

Precipitation and disturbance as main determinants of the spatial variability of carbon fluxes in 16 West African ecosystems

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1. Introduction

- High uncertainties remain on Africa's terrestrial carbon budget, especially on the spatial and temporal variability.
- Carbon dynamics remain until now studied for few African ecosystems compared to other regions in the world.
- Contribution of Africa represents 7 % to the total of the carbon emission that is the lowest, whose 48 % by land use changes.

2. Objectives

- to estimate the annual net ecosystem carbon exchange of the vegetation types in West Africa.
- to determine some factors that control the spatial variability of the annual carbon fluxes in the African's region.

4. Results and Discussion

- GPP responses to main climatic factors

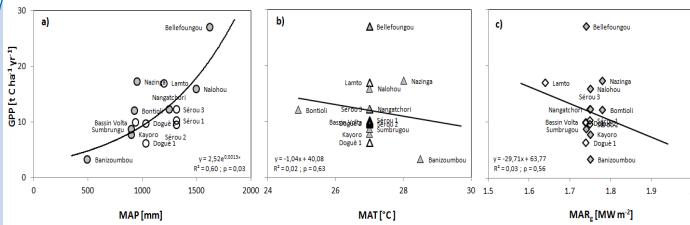


Figure 2. Relationships between GPP, MAP, MAT and MAR_g : EC (closed) and MI sites (open)

- GPP varied from 3.3 to 27.0 $t C ha^{-1} yr^{-1}$ consistent with the range reported by Malhi et al. (2012) for tropical region,
- A significant and positive correlation was found between GPP and MAP ($R^2 = 0.60$; $p = 0.03$),
- No clear relationship was found between GPP, MAT and MAR_g , probably due to the low range of the spatial variation of the two variables or masked by the response to MAP,
- A possible saturation could be found if some Guinean sites (MAP > 1600 mm) were included.

- TER responses to main climatic factors

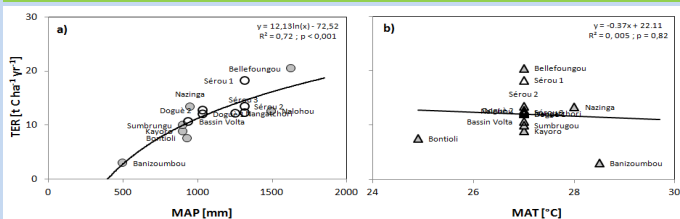


Figure 3. Relationships between TER, MAP and MAT except the Lamto site (Ivory Coast): EC (closed) and MI sites (open).

- TER varied from 3.0 to 20.5 $t C ha^{-1} yr^{-1}$,
- A significant and positive correlation was found between TER and MAP ($R^2 = 0.72$; $p < 0.001$),
- No clear relationship was found between TER and MAT, probably due to the low range ($< 9^\circ C$) of the spatial variation of this variable or masked by response to MAP.

References

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3. Material and methods

West Africa region and studied sites

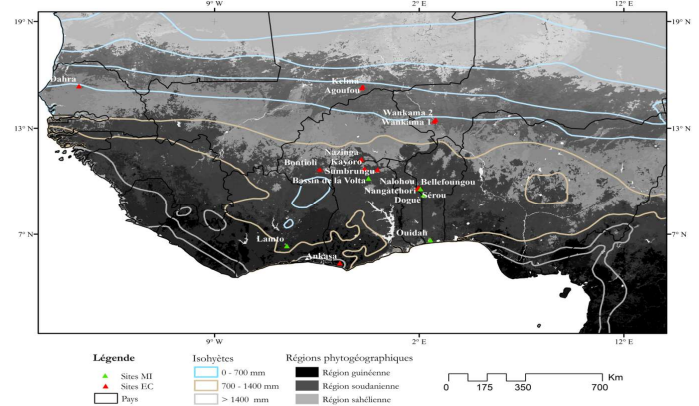


Figure 1. Main eco-climatic regions in West Africa and locations of the studied sites : MI = indirect methods and EC = the eddy-covariance approach

Region: 4-25°N, 18° W -15° E ; Annual Rainfall: 350-1850 mm
 Types of Ecosystem: Forest, Savannah, Fallow and Crop
 Annual temperature: 24-30° C ; Two seasons: one dry and one wet

Methodology

- Review based on the results of few studies that were published and unpublished

Indirect methods

GPP: Gross primary productivity ; TER: Total ecosystem respiration ;
 MAP: Mean annual precipitation ; MAT: Mean annual temperature ;
 MAR_g : Mean annual global radiation ; NEE: Net ecosystem Exchange

Eddy-covariance

GPP: Gross primary productivity ; TER: Total ecosystem respiration ;
 MAP: Mean annual precipitation ; MAT: Mean annual temperature ;
 MAR_g : Mean annual global radiation ; NEE: Net ecosystem Exchange

- Relationships between NEE, GPP, TER, MAT and MAP

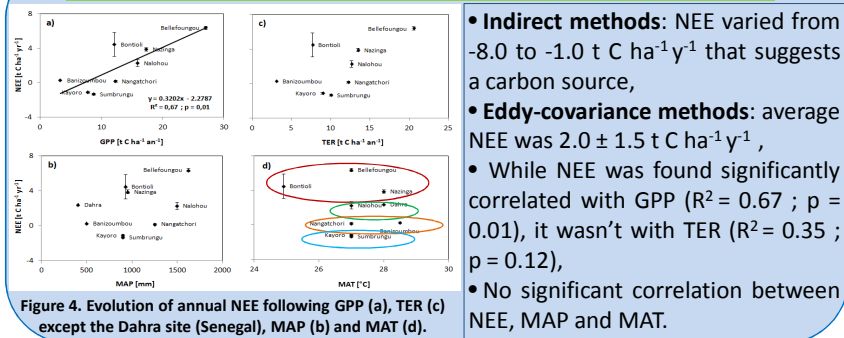


Figure 4. Evolution of annual NEE following GPP (a), TER (c) except the Dahra site (Senegal), MAP (b) and MAT (d).

- Indirect methods: NEE varied from -8.0 to -1.0 $t C ha^{-1} yr^{-1}$ that suggests a carbon source,
- Eddy-covariance methods: average NEE was $2.0 \pm 1.5 t C ha^{-1} yr^{-1}$,
- While NEE was found significantly correlated with GPP ($R^2 = 0.67$; $p = 0.01$), it wasn't with TER ($R^2 = 0.35$; $p = 0.12$),
- No significant correlation between NEE, MAP and MAT.

5. Main conclusions

- GPP and TER responses to climate: MAP controls spatial variation of GPP and TER.
- Response to temperature: No clear spatial influence of MAT: Masked by the response to MAP? No sensitivity for this temperature range?
- NEE response to climate: No clear influence of climatic variables. NEE was mainly determined by the disturbance degree and management strategy.
- Pattern of region : The ecosystems were a carbon sink of $2.0 \pm 1.5 t C ha^{-1}$.

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