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"*Faidherbia-Flux*", an open observatory for GHG balance and C stocks in a semi-arid agro-sylvo-pastoral system (Senegal)

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The mitigation of climate change by agro-sylvo-pastoral systems is complex to assess or model, owing to high spatial and temporal heterogeneities.
We set a new long-term observatory up for the monitoring and modelling of microclimate, GHG and deep SOC in a semi-arid agro-sylvo-pastoral system (Niakhar, Sénégal), dominated by the multipurpose *Faidherbia albida* tree. Crops were mainly millet and peanut, under annual rotation. Transhumant livestock contributed largely to manure, SOM and soil fertility.
Early 2018, we installed 3 eddy-covariance towers above (i) the whole mosaic, (ii) millet and (iii) peanut and monitored energy, CO2 balance and evapotranspiration for one full year. The mosaic ecosystem displayed low but significant CO2 and H2O fluxes during the dry season, owing to *Faidherbia* in leaf (Fig. 1). When rains resumed, the soil bursted a large amount of CO2. Just after the raising of millet, CO2 uptake by photosynthesis increased dramatically, then stabilized before harvest. However, this was compensated by large ecosystem respiration. The annual ecosystem CO2 balance was close to nil.
This observatory is currently installing soil chambers for GHG fluxes, studying the horizontal variability of SOC by Vis-NIR and of deep soil roots and C using wells. Microclimate (land surface temperature, energy balance and gas exchanges) and light-use-efficiency will be mapped through 3D modelling (Charbonnier et al., 2017; Vezy et al., 2018).
This observatory is open for collaboration.

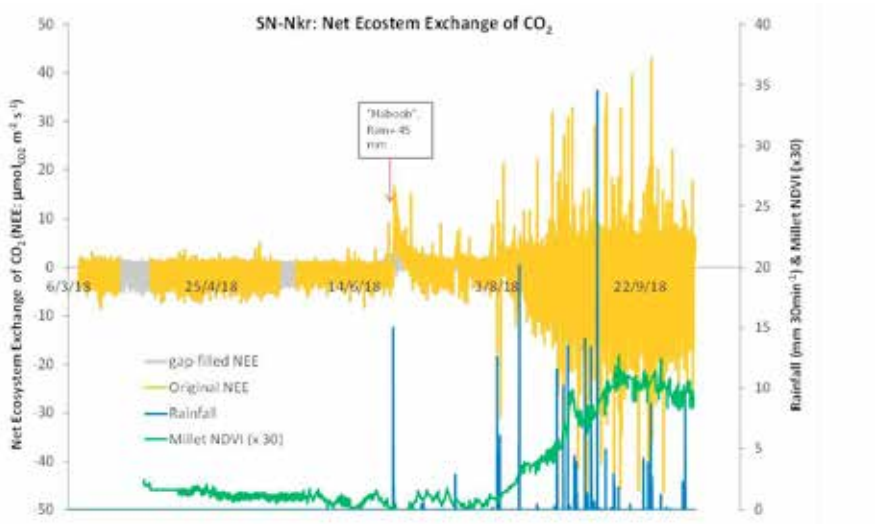

Fig. 1: The Net Ecosystem Exchange (NEE) of CO2 (or CO2 flux, negative = uptake during the day; positive = release at night) was very weak during the dry season, maximum photosynthesis (GPP) around 10 mmolCO2 m-2 s-1 and maximum ecosystem respiration (Re) around 1.5 mmolCO2 m-2 s-1. GPP was from Faidherbia trees only at that time. Just after the "Haboob", a large CO2 burst was recorded with slow decay during more than one week or so. Other CO2 peaks in July correspond to smaller rain events. Early August, millet NDVI took off, followed by a large CO2 uptake, but also ecosystem respiration. [Fluxes filtered out for wet sensor, Planar-fitted, WPL and spectral corrected, quality checked. Gaps are due to power failure. Grey dots are from gap-filling according to Lasslop et al. (2010)]

Keywords: Eddy Covariance, Faidherbia albida, Millet, GHG balance, SOM.

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