**Title:** *Drivers and CO₂ flux budgets in a Sahelian Faidherbia albida agro-silvo-pastoral parkland: Insights from continuous high-frequency soil chamber measurements and Eddy Covariance.*

**Author (s):** Seydina Mohamad Ba et al.

**MS type:** Original research article

**Manuscript No.:** egusphere-2025-2660, submitted to Soil

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Dear Riccardo Picone,

We sincerely thank you for your careful and thorough review of our manuscript, as well as for the positive and encouraging tone of your report. Your comments and suggestions have been extremely valuable and have significantly contributed to improving both the scientific rigour and the readability of the paper.

We have addressed all of your points in the revised version. For clarity, please note that the line numbers indicated in the responses are provisional, as additional revisions may result in changes to the manuscript's line numbering. We will ensure consistency in the final revised manuscript.

Below is a detailed point-by-point response to each of your comments. For ease of reviewing, the reviewer's original comments are reproduced in *black italics*, our responses are in black regular text, and the corresponding changes made to the manuscript are indicated in blue and bold.

With best regards,

On behalf of all the co-authors,

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# Authors' response to reviewer RC1

**Reviewer's report:**

*This work reports a comparison of carbon fluxes between different zones of an agroforestry system during one whole year assessed with two different methodologies. A comparison of the two methodologies was also done. The topic is therefore highly relevant for the journal. The abstract does a good work in framing the context of the study and the relevance of the findings. The introduction effectively presents the topic and its importance, by highlighting key knowledge gaps that will be addressed by the study. Anyway, I would suggest including a brief description of the Eddy Covariance method in this section. In my opinion, the main problem of the paper is that clear starting hypotheses that have driven the work were not stated. This should be addressed. Methodologies appear to be consistent and appropriately described, and all the reported methods have the appropriate bibliographic reference. I would only suggest some minor integrations to the experimental design description. Results are correctly reported in all the necessary detail. The discussion does a very good job in comparing the results to other studies, hypothesizing mechanisms driving the findings, and highlighting limitations of the study. Conclusions realistically summarize the key discoveries. All supplementary materials are relevant and correctly reported. The authors are requested to carefully proofread the "references" section because some journal names are not correctly abbreviated. Based on these considerations, I would recommend minor revisions to be applied to the manuscript before it can be accepted for publication.*

*Hereafter follow the specific comments I made on the text. Text between quotation marks indicates citations from the manuscript. When multiple lines are indicated, the comments refer either to a full sentence or to a meaningful part of it*

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## Comment #1

*L. 43 Please report the full name of the species when it is first mentioned in the abstract.*

## Response #1

The full name of the species was mentioned

Line 43: "*Faidherbia albida*" (Revised version)

**Comment #2**

L. 57 I would suggest deleting the phrase "of trees".

**Response #2**

The correction was done.

Line 57: "fertile island effect" (Revised version)

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**Comment #3**

*L. 64 I would suggest briefly describing the methodology used for this technique.*

**Response #3**

The methodology used for EC technique is described as follows:

"The EC technique quantifies $CO_2$ exchanges between ecosystems and the atmosphere by correlating fluctuations in vertical wind velocity with simultaneous variations in $CO_2$ concentrations, providing a direct and non-invasive estimate of $CO_2$ fluxes (Baldocchi, 2003)."

Line 66 to 69 (Revised version)

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**Comment #4**

*L. 95 "upscaling" Undertsanding/comprehension?*

**Response #4**

Thank you for pointing this out.

The main idea, here, is to partition the ecosystem fluxes by compartments (soil and trees). The corrected sentence becomes:

"When combined with EC, this dual-method approach strengthens source attribution and improves the partitioning of fluxes across complex agroforestry landscapes".

Line 97 to 99 (Revised version)

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**Comment #5**

*L. 99 The hypotheses that have driven the study are not stated.*

**Response #5**

Thank you very much for this comment, which further improves the quality of the paper.

