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Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparison of long term series of total ozone and NO_2 column measurements in the southern tropics by SAOZ/NDACC UV-Vis spectrometers and satellites" *by* M. Pastel et al.

Anonymous Referee #1

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The paper "Comparison of long term series of total ozone and NO2 column measurements in the southern tropics by SAOZ/NDACC UV-Vis spectrometers and satellites" by Pastel et al. describes long term O3 and NO2 column measurements from SAOZ UV-Vis GB instruments and various satellite instruments for the sites Bauru and Reunion in the Southern Tropics. Comparisons have been made between the SAOZ and satellite measurements, and the seasonal variation in O3 and NO2 have been analysed for the two sites. Although the topic of the manuscript is within the scope of AMT and it is of interest to the scientific community, in its present form the manuscript is not

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up to the standard for a scientific publication and can not be recommended for publication. The reviewer likes to encourage the authors to make an effort to address the major concerns listed below and improve the manuscript.

Major concerns:

The introductory discussion is insufficient. Important references are missing, and not referred to appropriately. Several references in the text are not included in the reference list. Several internet links are not correct.

The description of the SOAZ and satellite measurements is insufficient and inaccurate.

The main scientific question ("the reliability of the ground-based SOAZ observation at the two sites") is not clearly addressed.

The focus of this paper is on long term time series of ozone and NO2 but a discussion on the trends in the SOAZ and satellite measurements at the two sites is missing in the manuscript.

The results from the SOAZ and satellite comparisons do not sufficiently support the interpretations and conclusions (see detailed comments below).

Detailed comments

Section 1

P4853 The introduction is short and does not properly introduce the NDACC network, the SAOZ instrument and measurement principle. Add references.

P4853/L14-18: The current knowledge (i.e. results from previous studies) on the NO2 and O3 distribution at Bauru and Reunion (e.g. from SOAZ, other GB measurements or models) should be discussed in more detail. Add references.

P4853 It should be clearly described how the comparisons of the SOAZ data and the satellite measurements can be used to check the reliability of the SOAZ data: The ab-

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solute accuracy of the SOAZ measurements has not been analysed here, however, the comparisons with satellite measurements do provide information about the robustness and consistency of the SOAZ time series.

Section 2.1

P4854 The SOAZ measurements should be described in more detail. Especially, the sensitivity of the SAOZ measurements to the vertical distribution of ozone and NO2 in the troposphere and stratosphere should be discussed (averaging kernels).

P4854/L13: Add reference to DOAS technique.

P4854/L19 Add references to TOMS V8 ozone profile climatology.

P4854/L21 The description of the SOAZ NO2 retrieval is insufficient. What is the reference for the accuracy estimate? (the estimate mentioned here seems different from the one in Ionov et al., 2008).

Section 2.2

P4855 Two different error/accuracy estimates are given for the TOMS V8 ozone columns. Is the estimate mentioned on L13 only valid for 2002? Is the larger error related to the empirical correction? This is confusing.

Section 2.3

P4856/L1: Add reference to GDP4 O3 validation paper (Balis et al., JGR, 2007), internet link is wrong.

P4856/L3: add reference to GDP4 and IUP GOME NO2 products.

P4856/L5-18: The description of the two GOME NO2 products is confusing. From the algorithm description available at DLR and IUP, it follows that both products provide a total NO2 column based on a stratospheric AMF (underestimating the tropospheric NO2 contribution in case of polluted conditions). The main difference between the two

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products (i.e. the correction applied in the IUP product, which is related to the effect of spectral spectral artifacts in the GOME solar spectrum due to the GOME diffuser problems) should be explained in more detail, since this has a large impact on the GOME IUP NO2 column time series for Bauru and Reunion. Both internet links are wrong.

Section 2.4

P4857/L3 Is this the correct reference?

P4857/L9 To my understanding, the IUP NO2 columns (GOME and SCIAMACHY) are total NO2 columns (see comment above)

P4857/L11 An ESA SCIAMACHY NO2 product (total NO2 column based on a stratospheric AMF) is available since the beginning of the SCIAMACHY mission.

Section 2.5

P4857/L18 Which advantages of GOME and SCIAMACHY are combined?

P4858 The OMI NO2 description is confusing. Here, the retrieval of the total NO2 column, including a correction for tropospheric NO2 is described. However, in Section 3.2.2 it is mentioned that a stratospheric OMI NO2 product is used. This should be clarified and the version number of the OMI NO2 data product used in this study should be mentioned as well.

