Anonymous Referee #1

For clarity the referees comments are copied in black and our responses are offset in blue.

The authors present data from a month-long campaign concentrating on bio-aerosol characterization with Ultra-Violet-Light Induced Fluorescence (UV-LIF) technique. They explore the bioaerosol temporal variability, diurnal cycles, connection to rain and humidity as well as the emissions of the bioaerosols that they classify based on cluster analysis.

The article is well written and provides important insights into bioaerosol concentrations in the forested environment. I recommend this manuscript to be published in Atmos. Chem. Phys. after my minor comments have been addressed.

We thank the reviewer for their helpful comments and recommendations which we address below.

General comments:
The title is somewhat confusing as it mentions bioaerosol emissions. The emission flux is only presented in Fig 16 with the note that the typical constrains for the flux estimates have been relaxed. How reliable are these estimates?

The flux gradient method used here is an approximation for calculating fluxes from profile measurements and is certainly very limited for application to dense forest canopies, however, the Manitou Experimental Forest is sparse with a very low leaf area index so we assume that the technique represents a useful approximation. We refer the referee to the extensive review of fungal spore flux data sets and methodologies by Seartic & Dallafior (2011). Very few if any of these previous estimates use a micrometeorological approach, and simply rely on single height concentration accumulation with time. Given the relaxed constraints however we suggest that the fluxes are to be treated as order of magnitude estimates. We necessarily have to assume due to the constraints of the measurement resources that the particle emission sources, as well as their canopy concentration profiles are homogeneous throughout the forest, thus the estimate represents a net vertical flux. The very good agreement between the large horizontally separated WIBS-3 and WIBS-4 data sets (as shown by Robinson et al. 2012) suggest that this is a reasonable assumption for the tower sampling footprint.

The first part of the paper discusses the cluster analysis providing the separation between the bioaerosol types. The connection between the bioaerosol concentration and relative humidy as well as rain intensity is explored in detail. I understand that there is a need to parameterize the bioaerosol as function of environmental parameters, but what is the physical justification of a polynomial fit to the data?

Polynomial fits are often used by the atmospheric science community when parameterising biogenic emissions in complex systems such as the one observed here. The sources and sinks of each particle type are not well known and the parameterisations represent the cumulative response of each type to the given meteorological parameter. The presented parameterisations are likely only representative of emissions at the site studied. We will clarify this point in the revised manuscript.

In my opinion, the short discussion on ice nuclei concentrations and their connection to bioaerosol concentrations is somewhat outside of the primary scope of the paper. One of the main conclusions is that canopy was identified as the main source for bioaerosols. This is not apparent from Figure 9 as the different factors show high concentrations both at the surface and inside the canopy.

> Given the recent and increasing interest in bio-precipitation pathways, we feel that reporting the potential biological IN concentration is worthwhile.
>
> The highest dry concentrations are observed in the canopy for both $B_{4,1}$ and C_4. In wet conditions the concentration of C_4 is significantly higher in the lower canopy than at the surface.

Minor comments:

p. 2507: How is the variability in the refractive index taken into account in the measurements?

> Optical particle spectrometers measure the particle scattering cross section (SCS), not the particle size. The SCS is converted to equivalent optical size using the Mie solutions to Maxwell's equations, which are based on assumptions on the particle refractive index and shape. Laboratory tests using known bioaerosols show that a fixed value for the refractive index, which is used when calculating the scattering characteristics generally, is a good approximation. The calibration curve for the instrument is checked routinely using NIST standard monodisperse polystyrene latex microspheres with a quoted refractive index of 1.58 +/- 0.2. Due to this the reported size should always be taken as an estimate, and depending on the size of the particle is generally accurate to better than 1 µm. This is discussed in Robinson et al. (2013) which we have referenced.

p. 2510: The authors state that there is a good agreement between the instruments operated with a 300m distance between them. Were the instruments operated in laboratory / field at the same place to verify that there is no systematic bias that could explain this?

