

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

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EGU General Assembly 2022

Monitoring soil greenhouse gas (GHG) emissions in a Sahelian agrosilvopastoral parkland

Seydina Mohamad Ba, Olivier Roupsard, Lydie Chapuis-Lardy, Frédéric Bouvery, Djim Mouhamadou Lamine Diongue, Yélognissè Frédi Agbohessou, Håkan Torbern Tagesson, Bienvenu Sambou, and Dominique Serça

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https://lped.info/wikiObsSN/?Faidherbia-Flux

MOTIVATION AND AIMS

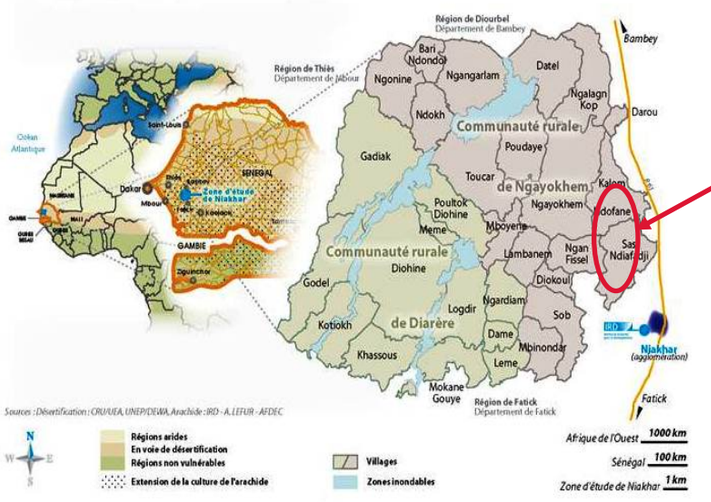
- **The impact of agrosilvopastoral systems in the Sahel on the carbon cycle and greenhouse gas (GHG) fluxes is very poorly documented**

- **Growing need to produce baseline data on GHG emissions**

  - **Study of the temporal and spatial variability of GHG fluxes (between soil and atmosphere)**

  - **Where?**

    - Agrosilvopastoral area dominated by the *Faidherbia albida*
    - Cropped area (millet, groundnut in an annual rotation)
    - Instrumented site (*Faidherbia* flux)



NIAKHAR (Sob) – Groundnut Bassin (SENEGAL)



***"Faidherbia-Flux"* Web site :** https://lped.info/wikiObsSN/?Faidherbia-Flux

METHODS : Experimental design

8 automatic chambers used (**04 under trees** *-Faidherbia albida-* and **04 far from trees**)
With a groundnut plant during the rainy season and without a groundnut plant during the dry season
The whole is coupled to a **Picarro 5 gas analyser**

