GOME Fast delivery and value-Added Products (GOFAP)

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Abstract A Fast Delivery processor has been developed to provide GOME ozone products within 3 hours after observation. This service meets the growing demand for ozone products for purposes like assimilation in numerical weather prediction models, UV radiation forecasts, and planning of experiments related to atmospheric chemistry research. The ozone products consist of total ozone columns, the global assimilated ozone field, global stratospheric ozone profiles, cloud fraction, cloud top pressure and the aerosol absorption index. The validation and current developments of the near-real time processor and the delivered ozone products are discussed.

INTRODUCTION

In the framework of the ESA Data User Program a Fast Delivery processor has been developed to provide near-real time (i.e. within 3 hours after observation) ozone products from the satellite instrument GOME [1] on ERS-2.
By making maximum use of the existing ERS ground segment and European Internet links, the retrieval of ozone products can be performed within 3 hours after observation from the Extracted GOME Instrument Header (EGOI) Data. This data
A spectral and radiometric calibration is performed on the raw EGOI data to calculate the earthshine and sunshine spectra (i.e. the level 1 product) [2]. This level 1 product contains parts of the ultra violet spectrum applicable for the retrieval of ozone columns and ozone profiles and parts of the visible spectrum used for retrieval of cloud and aerosol information. The cloud fraction and cloud top pressure are calculated with the FRESCO algorithm [3]. The aerosol absorption index is computed to have an indication for areas with heavy aerosol pollution. This index is comparable to the aerosol absorption index of TOMS [4].
After processing all products are directly available on the web site *http://www.knmi.nl/gome_fd/* .

NEAR-REAL TIME TOTAL OZONE

The retrieval of the total ozone column from the EGOI level 1 product can be divided in several steps. Firstly, the ozone slant column is calculated using the DOAS (Differential Optical Absorption Spectroscopy) method. The cloud cover fraction and cloud top pressure are determined with the FRESCO algorithm to account for a ghost ozone column below the cloud. Next, a look-up table of pre-calculated air mass factors is used to account for the optical path length through the atmosphere. And finally, the vertical ozone column (Fig. 1) is determined using the results from the previous steps. More details about total ozone column retrieval can be found in [5].

