

## GOME near-real-time service

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The generation of GOME near-real-time products from Kiruna station was initiated on January 1997. This paper gives an overview on the GOME-NRT-data processing chain up to level 3 data products. Due to an increasing request for at least NRT-GOME-level-3 data products, the near-real-time service will be extended to the other stations using EGOI data.

### Introduction

GOME fast-delivery services was initiated with the installation of the GOME Data Processor system at the Kiruna station (Sweden) in January 1997. This was done by DLR's Deutsches Fernerkundungsdatenzentrum (DFD) in collaboration with the Bremen Institute of Environmental Physics and Remote Sensing (IFE/UIP) and ESA, as part of the 1997 European Arctic winter campaign in Kiruna.

### NRT Ground Segment

The generation of earthshine radiances (level 1) and ozone total column (level 2) NRT products from Kiruna (Fig. 1), is done using the GOME Data Processor (GDP) system (Loyola *et al.* 1997), the ground segment of the GOME sensor developed and operated at the German D-PAF in DFD. The NRT products from Kiruna have the same precision as the off-line products and are available one hour after acquisition.

Level 3 data processing is performed at DFD, Oberpfaffenhofen, as soon as all level 2 data from Kiruna from one day are available (typically 7-9 orbits). The Kiruna station receives up to ten out of the daily fourteen orbits. Maspalomas, Gatineau and Prince Albert stations collect the remaining orbits. The optimal solution for having global fast-delivery ozone data, would be the installation of GDP in the remaining stations. This is not possible due to financial and technical constraints. The foreseen alternative solution is the usage of the so-called 'EGOI' data, a subset of the normal GOME EGOC science data,

sent from the stations to ESRIN for instrument monitoring.

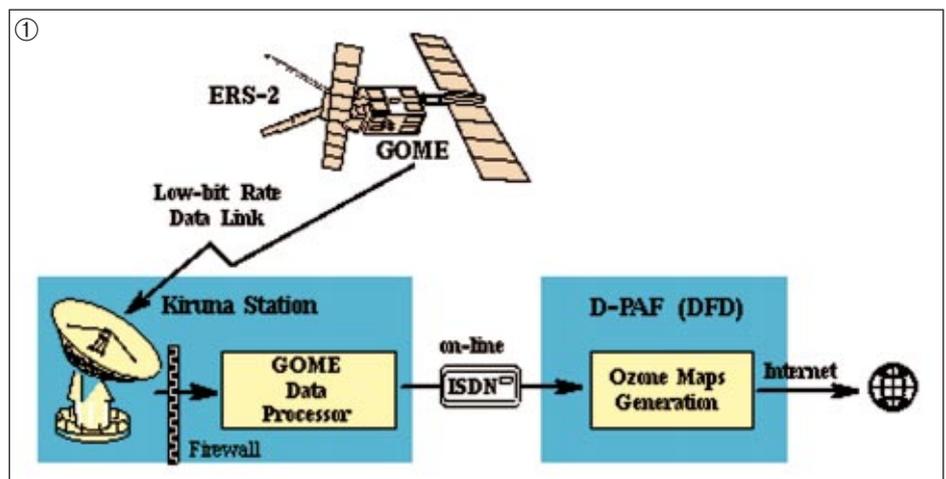
The EGOI data has been interfaced at DFD and can be processed using the standard GDP processing chain. The on-line calibration parameters computed by GDP in Kiruna will be used to process EGOI data (no straylight or polarisation correction possible with EGOI). Figure 2 shows the GOME NRT ground segment for EGOC and EGOI data processing.