© Design: F. Bouvéry

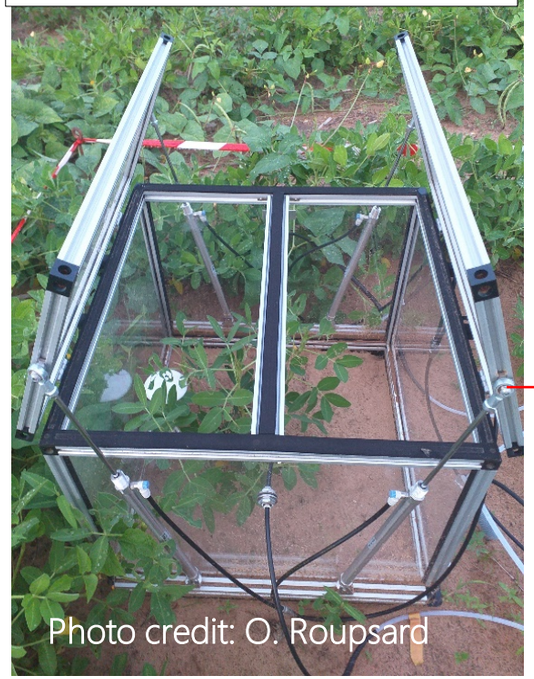
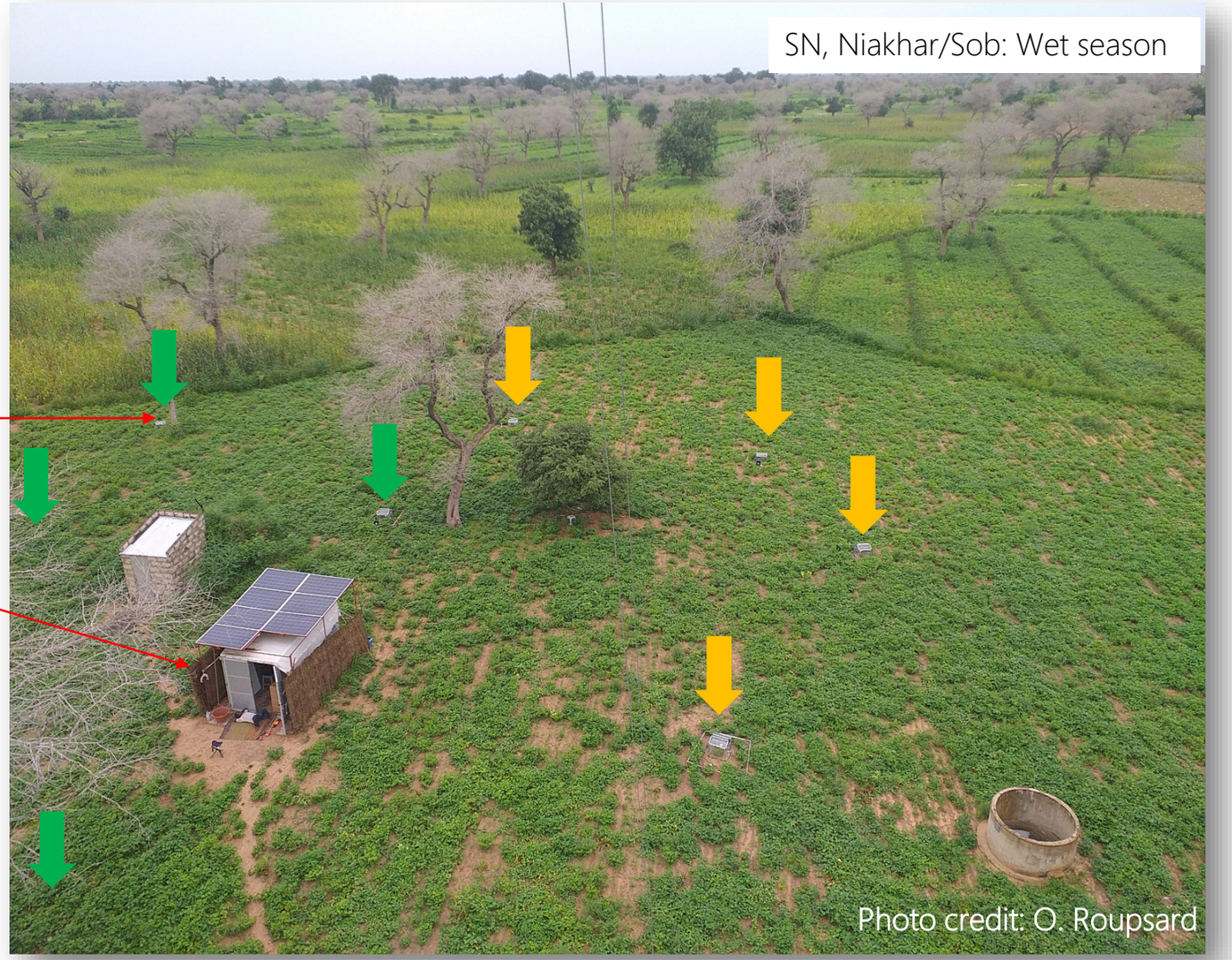


Photo credit: O. Roupsard

soil GHG analyser shelter

Shaded chambers

Full sun chambers



SN, Niakhar/Sob: Wet season

Photo credit: O. Roupsard

METHODS : in situ gas monitoring system (CO_2, CH_4, N_2O, H_2O and NH_3)

https://www.youtube.com/watch?v=32VflJF4wug

SDM-CD16AC relay



Autopilot control

Running program

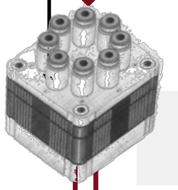
Chamber number sending

Autopilot control



Picarro G2508

From chamber to analyser



Matrix (9 ways)

