Validation of improved SCIAMACHY ozone limb data

Jia. Jia*, A. Ladstätter-Weißenmayer, A. Rozanov, F. Ebojie and J. P. Burrows

Institute of Environmental Physics/Remote Sensing, University of Bremen

Email: jia@iup.physik.uni-bremen.de

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Introduction

Ozone limb data has been upgraded from V2.9 to V3.0. The focus of this study is the validation of the improved SCIAMACHY limb profiles which will be used as an input to the limb-nadir matching (LNM) retrieval on purpose of retrieve tropospheric ozone from SCIAMACHY measurements SEE F. Ebojie 's POSTER. Main parameter changes are as follows:

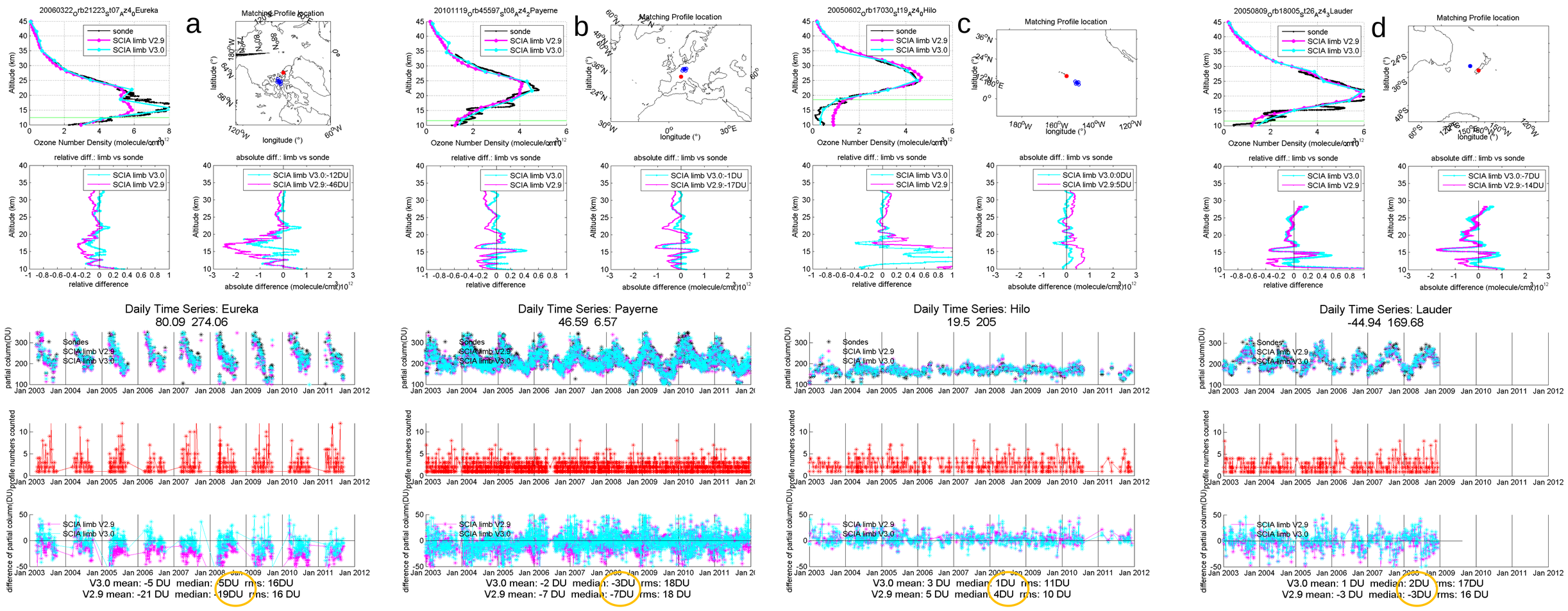
	V2.9	V3.0
METHOD	Radiance profiles in UV, triplet in Vis	DOAS, 0-th order polynomial in UV, 3-rd order polynomial in Vis
REFERENCE	Upper tangent height	Extraterrestrial solar spectrum
SNR	15 – 140 pre-estimated constant value	Estimated from the residual spectra
CLOUDS	Ignored	THs with clouds in FOV are rejected
AEROSOLS	SCIATRAN background aerosols (global mean)	Retrieved from SCIAMACHY measurements (Ernst et al., 2012)