Section 3.1

The description of the comparison results in these sections is unclear and inaccurate:

P4859 Please add a plot of the seasonal cycle in the O3 columns at the two sites to Fig 1 (in addition to the plot of the seasonal cycle of the difference). The seasonal cycle at the two sites (and the difference between the two) could then be discussed in more detailed here, including the contribution of tropospheric ozone (see comment on Section 3.1.3)

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P4859/L11-14: Please include a more precise and complete trend analyses. Trends in the O3 and NO2 columns from both the SAOZ and satellite measurements should be calculated using a standard linear regression method and discussed in this paper.

Table 1 What is exactly meant with “Bauru-Reunion” numbers?

Fig 2,3 Plots showing the seasonal cycle of the satellite minus GB difference should be added for the different satellite products. For some satellite measurements there might be a systematic seasonal cycle in the difference, but this is not obvious from Fig. 2 for all satellite measurements.

Table 2 How are the numbers in table 2 computed?

P4860/L1 It is unclear what is meant with the 5.8 DU difference.

P4860/L9 It is not clear from Fig 2 that the satellite observed seasonal cycle is smaller than measured by SOAZ.

P4860/L14 What is meant with sharper seasonal bias?

P4860/L15-16 What is meant with “only EP TOMS columns are similar . . .” ? Correct is that EP TOMS shows the smallest differences with the SOAZ measurements.

P4860/L20 What is meant with “the two versions of OMI are anticorrelated in 2005 and 2006”?

P4860/L20-24 It is mentioned that the largest dependencies on the stratospheric temperature and SZA are found for EP-TOMS and OMI-TOMS , but the comparisons with the SAOZ measurements show the smallest seasonality in the difference for these two satellite products. This apparent inconsistency should be further discussed and clarified.

P4862/L3 Should be Table 1?

P4862/L7-8 After the bias correction of the satellite measurements one would expect

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that the average bias between the satellite and SOAZ measurements is close to zero. What do the (large) intercept values mean? Why are the satellite observation higher at Reunion after the bias correction?

P4862/L8 A more detailed discussion on the seasonal cycles itself at the two sites (before focusing on the differences between the seasonal cycles) is missing in the manuscript (including the impact of tropospheric ozone).

P4862/L26-29 The explanation for the difference between the satellites and SOAZ O3 columns for Oct-Dec is not convincing. The results from Thompson et al., 2003 indicate that the enhanced tropical tropospheric ozone concentrations at the two longitude regions of Bauru and La Reunion are found at similar altitudes in the middle and upper troposphere. So one would expect a similar underestimation of the ozone column by SOAZ at the two sites.

Section 3.2

Fig 6 Please add a plot of the seasonal cycle in the NO2 column at the two sites to Fig.6 (in addition to the plot of the seasonal cycle of the difference).

P4864/L1 If the larger noise at Bauru is only visible in the satellite measurements and not in the SOAZ measurements than this could be an indication of variability in tropospheric NO2.

P4864/L23-24 It is not clear why SOAZ NO2 column measurements are used to adjust the satellite measurements for the diurnal variation in NO2.

P4865/L21-24 This is unclear. As explained in Section 2.3, the main difference between the IUP and ESA GOME NO2 columns is the normalization over the Pacific in the IUP product. Both product provide a total NO2 column based on a stratospheric AMF (but underestimating tropospheric NO2 in case of polluted conditions).

P4866/L15 This is unclear. Is a tropospheric contribution subtracted in the retrieval? I suppose you mean how the tropospheric contribution is taken into account?

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P4866/L17-19 This is unclear. Which OMI NO2 column is used, the stratospheric or the total column? The OMI stratospheric column is not determined as described here (see Bucsela et al., 2006).

P4867/L13 This is a strange formulation. Tropospheric NO2 has a larger effect on the total column that O3, but the previous section shows the importance of tropospheric O3 variability for the total column as well.

P4867/L13-21 In general, one would expect that the satellite NO2 retrieval is more sensitive to NO2 in the lower and middle troposphere than SAOZ (at least for the ESA GOME and the SCIA NO2 products). So in case of enhanced tropospheric NO2 in Bauru, one would expect that to be visible in the satellite vs. SOAZ comparisons. But this is not the case in Fig 9, 10 / Table 3. Is that because of the dominating contribution of lightning NOx emissions at 10-15 km in Bauru (for which both SAOZ and sat measurements are sensitive)? Please discuss.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 4851, 2013.