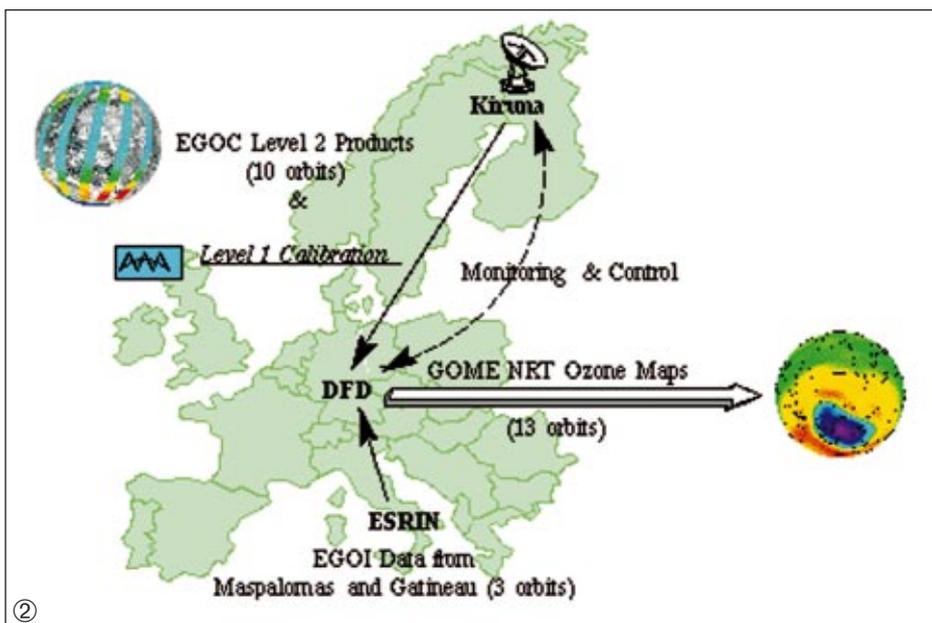
Using the calibration parameters from Kiruna, the EGOI ozone total column has only 0.2% difference with respect to the EGOC product. The EGOI data is available at ESRIN two hours after acquisition.

### Level-3 Data Processing - Daily distribution of total column ozone over Europe

A wide range of potential users of remotely sensed data voiced the need for near-real-time ozone. Besides scientists who predominantly use this information for example for campaign planning and support, there is a broad spectrum of individuals, companies, and government groups needing this information. Its usefulness is legion: for weather services to improve long-term weather forecasting, for public health authorities to define a strategy to better fight cancers, for chemical industries concerned with developing shieldings for UV-exposed sensitive materials such as plastics or rubber, for agriculture to develop a strategy to overcome UV-

Data flow from the ERS-2 satellite (level-0) to the GOME Data Processor (level-1 and level-2) in Kiruna. Ozone data is digitally transmitted to the DFD where global maps are generated (level-3) and distributed via Internet.





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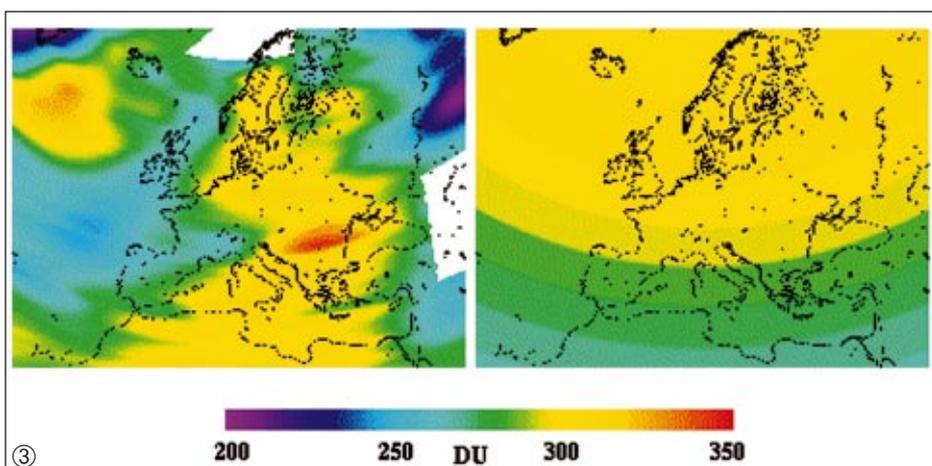
GOME NRT Ground Segment, level 2 ozone data and level 1 calibration parameters are transmitted to DFD from Kiruna. EGOI data is processed at DFD and the global maps are distributed via Internet. DFD does the remote monitoring and control of GDP in Kiruna.

induced decrease in crop yield, for fishing industries to study the impact of low-ozone-induced sudden increase in ground-level UV-B damaging fish embryos, for TV media and for environmental authorities hoping to increase the awareness of the general public to environmental risks. Near-real-time data are especially needed to perform forecasting and to early warn people

against peculiar structures such as ozone mini-holes and streamers containing ozone-low air masses approaching densely populated regions such as Europe.

Based on GOME GDP-level 2 data daily global and regional (Europe) maps of total column ozone are generated in different projections using the Harmonic

Left: Total ozone distribution over Europe on 15 October 1997 as derived from Kiruna near-real-time data (daily composite). Right: Total ozone distribution as it is given in CIRA'96 for October (monthly mean).