Water trap

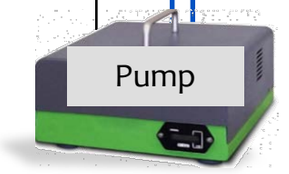
filter

Automatic chamber

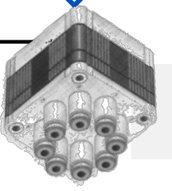




Campbell datalogger (CR1000X)
With automation program



Pump



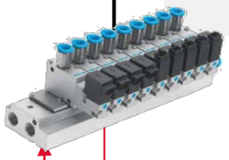
Matrix (9 ways)

From pump to chamber

Air compressor



Solenoid valve (9 ways)



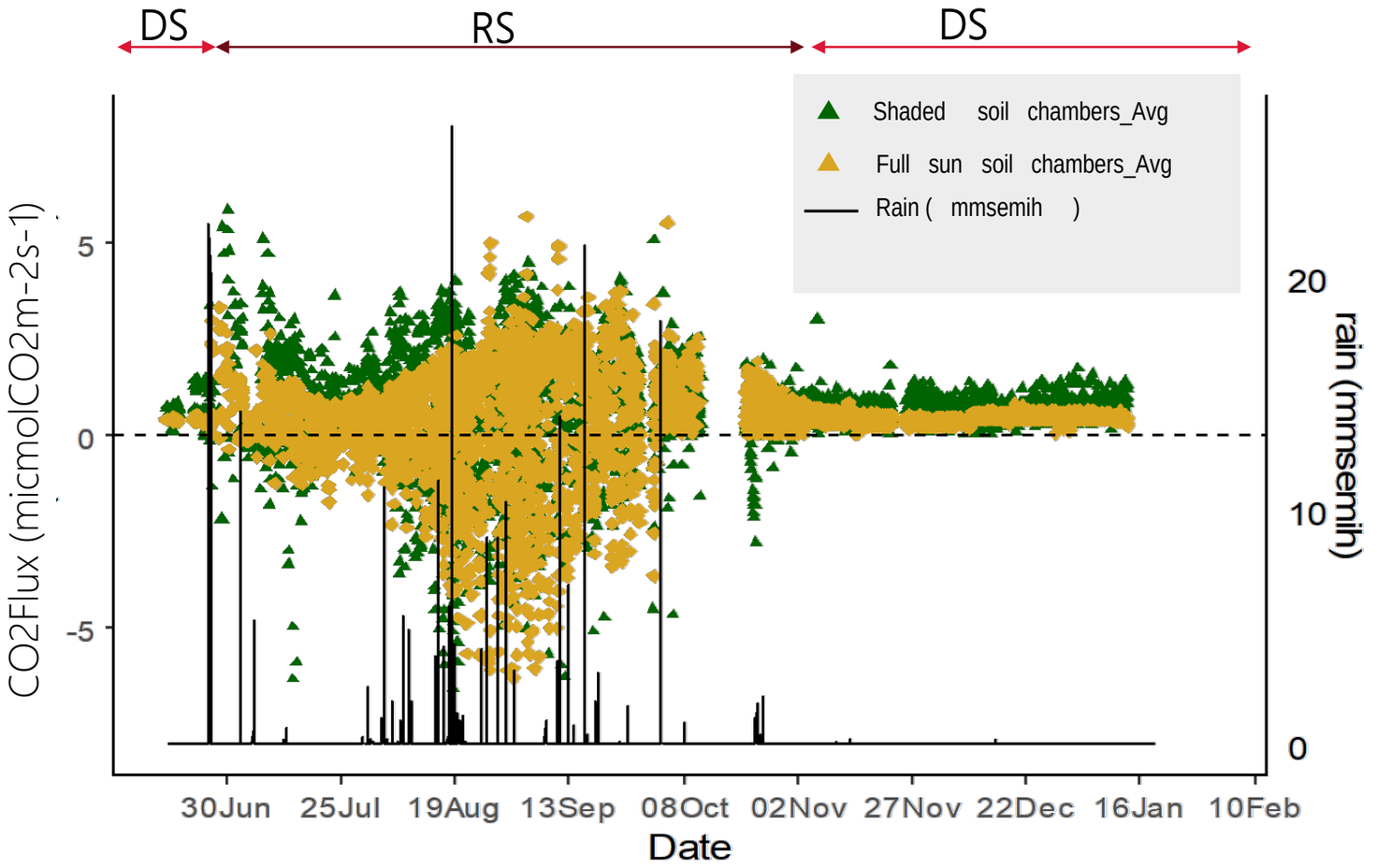
to solenoid valve

From solenoid valve

To pneumatic cylinders

Results : 8 months GHG fluxes (soil, plant and atmosphere)

❑ CO_2 fluxes (measured from June 21 to January 22)



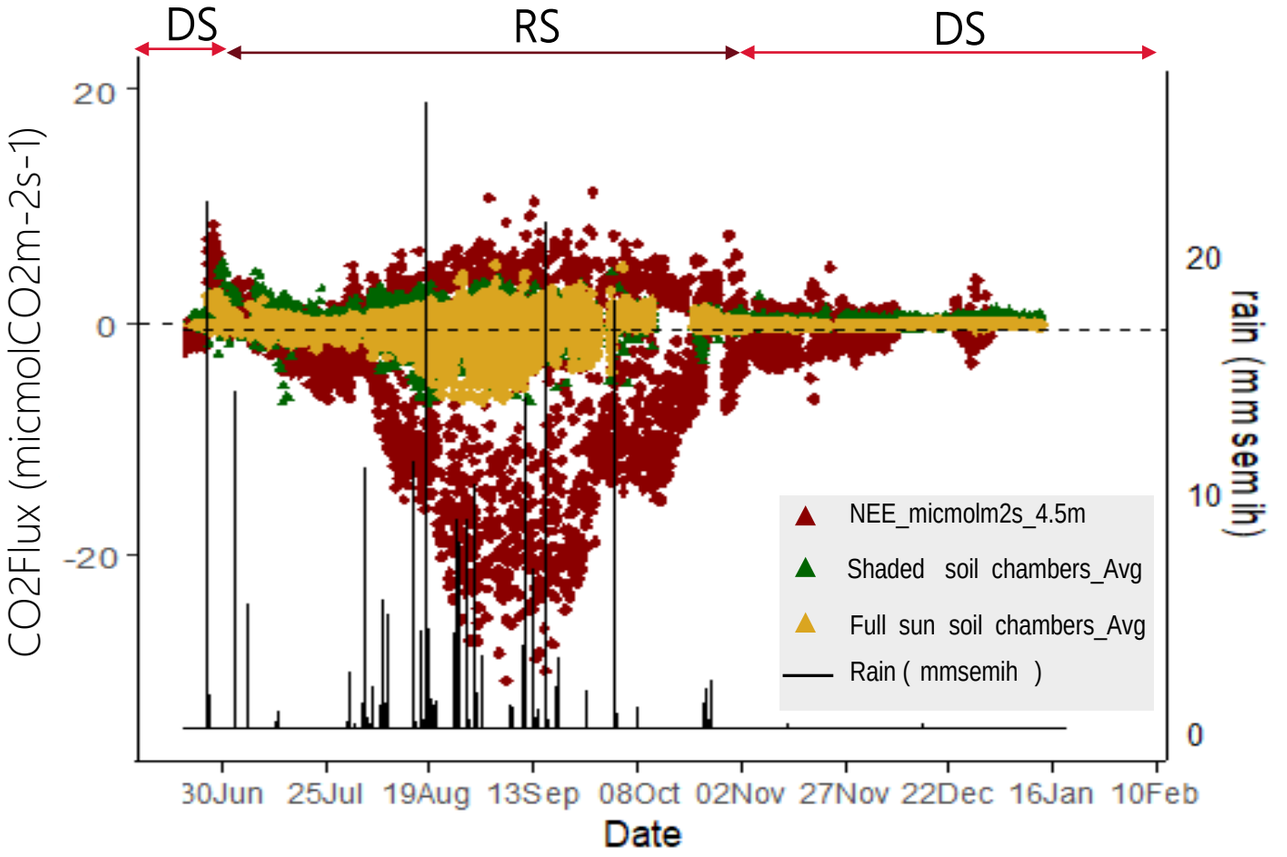
DS = Dry season with bare soil

RS = Rainy season with cropped soil (groundnut)

