Responses to the Reviewers for the Manuscript Submitted to Atmospheric Measurement Techniques entitled “A modular approach to volatile organic compound samplers for tethered balloon and drone platforms” (amt-2024-96)

Note: The reviewer comments from both reviewers and the corresponding responses from the authors are below. The reviewer comments are in blue, the authors’ responses are in black, and any changes to the text are included in red.

Comments to Reviewers:

We would like to thank all reviewers for their time and contributions to improving the manuscript. As requested, major and minor revisions have been made to improve the clarity, introduction, language, analysis, and interpretation. All minor/grammatical revisions were incorporated, and major revisions are discussed in more detail in the comments below.

Reviewer #1

In their manuscript "A modular approach to volatile organic compound samplers for tethered balloon and drone platforms" (amt-2024-29), the authors present an instrument for collecting multiple sorbent tube samples that is suitable for balloon- and drone-based platforms. In general, this is a major topic in VOC sampling and the subject of many recent advances. The instrument described here is a nice addition to the suite of custom tools that have been developed throughout the research community. And the reported applications demonstrate the utility of these measurements To be suitable for publication, this manuscript should more fully examine the existing literature and explore what tools are out there. Many of the goals achieved in this work have been previously demonstrated. The authors are in a bit of a rock and a hard place, because many of the samplers previously demonstrated are not commercially available, so there is value to providing detail and demonstrating their own solution and I think it is still valuable to publish this work. However, with that in mind, I would have liked to see a little bit more of a demonstration of the science that will actually be achieved with this device and/or a demonstration of some of the next-step advances they describe as being possible and would advance the field. Specifically my two major concerns are described here:

(1) There are details missing on the technical aspects of this device. For example: it's overall weight and size are only in the abstract, the capacity of the battery is not provided, there is a lack of clarity about the control system (why a computer and a microcontroller?), whether power for the UAV version is being supplied by the UAV itself, how or if it is being integrated into the TBS payload, etc.

> **Response:** The authors thank the reviewer for their comment and acknowledge the lack of specific details (e.g., sampler weight and power sources) on the technical aspects of the described TBS sampler. Additional information has been included in the methods section of the manuscript, including material regarding the weight, power sources, sample control (i.e., microcontrollers and computers), integration into the TBS payload, and the flexibility of the design as addressed in the specific comments below.

(2) The introduction overlooks prior work that demonstrated many of the achievements shown here, primarily multiple samples collected from a single airborne package. The authors elude to many promising features of their work, including communication with the ground, potential to integrate signals from other instruments, and complex sampling strategies. These advances would truly be novel and show the field what can be done, but are not really demonstrated here (and their theoretical possibility was mentioned in some of the previous literature). The authors should look a little more deeply into the literature (a few citations are provided, but I think there are others) and more thoroughly identify the gaps and how their work fits into that context.

> **Response:** The authors greatly appreciate this comment and took advantage of it to restructure the manuscript introduction, thereby providing more clarity of the previous literature. Specifically breaking down key advancements in UAV platforms and the corresponding gaps in TBS literature/approaches. This resulted in a more streamlined introduction and a more specific problem statement focusing on the TBS system.

<u>Specific comments:</u>

Comment #1: Line 68-70. There have been at least some efforts (including work published in this journal) on independent, drone-compatible VOC samplers, both for collection of multiple coordinated samples across multiple platforms (DOI: 10.5194/amt-16-4681-2023), and for sequential samples within the same platform (DOIs: 10.5194/amt-12-3123-2019; 10.1016/j.jes.2024.04.016) as is being reported here. So this statement is not really true and highlights some need for a bit more literature review to place this work in the context of prior work.

