

Interactive comment on “Observation of slant column NO₂ using the super-zoom mode of AURA-OMI” by L. C. Valin et al.

Anonymous Referee #1

Received and published: 24 May 2011

The study “Observation of slant column NO₂ using the super-zoom mode of AURA-OMI” by L. C. Valin et al. presents an interesting retrieval of NO₂ from spatially highly resolved OMI measurements. It is generally within the scope of AMT and introduces a dataset with unprecedented spatial resolution.

However, I have some concerns about the methodology, i.e. the use of the (not defined) SNR, which is taken as argument for the usefulness of this dataset.

The problem of the SNR is that it refers to the total SCD (including the stratosphere!) in the numerator, and the “fitting error” in the denominator. This has the consequence that, for a given fitting error, the SNR directly depends on the stratospheric SCD of NO₂, while the interest of this study are tropospheric gradients.

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In other words: If the stratospheric column of NO₂ would be 10 times higher, the SNR would be much higher as well, but the tropospheric patterns would be as noisy as before! Thus, the SNR is not the appropriate information to judge the precision of the super-zoom observations in contrast to operational pixels.

Instead, the actual variability (std) of SCDs over a clean region (Pacific) should be analyzed, which has been done in several studies on NO₂ retrievals from space (e.g. Boersma et al., Atmos. Chem. Phys. 7, 2103–2118, 2007). This quantity directly reflects the precision of SCDs, and could easily be compared for super-zoom versus operational pixels ($\sim 0.7\text{--}0.8 \times 10^{15}$ molec/cm², Boersma et al., 2007).

I recommend to revise the manuscript in this respect. Especially the comparison of precision for super zoom versus standard pixels should be based on standard deviations instead of (or at least in addition to) the SNR.

In addition, the aspect of tropospheric vs. stratospheric columns has to be discussed within the methods instead of introducing an - assumed - “background” (stratosphere+X?) (P1994, L11) or an explicit stratospheric correction (P1996 L9) without further explanations.

Detailed comments:

- Abstract L4: “operationally retrieved”: please add a reference
- Abstract L4: “operationally retrieved at 13x24”: this suggests that the operational OMI pixels are all 13x24 km² in size. “Nadir” is mentioned in the following, but the sentence should be restructured to avoid misunderstandings.
- Abstract L18: Two times “provide”.

P1992 L9-16: Please specify how far your DOAS retrieval is different from the operational retrieval.

P1992 L11: “The observed reflectance spectra are fit”: rather, the cross-sections are

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fitted to the measured spectra.

P1992 L9-16: The SNR is used below. Thus, it should be noted here (with references) how the SNR is defined for the DOAS retrieval.

P1993 L6: “performed” instead of “made”?

P1993 L10-12 and 18-22: The lengthy list of dates and places disturbs the readability of the text and should be put in respective tables.

P1993 L16: “six operational-scale overpasses from successive years”: are these data taken from the operational DOAS retrieval, or are they fitted with the same settings as described in P1992 L9-16?

P1994 L5-6: “non-overlapping”: what does that mean? Fig. 2d obviously shows an average of overlapping observations!?

P1994 L6: “observations, as listed in table xyz”

P1994 L27: “small” in terms of spatial extent or in terms of emissions?

P1995 L2: define the “fitting error” (see also Stutz and Platt, Applied Optics, 1996)

P1995 L11: “detection threshold deduced previously”: How is the detection threshold defined? How far does it depend on the assumed “background”?

P1995 L11: “SNR<5 are unreliable”: If the NO₂ column in the stratosphere would be 10 times higher, the SNR would be much better, but the value of the tropospheric pattern would be still the same! Determine the precision of SCDs instead (or in addition)!

P1995 L15: “large”: in terms of spatial extent or in terms of emissions?

P1995 L21: Move list to a table.

P1996 L21: “non-negligible”: How long is it?

P1996 L24ff:

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- please cite also other studies that estimated the NO_x lifetime from the downwind evolution:

Leue et al., JGR, 2001.

Beirle et al., GRL, 2004.

- The lifetime estimation is given as one application of the super-zoom mode of OMI. However, is the super-zoom mode really required here? The wind direction is almost parallel to the satellite flight direction. Thus, I would expect that a similar study using the standard resolution pixels would result in very similar numbers. In fact, you have averaged the super-zoom mode pixels over an area much larger than 13x24km²!

P1997 L23-24: “OMI has high signal to noise” – this is too general.

P1997 L24: “similar spatial extent”: What does that mean?

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1989, 2011.

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