congo, also located in the tropics ? Similarly, can the data in the Amazon be applied to semi-arid rivers draining savannah rather than tropical forest? There was some important information lacking here. Given that Africa contains 12 % of the world's freshwater, this study supplies a missing piece to the puzzle: a very significant and coherent data set in terms of the methodology employed and concerning an entire continent".

To bring this work to a successful conclusion, the scientists sampled 12 drainage basins (the area that includes an entire river and all its tributaries, from its source to its mouth), spread over the entire African territory and all the different variations of these basins according to the corresponding climate and vegetation: from the humid climate dominated by the tropical forest of the river Congo (DRC) to the semi-arid climate dominated by the savannah of the river Tana (Kenya) and the very steep basin of the river Rianila (Madagascar).

"This large spectrum revealed the mechanisms controlling greenhouse [gas emissions](#) in inland waters, from basin to basin across the entire African continent. This also opens the way for a comparison study between the Amazon and Congo rivers or any other tropical river", continues Alberto Borges, who intends to release the database as

all the authors are Open Access and Open Data adherents. According to him, the study undertaken establishes a "baseline", a photograph of Africa in the 2010s, at the dawn of great changes. "We know that the population of the Democratic Republic of the Congo is set to double, increasing from 65 to 130 million inhabitants in 25 years", he points out. "This huge increase will inevitably have an impact on the functioning of the river Congo, probably in response to increased deforestation and a shift towards intensive farming, since current farming practices are traditional. It is conceivable that the number of hydro-electric dams will increase as the hydroelectric energy potential of Africa is currently under-exploited. Similarly, water diversion for purposes of irrigation will increase. All these factors will have consequences for [greenhouse gas emissions](#) from rivers".

Among the factors learned from this study, the researcher draws particular attention to the important role of wetlands (these include inundated forests, flood plains and large "meadows" of floating plants). These wetlands are characterized by intense "aerial" photosynthesis (by submerged vegetation) but the organic matter produced is transferred into the water sooner or later. This organic matter in the water increases the production and emission of CO₂ and CH₄. The carbon emissions (CO₂ and CH₄) associated with the humid zones are enormous because the surfaces they occupy are also extremely vast. In the Congo basin, wetlands (mainly inundated forests) cover an area of 360 000 km², equivalent to the entire area of Germany.

More information: "Globally significant greenhouse-gas emissions from African inland waters," *Nature Geoscience* (2015) [DOI: 10.1038/ngeo2486](https://doi.org/10.1038/ngeo2486)

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