Inter-comparison of glyoxal vertical columns retrieved from SCIAMACHY, OMI, GOME-2A instruments

DPG 2017
UP 5.6

L.M.A. Alvarado[1], A. Richter[1], A. Hilboll[1,2], M. Vrekoussis[1,2], J. P. Burrows[1], S. Myriokefalitakis[3], M. Kanakidou[3]
[1]Institute of Environmental Physics/Remote Sensing, University of Bremen,
FB 1, P.O. Box 330440, Bremen, Germany
[2]Center of Marine Environmental Sciences - MARUM
[3]Environmental Chemical Processes Laboratory, Department of Chemistry, University of Crete,
P.O. Box 2208, Heraklion, Greece
Email: lalvarado@iup.physik.uni-bremen.de

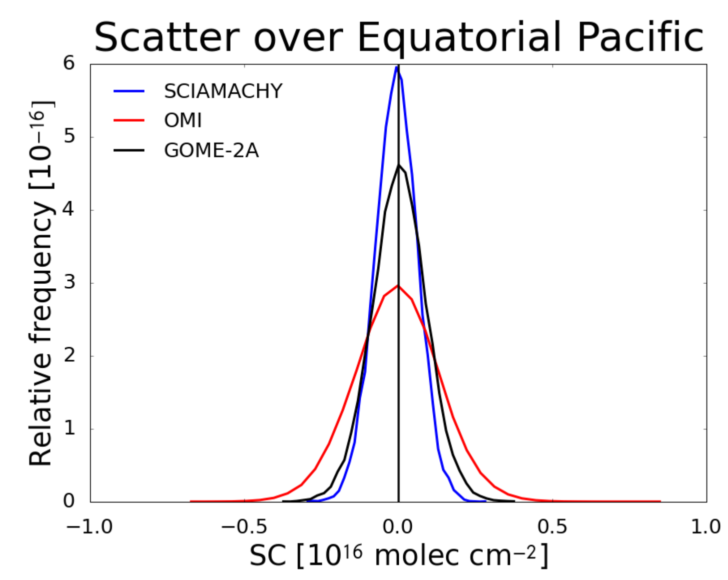
1. Introduction

Glyoxal is an intermediate product in the oxidation process of most VOC and an indicator of secondary aerosol formation in the atmosphere. Similar to other VOC, glyoxal is mainly emitted from natural sources. However, it has also a significant contribution from fires and anthropogenic sources.
This study focuses on a new homogenized glyoxal product using air mass factors computed based on the glyoxal profiles simulated with the TM4-ECPL Global 3D Model. This retrieval algorithm is applied to (a) the SCIAMACHY, (b) the OMI, and (c) the GOME-2 on Metop-A. Overall, the retrieved glyoxal column amounts from the homogenized retrieval algorithm show similar seasonal behavior and high correlation among the instruments over selected regions. In addition, the combination of three instruments provides more than 15 years of glyoxal measurements, which can be used for the investigation of the temporal variability of VOC on a global scale.

2. CHOCHO retrieval

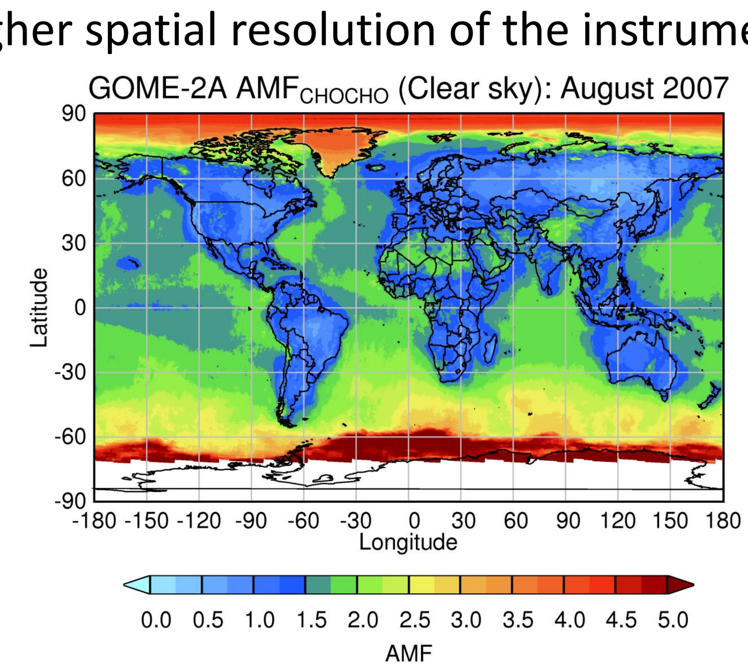
The satellite measurements are analyzed using the Differential Optical Absorption Spectroscopy (DOAS) method.