> **Response #1:** The authors thank the reviewer for their comment. This reviewer highlights the advancements of UAV-based VOCs samplers. We have corrected the text to highlight the lack of similar advancements for TBS-based VOCs samplers, which is the main focus of this manuscript.
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> Lines 78 – 83, "Recent advancements in sorbent tube VOCs samplers have focused on providing low cost, portable samplers (Hurley et al., 2023) and UAV-based VOC samplers with multiple tube sampling capabilities (Chen et al., 2018; Batista et al., 2019; Mckinney et al., 2019; Asher et al., 2021; Li et al., 2021; Leitner et al., 2023; Yang et al., 2023; Zhai et al., 2025). Many of these advancements have been made possible through miniaturization (e.g., size and power requirements) of key components such as computers, pumps, values, and relays. However, a modular sampling system capable of functioning independently to collect multiple VOC samples per flight on a TBS has not been designed and deployed."

Comment #2: Line 86-87. It's not clear what the author's mean by this statement. For example, commercially available options can monitor trace gas levels and use them as triggers for sorbent tube collection (see for example the SENSIT SPOD), and canisters have regularly been collected alongside comprehensive instrument payloads, includign with an arbitrary trigger for collection (DOI: 10.5194/amt-10-291-2017). What do the author's mean by "integrated" in this context?

Response #2: The authors thank the reviewer for their comment. The phrase integrated describes the need for VOC sampling systems to be able to work with the power and weight limits of the sampling platform itself (UAV or TBS). Additional text has been added to clarify this point.

Lines 75 – 76, "These systems were not designed for flight-based measurements or to be integrated into flight platforms with additional sensors by meeting the weight, size, and power limits."

Comment #3: Line 91: By "integration" in the ARM TBS payload, do author's mean they use the meteorological, aerosol, and ozone data to inform timing of sample collection, or just that they share a data aquisition system? The latter does not seem like a scientific advance, but rather solving a specific technoical issue relevant just to the TBS system. Throughout the work, it looks like this sampler only uses preset timing to determine sample intervals, so it's not clear to me that it is really "integrated" in any meaningful way.

Response #3: This comment was addressed in Response #2 (see above)

Comment #4: Line 103-104. "uses lighter-than-air principles to obtain its initial lift" seems overly jargony/complex. I would say that the fact that helium-filled balloons rise can be considered common knowledge and does not need to be explained

Response #4: The authors agree with the reviewer and their comment was incorporated. Note: The phrase "uses lighter-than-air principles to obtain its initial lift" was removed from the manuscript. The text now reads

Lines 99 – 100, "In brief, TBS flights can reach a maximum altitude of 1.5 km AGL when the weather permits and carry a maximum payload of 33 kg via a tether controlled by a winch system."

Comment #5: Line 111. Authors should note the size range of particles measured by POPS, since later concentrations are provided just as total numbers

Response #5: The authors appreciated the reviewer's comment and have incorporated it into the manuscript. The size range of particles measured by the POPs has been added to the text, as referenced in (Creamean et al., 2021), which now reads

Lines 106 – 108, "In addition, particle size distributions were measured using a Portable Optical Particle Spectrometer (POPS, Handix Scientific LLC, CO, USA; 135 nm – 3615 nm), and ozone concentrations were provided via an electrochemical concentration cell (ECC) ozonesonde (Model 2Z, En-Sci, CO, USA)."

Comment #6: Line 131. The authors should clarify what they mean by modular. Which components can be separated and recombined in different ways?

> **Response #6:** A key goal of the manuscript was to develop a sampler design that incorporates scalable components and flexible construction, allowing it to be adapted for the different mass and power requirements of TBS, UAV, or other platforms. This modular approach provides a robust lower cost design (e.g., reduced maintenance and down time, access to interchangeable parts, and redundancy between the designs) that enables future users to customize the sampler to suit their specific applications. For example, the internal components described can be scaled up or down for the user's needs to optimize features such as weight, VOC collection capacity, and sampling control. For example, in this study, the modular design facilitated the adaption of the sampler from the original TBS configuration down to a UAV platform, specifically by removing the computer and utilizing only the microcontroller to control VOC collection. Additional uses of this sampler have reintroduced the computer and used its remote access capabilities to control VOC collection during a long-term, ground-based deployment. The other internal components, including the valves, pump, and voltage regulators, can also be recombined or expanded in different configurations to adapt to the user's needs and complete various sampling designs, as described in the conclusions.

