First results of NO_2 and HCHO retrieved from GOME-2 on Metop-C and comparison with data from the precursor instruments on Metop-A and B

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1. Introduction

NO_2 and HCHO are important trace gases for life on Earth because they are hazardous to human health. In order to assess the spatial distribution of these trace gases on a global scale, long-term satellite measurements are needed. For this purpose, EUMETSAT's satellites Metop-A and B provide a continuous dataset created by similar instruments since 2006 which will be extended and enhanced by data from the recently launched Metop-C satellite.

Here, we present first NO_2 and HCHO results from the GOME-2 instrument on board of EUMETSAT's Metop-C satellite retrieved with the frequently used Differential Optical Absorption Spectroscopy (DOAS). Since all three GOME-2 instruments on board of the Metop satellites measure simultaneously, a direct comparison of results enables the quantification of instrumental characteristics and possible issues which may be corrected in improved versions of the lv1 data.

The focus of this poster is on the comparison of slant and vertical column densities from the three GOME-2 instruments in orbit.

2. GOME-2 instruments[1]

Satellite information

Satellites in orbit:
Metop-A: since Oct. 2006
Metop-B: since Sep. 2012
Metop-C: since Nov. 2018

Orbit: Polar, sun-synchronous
Altitude: ~817km

GOME-2 information

Spectral range: 240 – 790nm
divided into four channels:
240 – 314nm, 310 – 403nm,
397 – 604nm, 593 – 790nm
Spectral resolution: 0.26 – 0.51nm
Swath: 1920km (960km for GOME-2A)
Resolution: 80 x 40km (40 x 40km)

3. Fit settings

	NO2[2]	HCHO[3]
• **Fitting window:**	425/430 – 497nm	323.5 – 361nm
• **Polynomial:**	6 coefficients	6 coefficients
• **Cross-sections:**	NO_2, O_3, O_4, H_2O, H_2O liquid, Ring	NO_2, 4 x O_3, O_4,BrO HCHO, Ring, Eta, Zeta
• **Background:**	Daily sun	Daily sun / Pacific (clean region)
• **Offset:**	linear	linear

