#6-09

Validation and quality assurance of reprocessed GOME-2A/2B/2C ozone profiles, using homogenized ozonesonde data

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1 Introduction

- EUMETSAT's Satellite Application Facility on Ozone and Atmospheric Chemistry Monitoring (O3M SAF) is producing near real-time and offline products based on Metop satellite data from measurements of the Global Ozone Monitoring Experiment-2 (GOME-2) instrument. GOME-2, launched in October 2006, is a nadir scanning UV/VIS spectrometer designed for ozone and trace gas retrieval.
- Ozone profiles are retrieved from GOME-2 spectra by KNMI using optimal estimation. This involves the use of an a-priori ozone profile and error covariances to complement the profile information in the measured spectra.
- The GOME-2 ozone profile product is operational and available in NRT (3 hours from sensing) via the SAF-Europe channel of EUMETCast.
- This study shows global validation results of 15 years of reprocessed GOME-2 ozone profiles at a resolution of 80 x 40 km. Also reprocessed ozonesonde data is used as a reference to validate the ozone profiles in the first 30 km of the atmosphere.

2 Methodology

2.1 *Co-location criteria*

- The geographic distance between the GOME-2 pixel center and the sounding station location (Fig. 1) for the coarse resolution (CR) pixels is **300 km**, for the high resolution (HR) pixels, this distance is reduced towards **100 km**.
- The time difference between the pixel sensing time and the sounding launch time: $\pm$ **10 hours**.
- Each sounding that is correlated with a GOME-2 overpass is generally correlated with several GOME-2 pixels if the orbit falls within the 100 km circle around the sounding station. This means that a single ozone profile is compared to more than one GOME-2 measurement.

2.2 *Ozone sounding pre-processing*

- GOME-2 ozone profiles are given as partial ozone columns on varying pressure levels (40 levels between surface and 0.001 hPa). Ozone partial columns are expressed in Dobson Units.
- Ozonesondes measure the ozone concentration with a vertical resolution of 100 m along the ascent until 30 km, which is much higher than GOME-2.
- The integration requires interpolation, as GOME-2 levels never match exactly ozonesonde layers. This interpolation causes negligible errors given the high vertical resolution of ozonesonde profiles.

3 Validation results

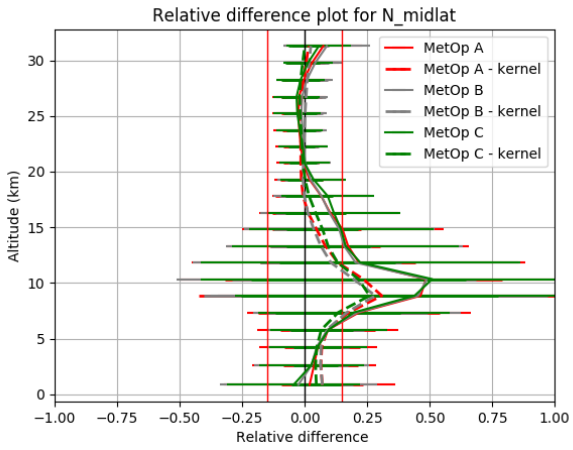

Figure 1. Relative difference profiles between GOME-2 data and ozonesondes (line) + smoothed ozonesonde data (dashed lines) for the Northern mid-latitude belts.