Comment #7: Line 140. It's not really clear to me why there needs to be a computer on board. Why not just provide firmware to the Arduino and re-program it on the ground if necessary? Including the computer seems like extra weight and power. Or conversely, it looks like the UDOO Bolt has analog and digital I/O, so why include the microcontroller at all?

> **Response #7:** The authors thank the reviewer for their thoughtful comment. We recognize that individually the microcontroller and computer each offer distinct advantages. However, in this study, the UAV sampler utilized the onboard computer to communicate with the microcontroller, whereas the TBS sampler incorporated a computer to provide greater flexibility and opportunities than a microcontroller alone, which highlights the modular design of our approach.
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> In future studies, for example, users may leverage metadata to direct sampling, which would require a sampler capable of capturing data, running diagnostics, and adjusting the sampling strategy in response to changing conditions. These capabilities necessitate a computer rather than a microcontroller. In addition, while the computer includes digital I/O pins, integrating a microcontroller expands the capacity to communicate with multiple valves and a pump, enabling more complex sampling configurations. Moreover, the UDOO computer is lightweight (< 250 grams) and is relatively low cost (~$400 USD), making its inclusion in the sampler practical and feasible.

Comment #8: Line 147. How was flow controlled? Is flow checked on each tube, since their resistances could be different, or is it measured in real time? Also, no information about the pump is provided - what pump is being used?

Response #8: This is a great comment, and more details on the sampling flow control and pumps was added. The reviewer's comment was incorporated and information about the flow calibration and the pump used were included in the text.

Lines 147 – 150, "Before each sampling day, a flow calibration was conducted on each sorbent tube to account for potential variability among the tubes and to ensure the flow remained at 0.1 ± 0.002 lpm, as measured using a flowmeter (Model 5200, TSI Inc, MN, USA). When adjustments to the sample flow rate were necessary, users modified the pump voltage (Model E242-12, Parker, OH, USA) using the digital voltage regulator."

Note: The error associated with the flow meter was addressed in a response back to Reviewer 2 (i.e., 2%).

Comment #9: Line 204. What do the author's mean the code initiation was synced? That the start time was synced with the start time of the flight?

Response #9: Yes, the start time was synced. The text has been updated to improve the clarity of the line.

Lines 210 – 211, "The code initiation was synchronized to match the sampling strategies of the VOC sorbent tube collection with the TBS platform's flight plan."

Comment #10: Line 236. More information about this pairing would be helpful. Is the power for the UAV being directly used to power this device? And what communication features are being used. In general, more description of the "modularity" of this device would improve understanding of its uniqueness and value. This is later described in more detail in lines 254-256 and I agree ground-based communication with the device is a big step forward that I'm not sure has been previously demonstrated; this should be described earlier and/or in the methods.

Response #10: The authors thank the reviewer for their comment and agree the details about the communication between the UAV and the sampler were separated. The texts from lines 254 – 256 were moved up to be with the initial description in line 236. The text now reads

Lines 243 – 247, "The UAV sampler design demonstrates the scalability of the modular VOC sampler, and the flights showcase the utility of pairing the internal power and communication features of the UAV with the lightweight, robust components of the sampler to successfully collect VOCs. In this setup, the UAV control software-initiated VOC collection by activating relays within the UAV system. These relays supply power from the UAV batteries to the sampling pump and the valves to control sampling timing and selecting which sorbent tube to sample."

In addition, more text about the modularity of the system has been added and described further in the authors response to comment #6.

Comment #11: Line 250. Was the use of metadata used here or demonstrated? Complex sampling strategies have been previously shown to be possible on the other samplers mentioned above, but the inclusion of other sensors, though likely possible in the other systems, would to my knowledge be a new advance worth demonstrating explicitly.

