Response to referee comments and suggestions on amt-2018-390 by Könemann et al.

Manuscript format description:

Black text shows the original referee comment, blue text shows the authors response, and red text shows quoted manuscript text. Changes to the manuscript text are shown as *italicized and underlined*. We used bracketed comment numbers for referee comments (e.g., [R1.1]) and author's responses (e.g., [A1.1]). Line numbers refer to the discussion/review manuscript.

Anonymous Referee #1

Received: 25 November 2018

General comment:

The paper describes an instrument that should be much superior to the WIBS or UVAPS in characterizing fluorescent aerosol. The 16-channel fluorescence spectra should provide far more information for characterizing aerosol than existing WIBS instruments, while still measuring very large numbers of spectra per day. This instrument appears to be able to significantly expand our understanding of bioaerosols and other fluorescent particles in the atmosphere. The paper is clearly written. It should be published. I suggest the authors think about the following.

Author response: We want to thank Referee #1 for his/her positive and constructive assessment.

Specific/technical comment:

[R1.1] The title and abstract say, "a new instrument for . . ." Then line 144 is: "Introduced here is a new instrument for the detection and characterization of individual particles; the Spectral Intensity Bioaerosol Sensor (SIBS, Droplet Measurement Technologies)." Then later the text says, "The SIBS was originally designed and marketed to record time-resolved fluorescence lifetime." If it has already been marketed, the use of "new" seems possibly inaccurate. How long has it been marketed? I suggest dropping "new" from the title and the text. There is no need for it. Also, a book chapter by Huffman (one of the authors

of the present paper) and Santarpia, "Online Techniques for Quantification and Characterization of Biological Aerosols," in Microbiology of Aerosols eds., Anne-Marie Delort and P Amato (2017) mentions both types of SIBS (the breakdown spectroscopy SIBS and the spectral intensity SIBS). That chapter was published over a year ago and was presumably written many months before that.

[A1.1] We agree with Referee#1 and took out the word "new" from the title and abstract. It is true that the SIBS was briefly introduced within the book chapter "Online Techniques for Quantification and Characterization of Biological Aerosols" (Huffman and Santarpia, 2017). This reference is based on the same unit as discussed in amt-2018-390 and referenced by a conference poster, because no other citation was available at that time. Information stated in this book chapter was based on unpublished and non-peer-reviewed data, available because we had already been working together with Alex Huffman in 2015 with respect to the earliest version of the SIBS. Since then, the instrument underwent many modifications (hardware and software) and revisions for which the SIBS unit from 2015 and the unit in its current state are not comparable anymore.

[R1.2] A new and noteworthy part of this paper (maybe the most new and noteworthy part) is that the instrument is commercially available. Instruments that could do the key parts of what is done here (two fluorescence spectra each with a different excitation wavelength is measured for each particle) have been around for some years, e.g., Huang, Pan et al., and Pan et al. But routine measurements were far from feasible by others. I suggest stating in the abstract and introduction that the instrument is built by DMT and commercially available. I suspect more people will read it if they know they could buy one. Many instruments described in papers, especially new instruments, can only be used by the researchers that built and know how to use them.

[A1.2] As suggested by Referee#1, we added a reference to DMT within the abstract and conclusions for clarification. The linkage between the SIBS and DMT is already given, within the introduction, in:

(P5, L155-156): "Introduced here is a new instrument for the detection and characterization of individual particles; the Spectral Intensity Bioaerosol Sensor (SIBS, Droplet Measurement Technologies)."

[R1.3] RE: "originally designed and marketed to record time-resolved fluorescence lifetimes". Are spectra required for measuring fluorescence lifetimes? Was the SIBS designed and marketed to measure spectra at two excitation wavelengths? I think what is meant is: It was designed and marketed to measure time- and spectrally-resolved fluorescence lifetimes.

[A1.3] Correct. The SIBS was originally designed to measure time- and spectrally-resolved fluorescence lifetimes at two excitation wavelengths. As suggested by Referee #1, the following sentence was changed from:

(P15, L495-496): "The SIBS was originally designed and marketed to record time-resolved fluorescence lifetime."

To (P15, L495-496): "*The SIBS was originally designed and marketed to record time- and spectrally-resolved fluorescence lifetimes at two excitation wavelengths.*"

[R1.4] Make Fig. 2 higher resolution so it can be seen in detail on a large monitor.

[A1.4] Within the current manuscript version, figures were used in lower resolution to keep file sizes as low as possible. The final version will include high resolution images and figures.

[R1.5] RE: SIBS (Spark Induced Breakdown Spectroscopy) already has a meaning in the measurement of aerosol particles, either single particles or many at a time. It is confusing to see SIBS used for the name of an instrument that has nothing to do with spark induced breakdown. SIBS (original meaning) provides information similar to LIBS, i.e., elemental composition of single-particles or multiple-particles. I imagine SIBS (or LIBS) may eventually be combined with an instrument such as the SIBS described in this

paper, to provide both breakdown spectra and fluorescence spectra for each particle. Since the SIBS of Konemann et al., is already marketed, and been around for a while, it is likely too late for this comment to be relevant, but I hope not.

[A1.5] It is indeed unfortunate that two similar acronyms exist for two different instruments. We added the following sentence to hopefully avoid potential misconceptions, including references as suggested by Referee#1:

(P12, L370-373): "*To avoid potential misunderstanding, it is important to note that the SIBS described in this study is not related to spark-induced breakdown spectroscopy instrumentation, which uses the same acronym (e.g., Bauer & Sonnenfroh, 2009; Hunter et al., 2000; Khalaji et al., 2012; Schmidt & Bauer, 2010).*"

It is true that the combination of both breakdown- und fluorescence spectra on single particle scale would provide a completely new level for particle characterization. However, this topic is beyond the scope of this manuscript.

References

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Huffman, J. A. and Santarpia, J.: Online Techniques for Quantification and Characterization of Biological Aerosols, Microbiol. Aerosols, 83–114, 2017.

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Khalaji, M., Roshanzadeh, B., Mansoori, A., Taefi, N. and Tavassoli, S. H.: Continuous dust monitoring and analysis by spark induced breakdown spectroscopy, Opt. Lasers Eng., 50(2), 110–113, 2012.

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