

## Response to Reviewers

Manuscript Number: AMT-2015-249

Manuscript Title: Broadband cavity enhanced spectroscopy in the ultraviolet spectral region for measurements of nitrogen dioxide and formaldehyde

The discussion below includes the complete text from the reviewer, along with our responses to the specific comments and the corresponding changes made to the revised manuscript.

All of the line numbers refer to the original manuscript.

### Response to Reviewer #1 Comments:

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The authors have submitted a paper entitled 'Broadband cavity enhanced spectroscopy in the ultraviolet spectral region for measurements of nitrogen dioxide and formaldehyde'. The paper reports the first laboratory measurement of formaldehyde by BBCES in the ultraviolet spectral region between 315-350 nm. A novel laser-driven light source was used as the light source. Results are presented on the simultaneous retrieval of formaldehyde and nitrogen dioxide concentrations from laboratory mixtures and a 2 sigma detection limit of 300 pptv for formaldehyde for 1 min measurement is obtained which is comparable to current ground and satellite based DOAS instruments.

I think the work presented in this paper is both novel and interesting to those in the field of atmospheric trace gas measurements and also practitioners of cavity enhanced spectroscopy and very much merits publication. My comments relate to mainly minor points which nevertheless should be addressed.

**We thank the reviewer for the positive review. Listed below are our responses to the comments and the corresponding changes made to the revised manuscript.**

1. The authors have chosen to use the acronym BBCES (broadband cavity enhanced spectroscopy) to describe their technique. The originators of the technique (Fieldler et al. and Ball et al.) used either IBBCEAS (incoherent broadband cavity enhanced absorption spectroscopy) or BBCEAS (broadband cavity enhanced absorption spectroscopy). I can't see any difference in the principle of the technique described in this paper and so I would suggest using BBCEAS to describe the technique and so prevent the unnecessary proliferation of new acronyms in the literature.

**We agree that this is the same technique described previously as BBCEAS or IBBCEAS. Recently, we have used the name Broadband Cavity Enhanced Spectroscopy (deleting "absorption") because it is more general and can include our aerosol extinction measurements. The difficult choice is whether to use a name that is searchable and consistent with past references (BBCEAS) or a name that encompasses all of the broadband experiments that we are doing (BBCES). For this paper about gas-phase measurements, we have changed BBCES to BBCEAS throughout, following the reviewer's suggestion.**

2. The introduction section contains a fairly comprehensive description of previous gas phase BBCEAS studies performed below 340 nm but misses out listing the work of Islam et al. who are instead referenced later on in the experimental section in relation to the description of the LDLS. However, as far as I'm aware, Islam et al. also performed the first gas phase BBCEAS measurements with a LDLS including measurements on acetone at 280 nm and oxygen at 760 nm. Consequently, their work should also be described in the introduction section as it is directly relevant to the experimental work and experimental setup used in this study.

**We have added the following text:**

**Page 9931, lines 23-25: These include measurements of O<sub>3</sub>, O<sub>4</sub>, and SO<sub>2</sub> at 335–375 nm (Chen and Venables, 2011)—and, measurements of nitrophenols at 320–450 nm (Chen et al., 2011), and measurements of acetone near 280 nm (Islam et al., 2013).**

3. In section 2.1 (page 9934, line 15-18), I found the description of the referencing method unclear. Presumably a small fraction of the LDLS output is directed onto the second lead of the custom fiber bundle and used for monitoring the drift in the intensity of the LDLS but this not explicitly stated anywhere in section 2.1. I would suggest correcting this by explicitly describing the method used.

**The two legs of the fiber bundle are best shown in Fig. 1. We have edited the text:**

**Page 9934, lines 15-16: “The two regions of the CCD were used to measure the light output by the laser-driven arc lamp and the intensity through the optical cavity, as shown in Fig. 1. This allowed monitoring for drift in the light intensity.”**

Page 9931 line 23; I would suggest using 'below' instead of '...shortward of...'

**Corrected.**

Page 9933 line 17; insert 'a' between 'and' and '600 um'

**Corrected.**

Page 9933 line 26; insert 'fiber' after 'carbon'

**Corrected.**