

Interactive comment on “Effect of smoke on the transmissivity of photosynthetically active radiation inside the canopy” by M. Yamasoe et al.

Anonymous Referee #3

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General Comments: This paper reports analyses of a multifaceted dataset collected in western Brazil, oriented towards understanding light and photosynthetic dynamics above and within a tropical rain forest. Multi-height datasets of this type are uncommon in tropical environments, and therefore this work could potentially be a valuable piece of our evolving understanding of relationships among aerosol optical thickness, cloud cover, diffuse light, and net ecosystem exchange (NEE) of CO₂ in tropical forest systems. However, several aspects of this study should be modified in order to better explain the phenomena of interest prior to its publication. Specifically, these aspects include the following:

1. The authors report that there is ambiguity in determining the relationship between

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cloudiness, AOD, and NEE. Part of the problem with the analysis, however, is that the authors limit their analysis to daily time steps. This is particularly troublesome in this part of the world, where cloudy conditions dominate. However, it does not preclude meaningful analyses of these relationships, which could likely be better explained/understood (and in a more statistically defensible manner) by analyzing the dataset at a finer scale time step. Previous studies commonly relate flux data to environmental parameters at 0.5 to 1 hour time steps, and a similar analysis for this paper would be entirely appropriate to 1) tease out differential effects of aerosol only vs. aerosol + clouds on NEE, 2) expand the number of data points available for analysis, and 3) analyze the dataset at a timescale that is commensurate with biological changes (e.g. changes in stomatal conductance) occurring within the canopy. These analyses will help the authors resolve, for example, their quandary that “It was not possible to conclude if the reduction on CO₂ flux observed in this work was caused by any instrumental problem or a real aerosol effect.” (p. 5917, lines 23-24).

2. Presently, the authors present their within-canopy light extinction findings without respect to any canopy structure information, but rather simply to the linear (m) depth in the canopy (e.g. Figure 4 and within the text). In order to aid the transferability of this study to others in the tropics and elsewhere, it would be very helpful for these light transfer data to be expressed with respect to Leaf Area Index depth (e.g. top of canopy=LAI depth of zero). In addition to allowing the NEE findings to eventually become more mechanistically linked with foliar processes occurring at various canopy layers, expressing canopy depth in this manner directly links the absorbing/scattering elements of the canopy (e.g. leaves) with the light attenuation.

3. Further elaboration of the possible explanations for the observed complex relationship between NEE and AOT/cloudiness (p. 5918, top of page) should be possible after finer time step analyses pointed above. That said, some of the current explanations, although certainly plausible, are overly simplistic with respect to known ecophysiological behaviours within plant canopies, and warrant further mention/consideration.

For example, not stated within explanation #2 (p. 5918, lines 3-6) is the fact that a more stable atmosphere will also lead to depletion of ambient CO₂ within the canopy, thereby driving down potential photosynthetic rates. Similarly, no mention is made of the links among AOT, radiative loading on foliage, foliar temperature, and foliar respiration. Because respiration exhibits an exponential relationship with temperature, such fluctuations may have large effects upon canopy CO₂ fluxes.

4. Given the nature of the dataset, I do not think it is necessary (or accurate) to limit the title of the paper to the “Effect of smoke...”. By including (and embracing) the “Effects of smoke and clouds...”, this paper would be stronger in this reviewer’s mind.

5. The organization of the paper could be improved. For example, methods are included in the “Results” section (see reference on page 5915, lines 22-23; last paragraph of page 5918). Also, I recommend that the Results be renamed “Results and Discussion”.

6. Brief description/citation of Spitters (1986) is warranted in the introduction, as this article was the first to my knowledge to spell out potential relationships between canopy photosynthesis and changes in diffuse light:

Spitters, C.J.T. 1986. Separating the diffuse and direct component of global radiation and its implications for modeling canopy photosynthesis. Part II. Calculation of canopy photosynthesis. *Ag. Forest Meteorology* 38: 231-242.

7. Refinement of the English grammar in the paper is needed. (See technical comments below) 8. What was the method of correcting the hazemeter and MODIS results? (p. 5913, lines 16-20) Can you cite earlier related studies employing this method? Is this method established in the literature?

Technical Comments: 1. p. 5910, line 5: “scattering processes, and thus has implications for photosynthesis within plant canopies.”

2. p. 5910, line 5 (and elsewhere): should be “photosynthetically active radiation”

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(similar to how it is spelled in the title)

3. line 18: use “PAR” acronym (it is already defined on line 6)
4. line 18-19: “As a consequence, the availability of diffuse radiation was enhanced due toĚ”
5. line 22-23: “to an increase of CO2 uptake by the vegetation.”
6. p. 5911, line 4: “climate by reflecting”
7. line 9: replace “implying” with “resulting”
8. line 10: replace “less” with “fewer”
9. line 11: “formed, an indirect aerosolĚ”
10. line 16: “the effect on vegetation carbon gain due to a reduction in totalĚ”
11. line 18: “increase of the diffuse fraction of PAR.”
12. p. 5912, line 5: insert LBA, as in abstract?
13. line 11: replace “settled” with “located”
14. line 11-12: “Ěprotected area, landless people have recently developed small scale slash and burn activities in the area (Andreae et al., 2002). In fact, during the field experiment (dates?) it was possible to see nearby fires and smokeĚ”
15. line 16: Irradiance implies downwelling, therefore delete “downward”
16. line 19: “Six other sensors measured upwelling PAR radiance...”
17. line 21: “Four other sensorsĚ”
18. p. 5913, line 4: “Aerosol optical depth was also retrieved from a portableĚ”
19. line 7: delete “was also analyzed.”

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20. line 21: “Latent heat, sensible heat, and CO₂.”
21. p. 5914, line 1: “(NEE) of CO₂ was performed”
22. line 8: “model within the PAR”
23. line 15: “Results and Discussion”
24. line 22: Please explain “for asymmetry factor”
25. p. 5915, line 12: “the canopy”
26. line 13: delete “it is shown”
27. line 15: add “is shown” after parentheses
28. line 24: “When analyzing the effect”
29. line 26: “by normalizing”
30. p. 5916, line 13: “calculated values”
31. line 18: “the case...”
32. line 26: “In analyzing”
33. p. 5919, line 17: “transported long-range”
34. line 19: “and sugarcane”
35. line 25: “varying canopy levels”
36. p. 5960, line 9: “During the dry season”
37. line 12: “carbon budget of ecosystems.”
38. line 13: “chambers, other field campaigns, and additional modeling”

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 5909, 2005.

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