

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2022-203

Anonymous Referee #2

Referee comment on "A lightweight broadband cavity-enhanced spectrometer for NO₂ measurement on uncrewed aerial vehicles" by Caroline C. Womack et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-203-RC2>, 2022

The manuscript, "A lightweight broadband cavity-enhanced spectrometer for NO₂ measurement on uncrewed aerial vehicles," by Womack et al. describes the design and performance of a new, compact instrument for atmospheric measurements of NO₂. NO₂ plays multiple roles in the atmosphere, including as a pollutant and key player in oxidation chemistry in the troposphere. The availability of inexpensive uncrewed aerial vehicles (UAVs) has increased the need for smaller, lighter, and less expensive instruments for measuring atmospheric trace gases. Previously, NO₂ has been measured with large, expensive optical instruments. Small electrochemical sensors exist but lack sufficient sensitivity for atmospheric measurements. Hence this work is of significant importance to the atmospheric chemistry community. The instrument design utilizes broadband cavity enhanced absorption spectroscopy, and is similar to an existing larger instrument by the same team with a demonstrated track record of NO₂ measurements. The paper is well written, and the description of the instrument is detailed and clear. The method has been tested successfully in preliminary flights, the results of which are included. I have only a few small comments and I recommend publication following minor revisions.

Equation 1: In equation 1, there is no Δ in front of a ray, ZA in the first parentheses, but in the description in the text, there is a Δ . This seems inconsistent and should be fixed. (In the equation in the referenced paper by Min et al., (2016), there is no Δ in front of a ray, ZA or a ray, sample. The Δ appears in Δ a ray, which seems correct as it is the difference between the two.)

Line 192: Reference is made to operating the instrument with the LED off, but no description of the instrument control is given. How is it controlled during flight, or on the ground? Is there an operation algorithm, or does everything turn on when powered?

Section 5.2: The instrument accuracy based on standards is very good, but it would be interesting to include an intercomparison of this instrument with the standard, aircraft-based BBCES instrument as well to further test the accuracy.

Line 225: The text says that Figure 3 shows the Allan deviation for the optical extinction and retrieved NO₂, but the figure only seems to show the retrieved NO₂.

Line 245: Little description is given on the inlet used, just that it extends above the UAV. More information is needed. How far above? What is its configuration? What is the residence time of the sample prior to entering the detection volume? This is of particular importance because of the disturbance to the surrounding air by the UAV, which in turn affects how the measurements can be interpreted.