This manuscript presents the VOLCANO3 instrument, a light-weight drone-deployable ozone monitor. Its chemiluminescence means of detection is designed to avoid cross-sensitivity to SO2 and therefore produce dependable measurements showing the depletion of ozone within volcanic plumes.

As a proof of its viability, the system is deployed to gather data within the plume of Mount Etna. The results shows decreased ozone concentrations within the plume.

This work is within the scope of the AMT journal. The creation of this system represents a significant advance in the capacity of researchers to investigate ozone depletions within volcanic plumes. While ozone depletions have been measured by other means, this is the first publication demonstrating a system for monitoring ozone that is practicable to deploy on a drone and resistant by design to interference in the signal from volcanic SO2.

The advantages that this system offers are evident in the example Etna results. There is q good level of detail to allow for replication and development by other researchers.

Overall I recommend this manuscript for publication in this journal with minor corrections.

1. Introduction

The introduction provides a reasonable background to the field.

I would suggest that the following are additionally addressed:

- Prior studies such as Rüdiger et al. (2018) and Karbach et al. (2022) have deployed drone-based in-plume measurements for other gases, notably SO2. Such drone based systems should be briefly referenced .
- So as to highlight the advantages of the VOLCANO3 being drone-deployed, the introduction should overview the settings for prior O3 measurements within plumes (i.e. aircraft based or ground-based and relying on grounding plumes)

2. The principle of CL-O3 monitors

This section describes, technically, the theory of chemiluminescence and reports the overall calculations that produce mixing ratio numbers as equation 1 and 2. This is useful and generally well described. The assignment of units to the parameters here needs to be consistent, with explicit units for pressure and temperature.

3. A compact CL ozone monitor

This section would be improved by a photograph of the system, in addition to the schematic shown in Figure 1.

There is a mismatch between the text and Figure 1 – there are references to labels A-D in the text but no such labels on the Figure.

The section on CL-Monitor Characterization is useful for replicability. Some minor comments regarding this:

- It would be helpful to know if such correction/calibration is required for each deployment.
- The parameter a_{cal} should be defined immediately after its use.
- The O3 generators for calibration are external to the main devoice. The specific O3 generators used in this study could be replaced with alternative model. Therefore, the wording should clearly state that “In this study [these devices] were used”.

- I assume the constant O3 periods discussed on line 180 are during calibration. This should be explicitly stated.
- As written the text in lines 190-193 describes only generating a step-up in O3. If a step-down was also tested, as implied on line 194, this should be explicitly noted.

4. Field measurements

This section describes a field campaign at Etna where the VOLCANO3 instrument was deployed and produced promising results.

Section 4.1 and Figure 4 demonstrate that VOLCANO3 can produce typical vertical O3 profiles.

Section 4.2.2. describes the instrumentation used in the campaign. VOLCANO3 is paired with "little-RAVEN" as described in Karbach et al. (2022) for various measurements including SO2. This is a critical element of the system, as without these volcanic plumes could not be identified in the signal. The weight of little-RAVEN should be given in this section, as it is useful for the reader to know the combined payload of the two instruments.

"little-RAVEN" has an SO2 saturation point of 16 ppm. This is a significant limitation and the current presentation at line 250 is too late. I suggest presenting this information within section 4.2.2..

Section 4.2.3. discusses the four flights of the campaign.

These flights are mapped on Figure 5. This map should clearly indicate the launch and return points for the flights. I also suggest adding arrows to the flight path so the reader can see the direction of flight.

Figure 6 shows clear anti-correlation of SO2 and O3 for one of the flight data sets. This is a very interesting result. Data for all flights are tabulated in Table 1. It is unclear how results where SO2 was above the saturation level were treated in the calculation of summary statistics, this should be made clear to the reader

5. Future developments

This section makes some reasonable suggestions as to how the VOLCANO3 system could be developed, particularly in terms of reducing weight.

I would like to see discussion here that relate to the 16 ppm saturation point for SO2 measurements. This is currently a significant limitation, as it prevents identification of the most dense parts of the plume where near total ozone loss may be expected. Could VOLCANO3 be paired with alternative SO2 monitors?

6. Discussion and conclusion

At line 286 "ambient measurements in Heidelberg" are mentioned, but these are not mentioned in the paper.

At line 289 the measurement accuracy is reported to be around 7% for 40 ppb O3.

The final sentence of this section appears to be incomplete.

Other comments, mostly technical

- Throughout: Some numerical values use commas rather than dots for decimal markers. These should be dots throughout
- Throughout: The format of minxing ratios (ppmv, ppbv vs. ppm, ppb) should be consistent throughout.
- Line 13: Add “tropospheric” before volcanic plumes
- Line 14. Suggest the statement “the underlying chemical mechanisms are still poorly understood” be changed. There exists now a reasonable theoretical understanding of the associated chemistry, albeit with some unknowns.
- Line 57: “in use since decades” change is “have been used for several decades”.
- Line 77: change “assumption” to “result” or similar. This phenomenon has been repeatedly observed and can be described in stronger terms than an “assumption”.
- Line 120: Change format of reference.
- Line 127: the presence of “(:” suggests some text or label is missing here.
- Line 150: change “in” to “at”
- Line 211: suggest “Geological evidence suggsts volcanic activity since 0.6 million years” changes to “Geological evidence suggests it has been active for approximately 0.6 million year”. Alternatively this sentence could be removed entirely.
- Line 212-213: suggest removing “is undergoing significant morphological changes over time”, and changing “currently hosting” to “currently has”.
- Line 247: remove “basically”
- Line 301-302: change “prove” to “proof”, change “those theoretical considerations” to “these model predictions”.
- Line 418-419: Check URL format
- Line 480: Change “Tabel” to “Table”

References

Karbach, N., Bobrowski, N., & Hoffmann, T. (2022). Observing volcanoes with drones: studies of volcanic plume chemistry with ultralight sensor systems. *Scientific Reports*, *12*(1), 17890. https://doi.org/10.1038/s41598-022-21935-5

Rüdiger, J., Tirpitz, J.-L., De Moor, J. M., Bobrowski, N., Gutmann, A., Liuzzo, M., Ibarra, M., & Hoffmann, T. (2018). Implementation of electrochemical, optical and denuder-based sensors and sampling techniques on UAV for volcanic gas measurements: Examples from Masaya, Turrialba and Stromboli volcanoes. *Atmospheric Measurement Techniques*, *11*(4), 2441-2457.