- Figure 1 shows the relative difference in ozone concentrations between GOME-2 ozone profiles, ozonesondes and smoothed ozonesondes (kernel) for the Northern mid-latitude belt and for different sensors (GOME-2A/2B/2C) for respectively the time periods January 2019 till August 2022 (GOME-2C), the time period October 2012 till August 2022 for GOME-2B and January 2007 until November 2021 for GOME-2A. The error bars represent one standard deviation on the mean error.
- GOME-2 vertical ozone profiles are given as partial ozone columns [in DU per layer] between varying pressure levels (40 levels between surface and 0.001 hPa). The ozonesonde data has a vertical resolution of about 100 m and is measuring ozone from the surface up to about 30 km. To validate the satellite derived ozone layers with the ozonesonde data, we integrate the ozone measured by the balloon ozone soundings between the corresponding GOME-2 pressure levels.
- GOME-2 ozone profile data are available by EUMETSAT on a daily basis. The reference data includes a global coverage of ozonesonde stations. We take into account the GOME-2 averaging kernels in our analysis to smooth the ozonesonde data towards the resolution of the satellite data. A degradation correction is applied on the datasets from these three sensors.
- In this study we did already include ozonesonde data that has been homogenized following the guidelines of the OzoneSonde Data Quality Assessment (O3S-DQA) activity. This homogenization involves the correction of biases in the time series due to changes in the instrument type, sensing solution strength, operating procedures, etc. Under the umbrella of the Tropospheric Assessment Report (TOAR-II) Focus Working Group "HEGIFTOM" (Harmonization and Evaluation of Ground-based Instrument for Free-Tropospheric Ozone Measurements), these data have been made available for more than 40 ozonesonde sites (https://hegiftom.meteo.be/).

4 Time series

- Figure 2 shows time series for the GOME-2A data record from January 2007 until 15/11/2021. It shows that the degradation issue is solved, by applying a degradation correction. Nevertheless, some seasonal behaviour is still present in the data.
- Especially during winter GOME-2 overestimates significantly the ozone concentrations in the UTLS region. In the upper stratosphere, the relative differences are close to zero with a standard deviation smaller than 10 %.

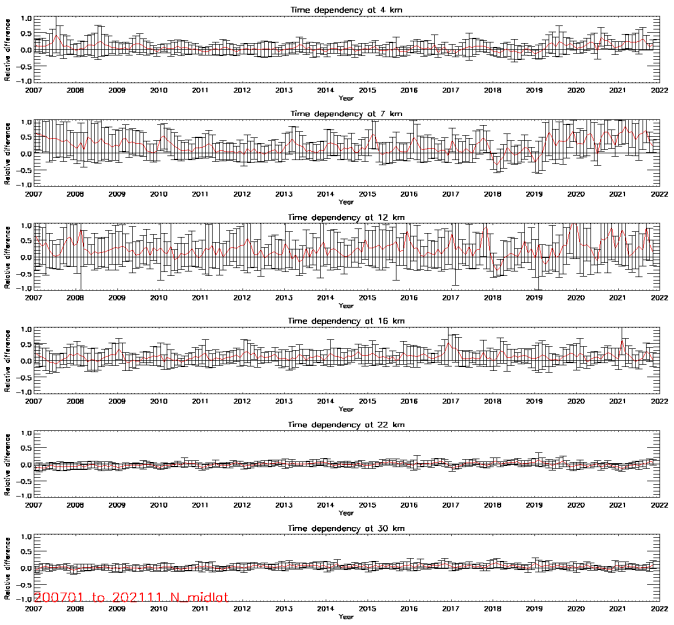

Figure 2. Time series of difference profiles between GOME-2 reprocessed ozone profile data and ozonesondes at different altitudes for the time period 01/2007-11/2021.

5 Conclusions

- Validation results show that the target values are met in the troposphere (30 %) and the stratosphere (15 %), not taking into account the UTLS zone, which shows more elevated relative differences which cannot be appointed to the troposphere or the stratosphere.
- Reprocessed ozonesonde data have been used from the hegiftom website: https://hegiftom.meteo.be/datasets/ozonesondes. More information @poster # 6-49.
- Ozone profile data are available in NRT (3 hours from sensing) via the SAF-Europe channel of EUMETCast. More information on http://acsaf.org and http://www.eumetsat.int

Acknowledgement

- Ozonesonde data was made available at https://hegiftom.meteo.be/datasets/ozonesondes.
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References

Andy Delcloo, Katerina Garane and Peggy Achtert, Validation report on the quality of GOME-2C near real-time and offline high-resolution ozone profiles, Validation Report for the EUMETSAT AC SAF, June 2020.

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