> **Response #11:** No, metadata was not used to direct sampling in this study. Instead, data from additional instruments on the TBS and UAV packages (e.g., meteorological, aerosol, and ozone) were utilized to provide context for interpreting VOC data. The authors agree that using metadata to influence and modify sampling would be a valuable consideration for future users. To support such advanced applications, the sampler design includes both a computer and microcontroller, providing the flexibility needed to implement complex sampling designs in the future. This direction is mentioned in the conclusions where a bulleted list of potential future operations is provided (see bullet point #3 below).
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> • Additional sensors or monitors (e.g., ozone, pressure, GPS, etc) could be added to the system and provide real-time measurements to the computer via Bluetooth communication. These sensors could be integrated into a data-driven sampling strategy that allows for a more targeted VOC analysis in response to in-situ conditions.

Comment #12: Line 266. "1 A" is not a unit of power, do the authors mean 1 Ah? What is the size of the battery?

> **Response #12:** The reviewer's comment was incorporated and the correct unit of measure (e.g., 1 Ah) was included in the text. The UAV battery information was also included in the text. The text now reads
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> Lines 277 – 279, "When onboard the UAV, the sampling system utilized the internal batteries and consumed 1 Ah of power during VOC collection, representing 4% of the capacity (two 21,000 mAh, 22.2 VDC batteries)."

Comment #13: Line 343. Could the authors estimate increase in mass due to each additional tube? This would involve the tube, valve, and lines, are there other components that would also need to be scaled?

> **Response #13:** The reviewer's comment was incorporated and the mass for a sorbent tube, a valve, the necessary tubing, and a compression fitting were estimated to be 75 g per additional resin tube. The text was updated to include this estimate and now reads
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> Lines 357 – 360, "For example, the sorbent tube quantity could be scaled up to increase the number of samples per flight, with minimal increases to the power draw and sampler mass. A sorbent tube, valve, tubing, and a Teflon compression fitting have a mass of approximately 75 g, representing 3% and 9% of the TBS and UAV sampler mass, respectively."

Reviewer #2

This article describes the conceptual design and deployment of a battery-powered sampler that was used for the collection of volatile organic compounds onto multi-stage solid adsorbent cartridges from a tethered balloon and a drone platform. The sampler was deployed at two sampling locations in Texas and data from these campaigns are presented.

While I appreciate the effort that was put into the study and preparation of the manuscript, in my opinion this work has crucial deficiencies.

There are quite a few other previous tethered balloon and drone VOC sampling systems and deployments that have been reported in the literature. There is relatively little novelty in the particular sampling approach and deployment presented here. Furthermore, I consider the data rather questionable for the reasons described below.

Response: The authors greatly appreciate reviewer 2. They acknowledge there are several UAV (i.e. drone) based sampling systems described within the literature. However, there is a lack of TBS based sampling systems described within the literature. Addressing this knowledge gap is the focus of this manuscript (see research goals 1 and 2 presented in the last paragraph of the introduction). Lastly, additional descriptions regarding QA/QC (i.e., error, accuracy, and precision; see comments/responses below) were also greatly expanded, which markedly improved and strengthened the manuscript.

Specific Comments:

Comment #1: The analytical experiments do not specify the accuracy and precision of the sampling and analysis method.

> **Response #1:** The authors thank the reviewer for their comment. After reviewing the data, the authors estimated a 30% error to reflect the variability in the sampling (e.g., flowrate accuracy) and analysis method (e.g., sampling efficiency, sorbent tube desorption, and instrumental response variability). These error estimates have been added to the text of the manuscript (see below), for example, the flow meter used to calibrate the sample flow has an error of 2%. Moreover, when sampling using a UAV, potential vertical mixing caused by the UAV propellers introduces an estimated altitude error of ± 5 m (Ventura Diaz and Yoon, 2018; Mckinney et al., 2019). These error estimates were also incorporated into the methods and results sections for clarity (see below).
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> Lines 147 – 149, "Before each sampling day, a flow calibration was conducted on each sorbent tube to account for potential variability among the tubes and to ensure the flow remained at 0.1 ± 0.002 lpm, as measured using a flowmeter (Model 5200, TSI Inc, MN, USA)."