Definitions

slant column density

$$SCD = \int n(s)\,ds$$

vertical column density

$$VCD = \frac{SCD}{AMF}$$

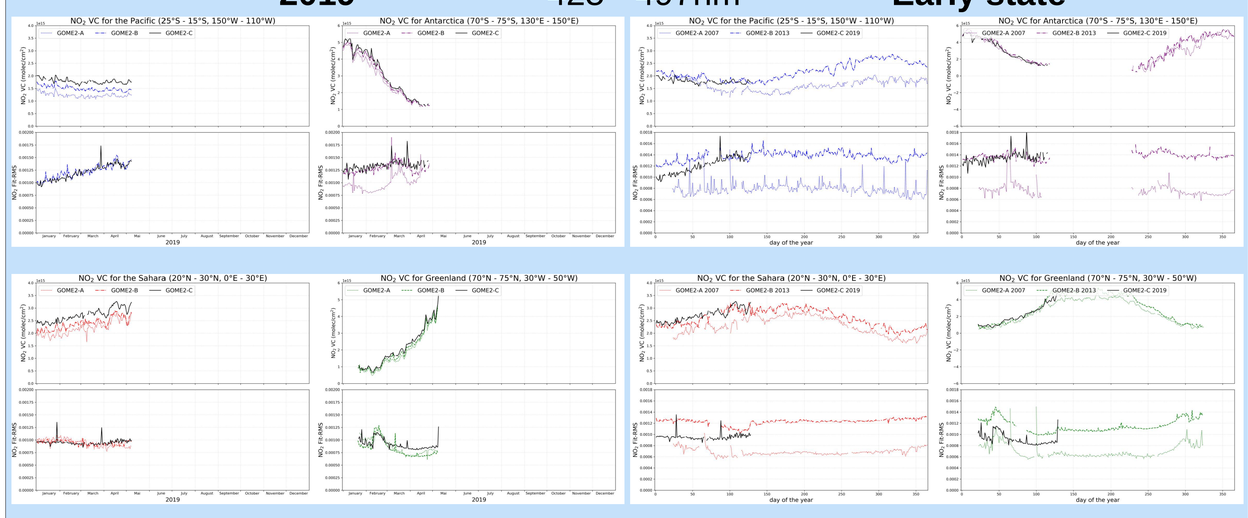
Fit RMS

$$RMS = \sqrt{\frac{\sum_i Res_i(\lambda)^2}{N}} = \sqrt{\frac{\chi^2}{N}}$$

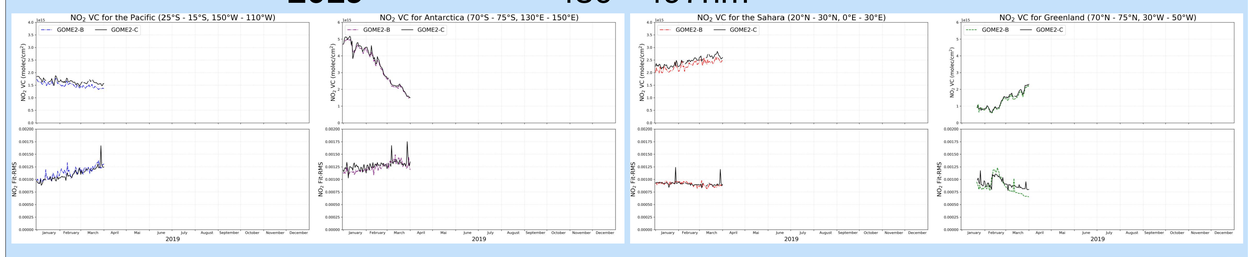
4. NO_2

Time series comparison

2019 425 - 497nm **Early state**

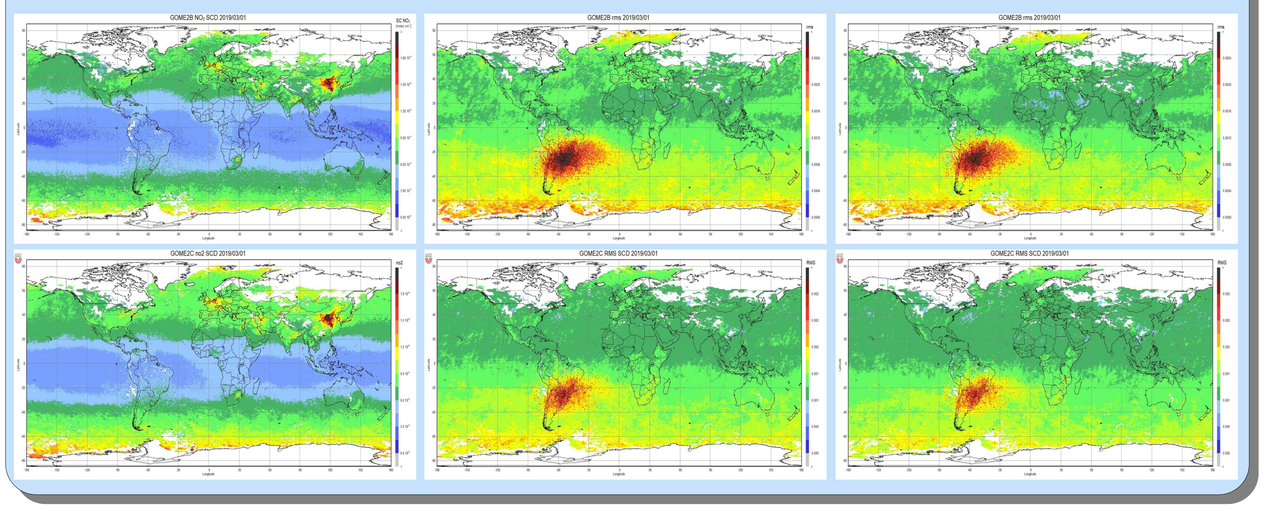


