

Interactive comment on “Folded Tubular Photometer for atmospheric measurements of NO₂ and NO” by John W. Birks et al.

Anonymous Referee #2

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This manuscript describes an instrument based on near-UV absorption for measuring atmospheric NO₂, with NO also measured by conversion to NO₂ upon addition of O₃. It contains an extensive description of the instrument, potential problems with the measurements and some field data comparison to more ‘traditional’ measurements of NO₂ (CAPs and conversion to NO followed by chemiluminescence detection). The manuscript is certainly within scope of AMT, is well written and gives a very good overview of this new measurement method. I recommend publication in AMT once the following relatively minor issues have been addressed.

General comments:

One of the key parts of the instrument is the ‘scrubber’ which removes NO and NO₂ in order to get the I₀ measurement required for the Beer Lambert law calculation of

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concentration. This is first mentioned in section 2.1 but with no details of what material is used. The material details are mentioned later in the manuscript but these should be described in the earlier section. There is also no discussion of how efficient the scrubber is or the potential time interval required between scrubber replacement. Any degradation in the efficiency of the scrubber will have a direct detrimental effect on the quality of the NO₂ measurements so something should be said about this. Have any tests been carried out on the scrubber in different ambient NO₂ levels? The instrument is likely to be most often used in polluted environments and I wonder how well the scrubber works at ambient NO₂ levels of 100’s of ppb?

NO measurements are made by converting it to NO₂ by addition of O₃ to the gas flow, with the O₃ produced using photolysis of air using a low pressure mercury discharge lamp. The authors state that they get 98.8% conversion within the system. Have they investigated how this conversion might change with lamp age? For how many hours can the instrument be run before a change of O₃ lamp is needed. This would seem to be crucial information if the instrument is indeed to be used for long term measurements of NO and NO₂.

The authors go into detail about how the accuracy of the instrument is calculated. Could they also make some comment on the detection limit for NO₂. This is important information for anyone wanting to use the instrument in more rural or remote environments? By how much could the ultimate sensitivity of the instrument be improved by increasing the pathlength, something that it is stated is possible on P8 L7.

In section 4 the authors describe other techniques (both direct and indirect) for measuring NO₂ but Laser Induced Fluorescence (LIF) is not included as a direct technique. Whilst there are no commercially available LIF instruments available it has been used extensively for research with a large amount of literature on the subject so it should at least be briefly mentioned.

On P16 line 22 the authors state that “the cost of both the CAPS and CRDS instru-

ments are significantly higher than the single-pass folded Tubular Photometer described here". I'm not sure this is strictly true, especially with the Teledyne T500U CAPS instrument. Also, CRDS instruments generally has a significantly better detection limit than the instrument described here, which maybe what a user required. I suggest removing reference to the cost of instruments.

The manuscript describes an instrument to measure NO₂, however there is a section at the end describing how O₃, SO₂ and aerosol extinction could be measured by the same technique. Could the authors make some estimates as to how sensitive / accurate such an instrument would be? I also wonder if the text mentioning the other species should really be in the first sentence of the abstract?

The final sentence of the abstract "In contrast to other commercially available direct NO₂ measurements, such as cavity-attenuated phase shift spectroscopy (CAPS), the Folded Tubular Photometer provides a means for measuring NO simultaneously in the same apparatus by quantitatively converting NO to NO₂ with ozone, which is then detected by direct absorbance.", kind of suggests these other techniques could not measure NO with similar addition of ozone. I don't think this is true - it is just the manufacturers have chosen not to do it. This should be made clear in the abstract and text.

Technical corrections:

P5 L12: The acronym FTP is used here for the only time in the manuscript. The authors should either remove it or use it every time Folded Tubular Photometer is used after the first mention.

P6 L34: Is the a reference to for the black carbon measurement at 880nm?

P8 L5: what material o-rings are used?

P8 L17: what does 'nearly plug flow' mean?

P11 L35: Surely the instrument cannot operate in "NO only mode" as the measurement

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would be a sum of NO and NO₂? So should this read "NOx or NO₂"?

P16 L9: "O₃resulting" space required. Also I think this is the only time O₃ is used instead of ozone in the manuscript. The authors should be consistent throughout.

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