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Atmospheric Measurement Techniques Discussions

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 #1

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Review of Wang et al.: Development of a portable Cavity Enhanced Absorption Spectrometer for the measurement of ambient N2O5: experimental setup, lab characterizations, and field applications under polluted urban environment.

The manuscript of Wang et al., which reports on their new instrument to measure N2O5 is difficult to read. The level of English language is inadequate and only someone very close to this sort of instrument and its operation will make sense (after several readings) of some passages of text.

The manuscript offers little that can be considered more than repetition of that which is already found in the literature for similar instruments. There is no "significant" design innovation and indeed the use of just one cavity to measure the sum of NO3 and N2O5 means that this instrument can only be operated under high NOx (or low temperature) conditions when the NO3-to-N2O5 ratio is likely to be low.

The instrument is described as small and portable, yet no information about its weight or size (or power consumption) or given. No useful comparison is made to existing devices that measure N2O5.

The manuscript is not suitable for publication in AMT. The following comments may help the authors should they consider re-writing. They should also seek assistance in improving the English.

L25. Why do high levels of N2O5 imply an active nighttime chemistry ? If N2O5 builds up it may in part be due to lack of reactivity of NO3 or lack of uptake of N2O5 to aerosol.

L64. CEAS is suggested to give better selectivity that CRDS. Can the authors give an example of when CRDS measurements of NO3 are not specific. ?

L70. Vertical profiles of NO3 are suggested to be important. This is undoubtable the case, but why is it mentioned here ? is the instrument designed for or suitable for airborne operation (weight, power, size) ?

L90. Compare this instrument with the IBBCEAS already in operation (Langridge, Benton, Kennedy) ? Compare LOD and uncertainty with other N2O5 detection methods.

L148. Coated stand steel tube (stainless ?)

L187. "N2O5 is normally two orders of magnitude small concentrated than NO2 during nighttime. This is not true. There are plenty of examples where N2O5 is a substantial fraction of NOx. Also, N2O5 (and thus the NO3) formed can be close to zero at night (as the authors show in their own data). When N2O5 is close to zero, the NO3 formed by thermal dissociation is then not the dominant absorber.

L195. How was the deff established to be 45.0 cm using NO2 ? Was this a bottled standard of

NO2. What is the uncertainty of this approach (bottled mixing ratios, NO2 cross sections)?

L237. "The excess NO is sufficient to chemically destroy (destruct) the . . ..NO3." What was the NO mixing ratio, show the calculation. What was the NO2 impurity in the NO bottle ?

L295-313. The whole section is confusing. Some points: The purge flow does not result in a dilution of the NO3. It flushes the NO3 through the cavity changing the optical path length. This requires a different calculation to make the correction. Stopping the flow to measure NO3 loss in the cavity will mean that you lose information about point losses in front of the cavity (i.e. at mixing points in the tubing). Show the calculations to derive the effective transmission from the measurements of wall loss and residence time.

L311. How was the total transmission efficiency of NO3 derived ? What is the loss rate constant in cold PFA piping (the inlet) ?

L320. Explain how the best limit of detection was derived. Was it taken from the intersection of the two dotted lines ? Why should this give the best detection limit ?

L324. The total uncertainty on the scattering cross sections of He and N2 is given as 5 %. Where does this number come from ? Any significant difference between N2 and air ?

L344. What were the "conditions experienced for the winter campaign" that ensure that N2O5 / NO3 is greater than 10 ?

L355. The presence of HDV results in loss of N2O5. Provide (and justify) a hypothesis why this is the case.

L364. What is meant by "a steady state calculation" ? Is this referring thermodynamic equilibrium between NO2, NO3 and N2O5 ?

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