Supplementary of: Open Path Incoherent Broadband Cavity Enhanced Absorption Spectrometer for *in situ* measurement of nitrogen oxides, iodine oxide, and glyoxal in the atmosphere

Filip Pastierovič et al

Correspondence to: Roberto Grilli (roberto.grilli@cnrs.fr)

1 Results and Discussion

1.1 Measuring CHOCHO and IO

This work was derived from a previous study (Barbero et al., 2020), in which more detailed information on the detection of CHOCHO and IO was provided. During the development phase, data with relatively high levels of CHOCHO and IO were acquired in order to demonstrate their detection, allow comparison of the spectra with those available in the literature, and generate the reference spectra used in the multi-component fit routine. In the present study, the comparison of the systems (CP and OP) was confined to indoor and outdoor measurements.

The Figure 1 presents the correlation plots of IO and CHOCHO with NO_2 concentrations, which have been measured in outdoor locations, as these exhibited the highest NO_2 levels. It was observed that minor effects became apparent at NO_2 concentrations that exceeded 20 ppb. Nevertheless, these concentrations were found to be within the acceptable range of measurement precision. This finding confirms that no significant bias is introduced in the recovery of CHOCHO and IO concentrations, even at high NO_2 levels.

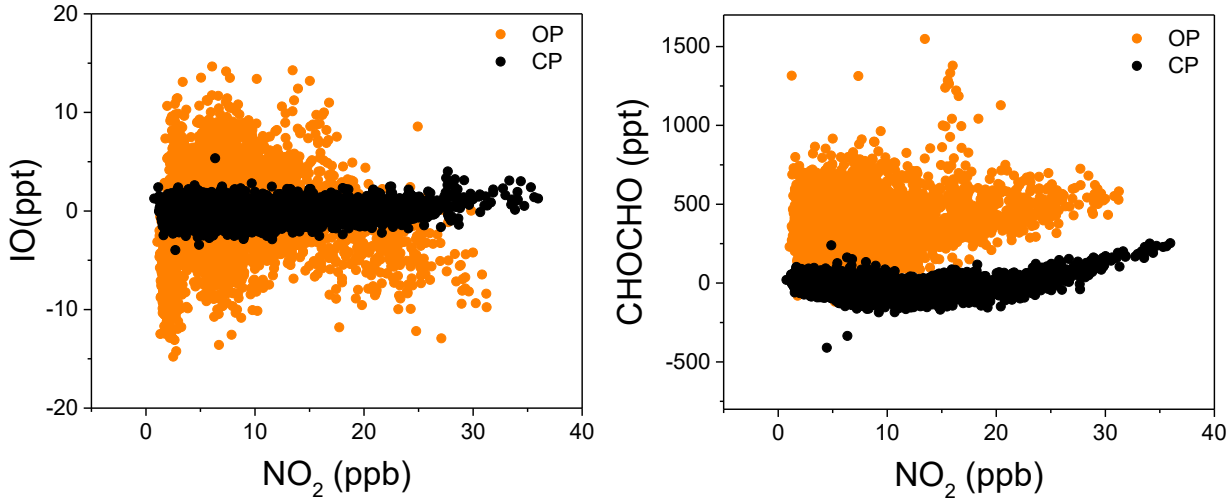

Figure 1. The correlation plots of IO (left) and CHOCHO (right) with NO_2 concentrations for outdoor measurements for both open path (orange) and closed path (black) systems.

To highlight the low but visible contribution of the CHOCHO absorption spectrum, an example of the spectrum registered with the open-path system on 12/10/2023 at a time when the NO_2 concentration was low is shown in the Figure 2.