Lines 200 – 202, "A 30% error was applied to the VOC measurements to reflect the variability in the sampling (e.g., flowrate accuracy) and analysis method (e.g., sampling efficiency, sorbent tube desorption, and instrumental response variability). Specifically, the flow meter used to calibrate the sample flow has an error of 2%.

Lines 117 – 121, "Previous studies have investigated the air velocity distribution around UAVs and found the air flushing time below the UAV is much faster (i.e., seconds) than the VOC sampling timescale (i.e., 10 min), therefore the VOC samples may represent air parcel extending up to ± 5 m surrounding the sampling height (Ventura Diaz and Yoon, 2018; Mckinney et al., 2019). As such, a ± 5 m was applied to the sampling altitudes presented in the text associated with VOC measurements."

Comment #2: The effect of the downwash from the UAV rotors on the actual effective sampling height is not addressed.

Response #2: The error associated with the vertical mixing of the sampled air parcel due to UAV propellers has now been addressed in the response to reviewer Comment #1.

Previous studies have investigated the air velocity distribution around UAVs and found the air flushing time below the UAV is faster (i.e., seconds) than the VOC sampling timescale (i.e., 10 min), therefore the VOC samples represent an air parcel extending up to ± 5 m surrounding the sampling height (Ventura Diaz and Yoon, 2018; Mckinney et al., 2019). The flushing time is likely to be dependent on the size of the UAV, therefore smaller ones may have smaller flush times. The UAV we use is on the same size as the one in (Mckinney et al., 2019), which aligns with the ± 5 m estimation. Furthermore, the models suggest that the area under the UAV body is the least impacted by turbulent flow and therefore the best place to sample VOCs. The following text has been added to the manuscript

Lines 117 – 121, "Previous studies have investigated the air velocity distribution around UAVs and found the air flushing time below the UAV is much faster (i.e., seconds) than the VOC sampling timescale (i.e., 10 min), therefore the VOC samples may represent air parcel extending up to ± 5 m surrounding the sampling height (Ventura Diaz and Yoon, 2018; Mckinney et al., 2019). As such, a ± 5 m was applied to the sampling altitudes presented in the text associated with VOC measurements."

Comment #3: It appears that sampling tubes do not seem to have shutoff valves on the inlet side but are always open to the outside air during the flight, which allows them to passively sample VOCs during the entire deployment. These types of adsorbent tubes have been found to have passive uptake rates of approximately 0.5 ml/min in typical deployments at the surface (e.g. [*Mowrer et al.*, 1996; *Walgraeve et al.*, 2011; *Markes*, 2021]). This sampling rate might be higher under the highly turbulent conditions during the flight deployment. This will add substantial additional sampling VOCs during times when there is no active (pumped) sampling. For instance, if a deployment would be 2 hours from the time of installation to the removal, this would add on the order or 60 ml of sampling to the 1 l of sampling at the deployment altitude. VOCs might be higher at the surface than aloft, so one will never know exactly now much of the analysis results actually reflects the VOCs mole fraction at the balloon sampling height.

Response #3: The authors agree the sorbent tubes can be used in both active (i.e., pumped) and passive sampling, thus the authors collected several passive samples on TBS and UAV flights to characterize any sampling artefacts resulting from passive sampling. These sampling blank tubes (e.g., passive) were analyzed in the same manner as the sample tubes (e.g., active) and revealed collection of minimal masses of the measured VOCs from passive sampling (e.g., < 5% of the mass collected on the active sampled tubes). During the QA/QC process, the authors also blank corrected their VOC samples for potential passive sampling during flights (as described above), travel, and storage prior to chemical analysis. Therefore, the VOC values presented in the manuscript represent the most conservative values and are designed not to overestimate the VOC amount collected. For additional information the following text was added.

