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Monitoring soil greenhouse gas (GHG) emissions in a Sahelian agrosilvo-pastoral parkland

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Estimates of greenhouse gas (GHG) emissions from soil are essential to understand possible climate change mitigation from ecosystems. There is currently very limited and reliable information on GHG emission factors for most land-use types of Sahelian Africa. GHG (CO_2, H_2O, CH_4, N_2O) and ammonia (NH_3) emissions were measured in a Sahelian agro-silvo-pastoral parkland dominated by *Faidherbia albida* trees (Niakhar, Senegal) using 8 automatic chambers coupled to a Picarro G2508 gas analyser. The measurements were carried out in 2021 covering the late dry season (bare soil), the full rainy season (with groundnut plants in the chambers) and the beginning of the next dry period (senescent vegetation and bare soil). The chamber-based CO_2 fluxes were compared to the Net Ecosystem Exchange of CO_2 (NEE) as measured by a 4.5m-eddy covariance tower (below tree crowns) installed over the same agro-silvo-pastoral field. To avoid small scale heterogeneity, we compared here EC fluxes with chamber measured fluxes far from the *Faidherbia albida* area of influence. Indeed, for a given day, soil CO_2 respiration is significantly higher under trees (shade) than far from trees (full sun) due to trees 'island effect' ($p<0.0001$).

Soil CO_2 respiration was very low at the end of the dry season, with an average of about 0.6 µmol CO_2 m^{-2} s^{-1}. During the wet season, the maximum soil respiration at night was about 5 µmol CO_2 m^{-2} s^{-1} and the maximum net CO_2 uptake during the day was around -6 µmol CO_2 m^{-2} s^{-1}. Only negligible fluxes of CH_4, N_2O and NH_3 were recorded for all seasons. The low N_2O fluxes could be related to low soil fertility and lack of nitrogen supply, and low soil moisture in these sandy soils

does not favor soil gas production processes for both N_2O and CH_4. The CO_2 fluxes from the automatic chambers showed similar typical semi-arid ecosystem patterns as that of the EC tower. We saw large emission peaks during the first rain events of the rainy season, positive and negative fluxes at night and day, respectively, high fluxes when the soil was wet, and decay during the next dry season. However, in average the soil CO_2 respiration magnitude of the chambers with groundnut plant were much lower (1.26 μmol CO_2 m^{-2} s^{-1}) than the ecosystem respiration as seen from the EC tower (3.74 μmol CO_2 m^{-2} s^{-1}), and the difference was even worse for diurnal net CO_2 uptake (by a factor of 7).