Parameters	CHOCHO
Fitting window	*433-460 nm*
Polynomial order	*4*
Cross-sections	*CHOCHO, O_3, NO_2 (220 K and 298 K), O_4, H_2O_{vap}, liq. water, Ring*

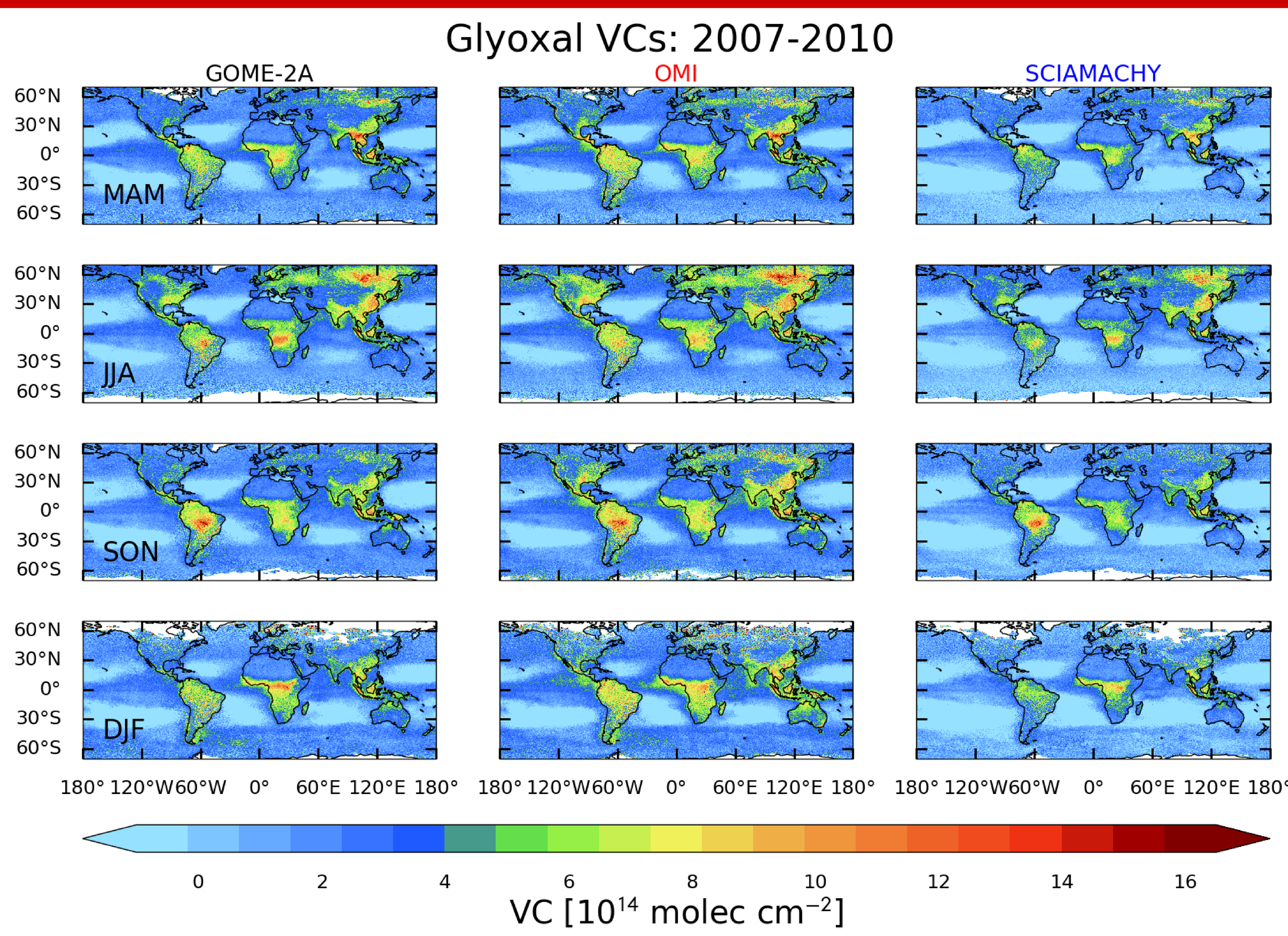


Comparison of slant columns (SCs) over a clean region over the equatorial Pacific (5° S-5° N, 160-200° E) has been computed for August 2007.
The SC scatter shows a distribution around zero for the three instruments with a starndard deviation of $1.3X10^{15}$ (OMI), $8.9X10^{14}$ (GOME-2A), and $6.8X10^{14}$ molec cm^{-2} (SCIAMACHY).
The scatter of the OMI SC values is larger in comparison to the GOME-2A and SCIAMACHY ones, which is the result of the higher spatial resolution of the instrument.

A normalisation over the Pacific region is applied and air mass factors (AMF) have been used for conversion of the SCs (main output from DOAS analysis) into vertical columns (VCs). The AMFs are computed based on profiles simulated with the TM4-ECPL Global 3D Model.

