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Quantification of soil greenhouse gases under dorminant land use in the lowland area of Taita in Kenya

Sheila Wachiye (1,5), Lutz Merbold (2), Timo Vesala (3), Janne Rinne (4), Matti Räsänen (3), and Petri Pellikka (1)

(1) Institute for Atmospheric and Earth System Research (INAR), Geography and Geosciences, University of Helsinki, Helsinki, Finland , (2) Mazingira Centre, International Livestock Research Institute (ILRI), Nairobi. Kenya, (3) Institute for Atmospheric and Earth System Research (INAR), Physics, University of Helsinki, Helsinki, Finland, (4) Department of Physical Geography and Ecosystem Science, Lund University, Sölvegatan, Lund, Sweden, (5) Department of Environmental Management and Integrated Resource Conservation, University of Kabianga, Kericho, Kenya

Abstract
For effective adaptation and mitigation strategies of climate change, adequate data on greenhouse gases (GHGs) emissions from a wide range of land use and land cover types is a prerequisite. Such data is limited in Africa and especially in areas that face diverse land use changes because of human activities. In this study, we measured carbon dioxide (CO_2), nitrous oxide (N2O), and methane (CH4) fluxes in the lowland part of South-Eastern Kenya, using the static chamber method and gas chromatography. Gas samples were collected from four dominant land uses: farmland, bushland, conservation area, and grazing land. Eight individual gas sampling campaigns were conducted targeting wet and dry season and transition periods in between covering a total of 12 months. Data on soil moisture and soil temperature were also collected to better understand the flux patterns. Conservation area recorded the highest average CO_2 fluxes (74.2mg CO_2 m-2 h-1) followed by bushland (46.2mg CO_2 m-2 h-1), grazing land (45.6mg CO_2 m-2 h-1) and lastly farmland (39.5mg CO_2 m-2 h-1). CO_2 fluxes across land use were found to vary significantly (p-value<0.001). Those in the conservation area were higher than the other land use by about 37%-47% on average. CO_2 fluxes also varied significantly across seasons with highest fluxes recorded during the transition period from wet to dry season. N2O, on the other hand, was highest in the grazing land (1.2ug N2O m-2 h-1), followed by farmland (1.14 ug N2O m-2 h-1), conservation area (1.13ug N2O m-2 h-1) and lastly bushland (0.91ug N2O m-2 h-1). The differences between the land uses were not found to be significant. Most CH4 fluxes across all land use were below the detection limit ranging on average from -0.011mg CH4 m-2 h-1, -0.018mg CH4 m-2 h-1, -0.024mg CH4 m-2 h-1, -0.025mg CH4 m-2 h-1 for in the grazing area, bushland, conservation area, and farmland respectively. For N2O and CH4, there were no significant differences in fluxes across seasons. Our results showed a non-linear relationship of CO_2, N2O and CH4 fluxes with increasing temperature. For soil moisture, the rate of CO_2 emission increased with increasing soil moisture contents especially after a period of dry season. In the conservation area and grazing area, higher CO_2 and N2O fluxes can be attributed to high carbon (C) and nitrogen (N) contents, a dense root network and high C input from grass decay.
KEYWORDS: Static Chamber, Seasonal Variability, Climate Change, Bushland, Conservation, Grazing land, Farmland.