Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-866-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Near-surface and path-averaged mixing ratios of NO_2 derived from car DOAS zenith-sky and tower DOAS off-axis measurements in Vienna: a case study" *by* Stefan F. Schreier et al.

Anonymous Referee #2

Received and published: 9 December 2018

General comments:

The paper presents approaches to derive near-surface and path-averaged mixing ratios from zenith-sky car DOAS and azimuth tower DOAS observations as well as a comparison with mixing ratios derived from in situ monitoring stations. Based on 9 days of car DOAS measurements and 5 days of tower measurements, acquired in 2015 and 2016, the paper provides an insight on the NO2 spatiotemporal distribution in Vienna, Austria.

The paper is well written and generally well-structured and provides interesting approaches to study the urban spatiotemporal NO2 distribution. The paper has improved compared to the initial submission and most comments provided in the quick review are addressed well. However, some critical issues remain and therefore my opinion has not changed that the paper would better fit in the scope of AMT than ACP.

The work has a stronger focus on the performed measurement techniques and applied retrievals approaches than on geophysical interpretation of the data, chemical/physical processes and new findings on the urban spatiotemporal NO2 distribution. I would support publication in ACP when more data and better statistics would be available in order to thoroughly assess the novel approaches and to substantiate the findings, e.g. based on long-term, routine tower DOAS and car DOAS measurements. The authors recognize the limited data set several times in the paper and foresee routine measurements based on tower DOAS off-axis and MAX-DOAS in the future.

A new, and indeed interesting, approach to convert DOAS columns to near-surface VMR (a very relevant but complex problem!) based on a linear regression analysis is introduced but not developed well in the paper. This is something that the authors recognize and attribute to the limited data/statistics available. Most of the analysis in 4.3 (comparison of car-DOAS with in-situ measurements) is not based on the new approach but on a simple assumption, assuming a constant mixing ratio in the BLH. The authors discuss that this is not necessarily valid in an urban area. I fully agree with this and I highly doubt the validity of this approach in a city, where you rather expect an exponential NO2 profile and also a strong variability over city, industry and highways. The data set is too small to fully evaluate the approach and some correlations are bad which is most likely related to the wrong assumptions in the NO2 vertical distribution. If the authors keep this approach in the paper they should at least assess the impact of other, more realistic, NO2 profiles on the statistical comparison with in situ stations and perform a sensitivity study. Eventually typical urban NO2 profiles could be derived from a high resolution CTM.

Specific comments:

P3, L9: The background signal in the reference could also be obtained by measuring one additional spectrum at 30° at the reference area and by application of the geometric approximation approach.

P10, L13: Please quantify improvement in SNR after averaging + same for averaging tower measurement on P16,L17.

P26, L3: I would elaborate a bit more on the comparison between tower VMR (at 160 m) and in-situ station VMR as this is indicated as novel in the introduction, e.g. by quantifying both instead of only giving an overall factor.

P20, L18: Please give a number on how far the air masses moved based on wind speed and time difference between the measurements. This allows to cross-check if indeed the same air masses are observed.

P24, L4: As indicated earlier, weak correlations are probably related due to wrong assumptions in the NO2 profile.

Technical corrections:

P3, L9: great advantage < added-value

P4, L9: add “for example” after estimated

P8, L12: rotations < rotation

P10, L10: drives < route

P10, L11: lines < box

P11, L26: the < an

P15, L4: In situ < in situ

P19, L5: move “are” behind “magnitude”

P19, L16: Is “temporal evolution” appropriate in the title, as you also measure spatial distribution with the moving measurement platform? Maybe split as well the car and tower measurements in different (sub)sections as they are not directly linked.

P26, L22: “unique” is not appropriate

P46 – Figure3: Please put residuals on another scale. It is not possible to check potential residual structures at this scale.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-866, 2018.