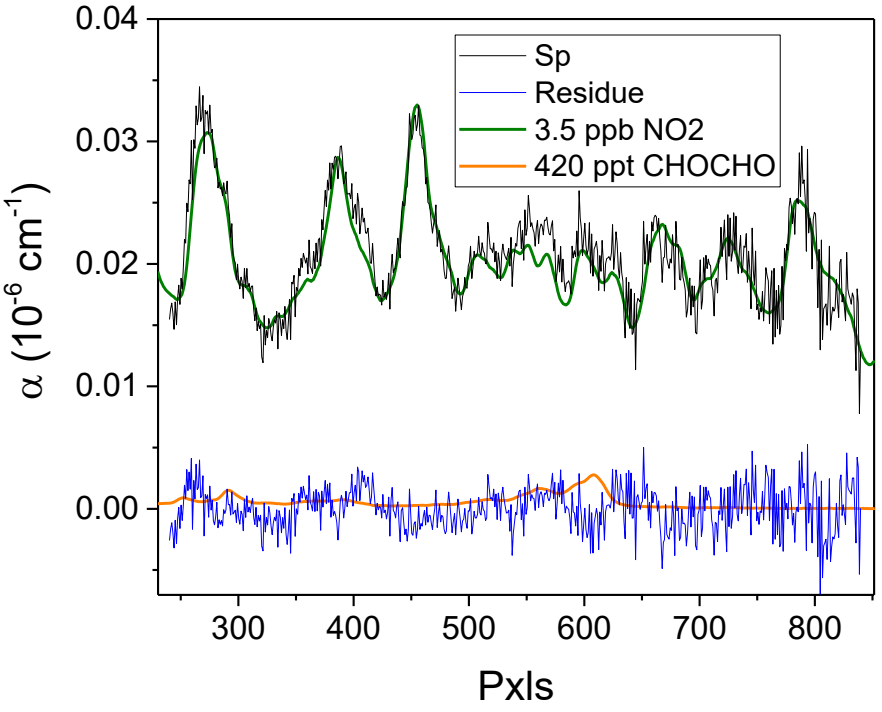

Figure 2. An example of the spectrum registered with the open-path system on 12/10/2023 at a time where NO_2 concentration was low.

With regard to the diurnal cycles, the measurements were conducted in the ambient air of Grenoble, in close proximity to the laboratory. Consequently, the probability of observing IO in this region is considered low, and its diurnal variability is therefore not expected.

For CHOCHO, all available outdoor OP data were averaged and a diurnal cycle with an amplitude of $\pm$100 ppt has been identified, as demonstrated in the Figure 3. An increase of CHOCHO concentration was observed also in conjunction with morning and evening NO_2 peak events. These peak events are attributed to urban traffic (Forster et al., 2023).

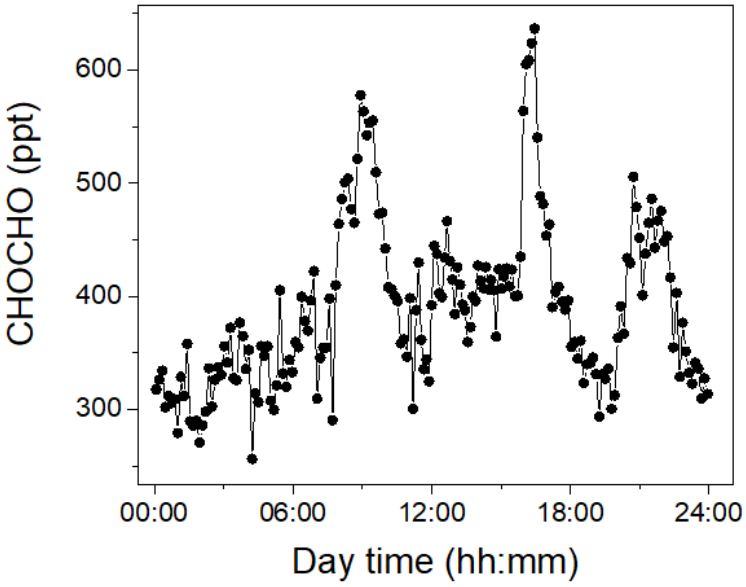

Figure 3. A diurnal cycle of CHOCHO with an amplitude of ±100 ppt.

References

Barbero, A., Blouzon, C., Savarino, J., Caillon, N., Dommergue, A., and Grilli, R.: A compact incoherent broadband cavity-enhanced absorption spectrometer for trace detection of nitrogen oxides, iodine oxide and glyoxal at levels below parts per billion for field applications, Atmospheric Measurement Techniques, 13, 4317–4331, https://doi.org/10.5194/amt-13-4317-2020, 2020.

Forster, P. M., Smith, C. J., Walsh, T., Lamb, W. F., Lamboll, R., Hauser, M., Ribes, A., Rosen, D., Gillett, N., Palmer, M. D., Rogelj, J., von Schuckmann, K., Seneviratne, S. I., Trewin, B., Zhang, X., Allen, M., Andrew, R., Birt, A., Borger, A., Boyer, T., Broersma, J. A., Cheng, L., Dentener, F., Friedlingstein, P., Gutiérrez, J. M., Gütschow, J., Hall, B., Ishii, M., Jenkins, S., Lan, X., Lee, J.-Y., Morice, C., Kadow, C., Kennedy, J., Killick, R., Minx, J. C., Naik, V., Peters, G. P., Pirani, A., Pongratz, J., Schleussner, C.-F., Szopa, S., Thorne, P., Rohde, R., Rojas Corradi, M., Schumacher, D., Vose, R., Zickfeld, K., Masson-Delmotte, V., and Zhai, P.: Indicators of Global Climate Change 2022: annual update of large-scale indicators of the state of the climate system and human influence, Earth System Science Data, 15, 2295–2327, https://doi.org/10.5194/essd-15-2295-2023, 2023.