

Interactive comment on “Biological aerosol particle concentrations and size distributions measured in pristine tropical rainforest air during AMAZE-08” by J. A. Huffman et al.

Anonymous Referee #2

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GENERAL REMARKS The overall objective of this work is to ferret out the dynamics of biological aerosols from the total aerosols in the atmosphere of the Amazon rainforest by coupling data about particle size and shape, chemical tracers and abundance patterns. The work deploys two instruments in particular, the UVAPS and a semi-automated SEM. The novel contributions of this work are the demonstration of the utility of the instruments used here (and of their limits) and the observation of organic coatings of biological aerosols. This work also corroborates previous evidence that biological aerosols are a marked component of total aerosols and that their emissions show cyclic (diurnal) patterns. The research presented here is a technical tour de force in terms of sampling and analysis. However, the conclusions are not as strong

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as the experimental effort made for this work. Some suggestions for strengthening of the conclusions are proposed below.

I commend the other reviewer on his/her in depth remarks about technical considerations.

SPECIFIC REMARKS:

1. Could the title be more active, by indicating in a statement the main findings, rather than being descriptive? This would add value to their contribution.
2. P 25184, first sentence. There are two words that have been used to describe aerosols derived from living organisms. “Biological aerosols” refer to parts of living organisms or whole spores or microbial cells. “Biogenic aerosols” are generally considered to be those generated from living organisms via chemical transformations or emissions, such as volatile organic compounds. I think that the type of aerosols considered in this work should be clarified. The use of “biological” rather than “biogenic” might be more appropriate here.
3. P 25185, L 14: “than had been previously attainable by methods”. There are some grammatical problems here. Better stated as: “than had been previously attainable”?
4. P25189, L8-11: “polycarbonate filters pre-coated with sputtered gold and with a pore size of 5 μm for coarse particles and 0.2 μm for fine particles, respectively”. These filter pore sizes confound the definition of coarse and fine particles established earlier in the Materials and Methods section. Hence, on the 0.2 μm filters, particles up to sizes of just under 5 μm can accumulate. Some of these would be considered coarse particles according to the previous definition. I don't think that this is a problem, but I expect that this will be pointed out in the results, particularly if there are any conclusions particularly pertinent to particle size.
5. P25190, L14-15: “The recorded data were used to classify the particles according to size, composition and mixing state” What does “mixing state” mean?

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6. P25191, L23: "Filters were mounted on a glass microscopy slides", Eliminate "a" from the sentence.

7. P25191, L23: Lactophenol blue was used "to selectively highlight chitin molecules". Chitin is the major cell wall component of the Eumycota (the true fungi). However, there is another large group of "fungi" (the Chromista) containing oomycetes such as *Phytophthora* spp. that can also form air-borne spores. *Phytophthora* and related organisms are of increasing importance in forests and hence they are likely to be in the samples examined in this work. The cell walls of these organisms contain cellulose but not chitin. Many of the readers of ACP might not be aware of this, and hence it should be mentioned somewhere in the discussion or results that some types of spores were not targeted by this method.

This group of microorganisms might account for part of the PBAP between 0.5–1.0 μm reported on pg 25198.

8. P25193, L11: "and is thus are more representative". Eliminate "are".

9. P25199, L13-14: "Figure 7I shows an intriguing image of a particle type not seen often during the study, which may represent an agglomeration of bacterial cells. This highlights how bacteria, though individually small, can be detected at much larger sizes" These cells are rather large for bacterial cells. They have the size and typical egg-like shape of basidiospores of filamentous fungi or yeasts. An agglomerate of bacterial cells was observed by Lighthart (Lighthart, B., 1997. The ecology of bacteria in the alfresco atmosphere. *FEMS Microbiol. Ecol.* 23, 263-274.) in air samples, In this case the cells are about 1 μm or smaller in size and rod shaped.

In Fig. 7 overall there seem to be several examples of Basidiomycetes in the images shown as might be expected in light of the work of Fröhlich et al that the authors know well: Fröhlich-Nowoisky, J. et al. 2012. Biogeography in the air: fungal diversity over land and oceans, *Biogeosciences*, 9, 1125-1136, doi:10.5194/bg-9-1125-2012. As an example, Fig 7e looks very much like a basidiospore of an Agaricales, as in the image

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of the spinose basidiospore of *Inocybe calospora* at <http://tolweb.org/Agaricales/20551>

10. Fig 7: The legend indicates that these are examples of supermicron particles. However, panel j shows particles that are smaller than 0.5 μm in diameter (i.e. sub-micron).

11. P25205, L24-27: "They further suggested that spore phyla such as *Cladosporium*, *Alternaria*, and *Epicoccum* (included in their second group) tend to be most prevalent in warm, dry conditions while other ascospores and basidiospores tend to be more common during cooler,..." Modify sentence to "... that spores in phyla such as ... while (delete "other") ascospores and..."

12. P25206, L3-4: "were intended only to allow a rough hypothesis meant for the purpose of discussion" Change to "were intended to allow us to formulate a rough hypothesis..."

13. P25207, L6-7: "electrolytes from several species of fungal spore" Change to "electrolytes from spores of several species of fungi"

14. P25207: The organic coating on biological particles described on this page could also have an important impact for survival of the particle (if it is living). If these coatings also play a role in atmospheric processes, then their dual function in survival would be the basis on which natural selection would operate thereby indirectly contributing to assuring their function in atmospheric processes. Hence, natural selection could re-enforce the role in atmospheric processes if the role is linked to microbial survival. I don't know if the authors want to speculate about this, but it could enhance the importance of this observation.

15. P25207, L25-26: "Here we summarize our observations with five key areas of conclusion:" Why not be more forthright and simply state "five key conclusions"?

16. P25208, Conclusion 1: "Biological and non-biological particles observed are separable due to unique trends and sources". I am not sure if this comment refers to the

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ability to differentiate biological and non-biological particles in field measurements or to the overall nature of the particles. This should be clarified. Do the authors mean that biological and non-biological particles have distinct trends of abundance and distinct sources leading to different dynamics over time?

17. P25208, Conclusion 2: "Biological particles in the Amazon are key fractions of supermicron aerosol". The word "key" is vague. Clearly the authors do not intend to specify the fraction of the supermicron component composed of biological particles. However, they have observed that biological particles are consistently present among supermicron particles and that their abundance is sufficient to permit characterization of a range of diverse particle types. Their observations support the idea that the presence of biological particles among the supermicron particles is not an anecdote and corroborates other observations of their consistent presence in aerosols sampled from various regions. This supports the notion that biological aerosols should not be ignored when investigating aerosol-atmosphere interactions.

18. P25210, Conclusion 3: "Biological particles were often coated with mixed organic-inorganic liquid". The conclusions can be stated in the present tense as if they are fact; i.e. facts arising from the research reported here. Change to "...are frequently coated with..."

19. P25210, Conclusion 4: "The UV-APS instrument is able successfully able to detect biological particles" and P25211, Conclusion 5: "The UV-APS may not count all weakly fluorescent particles as biological". I think that conclusions 4 and 5 should be melded into one: "The UV-APS instrument is adapted for the detection of biological particles with some limitations".

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 25181, 2012.