

Interactive comment on “High-resolution measurements from the airborne Atmospheric Nitrogen Dioxide Imager (ANDI)” by J. P. Lawrence et al.

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General comments:

This paper by Lawrence et al. reports on the airborne Atmospheric Nitrogen Dioxide Imager (ANDI) system and its test flights around Leicester City in February 2013. The capability of this system to map two-dimensional NO₂ vertical column densities (VCDs) with high spatial resolution (80 m × 20 m) is demonstrated and emissions from several NO₂ sources such as traffic, power plant, or an airport in the study area identified. In addition, a temporal increase in NO₂ VCD in the early afternoon was detected and

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quantified. The authors performed an error analysis to estimate the SCD and AMF errors. It is concluded that ANDI provides a unique and informative perspective on the NO₂ spatial distribution in and around urban environments.

Airborne remote sensing systems for measuring atmospheric trace gases are of interest to the atmospheric science community because they can provide a crucial link and complement between ground-based measurements, satellite measurements, and air pollution models. This is a well-written and organized paper well within the scope of AMT. This study provides novel data and substantial conclusions that in my opinion merit publication in AMT. Nevertheless, I have a few comments and questions the authors might address.

Specific comments and technical corrections:

Abstract, L. 9: would be nice to have the month and year mentioned here (February 2013).

P. 5684, Eq1: The same version of the Greek letter phi should be used here and in Fig. 3.

P. 5685, L.16 and Fig. 4: is surface intensity really the correct term here? Or should it rather be just “measured intensity”? Or are those raw DN’s? Are the data atmospherically corrected? Please clarify. Also, maybe a color bar should be added to the Fig.

P. 5686: Please justify how the fitting window was chosen. Have you also tested different ones? The fitting window given in the text and the one in Tab. 2 slightly differ, please correct or explain. A little more information about the spectroscopy here would be nice in general. For example, what’s the outcome of the wavelength calibration? Have you also used a solar reference spectrum to determine spectral shifts and spectral resolution?

P. 5687, L.6: please specify how exactly the fitting errors are calculated (or what is the

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“standard mechanism within QDOAS”?).

P. 5687, L.8: maybe something like “spatially varying” would be clearer than “unmixed” here.

P. 5687, L.21: I think this approach is fine. However, I wonder what might cause this large spike around rows 80-90? Is that really just due to CCD artifacts?

P. 5690, L.16ff: I’m a little confused about the nomenclature used here and in other parts of the study. To my understanding, radiometric calibration is the process that converts the initial digital numbers to (at-sensor) (spectral) radiances (e.g. in units of $\text{W m}^{-2} \text{sr}^{-1} \text{nm}^{-1}$). So when you use the term radiances here, do you mean the raw DNs instead to infer surface albedo? Please clarify.

P. 5692, L.6: I don’t quite understand the 98% here. Is this 98% of the average SCD? The calculation of the uncertainty should be defined somewhere. It would in addition be informative to also have the average SCD here.

P. 5697, L. 15: I cannot clearly see if those four stripes are really that temporally consistent, for example in region A the said junction reveals high NO_2 in the first and third flights ($\sim 4.8 \times 10^{16} \text{ molec cm}^{-2}$) whereas the second and fourth flights reveal rather low NO_2 ($\sim 3.8 \times 10^{16} \text{ molec cm}^{-2}$). It’s also hard to detect the low NO_2 region within the city center. I suggest the authors add some arrows to that Figure to better highlight the discussed areas. It might also help to plot the NO_2 values along a common transect for the four flight lines. Further, if available ground-based in-situ NO_2 measurement should be integrated in the discussion here.

P. 5701, L.20-23: Are the $0.7 \times 10^{15} \text{ molec cm}^{-2}$ the error on the SCD (like written on p5692; L.5 and 6) or on the VCD or dSCD like written here. Please clarify. Also, the $1.9 \times 10^{16} \text{ molec cm}^{-2}$ should be mentioned earlier, in Sec. 3.7.

Fig. 14: What is the region with enhanced NO_2 to the north-east of Leicester, where the aircraft turned around? Is that an artifact or real? The retrieved NO_2 VCDs there

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are distinctively higher than in the city center but are to my knowledge not mentioned in the text at all. Please discuss and provide some details somewhere in the text.

Table 2: Typo: The O from H_2O should not be a subscript.

Table 5: regions 1 and 2 could also be marked in Fig. 14

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