Algorithm

		OZONESONDE	IIDAR
COLLOCATION		From the centre of SCIAMACHY footprint to the station : 5° in latitude, 10° in longitude	
CLOUD INFORMATION		Only cloud-free layers	
ALTITUDE LIMITATION	MAX	30km	Maximum altitude of Lidar data
	MIN	10km or cloud-top height*	11km or cloud-top height*

Ozone sonde data from almost 60 WOUDC stations and 10 SHADOZ stations, ozone lidar data from 10 NDACC stations and satellite data e.g. OSIRIS are used in this study to evaluate both versions of SCIAMACHY ozone limb data.

*Marked as green line in in-situ comparison part.

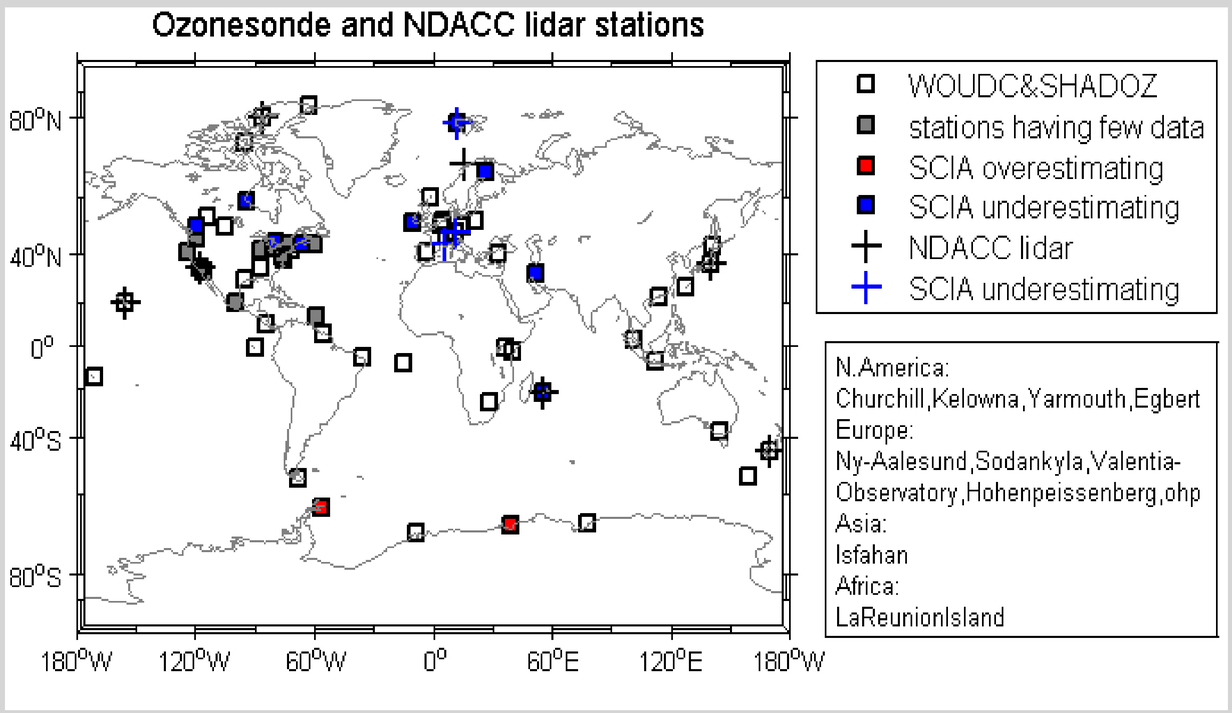


Comparison with in-situ

For each latitude bin (60° N~90° N, 20° N~60° N, 20° S~20° N, 20° S~60° S) a representative station (a, b, c, d) is presented in the figure above to demonstrate the vertical structure and stratospheric partial columns respectively, covering a period from Jan 2003 to Dec 2012. Seasonal variation patterns in different latitudes can be observed.