> The two instruments were operated side by side at the field site prior to the start of the experiment to identify any differences between them following shipment. They were found to be in good agreement (Fig. 1). The WIBS4 used here was operated at a higher flow rate than the WIBS3, which explains the lower variability in the measurement due to the enhancement in sample volume and improvement in particle counting statistics.

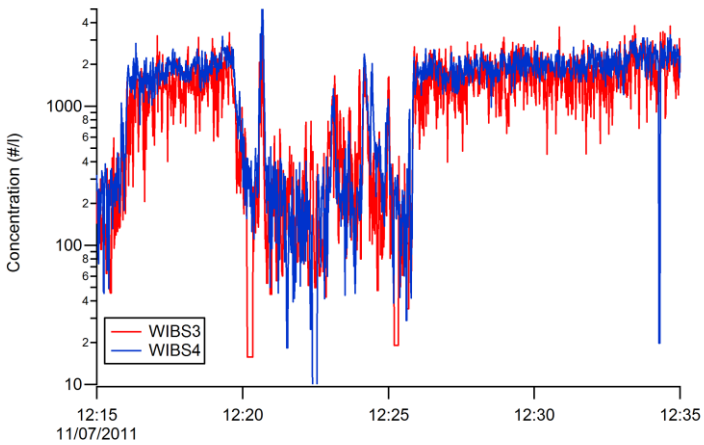

Figure 1. Comparison of co-located WIBS total concentration.

p. 2513: Do you consider OPC and/or other aerosol physical characterization data in the cluster analysis, ie. is your A3 and A4,1+A4,2 factors correlating with the accumulation mode concentrations? Also discussed in section 5.1.

> We have assumed that the A_x clusters are a part of the accumulation mode owing to their non-fluorescent nature but we have not performed a closure with other instruments measuring the accumulation mode. It was noted in Robinson et al. (2013) that the extreme upper size range of the accumulation mode, which clusters A_x represent, may not have the same source profile as the rest of the accumulation mode which may make such a closure difficult.

Technical comments:

p. 2501, line 22: Observations on emissions and their relation to disease dynamics and pathogen dispersal one could cite Tack et al. (2014).

> We thank the referee for their suggestion and we will include this reference in the revised manuscript.

p. 2503, line 15: this sentence needs a reference.

> We note the omission and we will include a suitable reference in the revised manuscript.

p. 2505, line 16: please use SI units throughout the paper.

> We feel that the use of imperial units is justified on this occasion when discussing the technical aspects of the experimental arrangement and is consistent with previous publications.

p. 2506, line 25: L min-1 ?

> We note this typographical error and this will be corrected in the revised manuscript.

p. 2513, line 3:: : : between the clusters.

> We note the omission and this will be corrected in the revised manuscript.

p. 2517, line 13:: : : the greatest

> We note the omission and this will be corrected in the revised manuscript.

p. 2517, line 25:: : : the greatest

> We note the omission and this will be corrected in the revised manuscript.

Figure 2-6, 8: use capical L for liter consistently.

> We note the discrepancy and this will be corrected in the revised manuscript.

Figure 9: Averaging time? Would median work better? This could be normalized to the total bioaerosol concentration.

We don’t state the averaging time in each bin as it is non-uniform due to the motion of the platform.
This made little difference.

Figure 14:: : : concentration

We note this typographical error and this will be corrected in the revised manuscript.

References:

Tack, A.J.M. et al. (2014) Genotype and spatial structure shape pathogen dispersal and disease dynamics at small spatial scales, Ecology, http://www.esajournals.org/doi/abs/10.1890/13-0518.1. (in press)

Robinson et al. (2013): Cluster analysis of WIBS single-particle bioaerosol data, Atmos. Meas. Tech., 6, 337-347, doi:10.5194/amt-6-337-2013

Sesartic, A. and Dallafior (2011), T. N.: Global fungal spore emissions, review and synthesis of literature data, Biogeosciences, 8, 1181-1192, doi:10.5194/bg-8-1181-2011