We have therefore added the following assumptions:

(1) Rch and GPPch are higher under the canopy of F. albida than in full sun, (2) soil moisture is the main environmental factor directly controlling both Rch and GPPch, (3) when extrapolated to the field scale, the chamber-based method provides seasonal dynamics of respiration and photosynthesis fluxes comparable to those derived from EC technique.
Line 108 to 112 (Revised version)

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## Comment #6

*L. 139 At which distance from the trees were the chambers installed?*

## Response #6

This was already mentioned in non-revised version line 139 (...at least 20 m from trees).
Now in line 148 (Revised version)

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## Comment #7

*L. 147 "half-hour flux measurements" Does this mean that the measurement was repeated every 30 mins in each chamber? If so, I suggest being more clear on this.*

## Response #7

This means that a full flux measurement sequence (chamber closure, data acquisition, chamber opening, and purging) takes 30 minutes, before moving on to the next chamber, and so on.

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## Comment #8

*L. 160 "indicated" Indicating?*

## Response #8

The correction has been made.
Line 169 : "indicating" (Revised version)

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## Comment #9

*L. 166, 168 "NDVI", "LAI" Please report the full name.*

## Response #9

The full name for NDVI (normalised difference vegetation index) and LAI (leaf area index) was reported.
Lines 175 and 178 (Revised version):

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**Comment #10**

*L. 172-174 How often were VWC and Tsoil measurements repeated?*

**Response #10**

"All at 5-min intervals", this measurement frequency for VWC and Tsoil was already indicated in non-revised version line 174.

Line 184 (Revised version).

**Comment #11**

*L.223-227 These two sentences are a repetition.*

**Response #11**

The repetition has been removed.

Line 231 to 233 (Revised version)

**Comment #12**

*L. 344 Inside "the" chambers.*

**Response #12**

The missing article ''the" has been added.

Line 368 (Revised version)

**Comment #13**

*L.351 "references" Reference*

**Response #13**

The correction has been made.

Line 376 (revised version)

**Comment #14**

*L.s 387-388 How do you account for a standard error of the same entity of the measurement itself?*

**Response #14**

Here, it refers to the mean $\pm$ standard deviation, not the standard error. I have added this clarification in the text.

The sentence now reads: "FS showing (mean $\pm$ standard deviation) $0.9 \pm 0.9$ µmol $CO_2$ $m^{-2}$ $s^{-1}$ (modeled) and $1.3 \pm 1.2$ µmol $CO_2$ $m^{-2}$ $s^{-1}$ (measured)".

Line 412 to 413 (Revised version).

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**Comment #15**

*L. 483 "GPPshowed" A space is needed here.*

**Response #15**

Corrected.

Line 483 (Revised version)

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**Comment #16**

*L. 553 "F. albida" Italics is needed here.*

**Response #16**

Corrected

Line 594 (Revised version)

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**Comment #17**

*L. 617 "roots" Root*

**Response #17**

Corrected

Line 658 (Revised version)

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**Comment #18**

*L. 634 I suggest deleting these two abbreviations (AF and FS).*

**Response #18**

The deletion was made

Line 675 to 683 (Revised version)

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**Comment #19**

*L. 683 "have been also" Have also been.*

**Response #19**

Corrected

Line 725 (Revised version)

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**Comment #20**

*L. 692 "and cowpeas" I do not understand why this is reported here since this crop was not grown during the experimental period.*

**Response #20**

The field where the EC flux tower is installed features peanut cultivation intercropped with cowpea. Therefore, the ecosystem respiration fluxes (Reco.EC) measured by the tower include the contribution of cowpea to respiration.

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**Comment #21**

*L. 696 "field's" Field.*

**Response #21**

Corrected

Line 738 (Revised version)

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**Comment #22**

*L. 710 "footprint's" Footprint.*

**Response #22**

Corrected

Line 752 (Revised version)

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**Comment #23**

*L. 727 "compartment's" Compartment.*

**Response #23**

Corrected

Line 762 (Revised version)

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**Comment #24**

*L. 734 "advancing understanding" Advancing the understanding.*

**Response #24**

Corrected

Line 770 (Revised version)

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**Comment #25**

*L. 740, 767, 772 "system's" System.*

**Response #25**

Corrected

Lines 781, 811 and 816 (Revised version)

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**Comment #26**

*L. 770, 794, References "F. albida" Italics is needed here.*

**Response #26**

Corrected

Lines 816 and 847 (Revised version)