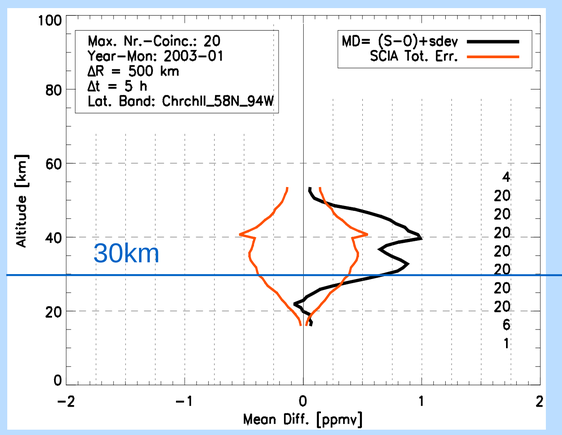
Comparison summary

- The figures presented here give all in-situ data locations.
- In most comparisons the V3.0 ozone limb data have reduced differences with in-situ datasets comparing to V2.9 (basics the same with official V2.5) by 2~20 DU.
- For all locations where both ozonesonde and lidar data exist, the results are consistent.
- When talking about over- or under- estimating, a median difference of >10 DU is counted as a condition. The 'over-estimating' occurs in Antarctic. The 'under-estimating' position have been marked as blue, station names are listed in right corner according to WMO region definition.
- Till now no appropriate reason was found to explain the under-estimating of SCIAMACHY ozone limb data around these stations.
- Since V3.0 is still on producing processes, only V2.9 is used to compare with OSIRIS data among 'under-estimating' locations. Around some locations, e.g. 'Churchill', an SONDE>SCIA >OSIRIS order shows up.
- Comparison of SCIAMACHY V3.0 and OSIRIS need to be done in the next investigation.



Comparison with OSIRIS

The comparison with OSIRIS profiles is also performed in the stations where SCIAMACHY limb has large(>10DU) difference with in-situ data to figure out whether the errors come more from in-situ or from SCIAMACHY. The figure in the right side shows monthly mean absolute difference of 'Churchill'-collocated SCIAMACHY and OSIRIS in Jan 2003. Since SCIAMACHY is under-estimating to in-situ, this over-estimating to OSIRIS needs further study.



Take-home knowledge

- Ozone limb data has been upgraded from V2.9 to V3.0, Ozone sonde data from WOUDC, SHADOZ, and ozone lidar data from NDACC are used to validate both versions of SCIAMACHY ozone limb data. The results agree in both: the vertical profile and partial columns.
- As follows a decline of differences of about 2 ~ 20 DU in the amount of stratospheric ozone can be determined. There are substantial value improvements in high latitude regions and slight improvement at low latitudes.
- Trop.O_3 retrieval accuracy has been improved by 3 ~ 9 DU in preliminary results due to this work.
- One should be careful when discussing about data around some mid-latitude location.

Selected References

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- Sonkaew, T., V. V. Rozanov, et al. (2009). "Cloud sensitivity studies for stratospheric and lower mesospheric ozone profile retrievals from measurements of limb-scattered solar radiation". Atmospheric Measurement Techniques, 2(2):653–678
- F. Ernst, C. von Savögny et al. (2012). " Global stratospheric aerosol extinction profile retrievals from SCIAMACHY limb-scatter observations". Atmos. Meas. Tech. Discuss., 5, 5993–6035.

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- SHADOZ data have been provided by NASA Goddard Space Flight Center http://croc.gsfc.nasa.gov/shadoz/
- NDACC data have been provided by NOAA http://www.ndacc-lidar.org/
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Universität Bremen*