Referee #2:

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.

We thank the reviewer for these comments on our manuscript. We have addressed the comments listed below, and provide changes listed in blue. We also provide a tracked-changes version of the manuscript. Line numbers in our response refer to this manuscript version.

Equation 1: In equation 1, there is no Δ in front of α 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 α ray,ZA or α ray,sample. The Δ appears in Δ α ray, which seems correct as it is the difference between the two.)
We thank the reviewer for catching this. The Δ in the text is indeed a typo and has been removed.

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?

Currently, the LED and pump are both powered on and off by physically disconnecting their power cables from the main power source. As the calibrations are completed on the ground, electronic/remote control wasn't necessary, but future efforts will focus on developing this capacity for added ease of use. We would prefer to keep this description simple, but for clarity, we have changed line 200 to read "We then power on the instrument and record dark background spectra with no LED light."

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.

Future field studies with both instruments can be used to compare them directly while sampling ambient air at a range of conditions. For now, we note the fact that both the original aircraft-based ACES and mACES use an identical detection technique and analysis approach, and we have confirmed their responses to standard NO2 concentrations (in this work, as in Min et al. 2016). We have included the following paragraph on line 287: "Despite its small size, the accuracy of this method is comparable to that of other spectroscopically based instruments (e.g., CRDS (Wild et al., 2014), LIF (Thornton et al., 2000)) and of research-grade photolytic conversion of NO_2 followed by detection of NO (Pollack et al., 2010). The versatility of mACES may facilitate intercomparisons of research grade and monitoring network NO_2 and NO_x instruments."

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.

This was a typographical error from a previous draft. That line should have referred to the Allan deviation of just the retrieved NO_2 concentration. We thank the reviewer for catching this. The line now reads "Allan deviation plots (Werle et al., 1993) were calculated for the retrieved NO_2 concentrations, to quantify the precision and drift as a function of time. Fig. 3a and 3b show the Allan deviation and normalized histogram for the retrieved NO_2 concentrations during the zero air measurements."

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.

(Response to Referee #1, item (1) is reproduced here): We opted for a simple inlet in this instrument paper, consisting of just a Teflon tube protruding above the propellers, but still within the estimated propeller wash. For some sampling applications, we anticipate this will be sufficient, while for others, a more complicated sampling setup may be desired. But detailed investigation of sampling from drones is beyond the scope of this paper, and concerns all types of drone-based instrumentation, not just our NO_2 instrument. Therefore, we opted to focus on the mACES instrument, and keep the inlet simple. We have added further clarification about it on lines 105 - 107: "During the test flights described here, the sampling inlet was a 0.635 cm OD Teflon tube that extended 0.2 m directly above the UAV rotors and was secured to the drone's antenna.", and on lines 118 - 119: "The residence time in the sampling inlet line is estimated as

0.2 s and therefore did not add significantly to the total residence time." Additionally, we added the following at line 257 - 258 to discuss possible upgrades to the inlet, if sampling outside the prop wash is desired. *"If sampling outside the propeller wash is desired, a lightweight sideways sampling inlet arm could be added to the payload."*