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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of tropospheric NO_2 columns over Berlin from high-resolution airborne observations with the spectrolite breadboard instrument" *by* Tim Vlemmix et al.

Anonymous Referee #1

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Vlemmix et al. 2018 present a method to derive surface reflectance (SR) and tropospheric NO2 columns from the airborne UV/VIS imaging spectrometer measurements on 21-April-2016 over Berlin, Germany. Calculation of SR is based on the a priori knowledge of the aerosol optical thickness (AOT) and can be applied only when AOT is less then 0.2 at 440 nm. The authors compare the derived SR at 440 nm with Landsat 8 SR (slope = 1.03, R2 = 0.64). Agreement improves when Spectrolite measured radiance is increased by 6%. Differential Optical Absorption Spectroscopy fitting is used to first derive differential slant column densities of NO2 and than using SR, specific profile shapes of aerosols and NO2, and estimation of NO2 column in the reference spectrum to covert to tropospheric columns. Amount in the reference spectrum is es-

timated from OMI NO2 observations. NO2 measurements are shown not to depend on SR. A detailed discussion of uncertainty sources and potential improvements are presented. The paper addresses an important question of estimation of SR by the airborne instrument for NO2 retrieval. The topic is very suited for AMT publication. In my opinion, the scientific community would benefit if the authors divide the current paper in two articles: (1) Feasibility study of surface reflectance measurements from the high resolution airborne UV/VIS imaging spectrometer during AROMAPEX; and (2) Retrieval of tropospheric NO2 columns using various surface reflectance sources during AROMAPEX.

Major comments and recommendations for "Feasibility study of surface reflectance measurements from the high resolution airborne UV/VIS Spectrolite imaging spectrometer during AROMAPEX":

1) The SR retrieval method needs to be described step-by-step, especially the radiance-to-RS linking step. Every assumption should be stated and justification for that assumption should be given. Advantages and disadvantages of this method in comparison with the other radiance based methods should be discussed.

2) More information is needed about the practicality of the surface reflectance method proposed in this paper. The AROMAPEX campaign was 2 weeks in duration but only one day was suitable for surface reflectance measurements (with AOT < 0.2 at 440 nm). Maybe this method could be presented as a "consistency check" method if the required AOT data are available.

3) The authors suggest that the proposed SR method is superior to using Landsat SR data (P5, L9) but than give multiple reasons why their SRs disagree and what it takes to bring them in agreement mainly from the SBI point of view (e.g radiance correction by 6%). Does this mean that the model uncertainties in look-up tables (e.g. different modeled aircraft height vs. actual height; nadir viewing observation geometry for all cases vs. actual, assumption of the AOD spatial homogeneity, etc) make Landsat 8 SR

a better source of SR? Would the radiance scaling (6%) be considered if no Landsat data were available?

4) What errors in tropospheric NO2 columns arise from the difference between SBI and Landsat SRs (this can be a sensitivity study using synthetic data)

5) One of the potential conclusions could be the need of simultaneous airborne aerosol LIDAR measurements to help with SR and NO2 calculations

Major comments for “Retrieval of tropospheric NO2 columns using various surface reflectance sources during AROMAPEX”.

1. The biggest disadvantage of the NO2 retrieval is usage of OMI measurements for estimation of NO2 column in the reference spectrum. I am wondering how practical would it be to measure radiances over the same locations with low local emissions at various SZA so modified Langley extrapolation method can be used to derive SCDref.

2. Evaluating effect of SR (SBI derived vs Landsat) on tropospheric NO2

3. Comparison with other independent NO2 tropospheric column measurements is needed to evaluate the effectiveness of SBI retrieval algorithm

Minor comments:

1. Some abbreviations are not spelled out (e.g. DOAS, OMI)

2. P4, L9 Is radiometric calibration performed in flight or do you mean correction?

3. TROPOMI has been launched.

4. Figure 2(a) has no units.

5. Asymmetry parameter is not specified.

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