- Soil respiration was highest after the first rainfall (high release of CO_2 trapped in the soil pore spaces) and throughout the wet season.
- During the wet season, the maximum soil respiration at night was about 5 µmolCO_2m-2s-1 and the maximum net CO_2 uptake during the day was about -6µmolCO_2m-2s-1
- Soil CO_2 respiration was very low at the end of the dry season, with an average of about 0.6 µmolCO_2m-2s-1.
- daily soil respiration is highest under trees (p< 0,0001), but the patterns remain similar

Results : GHG fluxes exchange trends (soil, plant and atmosphere)

❑ Comparing soil fluxes to Eddy covariance (EC) measurements at 4.5 m above the crop



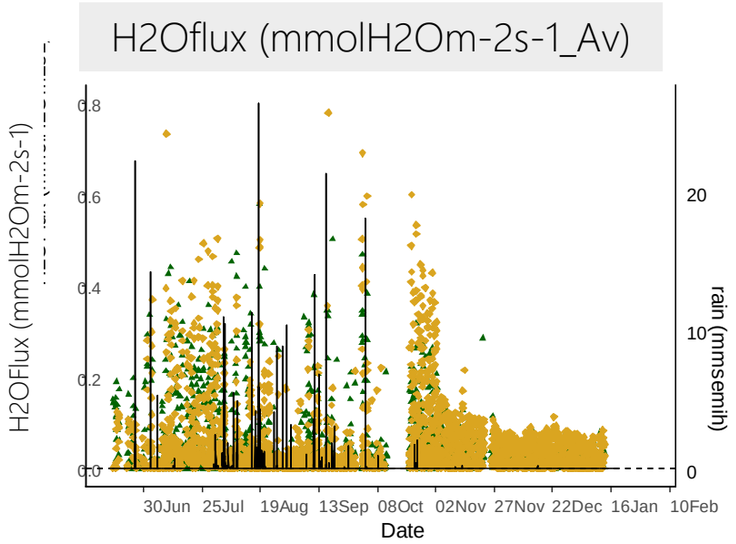
DS = Dry season with bare soil

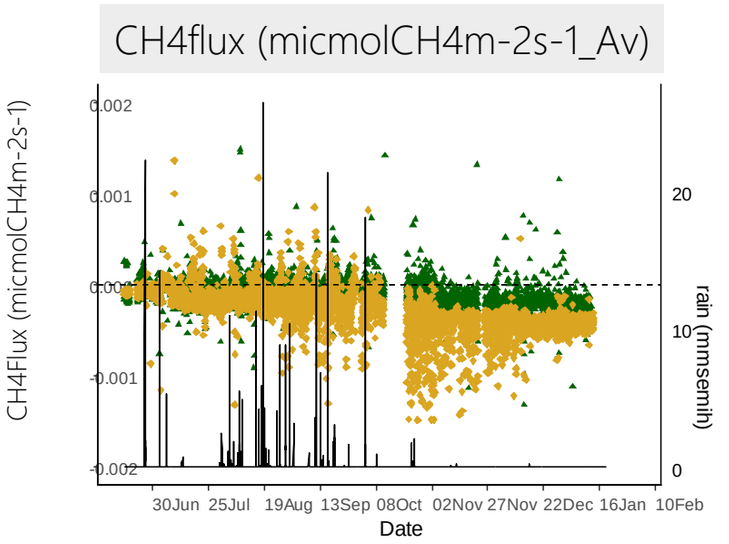
RS = Rainy season with cropped soil (groundnut)

