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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Morphology, mixing state, and hygroscopicity of primary biological aerosol particles from a Chinese boreal forest" *by* Weijun Li et al.

Anonymous Referee #1

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This paper examines the composition of primary biological aerosol particles (PBAP) collected on various substrates for offline analysis, at a mountainous boreal forest site in China. Particles were classified optically based on morphology and composition was determined using a combination of TEM & EDS.

The authors report that PBAP were found to contain key, unique compositional markers (e.g., elemental P), which is consistent with previous studies performing similar analysis. A key result of this study was demonstrating that 20% of bacterial particles were internally mixed with non-PBAP, which may have a significant impact on the long-range transport of bacteria and aerosol budgets as well as mixed-phase aerosol-cloud

interactions. The authors also examined PBAP hygroscopicity, demonstrating that the sampled PBAP display small growth factors and subsequently weak hygroscopicity.

Overall the paper is reasonably well written and provides useful information to be absorbed into our general understanding of PBAP emissions and quantifying the fraction of PBAP which are internally mixed is a key result. My only significant criticism is that the paper lacks detail on the sample/substrate handling procedure employed, what procedures were in place to minimise contamination and how any contamination was dealt with during analysis. I would also have liked to have seen a short section examining any meteorological influence and perhaps some short scale back trajectory analysis to attempt to define source regions. I recommend publication after the following comments have been addressed.

Specific comments

L65: Please be cautious of overinterpreting these results. A major criticism of these findings is that it is not possible to separate nucleation processes from scavenging, which should be noted. You may also wish to mention the bioprecipitation hypothesis in this section too, e.g., Morris et al., (2014).

L105: Whitehead et al., (2016) demonstrated up to 90% of detected particles at a Brasilian rainforest site to be PBAP, and likely fungal spores. They also demonstrated a strong, RH driven, diurnal variation in PBAP, which is consistent with arguments you make later in the paper so I recommend citing this work here.

L119: Please include the altitude of the site.

L123: Please state the start and end time and dates of sampling.

L139: Please include a description of the sample handling procedure, including any steps taken to minimise contamination, e.g., as in Smith et al., (2018). Were substrate holders and the impactor assembly sterilised in any way prior to sampling? If so, how and with what frequency? I appreciate that you are not performing DNA extraction

analysis or any other methods that require strict handling/contamination protocols in this study, but I feel it is a significant weakness to not include this information as it is needed to assess the reliability of your results. Have attempts been made to screen out biological particles introduced by contamination? If so can you quantify the amount of contamination?

L202: Here you state that more PBAP were observed at night than during the day. This is not a particularly novel result so I would ask the authors to include some citations to previous studies to contextualise this. Strong, RH driven, diurnal variation in PBAP concentrations at forest sites has previously been demonstrated by Crawford et al., (2014,2015), Gosselin et al., (2016), Toprak and Schnaiter (2013) & Whitehead et al., (2016) for example.

L202/Fig.3: I would like to see some of the data from the images tabulated here. Would it be possible to provide statistics of the particle size and aspect ratio for each of the PBAP types observed?

L210: Can you comment on the possibility of particle misclassification and how this is handled in subsequent analysis.

L211: Can you please comment on how the inlet system used may have impacted your ability to detect pollen? If the inlet was fitted with a PM10 head then it would be expected that the majority of pollen would be too large to be sampled.

L296: Please contextualise this with other results in the literature as suggested earlier.

L298: A short section here examining the influence of other meteorological factors (e.g., wind speed/direction) and possibly short time scale back trajectory analysis would strengthen the paper as this would be useful to attempt to define source regions. Are higher counts observed at higher wind speeds or from specific wind sectors for example?

L38/L352: I feel that the term full database overstates the work presented here as

the particles are only broadly sub-classified and only a few select parameters are presented. Please scale this back. For me, a full database would require deeper classification with comprehensive statistics presented for each phyla or species as appropriate, which is lacking here.

Technical corrections

L45: Too general. Please rephrase. E.g., "At this boreal forest site. . .."

L139: “a diameter of. . .”

L233/Fig. 6: I’m not sure that bubble is the correct term. Suggest protrusion or protuberance.

L369: Rephase this sentence as it doesn’t make sense as it is written. It may need splitting into two or more sentences.

Fig.3: Define day and night in the caption.

References

Crawford et al., (2014): Characterisation of bioaerosol emissions from a Colorado pine forest: results from the BEACHON-RoMBAS experiment, Atmos. Chem. Phys., 14, 8559-8578, https://doi.org/10.5194/acp-14-8559-2014

Crawford et al., (2015): Evaluation of hierarchical agglomerative cluster analysis methods for discrimination of primary biological aerosol, Atmos. Meas. Tech., 8, 4979-4991, https://doi.org/10.5194/amt-8-4979-2015

Gosselin et al., (2016): Fluorescent bioaerosol particle, molecular tracer, and fungal spore concentrations during dry and rainy periods in a semi-arid forest, Atmos. Chem. Phys., 16, 15165-15184, https://doi.org/10.5194/acp-16-15165-2016

Morris et al., (2016), Bioprecipitation: a feedback cycle linking earth history, ecosystem dynamics and land use through biological ice nucleators in the atmosphere. Glob

Chang Biol, doi: 10.1111/gcb.12447

Smith et al., (2018), Airborne Bacteria in Earth's Lower Stratosphere Resemble Taxa Detected in the Troposphere: Results From a New NASA Aircraft Bioaerosol Collector (ABC), Front. Microbiol., doi:10.3389/fmicb.2018.01752

Toprak and Schnaiter (2013).: Fluorescent biological aerosol particles measured with the Waveband Integrated Bioaerosol Sensor WIBS-4: laboratory tests combined with a one year field study, Atmos. Chem. Phys., 13, 225-243, https://doi.org/10.5194/acp-13-225-2013

Whitehead et al., (2016): Biogenic cloud nuclei in the central Amazon during the transition from wet to dry season, Atmos. Chem. Phys., 16, 9727-9743, https://doi.org/10.5194/acp-16-9727-2016

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