GOMOS High-Resolution Temperature Profile (HRTP) dataset processed with FMI Scientific Processor v1

Readme document

29 January 2019

1 Dataset and processor

The high-resolution temperature profiles are retrieved from the GOMOS nigh-time occultations (solar zenith angle > 105°) using the FMI Scientific Processor (FSP v1.0). GOMOS (Global Ozone Monitoring by Occultation of Stars) operated on board the Envisat satellite in 2002-2012.

HRTP is retrieved using bi-chromatic stellar scintillation measurements by the GOMOS fast photometers. The retrieval method exploits the chromatic refraction in the Earth's atmosphere. The bi-chromatic scintillations allow the determination of refractive angle, which is proportional to the time delay between the photometer signals. The HRTP profiles are retrieved with very good vertical resolution ~200 m and high accuracy ~1-3 K for altitudes 15-32 km and a global coverage. The best accuracy is achieved for vertical (in orbital plane) occultations, and the accuracy weakly depends on star brightness. The details of the inversion algorithm can be found in (Sofieva et al., 2019).

2 Main differences from the previous GOMOS HRTP data

The validation of the official ESA IPF v6 HRTP profiles has shown that HRTP temperature fluctuations have an excessive amplitude in case of oblique occultations or not bright stars (Sofieva et al., 2009). The main difference of the FSP v1 is the regularization, which controls the amplitude of temperature fluctuation and makes it realistic for all types of occultations. The validation of HRTP FSP v.1 against the collocated radiosonde temperature profiles is presented in (Sofieva et al., 2019). It demonstrates good quality of the GOMOS HRTP profiles.

The HRTP profiles in the present dataset are interpolated to a common altitude grid from 10 to 32 km with 50 m spacing. No additional data filtering by data users is needed: the unreliable data (outliers), which constitute less than 1% of data are removed from the original dataset. These outliers are the data that deviate from a priori (ECMWF) more than 20 K.

3 Data format and parameters

The HRTP data are stored in netcdf-4 (identical to HDF-5) format, in yearly data files. For example, the file "HRTP-GOMOS_ENVISAT-FMI_FSP_v1_2002-fv0001.nc" contains the altitude-gridded data for 2002.

Table 1 presents all parameters in the netcdf files.

Table 1. Parameters in the HRTP FSP v1.0 netcdf files. N_{prof} and N_{alt} denote the number of profiles and number of altitude levels (441), respectively.

Parameter and unit	***Dimensions***	***Description***
time (days since 2000-01-01 00:00:00)	$N_{prof} \times 1$	The date of the measurements
altitude (km)	$N_{alt} \times 1$	The geometric altitude above the mean sea-level
latitude (degree_north)	$N_{prof} \times 1$	Latitude of each profile (at 32 km)
longitude (degree_east)	$N_{prof} \times 1$	Longitude of each profile (at 32 km)
HRTP (K)	$N_{alt} \times N_{prof}$	High-resolution temperature profile
HRTP_uncertainty (K)	$N_{alt} \times N_{prof}$	1σ uncertainty of HRTP
pressure (hPa)	$N_{alt} \times N_{prof}$	Air pressure profile
air_density (kg m^{-3})	$N_{alt} \times N_{prof}$	High-resolution air density profile
air_density_uncertainty (kg m^{-3})	$N_{alt} \times N_{prof}$	1σ uncertainty of high-resolution air density profile
apriori_temperature (K)	$N_{alt} \times N_{prof}$	A priori (ECMWF) temperature profile used in the inversion
measurement_fraction	$N_{alt} \times N_{prof}$	portion of measurements in the retrieved profiles, ranges from 1 (measurements only) down to 0 (a priori only); more details are in data description
orbit_number	$N_{prof} \times 1$	Envisat orbit number
star_number	$N_{prof} \times 1$	Star number in GOMOS catalogue
star_magnitude	$N_{prof} \times 1$	Star visual magnitude
star_temperature (K)	$N_{prof} \times 1$	Star effective temperature
obliquity (deg)	$N_{prof} \times 1$	Obliquity of occultation: the angle between the direction of the apparent motion of the star and the local vertical at the ray perigee

Remark. The order of profiles is not chronological: they are sorted by orbit number and then by star number.

4 Contact

For all questions related to the HRTP data please contact Viktoria Sofieva (viktoria.sofieva (at) fmi.fi)

Original (not interpolated) data can be obtained by request.

5 References

Sofieva, V. F., Dalaudier, F., Hauchecorne, A., and Kan, V.: High-resolution temperature profiles retrieved from bichromatic stellar scintillation measurements by GOMOS/Envisat, Atmos. Meas. Tech., 12, 585-598, https://doi.org/10.5194/amt-12-585-2019, 2019

Sofieva, V. F., Vira, J., Dalaudier, F. and Hauchecorne, A.: Validation of GOMOS/Envisat high-resolution temperature profiles (HRTP) using spectral analysis, in New Horizons in Occultation Research, Studies in Atmosphere and Climate, edited by A. Steiner, B. Pirscher, U. Foelsche, and G. Kirchengast, pp. 97–107, Springer-Verlag Berlin Heidelberg., 2009.