Lines 198 – 200, "Following chemical analysis, the samples underwent a blank correction to account for artefacts from passive sampling, travel, storage prior to analysis, and potential laboratory contamination."

Comment #4: The manuscript does not clearly state that samples are collected sequentially. The profiling data do not truly represent vertical profiles as intended in this sampling, but also need to consider that atmospheric VOCs may change rather rapidly in plumes in an urban or suburban environment. This temporal aspect of the sampling is not recognized in the manuscript.

Response #4: The authors have added details to the manuscript to clarify that the samples were collected sequentially during the test flights and the sample flights. Evidence of the samples being collected sequentially is also provided in Figures 2 & 3, which show a timeseries of the meteorological, ozone, VOC, and aerosol data. The specific text addressing this comment is below. Additionally, a note describing the temporal offsets during descending legs of the flights as it relates to VOC measurements was also provided (see below).

Lines 214 – 215, "During sampling, each sorbent tube was used once, while the process (i.e. powering the pump and opening and closing a unique combination of values) was repeated sequentially until all samples were collected."

Lines 236 – 238, "Sequential VOC samples were collected on three of the August 4th flights, including a morning flight (Flight #2, Sample 1), a midday flight (Flight #3, Samples 2 and 3) and a late afternoon flight (Flight #6, Samples 4, 5, and 6)."

Lines 216 – 217, "Note, these sequential samples provide VOCs measurements along a vertical TBS or UAV flight, where VOCs measurement are offset temporally during the descent leg of the flight."

Comment #5: It has long been known [*Goldan et al.*, 1995] [*Pollmann et al.*, 2005] that unsaturated VOCs, in particular biogenic VOCs such as isoprene, undergo rearrangement and loss during atmospheric sampling with prefocusing techniques from reaction with ozone in ambient air. A series of approaches have been researched and used by researchers over the years to mitigate this artifact [*Helmig*, 1997]. It does not appear that the sampler had any sort of scrubber for selective removal of ozone in the sampling flow path. It is therefore questionable if and what fraction of the actually present VOCs were captured by the sampling protocol.

Response #5: Similar to a number of UAV systems described in the literature (Chen et al., 2018; Mckinney et al., 2019; Batista et al., 2019; Asher et al., 2021; Li et al., 2021; Leitner et al., 2023; Zhai et al., 2025), this system did not incorporate an ozone scrubber prior to the sorbent tube. This potential issue has been acknowledged in the manuscript (see conclusions and future considerations). However, it is important to note that while VOCs may have large reactivity coefficients with the hydroxyl radical, for example isoprene's $k_{OH} \approx 100 \times 10^{-12}$ cm^{-3} mol^{-1} s^{-1}, they can have smaller reactivity coefficients with ozone, $k_{O3} \approx 1 \times 10^{-12}$ cm^{-3} mol^{-1} s^{-1} (Atkinson and Arey, 2003). Based on the estimated lifetime of isoprene with the hydroxyl radical (1 -2 hours; (Atkinson, 2000)) and the two order of magnitude difference in the reactivity coefficients, the isoprene ozone half-life is estimated to be significantly longer (e.g., hours to days) than the active sampling period (10 minutes).

Comment #6: Calibrating the adsorbent sampling with diluted liquid solutions is far from ideal as it does not reflect the actual air sampling. Utilization of certified VOC compressed gas standards is a much more widely used and accepted way for calibration in atmospheric VOCs monitoring.

