Atmos. Meas. Tech. Discuss., 7, C2923–C2925, 2014
www.atmos-meas-tech-discuss.net/7/C2923/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "An improved retrieval of tropospheric NO_2 from space over polluted regions using an earthshine reference" *by* J. S. Anand et al.

Anonymous Referee #2

Received and published: 29 September 2014

This paper presents an investigation of the potential of using earthshine radiance reference spectra to retrieve tropospheric NO2 from push-broom imaging satellite sensors such as OMI. It is shown that this approach provides results consistent with those already obtained in the literature using solar irradiance spectra. It is concluded that for future satellite instruments, the need for a solar channel could be avoided. My problem with this study is, that it remains very superficial and does not really explore the full implications of the proposed experimental simplification. It is rather evident that DOAS retrievals of tropospheric gases can be performed using earthshine radiances as a reference. Such an approach has been successfully used in many instances in the past,

e.g. already with the ERS-2 GOME instrument more than 10 years ago. So there is no real innovation on this particular aspect. The results presented here just confirm what could already be logically inferred. The issue of the inaccurate stratospheric NO2 correction in case of zonally inhomogeneous stratospheric NO2 fields is not really solved (the proposed approach is certainly not applicable operationally). In addition there are a number of not well justified (or even erroneous) statements (see more details below). But the main deficiency in my view is that the other implications of getting rid of the solar channel are not discussed at all. How to cope with cloud detection (cloud fractions and cloud top heights are necessary inputs for the trace gas retrievals), how to estimate surface albedos? Also, with such a design, products such as ozone profiles or aerosol absorbing indices cannot be retrieved at all. In brief, I remain to be convinced that it is worth investigating the proposed option (even though I am fully convinced that using earthshine radiances as reference can be a very good idea for a number of reasons, some of them – but not all - being described in the paper).

Specific comments

- The introduction lacks references

- Pg. 6703, l.3: it is mentioned that the DOAS fit uses non-linear least-squares, however eq. (1) is fully linear in all parameters. Clarify what is non-linear here.

- Pg. 6705, l. 5: the explanation given here for the Ring correction is incorrect. This approach does not take atmospheric absorption into account, it only corrects for the impact of RRS on solar fraunhofer lines

- Pg. 6706, l. 5: why describing the BEHR approach here, since it is of no use later on in the paper?

- Pg. 6707, l. 5: why would the 405-465nm fitting interval minimize absorption by H2O and the Ring effect? In comparison to other traditionally used intervals (e.g. 425-450 nm) there is no gain on these points. The main motivation to extend the fitting interval

(as stated in Boersma) is to reduce the noise on NO2 SCDs.

- Section 2.1: this section is in my view useless. It is obvious that on synthetic data, a perfect agreement will be obtained.

- Section 2.2: the wavelength calibration scheme does not seem to be optimal. From what I can read, it is assumed that the wavelength calibrations (from L1) of the solar irradiance and earthshine radiance are fully correct, except for a potential (simple) shift of the radiance corrected before the DOAS procedure by alignment against the reference solar atlas. There does not seem to be an optimization within the DOAS procedure of the relative shift and stretch between solar irradiance and earthshine radiance. How is the Doppler shift corrected?

- Pg. 6710, l. 15: the SCD bias of 1.0x1015 molec/cm2 in the OMNO2A data product has been recently identified has being due (mostly) to a wavelength calibration problem in the KNMI operational algorithm (van Geffen et al., recently submitted to AMT).

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 6699, 2014.