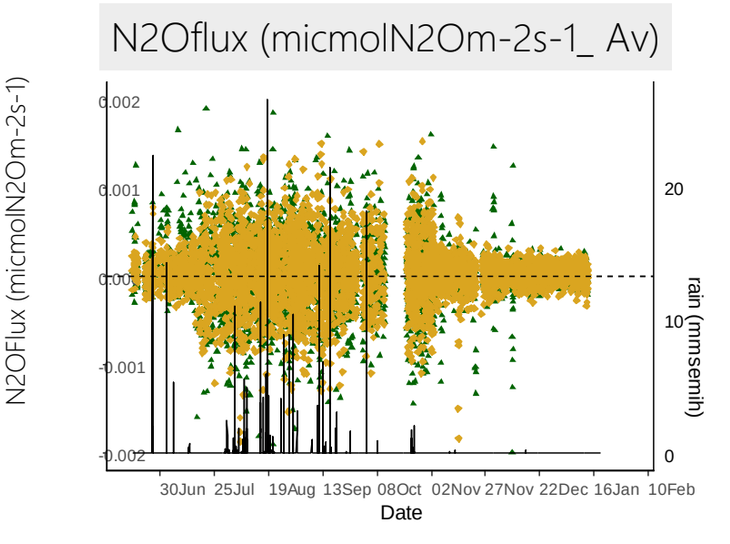
- The CO_2 fluxes from the automatic chambers show similar patterns to those from the EC tower.
- During the dry season, the CO_2 fluxes obtained by automatic gas chambers were close to the EC fluxes. However, during the rainy season, with crop growth, a large difference was observed (i.e. a factor of 3.74 and 7 respectively for soil respiration and photosynthesis)
- This gap could be due to higher leaf cover in the field (as sensed by EC) as compared to leaf cover inside chambers.
- Therefore, we will soon apply correction per unit leaf area.

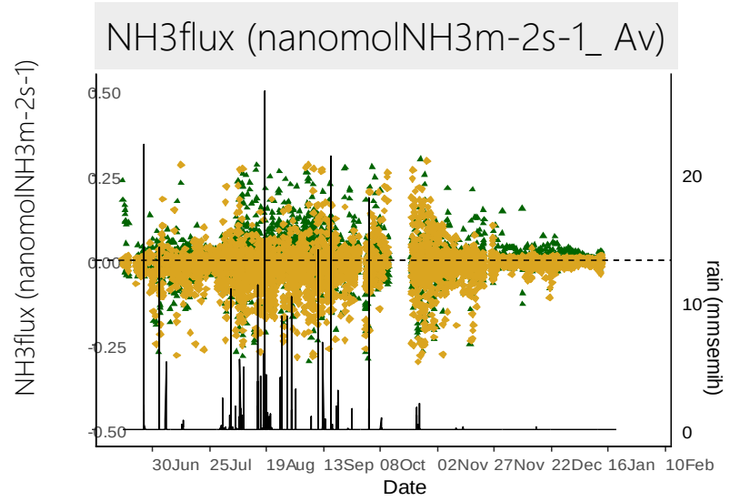
Results : GHG fluxes exchange trends (soil, plant and atmosphere)

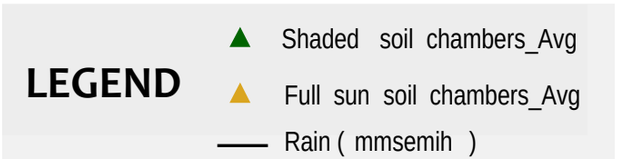
❑ H2O, CH4, N2O and NH3 fluxes trends











- No clear trend for the CH4, N2O, and NH3 was found during the rainy season. The fluxes recorded look more like noise which decreases considerably in the dry season.
  Another reason might be the low soil fertility, the lack of nitrogen supply, and the low moisture content in these sandy soils which are not suitable for trace gases production processes like N2O and CH4.
- H2O fluxes seem to be more perceptible during the rainy season, possibly due to soil evaporation and plant transpiration, but with low intensity, as compared to EC fluxes (data not shown), probably due to vapor condensing in the pipes.

Thank you

Looking forward to receiving any questions or comments



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https://lped.info/wikiObsSN/?Faidherbia-Flux

https://www.cassecs.org/

https://www.youtube.com/watch?v=32VfIJF4wug

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CASSECS

ÉLEVAGE SAHÉLIEN ET BILAN CARBONE