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Greenhouse gas exchange in West African savanna ecosystems – how important are emissions from termite mounds?

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Savannas cover large areas of the Earth's surface and play an important role in global carbon and nitrogen cycling. In this study, we present the soil-atmosphere exchange of N2O, CH4, and CO_2 during two field campaigns throughout the growing seasons 2005 and 2006 at a natural savanna site that was not subject to human disturbances except for annual burning, and four agricultural sites planted with sorghum (n=2), cotton and peanut in Burkina Faso.

The annual N2O emission of the nature reserve site amounted to 0.52 kg N2O–N ha^{-1} yr^{-1} in 2005 and to 0.67 kg N2O–N ha^{-1} yr^{-1} in 2006, whereas the calculated average annual N2O release of the crop sites was only 0.19 and 0.20 kg N2O–N ha^{-1} yr^{-1} in 2005 and 2006, respectively. As a result of a temporal up-scaling approach, a lower bound of annual N2O release could be given for two fertilized sorghum plots, that is, 0.83 kg N2O–N ha^{-1} yr^{-1} for a highly fertilized plot and 0.44 kg N2O–N ha^{-1} yr^{-1} for a moderately fertilized plot.

During the rainy season both CH4 uptake in the range of up to 20 μg CH4−C m–2 h–1 as well as CH4 emission up to 300 μg CH4−C m–2 h–1 were observed at the nature reserve site, which was on average a CH4 source of 87.4 and 30.8 μg CH4−C m–2 h–1 in 2005 and 2006, respectively. All crop sites were on average weak CH4 sinks without significant seasonal variation. Uptake rates ranged between 2.5 and 8.7 μg CH4−C m–2 h–1. Occasionally very low net CH4 emission was observed after heavy rainfall events. Mean annual CH4 rates could be estimated to 2.48 kg CH4−C ha–1 yr–1 and −0.68 kg CH4−C ha–1 yr–1 for the nature reserve site and the crop sites, respectively.

Trace gas emissions from termite (Cubitermes fungifaber) mounds that were almost exclusively found at the nature reserve were one order of magnitude higher for N2O and CO_2, and two orders of magnitude higher for CH4 than soil emissions of the respective trace gas. Termite N2O, CH4 and CO_2 release at the nature reserve contributed only 3.2%, 8.1% and 0.4% to total soil N2O, CH4 and CO_2 emissions, respectively.