Minutes of the Progress Meeting 1
of the ESA Study

DEVELOPMENT OF ALGORITHMS FOR RETRIEVAL OF GOME TOTAL OZONE COLUMN "GOTOCORD"

Meeting Place: ESA/ESRIN, Frascati, Italy

Date: 6th December 2002, 14:00h-16:30h

Participants: Claus Zehner (all ESA/ESRIN), Melanie Coldewey-Egbers, Mark Weber (all IUP University of Bemen).

Introduction

During this progress meeting the main results from the Phase 1 work were presented and discussed. The presentation was given by Melanie Coldewey-Egbers.

Summary of Phase 1 activities

Results from the following Phase 1 Activities were presented:

- Definition of the optimum parameter space of the intensity and weighting function look-up-table
- Definition of all atmospheric parameters to be included in the fitting procedure
- Investigation of the complexity to which the Ring effect has to be treated
- Find the optimum spectral fitting window
- Investigate whether the *shift-and-squeeze* procedure can be avoided
- Select a radiative transfer model and define the optimum processing of geolocation information

Parameter space for Look-Up-Tables

An overview of the parameter space selected for the intensity and weighting function look-up-table were presented. Ozone and temperature profiles come from the TOMS Version 7 climatology. Between albedo and altitude a linear interpolation is performed for those values which are between two grid points. As albedo estimate the Lambertian equivalent reflectivity at 377 nm is selected. For the solar zenith

angle interpolation, linear interpolation is sufficient below 70° solar zenth angle. For larger SZAs a polynomial will be fitted and the coefficients will be stored in the table. To account for the varying line-of-sight over each pixel, each spectrum is fitted three times for three different LOS. Afterwards a weighted average is calculated.

The parameters which we include in the fitting procedure are ozone and temperature weighting functions, cross sections of nitrogen dioxide and bromine oxide (slant column fitting), as well as an undersampling spectrum and a Ring spectrum. Additionally a low order polynomial is fitted. Including albedo and pressure weighting function leads to larger errors in fitted ozone vertical columns due to strong correlations between those weighting functions and the ozone weighting function. Including NO2 and BrO weighting functions instead of cross sections does not improve the fit residuals. Slant column fitting for the minor trace gases, however, reduces the dimension of the LUT significantly.

Ghost vertical column corrections will be done using cloud-top-height and cloud fraction information from FRESCO and ozone climatological information from the Labow climatology. It is believed that the zonal and monthly ozone climatology provides more realistic mean tropospheric information than the TOMS V7 climatology.

Ring studies

At the moment a set of 32 Ring spectra is available which has been calculated for different solar zenith angles but for only one atmospheric trace gas scenario from the MPI 2D climatology for September, 75°N, with am ozone column of 320 DU. In order to test if this data set suffices, 72 new Ring spectra have been computed for 12 different trace gas scenarios, two albedos and three line-of-sight angles. It was investigated how the influence of a wrongly selected Ring spectrum on the spectral fitting compared to the use of a correct Ring spectrum for a given scenario. It has been found that the errors in the ozone retrieval are between 0.2% and 3.7% if the incorrect Ring spectrum is used. The line-of-sight dependence of the Ring effect seems to be negligible. This is an important result since the Ring calculation for off-nadir viewing geometries is extremely time consuming. However, the albedo dependence is important and has to be accounted for. We suggest to compute a new Ring data base as function of solar zenith angle, total ozone and profile shape, and albedo. The influence of the ground altitude has still to be investigated.

Spectral fitting windows

We selected the spectral fitting window from 326.8 nm - 335.0 nm, which covers three ozone absorption maxima. Smaller fitting windows result in strong correlation between ozone and temperature weighting function and, therefore, produce large errors in the fitted vertical columns and temperature, even though the fit residuals become smaller.

The work concerning the treatment of the nonlinear shift-and-squeeze procedure is still in progress. First results are: The solar irradiance spectrum is used to be held fixed instead of the earthshine spectrum. The cross sections will be shifted before the calculation of the reference spectra. This avoids the time consuming nonlinear fitting

in the retrieval. The value for the constant shift is +0.017 nm following the recommendation of M. van Roozendael from BIRA-IASB (manuscript on DOAS Issues).

Selection of absorption cross-section

The effect of using Bass-Paur or GOME FM98 ozone cross section has been carefully evaluated by van Roozendael and there is no further action needed. His conclusion was that the GOME FM98 cross-section provide the most consistent fit results. However, inconsistencies between ground based data (Dobson and Brewer), retrieved using Bass Paur data, and GOME cannot be excluded. In agreement with the Statement of Work the GOME FM98 cross-sections are used for O3 and NO2 in our approach.

Radiative transfer model

We decided to adopt the radiative transfer model SCIATRAN for the calculation of reference spectra and weighting functions in preference over the CDI model. SCIATRAN allows in addition the calculation of theoretical Ring spectra.

Discussion items

Following items were discussed during the presentation.

- There is an option to use a more updated ozone climatology. A student of Mark Weber is currently working on this topics. Depending on the status of this work it may be available for this study.
- It was discussed how polarisation may effect ozone retrieval. In a recent GOME2 error study it was concluded that the O3 retrieval error due to polarisation correction error is below 0.3%.
- Claus Zehner suggested to use the new extraction software developed by KNMI (R. van der A), which includes improved calibration correction for GOME level1 data. After the meeting he provided us with the web address, where the tools can be downloaded. In a preliminary investigation it was found that differences for O3 column retrieval are quite small. It was decided to investigate this matter further. The retrieval procedure is not effected by the choice of the extraction software.
- Mark Weber has proposed to set up an internal web page for this project, where all participants and involved ESA representatives have access to documents (minutes, viewgraphs, documentations, drafts). This page has been created and the new address is *www.iup.physik.uni-bremen.de/~weber/GOTOCORD*
- It was agreed that the next progress meeting will take place in Bremen the last week of April 2003. Exact dates will be later confirmed.

M. Weber, M. Coldewey-Egbers

Bremen, 8th January 2003