Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-319-RC2, 2016

Atmospheric Measurement Techniques Discussions
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Interactive comment on "Development of a portable Cavity Enhanced Absorption Spectrometer for the measurement of ambient N_2O_5: experimental setup, lab characterizations, and field applications under polluted urban environment" *by* Haichao Wang et al.

Anonymous Referee #2

Received and published: 15 November 2016

This manuscript describes the construction, testing, and initial deployment of a cavity-enhanced spectrometer for the detection of N2O5. The instrument is quite similar to prior NO3 / N2O5 instruments in the literature, although this instrument might be more portable or operate at reduced power. The manuscript should do a better job differentiating what was done by the authors from prior work. The mechanism of alignment may be novel, but that is not fully clear based upon the short description. The writing of the manuscript is a major problem, and the authors need to improve that aspect of

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the manuscript to make it potentially acceptable for Atmospheric Measurement Techniques (AMT). The authors have clearly built a functional N2O5 instrument, but the manuscript needs improvement and better clarity of how this work is novel to be acceptable for AMT.

General issues:

Throughout the manuscript there are small missing details that should be included. Often these are things like the manufacturer / part number for components in the instrument (e.g. the filter, coating for cavity tube, "corrugated pipe", etc.) Please expand on these details so that one could have full details.

The discussion of d_eff in section 3.2 is confusing. This seems to indicate that the effective length of the cavity differs between NO2 and NO3, which would be strange. Potentially there is some change in the purge between the configuration where NO2 and NO3 were measured?

It is preferred to use "mixing ratio" (rather than concentration) as the term for the ppt abundance of N2O5 (or any other chemical). Additionally, use of pmol molˆ-1 is preferred as more clear than ppt. For gases in the ppb range, one would use nmol molˆ-1.

The manuscript describes a good laboratory test for the inlet filter transmission, but does not describe how often the inlet filter is changed in operation, or if that change is based upon mass loading of the filter or simply a time criterion. Please explain operational filter change procedures. Some discussion of the decay of filter transmission, how that is quantified, and how the filter transmission decay affects the overall instrumental accuracy should be included.

The manuscript mentions the comparison to an Aerodyne I- CIMS, but indicates that comparison will come in a future publication. If this publication doesn't show any CIMS data, then it should not mention that CIMS data. Without any evidence shown of what "good agreement" is, this manuscript cannot make such a statement. I think that inclu-

sion of the I- CIMS comparison would enhance this manuscript.

It is necessary to give some description of the instrument itself (e.g. size, weight, power consumption), and a photograph of the instrument would also be informative. Such a photograph would also probably answer question about the physical construction of the instrument.

It is not clear if NO3 is calculated from presumption of equilibrium and then corrected for or simply ignored. Please re-work discussion and presentation of NO3 in this manuscript.

Specific issues:

Line 38: Most areas with major NOx loadings also have significant aerosol loadings. Is this section meaning to indicate pollution aerosol, or potentially aerosol from nearby natural sources (e.g. desert dust)?

Line 46: Two ion CIMS ion chemistries have been demonstrated, NO3- and I-. Others could be possible, so the wording should be altered. Also, listing the reagent ion consistently is important.

Section 2.2 is listed twice on page 4 – it is both "optical layout" and "flow system".

Line 119: Please explain the "pilot experiments". Is there no flow cell in the middle? Are the mirrors on adjustable mounts, or how are they adjusted?

Line 126: What does "(-0.1) mm" mean?

Line 133: Maybe "homocentric" is "concentric"?

Line 148: "Stand" is maybe "Stainless"? How was the tube coated?

Line 173: Wording quite awkward here.

Line 234: Please clarify what is mean by "negative absorption of NO2". I understand this, but it could be made more clear to a general reader.

Line 296: I'm not clear on what is meant by ", which is limited by the transmission factor 2"? Clarify.

Line 343: This section discusses NO3, which apparently was not measured, but the figure shows a calculation of NO3. Please clarify that NO3 is only every calculated (e.g. in Fig. 12). It appears that the signals detected are simply interpreted as N2O5 without any correction for potential NO3, but that is made less clear by Eq.3, which seems to include NO3 in the observed signal. Please make this section more clear.

Fig. 6 caption: There are no labels as to what a), b) and c) mean. Is c) a residual or a non-detection of N2O5? The caption says "two spectra"

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