

Reply to the reviewer 2's comment

Before entering the reply section, we express our gratitude to Reviewer 2 for her/his careful and detailed reading of the manuscript and the insightful and helpful comments, which we were pleased to follow up. We believe that addressing all of reviewer's comment should improve a quality of our manuscript. Therefore, we hope to try address all reviewers' comment properly. Please find our reply color-coded as blue between reviewers' comments.

Reviewer #2:

The manuscript by Trisna and co-authors employs the widely-used active DOAS (Differential Optical Absorption Spectroscopy) technique in the deep UV range of 230–320 nm. The authors developed a custom-built active DOAS system to measure aromatic compounds, including benzaldehyde, formaldehyde, NO₂, p-cresol, m-xylene, phenol, ozone, and others within a measurement cell. The instrument setup was relatively simple, utilizing a low-quality compact spectrometer.

As Anonymous Referee #3 pointed out, since literature absorption cross-sections are typically measured with various types of spectrometers, it is essential to more thoroughly discuss the properties of the spectrometer used in this study.

To begin, I strongly encourage you to incorporate the valuable feedback from both Anonymous Referee #3 and Anonymous Referee #1. Furthermore, I would like to remind you of a few suggestions from the access review process that have only partially been addressed:

Consider splitting the manuscript into two separate papers: One focusing on the method for applying both measured and simulated literature absorption cross-sections, and another dedicated to the actual measured absorption cross-sections. The current manuscript lacks clarity regarding the method combining measured and convolute cross-sections, which is challenging to follow.

A separate analysis of the measured absorption cross-sections could be highly valuable for the scientific community, particularly if it includes more detailed comparisons with existing literature data, where not a lot of published laboratory measurements are currently available. For example, see the plots provided in Serdyuchenko et al. (2014).

- On the major comments:

Following the recommendation of the three reviewers who found it difficult to follow the flow of this manuscript, we agreed to split the paper into two parts. The first part is about the hybrid simulation (HS) method and the second part is about the precise measurement (PM) method. We will submit the second part separately.

Further investigate the instrument function on the technical side: This type of instrument generally produces higher-quality spectra. Ensure the slit and/or fibers are well and uniformly illuminated. Additionally, if using a xenon arc lamp in this wavelength range, the instrument may experience notable impacts from stray light within the spectrometer. These effects should be measured and discussed. Refer to comments from Anonymous Referee #3 for additional insights.

-Regarding the quality of the spectra, although it is not discussed in detail in the initial draft, we have already performed wavelength calibration, electronic offset (EO), and dark-current (DC) corrections on the ACS measurement data we provided. This ensures the reliability and high quality of the data.

-The discrepancy between laboratory measurements and simulations, when using only the convolution procedure, has also been observed in other studies, such as those by Fally et al (2009), even when more accurate instruments like FTIR were used (see Figure 2, Figure 4, and Equation 4 in their published manuscript).

-To prevent any misunderstandings, we will include additional details on wavelength calibration, electronic offset (EO), and dark-current (DC) noises corrections in the paper.

-We have thoroughly characterized the noise and stray light in the detector and found that, under optimal conditions, the detector performs well. By maintaining the detector temperature at 278.5 K, setting the exposure time to 0.02 s, and averaging 100 spectra, we were able to keep the noise below 1000 counts and achieve SNRs of 4442 for benzene, 4253 for p-xylene, and 383 for SO₂. These results are more than adequate for field measurements in LP-DOAS applications. For more detailed information, please refer to Section 2.3.1 in the new draft.

The data analysis and explanation of processes and variables remain somewhat challenging to follow. Thank you for adding a list of acronyms following the access review, which has improved clarity (a bit).

-We apologize for any confusion regarding the data analysis and explanation of the variables. We have fixed this issue by carefully proof read the draft and fix the variables and parameters. Here are the main parameters that often giving confusion:

$\sigma(\lambda)_{meas}$: Absorption cross section spectrum measured at wavelength λ

$\sigma(\lambda)_{HS}$: Absorption cross section spectrum simulated using HS approach at wavelength λ

$\sigma(\lambda)_{ref}$: Reference absorption spectrum from literature

Lastly, please address the issue in **Figure 6**: Applying a convolution should not alter the absorption cross-section itself, as the broadband contribution should be uniform across all instrument line functions. This discrepancy requires further discussion, if not revision. If this data represents fitted concentrations, it does not reflect the absolute absorption cross-section and may be misleading.

-You are correct that convolution itself cannot alter the absorption cross-section (ACS), as the broadband contribution should be uniform across all instrument line functions. The discrepancies observed in Figure 6 arise from the NLS fitting process, specifically from the multiplication parameter (c). Due to the spectrometer's uneven spectral resolution, the NLS fit generates different multiplication parameters depending on the fitting region. This variation is a result of the specific spectral range used for the fitting process.

-To address this, we have revised Figure 6 (now Figure 7 in the new draft) by replacing the "IF" with the region number, which better reflects the fitting regions and clarifies the results. We believe this adjustment resolves the discrepancy and provides a clearer understanding of the data.

Reference:

Fally, Sophie, Michel Carleer, and Ann C. Vandaele. "UV Fourier transform absorption cross sections of benzene, toluene, meta-, ortho-, and para-xylene." *Journal of Quantitative Spectroscopy and Radiative Transfer* 110.9-10 (2009): 766-782.

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