Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., author comment AC3
https://doi.org/10.5194/amt-2021-265-AC3, 2021

Reply on RC3

Jianqiang Zeng et al.

Author comment on "Design and characterization of a semi-open dynamic chamber for measuring biogenic volatile organic compound (BVOC) emissions from plants" by Jianqiang Zeng et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-265-AC3, 2021

Reply to comments by Reviewer #3

The authors show the performance of the open chamber that they have constructed for the measurement of VOC fluxes from plants. It is indeed important to characterize the chambers used in such studies. I feel that this manuscript still needs some work before it is ready to be accepted. Here are my comments that complement the other two referees' comments.

MAJOR COMMENTS

I share the concerns of other reviewers regarding the flow control and flow measurement of the outlet lines connected to holes 2 and 3 of the chamber. A better explanation is needed.

Reply: We have added more explanation as suggested in our revised manuscript (Lines xxx-xxx). In our system, flow rate (F_1) of main airflow is maintained by an air pump (MPU2134-N920-2.08, KNF, Germany) equipped with a mass flow controller (Alicat Scientific, Inc., Tucson, AZ, USA). Flow rates of all online analyzers (200 ml min^{-1} (F_2) for PTR-ToF-MS and 500 ml min^{-1} (F_3) for Li-7000) and automatic sampler (F_4, 200 ml min^{-1}) are controlled by their built-in MFCs, and total flow rate ($F = F_1 + F_2 + F_3 + F_4$) of circulating air is the sum of these flows and used to calculate emission rates. In addition, the accurate flow rate ($F_1 + F_2 + F_3$) through hole "3" is measured by a soap-membrane flowmeter (Gilian Gilibrator-2, Sensidyne, USA) before and after each measurement in the field. Flow rate through hole "2" for automatic sampler (F_4, 200 ml min^{-1}) is just ~ 2 % of the total flow rate, and thus has much less influence on the total flow rate.

Line 148: this statement is incorrect because a PTR-TOF-MS is capable of measuring with time resolutions higher than 1 Hz (e.g., when used for eddy covariance studies it is typically used at 10 Hz). In addition, the PTRMS natively measures mixing ratios instead of concentrations.

Reply: Thanks. We have corrected this in the revised manuscript.

Line 256-258: to make the units consistent in the equation(s), either the emission rate E must be expressed as "per minute" or the airflow rate F must be expressed as "per hour". I wonder if this could have an impact on the calculation that the authors perform in this paragraph about the detection capacity of extremely low emission VOCs. In addition, two more comments on the formulas. First, there is no indication on the equations of the unit of reference for the emissions (e.g., leaf area or mass of the plant emitting material), why is that? Second, Equations 1-4 do not account for the effect of water vapor effect (transpiration) on the calculated emission rates (see Niinemets et al 2011, section 3.5). Such a correction would probably look very similar to the correction for losses due to adsorptive loss (Equation 6 in the main text). What are the thoughts of the authors on that?

Reply: Thanks. We have taken care of the units consistencies in our calculation. All calculations are just right after carefully checked by different co-authors. To make it more clearer, in the revised manuscript we expressed the emission rate E in "μg min^{-1}". When normalized with dry mass leaves, we in fact obtain emission factors (*EF*) in equation (5). We have made changes the equation (5) as below:

As stated in Niinemets et al. (2011), the incoming air for most enclosures was pumped in with a constant flow rate, and this flow rate was used to calculate emission rate. However, the transpiration of enclosed leaves will add another flow into the outgoing air, causing total flow rate of outgoing air inequal to that of incoming air. That is, emission rate cannot be accurately calculated by just considering incoming air flow rate, and should be calculated with the outgoing air flow rate with the input due to transpiration. In our study, as we had noticed the consideration by Niinemets et al. (2011), we did not measure flow rates of the incoming air, which can freely flow into the chamber from holes on inlet panel, instead we measured total outgoing air flowrates already with the input from the transpiration. Moreover, to minimize the ambient-enclosure differences in temperature and RH (Fig. 7), we used a much larger flow rate in the field tests, and therefore the flow rate of transpiration will affect the total flow very slightly.

Although the transpiration correction in Niinemets et al., 2011 (Fig. 7) indeed looks very similar to the VOCs losses in this present study (Eq. 7; Fig. S7), they are quite different in their nature. The transpiration correction is about how the transpiration rate affects the total flow, and this transpiration correction therefore decreases with increasing flow rate. The adsorptive correction in this study, however, is about how the inner walls retain VOCs.

Line 357-361: This sentence is not clear to me.

Reply: Water molecules will compete with VOCs molecules for adsorptive sites on the chamber inner surface. If the adsorptive sites are occupied by water molecules, water-insoluble or hydrophobic BVOCs like isoprene, MTs and SQTs will lack sites for adsorption while more water-soluble or hydrophilic OVOCs molecules will be more easily be adsorbed.

MINOR COMMENTS

Line 64-65: I could find the reference Gu et al 2017 in the reference list.

Reply: We have added the reference in the revised manuscript.

Line 131. give the brand and model of the fan.

Reply: The fan was custom-made using PTFE Teflon material by Shenzhen Shuangmu Plastic Material Co. Ltd, China, and was driven by an electric motor (BLDC4260, Shenzhen Mingyang Motor Co. Ltd, China)

Line 143: "taps" should be "tape", I guess. Also, when referring to Teflon, which is a commercial name, please provide the name of the actual material (PFA, PTFE, etc) for each part involved (fan, wall coating, tubing, ...).

Reply: Thanks for your careful check. Yes, "taps" should be "tape" (Line 146). According to your suggestion, we have indicated the actual Teflon material in the revised manuscript (Line 129, Line 132, Line 146, Line 147).

Line 150-151: give the brand and model of the temperature and RH sensors.

Reply: HC2A-S, Rotronic, Switzerland. (Line 162)

Line 157: Marks should be Markes.

Reply: Revised as suggested (Line 180). Thanks for your careful check.

Line 220: the pressure unit should probably be bar and not mbar.

Reply: Yes. It should be bar and not mbar. (Line 244)

Line 436-437: This sentence about the light transmittance here is not needed, the same information and more is in the next paragraph.

Reply: As suggested this sentence was deleted in the revised manuscript.

Fig 7, line 775. Instead of "fitted changes", it may be better to say something on the lines of "fit lines expressed by the equations shown on the graph".

Reply: Thanks. We have revised as “The solid lines are exponential fit curves.”

Fig 8. Please define what "normal" means for sunlight. Probably there is a more precise word to express what the authors mean. Also, I guess the bars n Fig 8b are ranges of values? This should be clarified in the caption, as well as what the error bars mean in Fig.8a.

Reply: Temperature deviation under full sunlight, which is the maximum, has been reported in a few previous studies. Here the word “Normal” refers to sunlight conditions that are not restricted to full sunlight. We cannot find a better word and still use “normal” in the revised manuscript. The vertical bars in Fig. 8b are ranges of temperature deviations and points represent average temperature deviation.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2021-265/amt-2021-265-AC3-supplement.pdf