

Interactive comment on “Evaluation of SHADOZ sondes, HALOE and SAGE II ozone profiles at the tropics from SAOZ UV-Vis remote measurements onboard long duration balloons” by F. Borchi et al.

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MS-NR : acpd-2004si01-005 Title: Evaluation of SHADOZ sondes, HALOE and SAGE II ozone profiles at the tropics from SAOZ UV-Vis remote measurements onboard long duration balloons. Authors: F. Borchi, J.-P. Pommereau, A. Garnier and M. Pinharanda

Answers to Referees comments,

General Since the first submission, the paper has been revised in depth using newly available SAOZ-MIR ozone data processed with an improved version v3.4 of the retrieval algorithm including a refined high vertical resolution calculation of optical path by ray -tracing. The main change compared to the old version is a shift up by 200 m

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of the SAOZ measurements around 17 km and of decreasing magnitude at increasing altitude above. The altitude registration using the new algorithm is shown to be very consistent with that of lidar measurements at Reunion Island within -30 ± 25 m (specific paragraph included in the paper). The comparison with all other measurements (SHADOZ, HALOE and SAGE) has been completely renewed. Moreover, the PV correlation method used in the first version of the paper to remove the contribution of horizontal transport from ozone changes and evaluate the precision of SAOZ measurements only, has been applied now to all other data sets.

Specific answers to referee #1

1/ Sampling of satellite instruments. The details of latitude and dates of satellite measurements are now given in a Table showing the excellent consistency with that of the MIR latitude. The only remaining concern (commented in the text) is the long delay between SAGE SS measurements on Feb 3-4 2001 and SR on March 21-21 which could explain at least part of the difference of ozone bias (3.9% at SR, 0.4% at SS) with SAOZ.

2/ Separation between geophysical and instrumental variations. This was not done in the first submission, but is being applied now to all data sets, providing an independent estimation of precision of each of them.

3) Maps of the SAOZ, HALOE, & SAGE II measurement locations. We have plotted these but found them quite busy and not very informative. All relevant details are now given in a Table.

4) Ozone cross-sections. The data of Brion et al. used by SAOZ have been compared to other most recent determinations by Orphal (2003) concluding at consistency between all of them within 2% in the 410-690 nm spectral range. Unfortunately those of Shettle and Anderson (S&A) are not included in the comparison. All we have been able to find regarding the latter is a ppt presentation at a conference in 1994 where the comparison is limited to older data sets. However, we have found a comparison between

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S&A and Brion in a PhD thesis dissertation of Bazureau (2001) on the preparation of the SAGE III retrieval algorithms. The conclusion is that the S&A cross-sections could be smaller than those of Brion, by 2% between 500 and 600 nm and by a somewhat larger amount at smaller and longer wavelengths. This could explain part, if not all, of the difference in ozone concentration with SAOZ as well as HALOE.

Orphal, J., Acritical review of the absorption cross-sections of O₃ and NO₂ in the ultraviolet and visible, J. photochem. photobiol., A Chem., 157, doi:10.1016/S1010-6030(03)00061-3, 2003. Shettle, E. P., and Anderson, S. M., New visible and near IR ozone cross-sections for MODTRAN, Proc. 17th Annual Review. Conf. on Atmospheric Transmission Models, Gail P. Ed, vol AD-A295591, 1994. Bazureau, A., Preparation de l'inversion des mesures de transmission de l'experience spatiale SAGE III: mise en place et etude des algorithmes d'inversion, PhD thesis, Université des Sciences et Technologies de Lille, 2001.

5) I think it appears a presumptuous to state in the caption to figure 11 that the SAGE II altitudes have been "corrected" since the discussion indicates that it is not statistically significant. Why not clearly state that they were adjusted by 250m as per the text. We agree with this remark, which applies also to other altitude adjustments. The wording has been changed.

6) Writing / editing The paper has been reorganised. No more partial conclusions but summary at the end. Editing checked.

Specific answers to referee# 2

1) Methodology used in comparing various sets of profiles. Since the ozone concentration is shown to vary very little in the stratosphere, the comparison between mean profiles only is fully justified there. The problem arises in the troposphere because of the large ozone changes between western and eastern hemisphere, as well as the frequent apparition of zero ozone layers over the oceanic South Pacific Convergence zone. A zonal mean could certainly not be compared to an average between 3 individ-

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ual stations, among which 2 of them are very close. This is now explained carefully, and statistical and individual comparisons are separated.

2) Lidar at Reunion Island. Though lidar and SAOZ ozone measurements are found very consistent, the main interest of this comparison relies on the altitude comparison. We therefore change the figure to show better the last and how a small altitude shift could change the standard deviation of the mean difference.

3) SHADOZ-SAOZ a) using the new retrieval algorithm the altitude shift between the two measurements is now 300 m for the longest series of SAOZ profiles in 2001. This is fully consistent with a 50s time constant of the ECC cell ascending at 5-6 m/s. A larger shift of 500 m is observed in 2003 but less convincing because of the lesser number of SAOZ and SHADOZ profiles as well as the latitude gap between the MIR trajectory and the SHADOZ stations. We thus feel that the only robust conclusion is that the altitude shift is that which could be expected from the known sonde performance. b) tropospheric ozone. We have plotted separately the comparisons between sondes and SAOZ for each MIR overpass over the stations (twice at Fiji). The difference between Samoa and Fiji on the one hand and Reunion on the other is confirmed. We have checked GOES W or Meteosat pictures. It's quite clear that almost all ascents in the W Pacific during that period were performed in the SPCZ showing sometimes very low ozone, never observed with SAOZ. This is probably a weakness of SAOZ as well as of all remote sensing instruments, which could not look within or close to clouds. It could likely explain at least part of discrepancies reported for ex between TOMS and Shadoz. We took this remark in the conclusion of the paper since we felt that it could be important in the future, not only for comparisons with satellites, but also when discussing the zonal distribution of tropospheric ozone.

4) The paper has been fully reorganised according to your comments (which we share). The English has been improved.

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