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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurements of coarse mode and primary biological aerosol transmission through a tropical forest canopy using a dual-channel fluorescence aerosol spectrometer" *by* A. M. Gabey et al.

Anonymous Referee #1

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This is a highly interesting study. I would recommend publication in ACP, but only after major revisions and improvement of the manuscript.

The previous public comment by J.A. Huffman has already pointed out a number of shortcomings of the manuscript and made suggestions for improvement and so will not duplicate similar comments here. I agree with many of these suggestions and recommend following these suggestions, and I will address some additional aspects below.

1 Introduction

The authors state that "... measuring the degree to which the canopy impedes PBA transport into the free atmosphere is a logical first step in bridging the gulf between the predicted (Elbert et al., 2007) and observed atmospheric PBA loadings." However, I missed conclusions based on their measurements.

- Please state your conclusions about PBA transport more clearly.

2 Location of measurement

I would expect that the site at the top of the ridge was more affected by wind and regional transport of aerosol particles than the site at the base of the ridge.

- Is this true? It would be good to address this aspect within the text and provide wind data (§3.2).

I can understand that measurements above and below the canopy could not be performed simultaneously using a single WIBS instrument, although I did not immediately recognize that there was only one instrument employed and was therefore initially confused.

- But why were the above-canopy and understory measurements not performed at least at the same site?

It is not self-evident that the sources of PBAP, the (micro-) meteorological conditions, as well as the arrangement of nearby clearings should be the same at different locations in a tropical rainforest. In this experiment the measurement locations were situated one kilometer apart, with the below-canopy site at the base and the above-canopy site at the top of a ridge (200 m difference in altitude), which leads to the following questions:

- How dense and uniform was the understory vegetation (bioparticle sources) at both locations, and to what extend did the canopy trees shade (heat flux) at either site?

- In what distance and direction from the locations were clearings which could allow

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9, C6455–C6461, 2009

"channelled" near-ground aerosol particles to escape the canopy?

Which other minor or major parameters may influence the particle fluxes?

3.1 Particle measurements

Inclusion of some words and numbers concerning the comparison of the WIBS-3 against the GRIMM particle counter could give the reader an impression of the accuracy of the measurements.

The authors refer to Kaye et al. (2005) who described the WIBS-2 instrument, however, WIBS-3 was utilized at Borneo. The latter, however, was described in detail recently by Foot et al. (2008). Referring to this work and including some of the relevant information given there would substantially improve the understandability of this Gabey et al. manuscript. Moreover, describing experimental details more thoroughly here might provide answers to at least some of the following questions, which are currently left open:

- WIBS-2 and WIBS-3, what is different, improved, etc.?

- How was the inlet designed?

- What was the flow rate?

- Was this flow rate maintained through the whole system?

- Has the instrument been calibrated (particle size, fluorescence, etc.)?

- If done, which particles were used?

- How do the particles used for calibration compare to ambient rainforest aerosol?

- How does the high relative humidity influence collection of aerosols in a tropical rainforest?

- Do humidified ambient particles affect the way the WIBS-3 determines particle size?

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9, C6455–C6461, 2009

- Does air humidity affect whether particles reach the instrument's detector?

Natural bioaerosols are known to readily form aggregates of particles.

- How does this influence their fluorescence behavior?

Due to the often non-spherical shape of atmospheric aerosol particles, "aerodynamic diameter" (Da) is usually used to classify such particles as fine or coarse mode aerosol particles. Da partly determines transport behavior of the airborne particles, and, thus, is an important term. In the manuscript, however, "optical equivalent diameter" (Dp) is used.

- Could both terms be regarded as being equal to each other?

- If not, how can they be inter-converted?

3.2 Meteorological measurements

- Why were temperature and relative humidity the only meteorological parameters measured, and wind direction and velocity not determined?

Changes of above-canopy concentrations (see Fig. 5) might perhaps be alternatively interpreted if wind data were additionally taken into account.

4 Methods

Understory data seem to have been averaged across the whole campaign, whereas above-canopy data were two-day averages only. The latter was thus smoothed to a lesser degree.

- How could this influence the calculation of cross-canopy transmission efficiency?

- Do small PBAP ($\sim$1 μm in diameter) have the same transmission efficiency as large ones (=10 μm in diameter)?

5.1.1 Particle concentration below the canopy

ACPD

9, C6455–C6461, 2009

The authors conclude from Fig.1 (lower panel) and Fig.4 (ii) that understory PBAP release and relative humidity are linked at 15:00 LT. If "the nature of the emission process" is "fungal spore release triggered by raised relative humidity", the question naturally becomes:

- Why do the understory total coarse aerosol number concentrations show the same diurnal pattern (Fig.4 (i))? This question is not addressed within the text.

Fig.4 (i and ii) show, in addition, that understory particle concentrations began to drop at about 04:00 LT, i.e. two hours before sunrise, and reached a minimum at 10:00 in the morning. Relative humidity, however, remained constant during all that time.

- How can this be explained?

- Does the same mechanism control the emission and concentration of both the coarse PBAP and coarse total aerosol?

It is important to address and discuss these issues at least briefly in the present article and not only later in a forthcoming one, as mentioned.

5.2 Comparison of total and PBA size distribution in each location

Page 18972, line 9-10: "peak concentration reduces from ∼80 ... to ∼200 ..."

- Did you mean increases?

5.3 Comparison of asymmetry factor distributions in each location

Microscopy studies have shown a wide range in shapes of bioaerosol particles. Some are almost spherical, and some form long filamentous rods. Thus, a large range of AF could be expected.

- Can you specify this range, and compare your values?

6 Conclusions

The authors conclude that "the possibility that instrument artefacts dominate the tropi-

ACPD

9, C6455–C6461, 2009

Interactive Comment

cal AF measurements" exists. However, the manuscript gave no description/discussion of the nature and magnitude of potential artefacts. Please provide some information on these artefacts.

Figures

A) General

- Omit title on top of figure, include all information in caption

- Be consistent in labeling of axes (e.g. use "HOUR" only)

- Be consistent in using acronyms (e.g. PBA vs. PBAP)

- Replace (i) and (ii) by (a) and (b), and use it (Figs. 4,7, and 8)

- Use tick marks across the lines

- Lower value for y-axes should be zero (as long as there are no negative values)

B) Specific

Figure 4: in title (0.8-10μm), in caption (0.8-20 μm)

Figure 6 (ii): split into two graphs

References

1. Foot, V. E., Kaye, P. H., Stanley, W. R., Barrington, S. J., Gallagher, M., and Gabey, A.: Low-cost real-time multi-parameter bio-aerosol sensors, Proceedings of the SPIE - The International Society for Optical Engineering, 711601 (711612 pp.), doi:10.1117/12.800226, 2008.

2. Kaye, P. H., Stanley, W. R., Hirst, E., Foot, E. V., Baxter, K. L., and Barrington, S. J.: Single particle multichannel bio-aerosol fluorescence sensor, Optics Express, 13, 3583-3593, 2005.

ACPD

9, C6455–C6461, 2009

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9, C6455–C6461, 2009

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