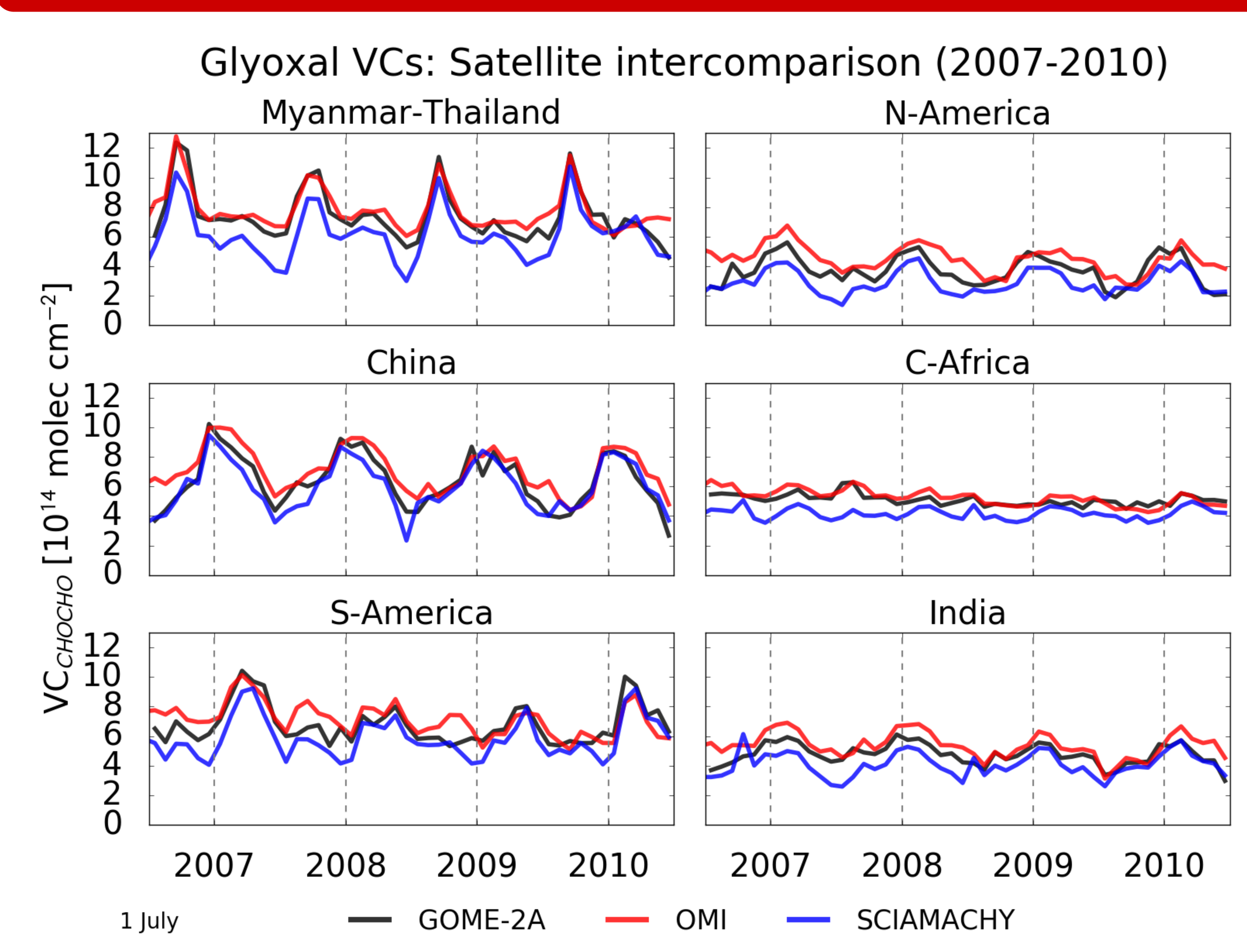


3. Global and seasonal glyoxal distribution



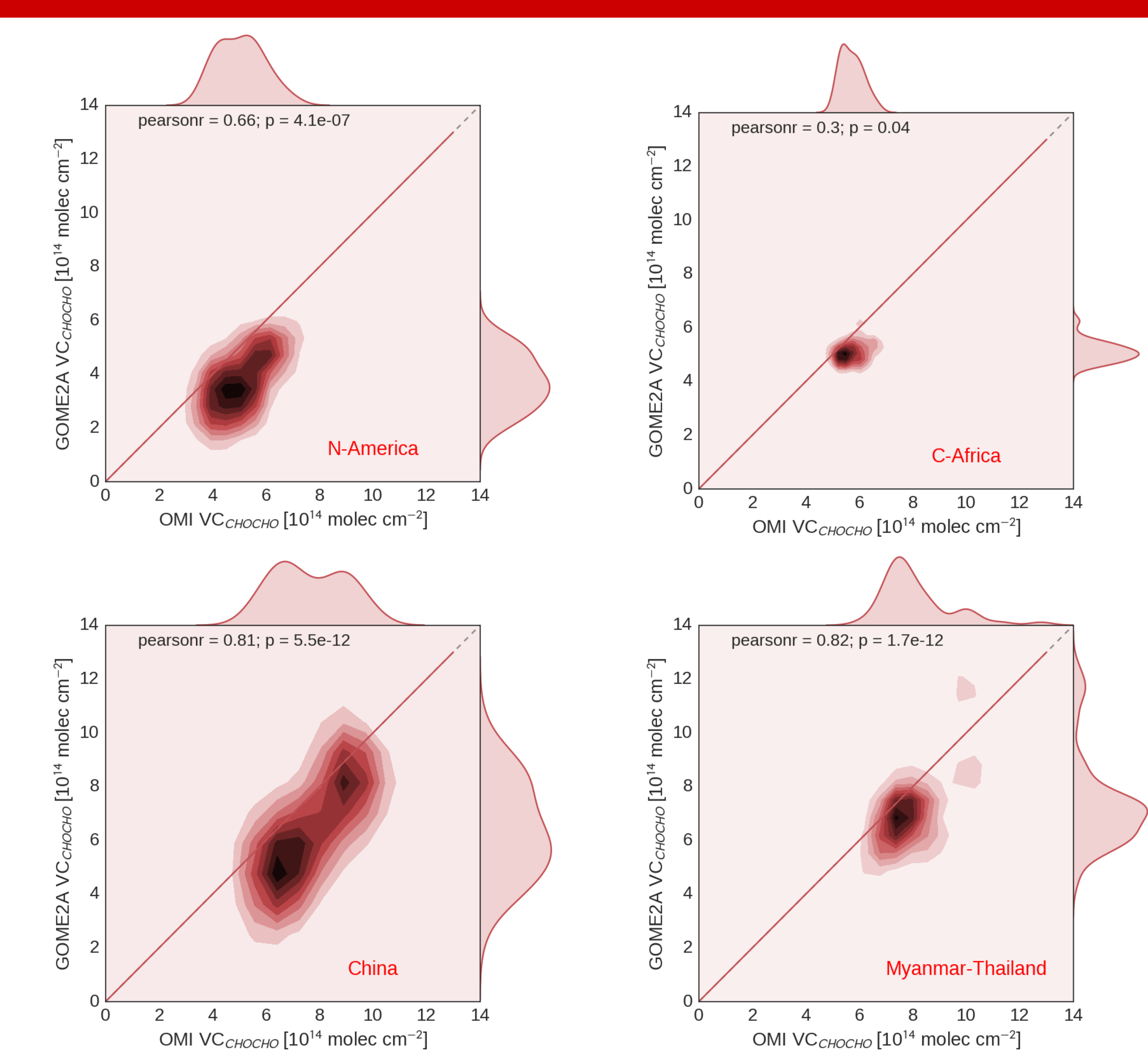
Global patterns of glyoxal from GOME-2A, OMI, and SCIAMACHY are similar.
High values over tropical and sub-tropical regions, mainly over regions with biomass burning and biogenic activities are observed. In addition, large amounts are identified in areas of anthropogenic activities.

