

Interactive comment on “Portable Ozone Calibration Source Independent of Changes in Temperature, Pressure and Humidity for Research and Regulatory Applications” by John W. Birks et al.

Anonymous Referee #3

Received and published: 10 June 2018

The manuscript describes a portable ozone calibration source to be easily used at field stations. The O₃ production is based on oxygen photolysis at 184.9 nm using a mercury lamp. Stable O₃ concentration are achieved by controlling the residence time in the photolysis chamber and by monitoring the lamp intensity at its emission wavelength at 253.7 nm. No zero air source is required and implications for the uncertainties are discussed. The authors have proven its capability to be suitable as an ozone calibration source under the tested conditions. I recommend publication after addressing following comments.

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General Comments:

The manuscript is well written and describes the device's concept including uncertainty analysis and experimental verification. Critical for the produced O₃ mixing ratio are i.e. the lamp intensity and the phototube which need further information. How stable is the phototube and the O₃ calibration source over time? A discussion about the dependency of O₃ production on the lamp line widths, characteristic for the lamp used, should be included in the manuscript. The O₂ absorption around 184.9 nm has fine spectra and therefore the absorption is highly dependent on the line widths of the lamp (e.g. Lanzendorf et al., Geophysical Research Letters, Vol. 24, no. 23, p. 3037-3038, 1997; Hofzumahaus et al., Geophysical Research Letters, Vol. 24, no. 23, p. 3039-3040, 1997; Ceasy et al., Geophysical Research Letters, Vol. 27, no. 11, p. 1651-1654, 2000).

Specific Comments:

Page 5, line 150: As no zero air gas is used ambient air is scrubbed for O₃, NO and NO₂. Please provide information what kind of scrubber is used and what its efficiencies are for O₃ and NO_x. In city environment with more than hundred ppb NO_x, residual NO_x could have a non-negligible effect on the produced ozone. In VOC rich environments, such as forested regions, the produced ozone has the potential to react with remaining ambient VOCs. Additionally, absorption of the UV light by VOCs could occur. Please estimate the uncertainty for your produced ozone concentration due to VOC reactions and absorption.

Page 5, line 153: The performance of the phototube is one of the critical devices in the setup. Please state, what kind of phototube is used. What is its long term stability?

Page 6, Line 165: What is the accuracy of the regulated flow?

Page 6, line 167: Please clarify what is meant by scaling the voltage of the photodiode.

Page 7, line 202: The measured precision is a combination of the precision of the O₃

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calibration source and the O₃ monitor. The authors state that the measured precision of the O₃ monitor at zero ozone is 2.1 ppb and the regression of the combined precision of O₃ monitor and O₃ calibration source has an intercept of 1.8 ppb. However, it is unclear, how a constant offset in the precision can be attributed to the O₃ monitor alone.

Page 8, Line 229: What is the uncertainty using this approximation?

Page 8, Line 236: The obtained O₃ mixing ratio is a function of O₃ production and O₃ loss. In equation (5) the time dependent loss terms, e.g. O₃ photolysis (184.9 nm, 253.7 nm), have to be considered.

Page 9, line 272: The authors have estimated the effect of water on the flow meter reading and its absorption for one special case to be 0.5%. Is this the maximum deviation which can occur?

Page 16, Table 2: The author stated a lower precision and accuracy than described in the paper to account for potential variability among individual instruments. How were these numbers derived? What is the reason for this variability?

Technical Comments:

Page 1, line 22: Not consistent: Later in the manuscript response time was stated to be < 30 s.

Page 3, Line 69: "Because ozone is an unstable gas, easily decomposing to molecular oxygen, calibrations ..." Please add that ozone is not stable in gas cylinders, e.g. "Because ozone is an unstable gas, easily decomposing to molecular oxygen in gas cylinders, calibrations ..."

Page 6, line 174: Please specify the type and material of the three-way solenoid valve.

Page 8, Line 223: "... and the oxygen concentration (cO₂) in air at a temperature of 298 K ..." Please change to: "... and the oxygen concentration (cO₂) in dry air at a

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temperature of 298 K ..."

Page 8, Line 223: Please use SI units.

Page 8, Line 245: Please add the range in which the flow can be maintained.

Page 8, line 250: Please quantify indistinguishable.

Page 11, line 321: Please quantify "sufficiently accurate".

Page 11, line 337: Please specify type and material of the three-way valve.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-110, 2018.

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