

## ***Interactive comment on “An aircraft based three channel broadband cavity enhanced absorption spectrometer for simultaneous measurements of NO<sub>3</sub>, N<sub>2</sub>O<sub>5</sub> and NO<sub>2</sub>” by O. J. Kennedy et al.***

**Anonymous Referee #2**

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This paper describes an instrument for airborne measurements of NO<sub>2</sub>, NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub> (via thermal dissociation) by cavity enhanced absorption spectroscopy. It also shows first measurements of a nighttime chemistry campaign (Ronoco) over the UK, and a direct NO<sub>2</sub> measurement validation with a chemiluminescence detector.

The paper should be published after the following issues have been addressed:

The following two references should be added for further information:

1. Thalmann, Volkamer (<http://www.atmos-meas-tech.net/3/1797/2010/amt-3-1797-2010.html>) Shows a BBCEAS instrument measuring (amongst others) NO<sub>2</sub>, and also  
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deals with aerosols.

2. Wagner, Brown, et al. (<http://www.atmos-meas-tech.net/4/1227/2011/amt-4-1227-2011.html>) Describes a CRDS Instrument measuring NO<sub>3</sub>, NO<sub>2</sub>, N<sub>2</sub>O<sub>5</sub> on aircraft.

In general, information about pressure levels in the cavities is missing, as well as the measurement.

78: Replace "of some species" with a detailed information.

128: Is there a reason for using fibers? Couldn't one collimate the LEDs directly?

162: N<sub>2</sub>O<sub>5</sub>/NO<sub>3</sub> equilibrium is kept at a constant temperature in channel 2. Isn't this needed also for the NO<sub>3</sub> channel? How is the temperature measured in channel 2?

166: Is there a reason the flow is provided as a volume flow?

171: This should be worded differently, as a modelling study cannot prove the statement. Could one not measure the efficiency?

279: mention Crowley's coefficient here

290: Since the inlet outside the aircraft is probably not produced from PFA, shouldn't its effect be mentioned here as well?

301: Only an upper limit for the KNO<sub>3</sub> wall loss is known; wouldn't this affect the calculations using R<sub>2</sub>-R<sub>4</sub>?

385: What is the pressure inside the cavities for these measurements? Which absolute humidity values were used for the measurement?

391: The N<sub>2</sub> flow could also extend into the cavity which would be no slow diffusion process. How would that affect your error calculation?

482 Detection limits should be provided with the corresponding pressure level (or cite detectable molecular density).

484 Shorter averaging time does not change sensitivity (if statistical noise prevails). What it does change is the minimum detectable concentration.

500 These values should be quoted as 2,4 and 1,0 pptv

516 Is SeptEx also a campaign name?

527 and 528: These values should be quoted as 548 +/- 3 and 80,0 +/- 1,0 ppt

530 Ditto, 21,0 +/- 2,6 %

522-531: Is there a reason for the three different integration times?

532 How good is the extraction of the pressure from this absorption feature?

534, 569, 596: Future publication announcements should be eliminated from the paper's main text; they can be mentioned in the outlook.

606: If I understood correctly, the method (phase shift CRD) was already developed and is just implemented here with a (in my opinion) minor change: the use of a 5nm FWHM filter instead of a monochromator. This is not a refined version but instead a simpler measurement of only the peak mirror reflectivity and should be worded accordingly.

630: Please spell out MD and NERC. Bill Dube and Steve Brown should be cited with their respective institutes.

Fig. 3: In general, tubing and flow lines should be bigger. In the middle, the text "Flow controllers" points to the wrong parts. The flow meters should be bigger and the middle ones seem to point in the wrong direction. The connection between the cross after the first valve after the N2 bottle is not clear to me.

Fig. 7: The decision in the diagram should be drawn as a diamond. No and Yes should be used to mark the different ways (not in a rectangle).

Fig. 8: Lines must be bigger

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826 (gradients of)

833: 1 s integration time(s)

836: The values should be cited as 2,4 and 1,0 ppt

Fig. 10, 3rd picture: Value should be cited as 548,0 +/- 3,0 ppt

4th picture: 80,0 +/- 1,0

6th picture: 21,0 +/- 2,6 %

Fig. 13: Since the NO2 concentration values of interest are between 0 and ~1000 pptv, the figure axis should be chosen accordingly (or a zoom should be added).

Spelling errors:

175 than (that)

176 enters (into) channel 1

176 ID and OD should be defined at least once

241 (at)

252 section 3.1.3 (3.2.3)

308 is (was)

346 the determination

351 to the retrieved

365 and in the

368 Hitran 2008 database

396 (,)

413 inaccuracy

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418 often (usually)

430 higher (more)

506 limit(s)

514 were conducted

538 took (-) off

518 airport(s)

520 from continental (near) Europe

524 (from of the)

440 for longer times

461 Allan (Allen) - this is wrong in a few instances throughout the paper

483 worse (less) than the (that) values quoted

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 3499, 2011.

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