

Interactive comment on “Retrieval of stratospheric and tropospheric BrO columns from multi-axis DOAS measurements at Reunion Island (21° S, 56° E)” by N. Theys et al.

Anonymous Referee #1

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In their paper "Retrieval of stratospheric and tropospheric BrO columns from multi-axis DOAS measurements at Reunion Island (21°S, 56°E)", N. Theys et al. report on a full year of measurements of tropospheric and stratospheric BrO in a tropical location using a ground-based DOAS instrument. The manuscript describes a novel retrieval method, provides a detailed error discussion and reports several valuable results on tropospheric and stratospheric BrO and Bry. The paper is clearly structured and well written and I recommend it for publication in ACP after minor revisions.

Introduction:

* Reference to Wagner & Platt - is that really appropriate here? In my recollection, this

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paper deals with boundary layer BrO explosions, not the free tropospheric BrO.

* Reference to Schofield et al, 2004a: I would read that paper as rather arguing against a significant amount of BrO in the troposphere

* References to Bromine explosion - it would be worthwhile to add an earlier reference on the discussion of the role of Br in the polar ODEs or make reference to the recent overview paper by Simpson et al.

* Ozone reduction on up to 40% - if that statement includes polar regions, up to 100% of ozone can be lost locally.

Instrument:

* Geo-location of measurement site varies through the paper, please check

* Is flipping mirror the right word here - I assume the mirror can be rotated to arbitrary positions

Inversion of stratospheric and tropospheric columns:

* Here, the slant column is introduced but later the differential slant column is discussed. In my opinion, the concept of DSCD should already be mentioned here

* MAXDOAS spelled differently in different parts of the paper

* Equation 1: Why is the azimuth angle a function of SZA? Isn't both a function of time?

* Equation 1: Why can the stratospheric AMF considered to be independent of viewing angle elevation? Is that an approximation or exact?

* two-dimensional arrays of BrO - if altitude is one dimension, what is the second - SZA? time?

* found typical => found to be typical

* Why are VCs interpolated linearly between the selected angles? A smoother in-

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terpolation (e.g. spline) appears more appropriate for the curved shape of the SZA dependence of the BrO VC at twilight

Error analysis:

* I don't understand how the errors on the SCs have been determined from the scatter of one year of measurements - do you assume that BrO is constant, and that the scatter is from measurement noise only?

* Systematic uncertainties - I agree that the uncertainties in the absorption cross-sections are a large source of systematic errors, but even perfect cross-sections could have non-zero correlations and thereby interfere with the BrO columns

* I'm not convinced that the analysis of the absorption cross-section errors used is really giving the right answer. What about the changes you see when changing the fitting window by a very minor value - are such errors also covered in this analysis?

* Use of measured NO₂ profiles in model - a good idea, but how sensitive / accurate are the ground-based profiles in the altitude range relevant for BrO chemistry?

* Diurnal variation of tropospheric BrO - I found this discussion rather optimistic - the tropospheric BrO amounts could vary a lot in response to emissions from the ocean (temperature, wind, biological activity), clouds (photolysis rates, also multiple scattering for high clouds) and e.g. NO₂ from pollution (if there is any close to the measurement location)

Determination of aerosol settings:

* To my knowledge, the method described has already been used for ground based measurements by Heckel et al., 2005

Tropospheric BrO:

* how does the altitude of the measurement site of Fietkau et al. (Nairobi is at more than 1600 m) affect the comparison?

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Stratospheric BrO:

* I'm not convinced that the diurnal variation of BrO is really directly linked to NO₂. In contrast to NO₂ which increases more or less linearly over the day, BrO first seems to increase and then decreases

* How does the simplified treatment of additional Bry in the model affect the AMFs?

Comparison with SCIAMACHY data:

* Although I agree that the consistency between satellite and ground-based measurements is good when considering all the uncertainties involved, it would be interesting to speculate about possible origins of the reproducible seasonality in the satellite data which seems to disagree with the ground-based results.

Figure 9:

* I'm surprised by the excellent agreement between the Bry profiles from Pundt et al and the present manuscript - does this imply that stratospheric Bry has not increased in between?

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 8261, 2007.

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