Response #6: The authors agree with the reviewer that compressed gas standards are also used to calibrate VOC instrumentation and are likely considered the gold standard for atmospheric VOC monitoring, particularly for online gas phase instrumentation such as a PTR-MS. Moreover, our group operates a PTR-MS that is calibrated using certified gas standards and we recognize that acquiring these types of standards can be difficult to obtain with lead times taking at least 6 – 12 months (as there is a limited number of vendors that supply custom VOC blends, such as Apel-Riemer Environmental Inc). However, more importantly these types of certified gas standards are for a select few VOCs and often are designed for instruments such as the PTR-MS. This means that they often are missing VOCs typically not measured using PTR-MS or the Aerodyne Vocus. These types of calibration gases also require a dilution system or approach that provides different concentrations to the instrument. Otherwise, they are calibrating at one single concentration, whereas we deployed a minimum of 5 calibration concentrations using certified liquid standard solutions with dynamic linear ranges varying with individual VOC sensitivity.

In this study, sampling is specifically designed to be portable to assess a wide range of VOCs. Certified liquid standard solutions for calibration or internal standards are a necessity for any TD-GC/MS system (Mckinney et al., 2019). Moreover, utilizing diluted liquid solutions to calibrate sorbent tubes is also a well-established and accepted calibration approach for offline analysis. Liquid standard solutions have been used for sorbent tube analysis in several studies, including (Ribes et al., 2007; Gallego et al., 2010; Gallego et al., 2012; Schieweck et al., 2018; Schieweck et al., 2021; Hellén et al., 2024). In addition, the US EPA TO-17 method for the analysis of VOCs from active sampling onto adsorbent tubes enables both gas and liquid standards to be used for calibration purposes.

Comment #7: I could not find the Dieu Hein , 2019, reference (line 55) in the references list.

Response #7: The Dieu Hein reference was added to the list of references. The sentence was also reworded as

Lines 65 – 68, "A review of vertical sampling technologies for VOCs highlighted the limitations of available chemically sensitive sensors for aerial platforms and noted the UAV's potential to carry payloads consisting of multiple sensors and provide high spatiotemporally resolved data (Dieu Hien et al., 2019)."

Comment #8: The sampling only captures a subset of VOCs present in the atmosphere, probably well below half of the total VOC ppbC. This needs to be realized. The term 'Total VOC concentration' (line 286) is not quite accurate in this context.

Response #8: The authors thank the reviewer for the comment and apologize for any confusion caused by the terminology. The intent was not to refer to the total VOCs present in the atmosphere at a given time but rather the VOCs included in our list of target analytes. Where applicable, the terminology has been changed to "select VOCs" or "VOC mixing ratio". To clarify this further and provide appropriate context, the following sentence has been added to section 3.3,

Lines 326 – 327, "It is important to emphasize that the analytes quantified in this study represent only a select subset of the total VOCs present in the atmosphere."

Comment #9: Results are presented in ppb, which is a mole fraction unit. Calling this a concentration (e.g. line 288) is not correct.

Response #9: VOC mixing ratios are typically presented as ppbv. This has been corrected throughout the manuscript including the specific line 288 given by the reviewer.

Comment #10: The url that is provided for the data availability statement only leads to the archive portal, but not to the particular data that were generated in the study.

Response #10: The link for the TBS data was updated and text describing data availability was provided for the UAV measurements. Note: The data generated in the study were part of two TRACER field campaigns and were funded by different agencies (see below)

Lines 415 – 418, "TBS VOC data from select flights are presented here and can be found through the ARM Data Discovery portal, along with all ARM data used in this study (https://iop.archive.arm.gov/arm-iop/2022/hou/tracer-ozone/usenko-tbsvoc/?ticket=ST-25071-YsBQmA--n2APXsJidpMOvKzmbtQ-prod-cas-fwapp-5cdbdb454-dn9sh Last access date: 7 January 2025). The UAV VOC data is available upon request from the TCEQ."

Comment #11: Information provided in Table S2 is not clear. What does the product number refer to? What are the numbers in columns 4 and 5? Significant figures are inconsistent.

Response #11: The product numbers in the table refer to the vendor product number. For clarity, the vendor name was added to the Table S2 caption (Sigma Aldrich). The table was also adjusted to center the lower and upper limit of the calibration range (i.e., columns 4 and 5) under the table header. The significant figures were also modified and limited to two.

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