4. Temporal evolution of glyoxal VCs



Similar temporal behavior is observed for GOME-2A, OMI, and SCIAMACHY VCs.
The columns from OMI are larger than those from GOME-2A and SCIAMACHY, which could be related to the different overpass times and variations can also be introduced by different instrumental features.
The variation in the amplitude of glyoxal VCs depends on the dominant source of emission in the region (e.g. C-Africa is biogenic)

5. Correlation between OMI and GOME-2A



Correlation coefficients larger than 0.5 are found for regions with pronounced seasonal variability (e.g. N. America and China, and Myanmar-Thailand). In contrast, low correlation coefficients are found for regions where glyoxal changes in the seasonal variability are small, which could be related to a constant emissions of VOC over these areas (e.g. C-Africa).

6. Summary

- An improved and homogenized glyoxal retrieval has been developed for three instruments, which expands the dataset available of glyoxal to 15 years from morning and afternoon orbits.
- The comparison of glyoxal VCs retrieved from measurements of OMI, GOME-2A, and SCIAMACHY shows good overall seasonal agreement. However, OMI glyoxal columns are systematically higher than those columns observed by SCIAMACHY and GOME-2 A, having a consistent temporal evolution for all evaluated regions.
- Correlation coefficients larger than 0.5 are found for regions with large emissions from wild fires and human activities. Correlations are lower than 0.5 for regions where the variation of glyoxal between seasons is small (e.g. C-Africa, large biogenic contribution).

7. Selected references

- Alvarado, L. M. A., Richter, A., Vrekoussis, M., Wittrock, F., Hilboll, A., Schreier, S. F., and Burrows, J. P.: An improved glyoxal retrieval from OMI measurements, Atmos. Meas. Tech., 7, 4133-4150, 2014.
- Chan Miller, C., Gonzalez Abad, G., Wang, H., Liu, X., Kurosu, T., Jacob, D. J., and Chance, K.: Glyoxal retrieval from the Ozone Monitoring Instrument, Atmos. Meas. Tech., 7, 3891–3907, 2014.
- Vrekoussis, M., Wittrock, F., Richter, A., and Burrows, J. P.: GOME-2 observations of oxygenated VOCs: what can we learn from the ratio glyoxal to formaldehyde on a global scale?, Atmos. Chem. Phys., 10, 10145-10160, 2010.
- Wittrock, F., Richter, A., Oetjen, H., Burrows, J. P., Kanakidou, M., Volkamer, R., Beirle, S., Platt, U., Wagner, T.,: Simultaneous global observations of glyoxal and formaldehyde from space, Geophysical Research Letters, 33, L16804, 2006.

8. Acknowledgements

- OMI lv1 data have been provided by NASA
- GOME-2 lv1 data have been provided by EUMETSAT
- SCIAMACHY lv1 data have been provided by ESA through DLR.
- This project has been funded by the German Academic Exchange Service (DAAD), S5L2PP project, and the University of Bremen.