2019 430 - 497nm



Cloud filtered monthly mean values for March 2019

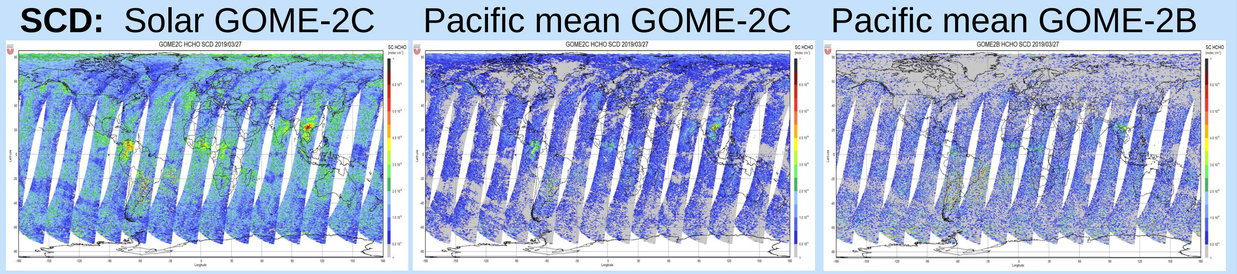
SCD 425 – 497nm **RMS** 425 – 497nm **RMS** 430 - 497nm



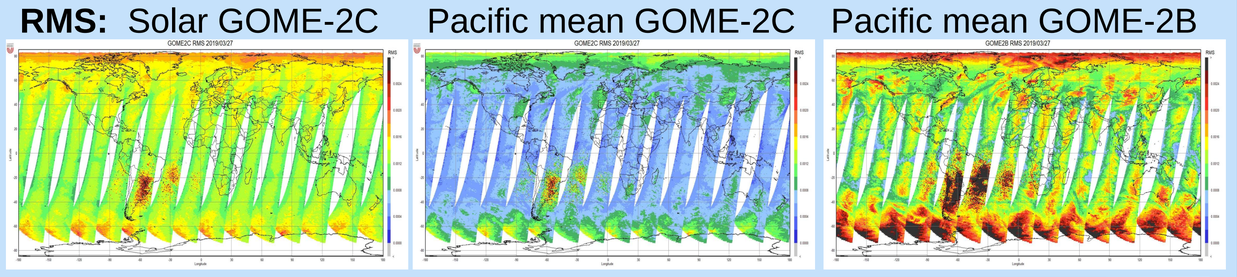
5. HCHO

Background comparison for GOME-2C

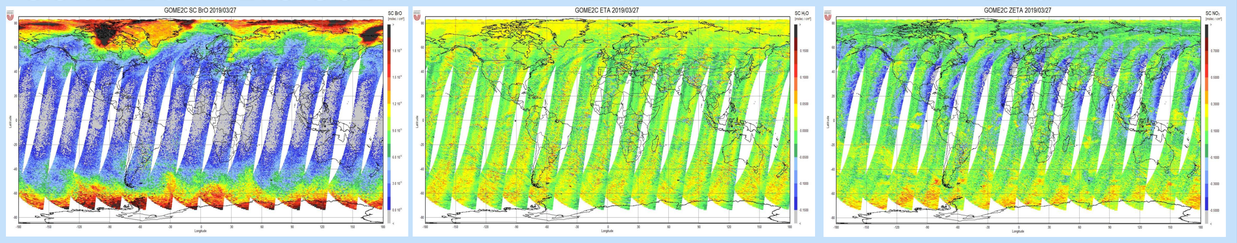
SCD: Solar GOME-2C Pacific mean GOME-2C Pacific mean GOME-2B