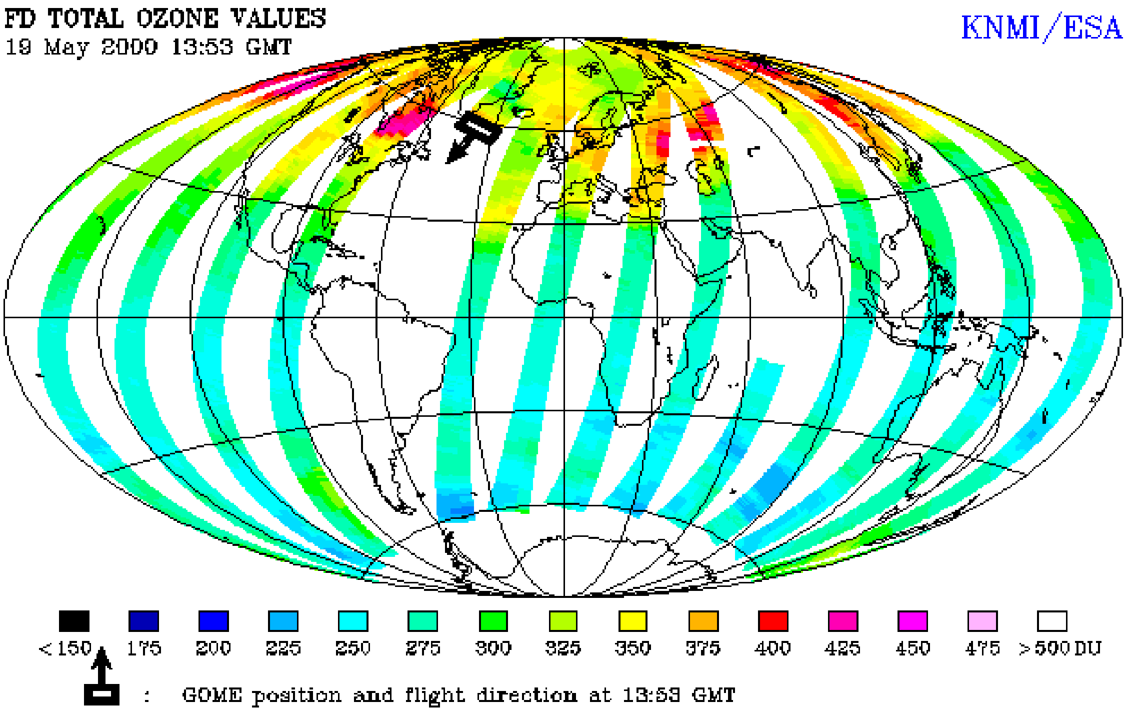

Fig. 1. The calculated ozone columns of GOME at May 19, 2000 as delivered by the NRT processor.

The total ozone columns have been validated with TOMS total ozone measurements and ground-based measurements. Comparisons with TOMS measurements show differences within 5% for solar zenith angles less than 70 degrees. Larger differences occur at high solar zenith angles and over high surface albedo areas. Differences between the NRT total ozone columns and ground-based Brewer measurements in the Netherlands and Suriname are generally less than 3-5%. Pole-to-pole comparisons with measurements from various NDSC stations also show differences generally less than 5% ([6], [7]).

Data assimilation software of [8] has been incorporated in the automatic GOME fast-delivery processing to provide global maps of ozone. In the data assimilation a transport model (TM3) describes the atmospheric flow of ozone by an advection scheme and a parameterized chemistry of the atmosphere [9]. The model uses the temperature, pressure and wind fields provided by the European Center for Medium-Range Weather Forecasts (ECMWF). With the data assimilation it is also possible to deliver forecasts of the global ozone field for up to 3 days.

NEAR-REAL TIME STRATOSPHERIC OZONE PROFILES

The UV part of the spectrum also contains information about the vertical ozone distribution. An existing off-line profile retrieval algorithm [10] has been adapted to produce reliable stratospheric ozone profiles within a strict time constraint (4 hours) with a spatial resolution sufficient for numerical weather predictions.

The steep rise of ozone absorption at wavelengths from 340 to 260 nm in the observed backscattered radiance offers the possibility of inferring height-resolved information on the ozone concentration ([11], [12], [13]). The ozone profile retrieval is performed with the optimal estimation method [14], where the information of the observation is combined with *a priori* information. This method is used on a linearisation of the forward model utilizing an iterative process to account for the non-linearity. For each iteration step the forward model is linearised by a weighting function. The weighting function is the derivative of the radiances to the ozone concentration at a number of altitudes. For the forward calculation the radiative transfer model MODTRAN 3.7 [15] is used. For each iteration, an optimal estimate profile is calculated from the profile of the former iteration step, the weighting function and the measured radiances. The *a priori* ozone profile is taken from the climatology of *Fortuin and Kelder* [16].

Every 12 seconds GOME makes an observation in the UV spectrum suitable for profile retrieval. This observation has a ground pixel size of 960 by 100 km, resulting in global coverage over a period of 3 days. Each day GOME is producing more than 3000 observations, which are processed to ozone profiles.

Because of the strict time limit, the fast analytic two-stream calculation for multiple scattering has been used. As a consequence the computed ozone values in the troposphere are less reliable. Therefore, only the stratospheric ozone profiles are delivered. Figure 2 shows an example of the ozone distribution along an orbit of GOME on September 19, 2000 retrieved with the near-real time processor. The location of the orbit is mainly above the Pacific Ocean at about 20 hour GMT. More details about NRT ozone profile retrieval can be found in [17].

