Formaldehyde and Glyoxal: New Products in the SCIAMACHY Operational Processor

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Introduction

In autumn of 2010 the version 6 of the SCIAMACHY ground processor (SGP v6.0) is planned to be delivered to ESA.
The SCIAMACHY Quality Working Group (SQWG) recommended to implement the formaldehyde (***H_2CO***) and glyoxal (***CHOCHO***) total columns into the SGP v6.0. They are formed during the oxidation of the volatile organic compounds (VOCs) emitted by plants, fossil fuel combustion, and biomass burning. Due to a rather short lifetime of formaldehyde and glyoxal, their distribution maps, obtained by SCIAMACHY, represent the emission fields of their precursors, VOCs. Obtained results will serve for the assessment of air quality as well as a VOC emission indicator.
New algorithms are included into the SGP at the German Aerospace Center (DLR), where the operational SCIAMACHY processor is maintained. The reference algorithms were developed by the Belgian Institute for Space Aeronomy (BIRA) for formaldehyde (I. De Smedt et al., ACP, 2008) and by the Institute of Environmental Physics, University of Bremen (IUP) for glyoxal (M. Vrekoussis et al., ACP, 2009), respectively.
This poster addresses the verification results for both new species.

Brief algorithms description

Both species are retrieved exploiting the DOAS technique (Platt, 1994). To correct retrieved slant column densities (SCDs) for fitting artifacts, the reference sector method is applied: the mean slant column of the corresponding gas in a chosen reference sector (Pacific Ocean) is subtracted from all SCD of the day and replaced by the background. This background value is either taken from the 3-D Chemistry Transport Model (CTM) IMAGES (Stavrakou et al., ACP, 2009) in case of formaldehyde, or constant in case of glyoxal. The corrected slant columns are then being converted into the vertical column densities (VCDs) using air-mass factors (AMFs) calculated by the radiative transfer model LIDORT. The retrieval settings for both species are listed in Table 1. The tropospheric distribution of both gases together with their screening by clouds affects the SCIAMACHY measurements. Only rather cloudless pixels (cloud fraction < 0.4) represent columns measured actually. As for the pixels with higher cloud fraction, their VCDs are predominantly based on the climatological data.

Table 1. Retrieval settings for formaldehyde and glyoxal

	Formaldehyde	Glyoxal
Sun reference	azimuth scanning mirror (ASM) (A0)	A0
Fitting window	328.5 - 346 nm	435 - 457 nm
Cross-sections	***H_2CO***, ***NO_2***, ***O_3***, ***BrO***, ***OClO***, ***Ring***, ***Polarization***, ***Undersampling***	***CHOCHO***, ***NO_2***, ***O_3***, ***O_4***, ***H_2O***, ***Ring***, ***Phytoplankton***
Reference sector correction	Pacific (**140° − 180°*W***)	Pacific (**160° − 180°*W***)
AMF	based on a priori profiles from the IMAGES CTM	VCDs not calculated

Verification results

In order to verify whether the implementation was successfull, the results obtained by the operational processor have to be compared with those from the reference algorithm. Ten full days have been chosen for the comparison (five in 2006 and five days in 2009). The test days have been picked from different seasons in order to have a representative set. In total the verification set consists of 136 orbits. Since the glyoxal implementation was not yet finalized - the computation of the vertical columns - only one day in 2006 (13 orbits) was used for the algorithms' comparison. As soon as the implementation will reach the final phase, the full verification using 136 orbits will be done. The scatter plots together with the absolute difference histograms are presented in Figs. 1 (for formaldehyde VCDs) and 2 (for glyoxal SCDs).

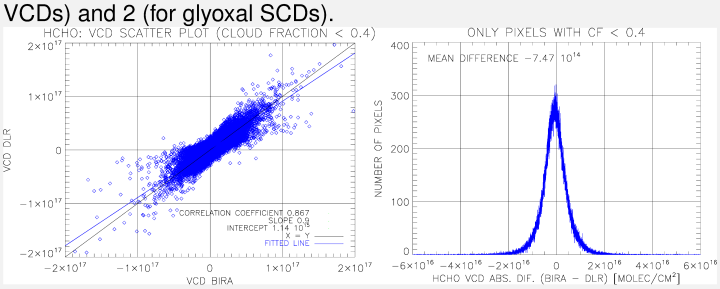

Figure 1. The scatter plot and the absolute difference histogram for the total columns of the formaldehyde.

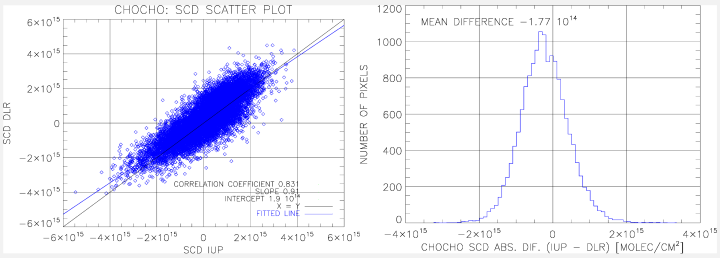

Figure 2. Same as for Fig. 1 but for the slant columns of the glyoxal

Conclusions

The comparison of the results obtained with the reference algorithms and with the SGP v6.0 revealed slight discrepancies between them (mean difference is $\sim$ **$7 \cdot 10^{14} molec \cdot cm^{-2}$** for the formaldehyde total columns; and $\sim$ **$2 \cdot 10^{14} molec \cdot cm^{-2}$** for the glyoxal slant columns), which in both cases correspond to $\sim$ **$10 - 11\%$**. This disagreement in the formaldehyde product can be partly explained by using the different albedo climatologies in the reference and the operational algorithms as well as the slightly different manner of the reference sector correction. However, the revealed bias is acceptable and it is within the current accuracy of the method, which is **30%** in the best case (I. De Smedt et al., ACP, 2008). Taking this into account, the SQWG already decided to consider the formaldehyde total columns as verified. As for glyoxal retrieval, the verification of (reference sector) corrected slant columns is currently being performed. After that, the remaining final step will be done - air mass factor calculation and subsequent computing of the vertical columns. Since all required auxiliary data as well as necessary changes in the processor code have already been introduced during formaldehyde implementation, no significant show-stoppers are expected. The final product is expected either in the autumn of this year (SGP v6.0) or will be implemented in the version 7 of the SGP.

Acknowledgments

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