RMS: Solar GOME-2C Pacific mean GOME-2C Pacific mean GOME-2B

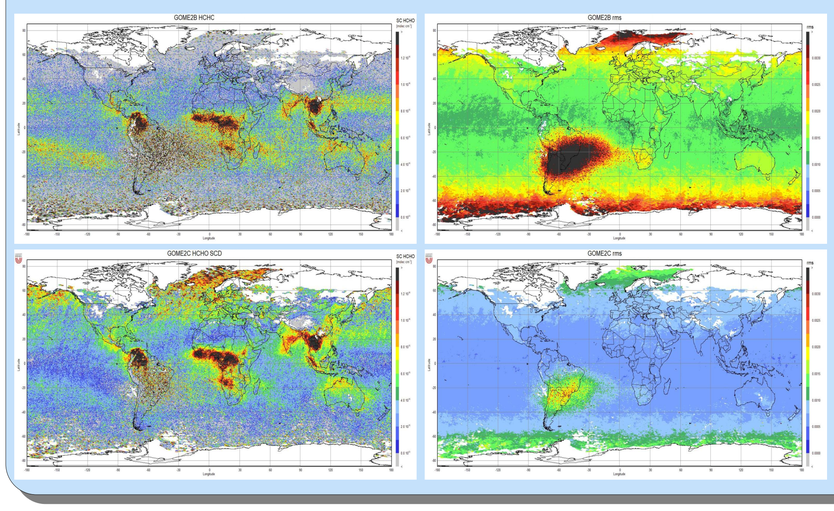


GOME-2C: BrO SCD Eta Zeta

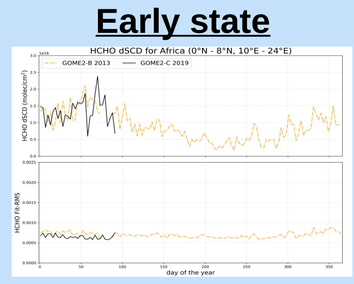


Cloud filtered monthly mean values, March 2019

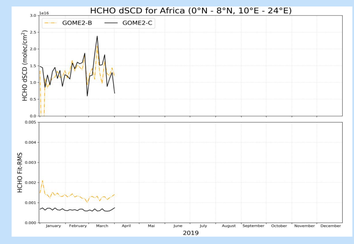
HCHO SCD **RMS**



Early state



2019



8. Summary

- NO_2 shows an offset between GOME-2C and A/B and the RMS is higher when using the large fitting window starting at 425nm for 2019.
- The RMS is in general in between GOME-2A and B w.r.t the early state.
- The HCHO fit is generally better when applying a mean background spectrum from a clean region (Pacific).
- An east-west trend can be identified in BrO and the polarisation corrections for GOME-2C.
- HCHO global pattern is more positive over the ocean for GOME-2C than for B.

Outlook

- Analysis of residuals and spectra in order to identify spectral issues for wavelengths < 430nm.
- The east-west trend in BrO, Eta and Zeta needs further investigations.
- Test of a smaller fitting window for HCHO. Spectral issues due to calibration or polarization?
- Pre-fit of BrO for reducing impact of cross-correlations?

9. Acknowledgements & Selected References

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[1] GOME-2 Fact-Sheet:: https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Metop/MetopDesign/GOME2/index.html
[2] Richter, A., Begoin, M., Hilboll, A. and Burrows, J. P.: An improved NO2 retrieval for the GOME-2 satellite instrument, Atmos. Meas. Tech., 4(6), 1147–1159, doi:10.5194/amt-4-1147-2011, 2011.
[3] Alvarado, L. M. A., Richter, A., Hilboll, A., Vrekoussis, M., Daskalakis, N., Burrows, J. P., Myriokefalitakis, S., Kanakidou, M.: Uniform formaldehyde retrieval applied to SCIAMACHY, OMI, and GOME-2 (A and B) data from 2003 to 2016, EGU General Assembly, 2018

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