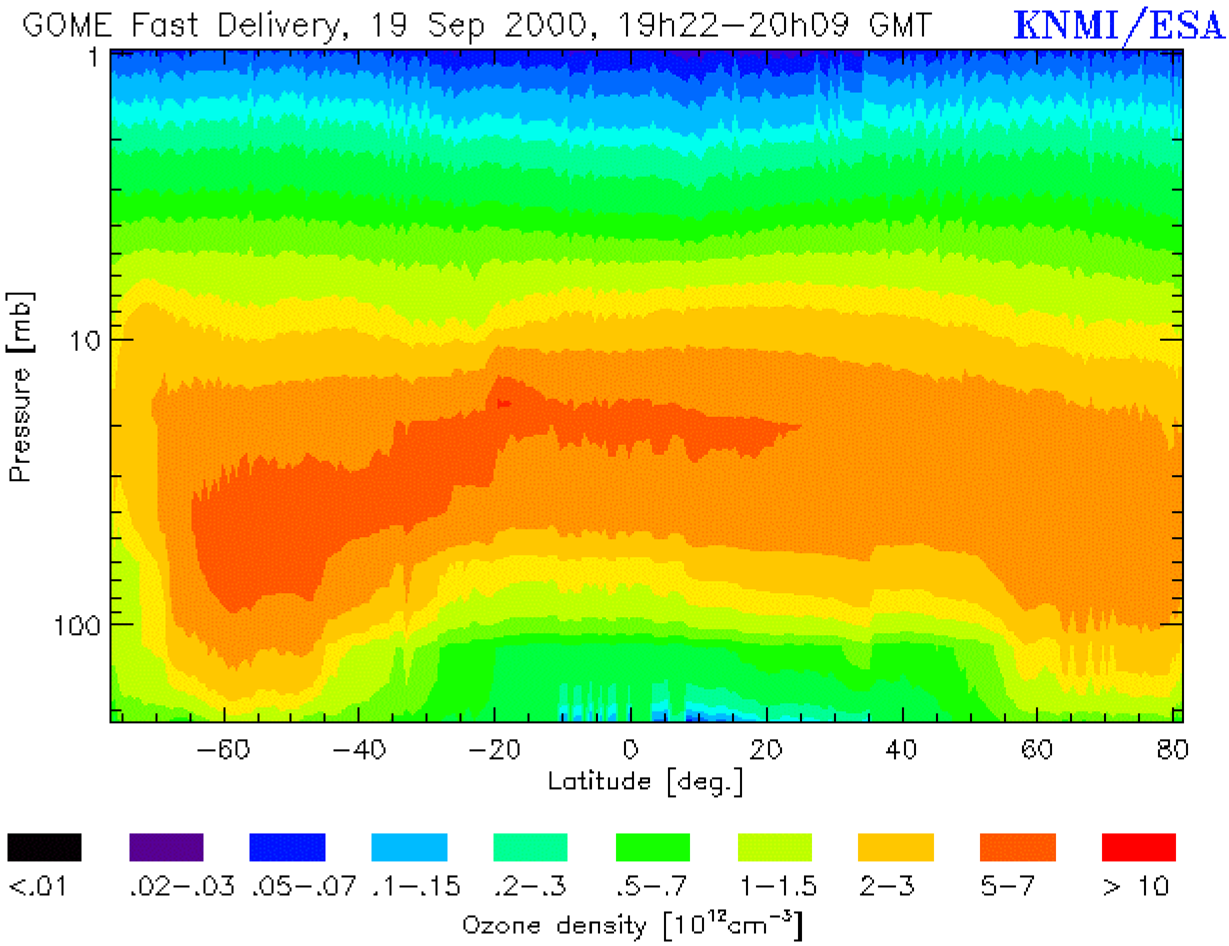

Fig. 2. Cross-cut of the calculated ozone distribution for an orbit of GOME at September 19, 2000. At 75 degrees South the Antarctic ozone hole is clearly visible.

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