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Comment on amt-2022-206

Anonymous Referee #2

Referee comment on "The AERosol and TRACe gas Collector (AERTRACC): an online-measurement-controlled sampler for source-resolved emission analysis" by Julia Pikmann et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-206-RC2>, 2022

Review of "The AERosol and TRACe gas Collector (AERTRACC): an online measurement controlled sampler for source-resolved emission analysis" by Julia Pikmann et al.

This manuscript by Pikmann et al., describes a novel automated batch sampler for aerosols and trace gases integrated into a mobile laboratory platform. The intended use of this instrument is to predefine continuously monitored trace gas measurements, aerosol measurements, and metrological data to control the sampling scheme for targeted airmasses (i.e. urban, biomass burning, cooking emissions, etc). The authors describe the hardware, software and a single source experiment to demonstrate the operation and data product this instrument can provide.

The AERTRACC system is a novel addition to the batch sampling measurement system community. This 'smart' sampler, allows for unattended sampling of different airmasses, without the input of an expert user. The authors describe the implementation of this system clearly and I believe this is well in the scope and interest of the AMT audience. However, I have concerns on the clarity of how this work is presented and the validity of assumptions made for this analysis:

- The filters were analyzed with Iodide FIAGAREO-CIMS and the thermal desorption tubes (TDTs) were analyzed with a custom desorption unit coupled to the Iodide CIMS, however little information is given on analyte sensitivities used in this analysis. It is well known that Iodide CIMS sensitivities vary many orders of magnitude by analyte (Iyer et al., 2016; Lee et al., 2014; Bi et al., 2021) and are a function of Iodide:H₂O ratio, ion optics tuning, and ion molecule reactor (IMR) temperature (Lee et al., 2014; Lopez-Hilfiker et al., 2016; Robinson et al., 2022). Nowhere in this manuscript or SI can the reader find information on what sensitivities are applied to the detected molecular ions in the mass spectra. If the authors did not calibrate, at minimum the assumed sensitivities and dependencies to water and IMR temperature should be

described or assumptions stated and the impact to uncertainty. For example, the IMR temperature dependence of sensitivity may explain the large uncertainties found for the TDT calibration samples (62%). I recommend adding sensitivities used for identified compounds from filter analysis in Table 2 and for TDT analysis in Table 3. Additional information on the temperature programed ramp for the FIAGERO-CIMS analysis should also be included (including the IMR temperature time series). Even if sensitivities are not applied to these data, it should be made clear to the reader that reporting ion signal intensities can falsely report molecular abundance in a sample due to the widely varying sensitivities.

- While the discussion of sampling time delay (3.2) is interesting, I believe the magnitude of the correction to be minimal, and the discussion detracts for the clarity of the methods. I believe most of this section could be moved to the SI.
- On a similar note as above, I found the introduction of the AMS PMF analysis to be abrupt and confusing. I believe a more thorough description of the AMS would be useful to introducing these data. It is not clear to the reader if the AMS is a part of the MoLa or was deployed at a different location. I recommend a separate section describing the AMS measurements to make this clear.
- A discussion of the detection limits for several important compounds (i.e. Levoglucosan, IPN1, IPN2) which appear in large abundance or are close to the $I_{\text{source}}/I_{\text{background}} = 1$ would be helpful to the reader, as it appears the 10% or 62% error bars are applied to all compounds detected (either by filter or TDT analysis). Furthermore, a more rigorous discussion of how these errors are determined would be useful.
- Do the sample media (filters and TDTs) have to be manually changed and at what frequency? It is unclear to the reader if this system can sample for several hours/days unattended or only short timescales (hours/minutes).
- Why does AERTRACC not measure sample flows in real time with MFCs or use a more robust flow control system than needle valves such as critical flow orifices in the sample paths? It seems as though flow drift could be a significant uncertainty in this measurement.
- Adding the exact masses, chemical formula, and sensitivities used in this analysis to Table 2 and Table 3 would be useful, rather than putting most of that information in the SI.
- Could the authors not have driven the MoLa setup to an appropriate background airmass sampling location and manually sampled in order to confirm the automated determination of background airmasses?
- A source/site map and MoLa sampling location, with Hysplit trajectories would improve the clarity of how these airmasses were sampled. It could be put in the SI if the authors don't believe it adds clarity to the main text.

Minor comments:

- The manuscript often begins a sentence with a conjunction or preposition:

Line 51 : "For chemical analysis, this approach..."

Line 64: "To obtain data with high time ..."

Stylistically, these sentences read better without beginning them with a conjunction or preposition.

- Line 79: "Currently, no instrument offers detailed chemical analysis...", I believe there are many instruments which provide this capability, one of which you are using (FIAGERO-CIMS), EESI, CHARON, VIA, all come to mind, so I believe this sentence needs to be reworded to more accurately describe the work you are presenting (Lopez-Hilfiker et al., 2019).
- Line 84: "Since offline methods or highly species-resolving semi-online methods...", this should be reworded, as written it is confusing.
- Line 110: "Table 1...", The AMS should be included in this table.
- Line 135: "Downstream of the cyclone..."
- Line 175: "The two available sampling modes for AERTRACC are either all four sampling paths collecting PM1 aerosol or two...", I believe this has been stated clearly already and is a somewhat redundant sentence.
- Line 182: "...EDM", has this been defined somewhere already?
- Line 226: "...CIMS", has this been defined already?
- Line 364: "...is only based on a literature review." The literature review methodology referenced here is not clear to the reader. Please provide references and more detail in the SI.
- Line 376: "... the ratio is expected to be *on* the order of one."
- Line 384: "In absolute concentrations...", please provide more information on how absolute concentrations are determined in this work or remove the sentence.
- Line 394: "Some of those species, associated with cooking and biomass burning, can also originate from various other emissions sources and were assigned to the mixed group." Couldn't this also be due to improperly assigning sampling criteria? This assumes the authors perfectly setup the sampling criteria, does it not?
- Line 404: "...have partially ratios *on* the order of one..."

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