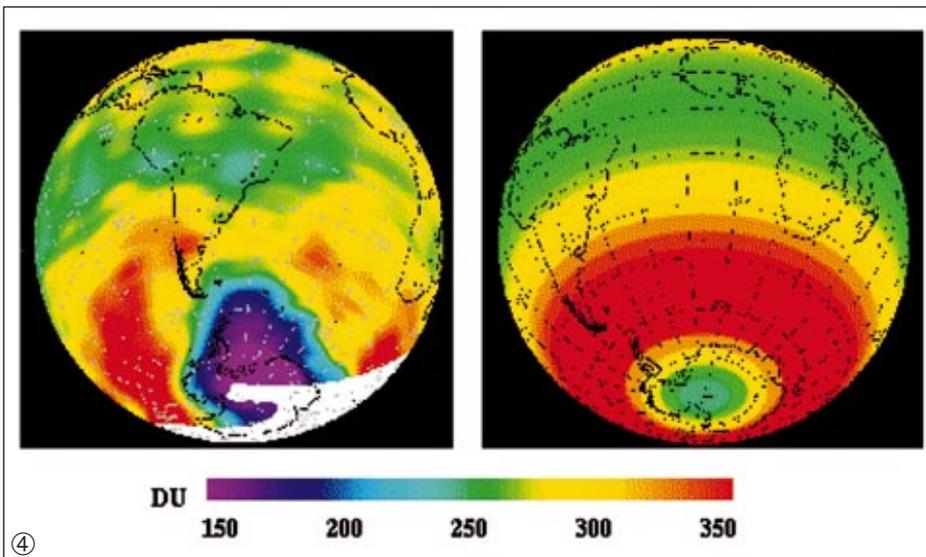
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Analysis technique for daily composites and the Kalman-Filter for generating maps for a specific time (snap-shot) (Bittner et al. 1997). To better judge the measured ozone distribution in terms of ozone trends or to identify peculiar situations, comparisons to the COSPAR International Reference Atmosphere (CIRA'96) total ozone climatology (Keating et al. 1996) are provided. The model total column ozone data given in CIRA'96 are based on 4 years (Nov.-Oct. 1982) of Nimbus-7 TOMS measurements using daily zonal averages every 5° in latitude over the illuminated portion of the Earth.

Typical examples for total column ozone maps derived from GOME near-real-time data are presented in Figures 3 and 4, respectively. White areas indicate data gaps due to the limited number of GOME orbits available from the Kiruna receiving station. No interpolation is performed for these parts to avoid artefacts.

Generally, the quality of the interpolated near-real-time ozone maps is lower than it is for the off-line products. This is because only 7-10 orbits instead of 14-15 can be used to generate the near real time daily maps. Therefore, to assure some quality standard and to routinely check the robustness of the processing, comparisons are made with ground-based total ozone measurements on a daily basis. To do so, total ozone data are provided from the German Weather Service as they are obtained at the Meteorological Observatory at Hohenpeissenberg (48°N, 11°E) using the European Standard Dobson instrument. Agreement turned out to be quite satisfactory; mean deviation is within only 3%.

In parallel, work was undertaken to analyse the total ozone distribution and dynamics of the middle atmosphere. These other level 3 data products are restricted to the off-line processing due to quality reasons. All GOME level 3 data standard and analysis products, near-real-time and off-line, can be obtained electronically free of charge using DLR's user interface, the Intelligent Satellite Data Information System



Left: Total ozone distribution over the Southern Hemisphere on 15 October 1997 as derived from Kiruna near-real-time data (daily composite). Right: Total ozone distribution as it is given in CIRA '96 for October (monthly zonal mean).

(ISIS) (<http://isis.dlr.de/>) and through WWW (<http://auc.dfd.dlr.de/news.html>).

### Conclusions

The GOME near-real-time segment for the generation of global ozone fast-delivery products was presented. The GOME Data Processing system, developed by DFD, is used not only for off-line processing, but also in the more time demanding environment of NRT processing. GDP is also able to retrieve ozone using EGOI data.

GDP was installed in Kiruna and is working operationally since January 1997. Level 1 and level 2 NRT products

from Kiruna have the same precision as the off-line products and are available one hour after acquisition. Ozone data from Maspolomas and Gatineau, three orbits, will be generated using the EGOI data (one orbit from Prince Albert is lost because the station can not generate EGOIs). EGOI-based ozone data will be available two hours after acquisition. Global and regional (Europe) daily maps of the distribution of total column ozone are generated operationally using NRT-GOME level 2 data. The maps are available with a maximum delay 12 hours. They are available free of charge via WWW or ISIS.

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