Geophysical Research Abstracts
Vol. 17, EGU2015-9240, 2015
EGU General Assembly 2015

Implications of agricultural encroachment on the carbon and greenhouse gas dynamics in tropical African wetlands.

Matthew Saunders (1), Frank Kansiime (2), and Michael Jones (3)

(1) The James Hutton Institute, Craigiebuckler, Aberdeen, UK (matthew.saunders@hutton.ac.uk), (2) Department of Environmental Management, College of Agricultural and Environmental Sciences, Makerere University, Kampala, Uganda (fkansiime@gmail.com), (3) School of Natural Sciences, Trinity College, University of Dublin, Dublin 2, Ireland (jonesm@tcd.ie)

Cyperus papyrus L. (papyrus) wetlands dominate the permanently inundated wetlands of tropical East Africa and support the livelihoods of millions of people in rural sub-Saharan Africa through the provision of multiple ecosystem services such as the supply of drinking water, fish protein, building materials and biofuels. These wetlands are also extremely important in local and regional scale biogeochemical cycles due to their extensive spatial distribution, high rates of photosynthetic carbon dioxide (CO_2) assimilation, long-term carbon (C) sequestration in the form of peat and the control of water loss through evapotranspiration. However, these wetlands are facing significant anthropogenic pressures due to the increasing demand for agricultural land where the papyrus plants are removed and replaced with subsistence crops such as cocoyam (*Colocasia esculenta*). Eddy covariance measurements were made on an undisturbed papyrus wetland and a cocoyam dominated wetland on the Ugandan shoreline of Lake Victoria to better understand the impacts of agricultural encroachment on the C sequestration potential of these wetlands. Peak rates of net photosynthetic CO_2 assimilation at the papyrus wetland were over 40 μmol CO_2 m^{-2} s^{-1}, even under increasing vapour pressure deficit ($\geq$2 kPa), while maximum rates of assimilation at the cocoyam site were 28 μmol CO_2 m^{-2} s^{-1}. Annual rates of papyrus net primary productivity (NPP) were amongst the highest recorded for wetland systems globally (3.09 kg C m^{-2} yr^{-1}) and the continual regeneration of the papyrus plants, due to an absence of pronounced seasonal climatic variability, can lead to significant C accumulation in the above and belowground biomass ($\geq$88 t C ha^{-1}). Where these wetlands remain inundated and anaerobic conditions prevail, significant detrital and peat deposits can form further increasing the combined C sink capacity of these ecosystems to over 700 t C ha^{-1}. The C sink strength of these wetlands is however offset by the production and emission of methane (CH_4), and plant-facilitated emissions of up to 32 mg CH_4 m^{-2} h^{-1} were measured from mature papyrus plants grown in a constructed wetland, suggesting that these wetlands may make a significant contribution to regional methane emissions. The conversion of the papyrus wetlands to agricultural land use has significant implications for the carbon budgets of these systems, as the decomposition of detrital material in addition to the carbon exported in the crop biomass resulted in a net loss of carbon of $\sim$10 t C ha^{-1} yr^{-1}. The development of sustainable wetland management strategies are therefore required to maintain and enhance the services provided by these ecosystems especially under increasing population pressures and future climatic scenarios.