Homogenization of UV-Vis reprocessing for ozone

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Introduction

In the frame of the NDACC UV-Visible working group a tentative homogenization of all UV-Vis zenith sky spectrometers processing has been initiated. One main topic is the use of climatological O_3 Air Mass Factor (AMF). We compare 3 different AMFs at the high-latitude station Sodankyla (Finland, 67°N, 27°E):

SAOZ: latitudinal annual AMF using radiative transfer model (and a combination of SAOZ-balloon and satellite profiles)
Ionov: TOMS climatology, SCIATRAN, AMF calculated with the average of the vertical column of the day
Hendrick: TOMS climatology, UVSPEC/DISORT, AMF calculated with the individual slant column for each measurement

Method of evaluation

- reprocessing of SAOZ data of 5 stations up to now with recommended settings
- comparison with 4 nadir viewing satellite instruments (TOMS, GOME, OMI-TOMS, and OMI-DOAS)

SAOZ AMF

differences satellite – SAOZ

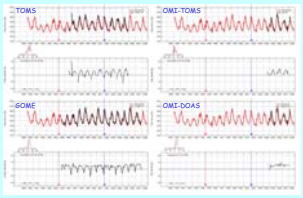

Fig. 1: Time series and differences of monthly mean data at Sodankyla of SAOZ and TOMS V8 (top left), GOME V4 (down left), OMI-TOMS (top right), and OMI-DOAS (down right) with SAOZ AMF.

seasonal variation of differences

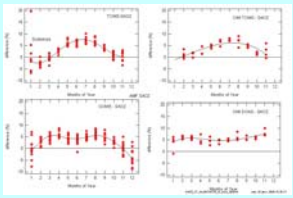

Fig. 2: Seasonal variation of the differences between TOMS V8 (top left), GOME V4 (down left), OMI-TOMS (top right), and OMI-DOAS (down right) and SAOZ with SAOZ AMF.

SZA dependency

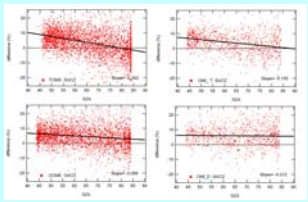

Fig. 3: SZA dependency of the differences between TOMS V8 (top left), GOME V4 (down left), OMI-TOMS (top right), and OMI-DOAS (down right) and SAOZ with SAOZ AMF.

O_3 dependency

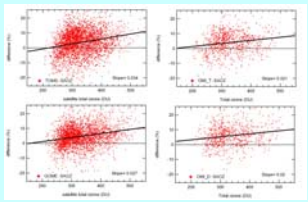

Fig. 4: O_3 dependency of the differences between TOMS V8 (top left), GOME V4 (down left), OMI-TOMS (top right), and OMI-DOAS (down right) and SAOZ with SAOZ AMF.

slope and 1 σ standard variation of SZA and O_3 dependency

	SZA	O_3
TOMS	-0.262 ± 0.01	0.034 ± 0.002
GOME	-0.089 ± 0.009	0.027 ± 0.002
OMI-TOMS	-0.155 ± 0.017	0.021 ± 0.004
OMI-DOAS	-0.013 ± 0.02	0.02 ± 0.003

latitudinal SZA dependency

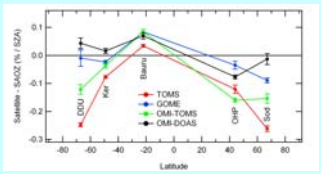

Fig. 5: Latitudinal SZA dependency of the relative difference between TOMS V8 (red), GOME V4 (blue), OMI-TOMS (green), and OMI-DOAS (black) and SAOZ with SAOZ AMF.

latitudinal O_3 dependency

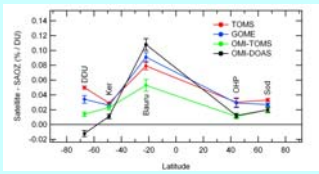

Fig. 6: Latitudinal O_3 dependency of the relative difference between TOMS V8 (red), GOME V4 (blue), OMI-TOMS (green), and OMI-DOAS (black) and SAOZ with SAOZ AMF.

Conclusions

- seasonal variation in differences satellite – SAOZ (Fig. 2): large in TOMS and OMI-TOMS, double peak in GOME, and nearly absent in OMI-DOAS
- clear SZA and O_3 dependency (Figs. 3 and 4):
  - SZA dependency not coming from SAOZ, but from satellite retrieval (SAOZ measuring in the Vis around SZA=90°, TOMS and GOME at SZA < 84°)
  - dependency larger in TOMS measurements, nearly absent in OMI-DOAS measurements => included in satellite-climatology?
- latitudinal SZA dependency (Fig. 5): small for OMI-DOAS and GOME
- latitudinal O_3 dependency (Fig. 6): max O_3 dependence in the tropics on all satellites => comes probably from SAOZ retrieval (H2O?, multiple scattering during rainy season?) or from missing QBO in satellite climatology?

Hendrick AMF

seasonal variation of differences

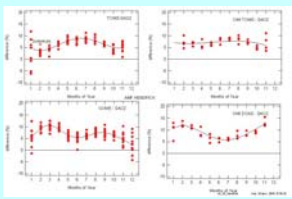

Fig. 7: Seasonal variation of the differences between TOMS V8 (top left), GOME V4 (down left), OMI-TOMS (top right), and OMI-DOAS (down right) and SAOZ with Hendrick AMF.

O_3 and SZA dependency

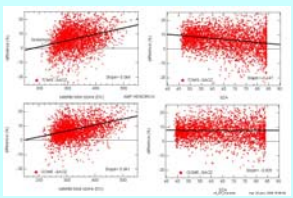

Fig. 8: O_3 and SZA dependency of the differences between TOMS V8 (top) and GOME V4 (down) and SAOZ with Hendrick AMF.

Conclusions

- TOMS and OMI-TOMS: smaller amplitude of seasonal cycle
- OMI-DOAS: re-introduction of SZA dependence: seasonal variation of opposite direction

Ionov AMF

seasonal variation of differences

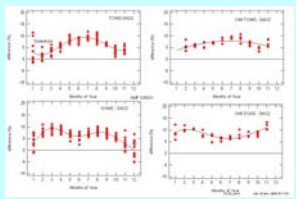

Fig. 9: Seasonal variation of the differences between TOMS V8 (top left), GOME V4 (down left), OMI-TOMS (top right), and OMI-DOAS (down right) and SAOZ with Ionov AMF.

O_3 and SZA dependency

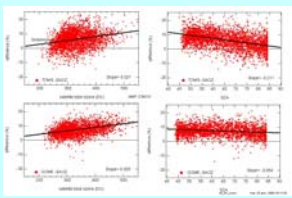

Fig. 10: O_3 and SZA dependency of the differences between TOMS V8 (top) and GOME V4 (down) and SAOZ with Ionov AMF.

Conclusions

- similar to application of Hendrick AMF, but noise reduced due to different calculation of AMF (average of vertical column ⇔ slant column for each measurement)

Conclusions

- best AMF calculation unclear!
- more investigation needed (maybe use OMI-DOAS climatology?)!

Acknowledgements
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