Geophysical Research Abstracts
Vol. 18, EGU2016-11495, 2016
EGU General Assembly 2016


# Greenhouse gas emissions in natural and agricultural lands in sub-Saharan Africa: synthesis of available data and suggestions for further studies

Dong-Gill Kim (1), Andrew D. Thomas (2), David Pelster (3), Todd Rosenstock (4), and Alberto Sanz-Cobena (5)

(1) Wondo Genet Collage of Forestry and Natural Resources, Hawassa University, Ethiopia (donggillkim@gmail.com), (2) Department of Geography and Earth Sciences, Aberystwyth University, SY23 3DB, UK (ant23@aber.ac.uk), (3) International Livestock Research Institute, PO Box 30709, Nairobi, Kenya (d.pelster@cgiar.org), (4) World Agroforestry Centre (ICRAF), PO Box 30677-00100, United Nations Avenue, Nairobi, Kenya (T.Rosenstock@cgiar.org), (5) Technical University of Madrid, School of Agriculture, Avd. Complutense s/n, 28040 Madrid, Spain (a.sanz@upm.es)

This paper summarizes currently available data on greenhouse gas (GHG) emissions from African natural and agricultural lands, outlines the knowledge gaps and suggests future directions and strategies for GHG emission studies. GHG emission data were collected from 73 studies conducted in 22 countries in sub-Saharan Africa (SSA). Soil GHG emissions from African natural terrestrial systems ranged from 3.3 to 57.0 Mg carbon dioxide ($CO_2$) $ha^{-1}$ $yr^{-1}$, -4.8 to 3.5 kg methane ($CH_4$) $ha^{-1}$ $yr^{-1}$and -0.1 to 13.7 kg nitrous oxide ($N_2O$) $ha^{-1}$ $yr^{-1}$. Soil physical and chemical properties, rewetting, vegetation type, forest management and land-use changes were all found to be important factors affecting soil GHG emissions. Greenhouse gas emissions from African aquatic systems ranged from 5.7 to 232.0 Mg $CO_2$ $ha^{-1}$ $yr^{-1}$, -26.3 to 2741.9 kg $CH_4$ $ha^{-1}$ $yr^{-1}$and 0.2 to 3.5 kg $N_2O$ $ha^{-1}$ $yr^{-1}$ and were strongly affected by discharge. Soil GHG emissions from African croplands ranged from 1.7 to 141.2 Mg $CO_2$ $ha^{-1}$ $yr^{-1}$, -1.3 to 66.7 kg $CH_4$ $ha^{-1}$ $yr^{-1}$and 0.05 to 112.0 kg $N_2O$ $ha^{-1}$ $yr^{-1}$ and the $N_2O$ emission factor (EF) ranged from 0.01 to 4.1%. Incorporation of crop residues or manure with inorganic fertilizers resulted in significant changes in GHG emissions but these were different for $CO_2$ and $N_2O$. Soil GHG emissions in vegetable gardens ranged from 73.3 to 132.0 Mg $CO_2$ $ha^{-1}$ $y^{-1}$and 53.4 to 177.6 kg $N_2O$ $ha^{-1}$ $y^{-1}$and $N_2O$ EFs ranged from 3 to 4%. Soil $CO_2$ and $N_2O$ emissions from agroforestry were 38.6 Mg $CO_2$ $ha^{-1}$ $y^{-1}$and 0.2 to 26.7 kg $N_2O$ $ha^{-1}$ $yr^{-1}$, respectively. Improving fallow with nitrogen (N)-fixing trees increased $CO_2$ and $N_2O$ emissions compared to conventional croplands and type and quality of plant residue is likely to be an important control factor affecting $N_2O$ emissions. Throughout agricultural lands, $N_2O$ emissions slowly increased with N inputs below 150 kg N $ha^{-1}$ $yr^{-1}$ and increased exponentially with N application rates up to 300 kg N $ha^{-1}$ $yr^{-1}$. The lowest yield-scaled $N_2O$ emissions were reported with N application rates ranging between 100 and 150 kg N $ha^{-1}$. Overall, total $CO_2$equivalent (eq) emissions from African natural and agricultural lands were 56.9 ± 12.7 Pg $CO_2$ eq. $yr^{-1}$ and natural and agricultural lands contributed 76.3% and 23.7%, respectively. Additional GHG emission measurements throughout Africa agricultural and natural lands are urgently required to reduce uncertainty on annual GHG emissions from the different land uses and identify major control factors and mitigation options on emissions. There is also a need to develop a common strategy for addressing this data gap that may involve identifying priorities for data acquisition, utilizing appropriate technologies, and establishing networks and collaboration.