

Comment on *High resolution mapping of the NO₂ spatial distribution over Belgian urban areas based on airborne APEX remote sensing* by Frederik Tack et al.

General Comments

The paper by Tack et al., describes mapping of NO₂ over Belgian cities using the APEX airborne spectral imager, an instrument that was not initially designed for the retrieval of trace gases. The authors present and their retrieval algorithm and discuss instrument performance during measurement flights. Airborne NO₂ results are compared with collocated car observations and yield good agreement.

Overall the paper is well written and arguments are mostly easy to follow. The manuscript presents a good summary of the data analysis and NO₂ results fulfills the in the introduction stated objective to assess the technical and operational capabilities of APEX NO₂ mapping. However, a more detailed analysis of the instrument in-flight performance, as well as a discussion on possible improvements is missing, which would be very fitting for the scope of AMT (see also specific comments).

Specific Comments

Abstract: Please state right away that Liege results are not further discussed or leave out.

Section 1: Typically airborne experiments are cost intensive field measurements compared to e.g. car measurements. Please explain why APEX measurements are described as “cost effective”.

Section 2.1: p.4, line 21: Please define typical altitude, speed, integration time.

Section 2.2: p.5, line 28: should say full NO₂ columns below the plane.

Section 3.1: p.6, line 14: How is the 58ms integration time chosen? Are there problems with saturated scans at times?

Section 3.1: p.6, line 21: It is not clear which setting are used for the noise analysis, since Sect. 3.2 talks about calibration and analysis.

Section 3.2: p.8: The strong variability of the instrument slit function is indeed a challenge for the DOAS analysis. Here further details on the instrument would be interesting, e.g., are there time traces of the instrument's pressure and temperature? Could these be correlated with the behavior of the slit function? Or even used to improve data analysis? The authors have optimized the DOAS analysis given the current state of the spectra, but recommendations of technical instrument improvements (if possible) or looking into exploiting technical in-situ data (if available) are missing, which would be well suited for the AMT audience.

Section 4.3.1: Is there in-situ temperature and pressure data available or ground measurements that could be interpolated? Please discuss choice of US Standard Atmosphere.

Section 4.3.2: p.12, line 29: “similar statistics” here and elsewhere could go into an Appendix.

Section 4.3.2: p.13 and Section 4.6, p.15, line 27: Based on Fig. 16, the station in Uccle is in a semi polluted area, so any AOD measured there will not be representative for heavily polluted areas. The error on the aerosol effect seems underestimated. Please include an assessment using higher AODs.

Section 5, p.18, line 4: dSCDs around 0 are not “well above detection limit”. Please be more specific with the respective statement (also in Fig. 15).

All Tables: Tables typically have a short caption. Please move explanations to text.

Table 1: Please choose detectors or pixel consistently. What does the plane speed relate to? The section “other” seems very random. I suggest integration in text where fitting.

Table 3: Can you comment on why the in-flight FWHM is significantly larger than nominal?

Table 4: Please explain “resol”

Fig. 3: Is the reference noise taken into account here?

Fig. 6: include description of lines in legend or caption.

Technical corrections

Please review manuscript for rules on spelling out digits.

p.3, line 1: Figs. 1 and 2

p.9, line 1 (SCDi) is already introduced

p.9 Eqs. 2 and 3: “ref” should be subscript

p.9, line 19: exchange word order of “wavelength” and “lower”

p.11ff: Please be consistent with either Box-AMF or box-AMF.

p.15, end of line 22: “the” is missing

p.17, line 20: 11:30 UTC

Fig. 4: labels a) and b) are missing

Fig. 6: Check rules on including units: “()” or “[]”, cursive or not?