

OCIO product specification document (version 1)

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Product description

Each product file contains the OCIO profile retrieved from a single limb scan. The observations are azimuthally averaged. The retrieved profile is given in number density (molec/cm³). OCIO is retrieved from 15 to 27 km, typically. The retrieval range depends strongly on the concentration profile of OCIO. There are approximately 7 retrieval levels, and vertical spacing between adjacent retrieval levels is 2 km. The actual vertical resolution is ~3 km.

Data accompanying the retrieved OCIO profile include the assumed air number density profile (in molec/cm³) from the McLinden *et al.* [2002] database of model atmospheres, the assumed wavelength and month-dependent surface albedo (from GOME) at ~350 nm [Koelemeijer *et al.*, 2003], and the tangent height offset (in km), used to correct the tangent heights provided in the L1b product, based on the ~305 nm knee [Sioris *et al.*, 2003], but averaged over the entire orbit.

Product format specification

The data is currently stored in Microsoft Excel spreadsheet format (*.xls). The product filename includes the orbit number and the record number (for the limb state) given by EnviView when “cat -2” is selected when calibrating and extracting the L1b data (see cell C21 for L1b filename information). Column C of each spreadsheet (rows 14-21) contain a list of input parameters and geolocation information, including tangent point azimuth difference and solar zenith angles, reference tangent height (km), surface albedo, latitude and date of the retrieved profile, latitude and date of the climatological background atmosphere, tangent height offset and forward model version number, and the filenames of the programs used for spectral fitting of the observations and simulations. All input parameters are labeled in adjacent cells (column B). In column C, one will also find information on the filename of the L1b product used to generate the Level 2 OCIO

product. An AM/PM designator is given in cell D16. The latitude of the retrieval is given by the average latitude of the tangent points for the elevation step at ~20 km (thus the latitude is azimuthally-averaged) and is located in cell C17. The database of model atmospheres has 24 time steps (bi-monthly) and latitudinal resolution of 2.5° (from 90° S to 90° N). The retrieval altitude vector, the OCIO number density profile and 1-sigma uncertainty are found in columns T,U and V (rows 12-22).

Software release history

This is the initial software release, namely version 1.

Implementation details

The following calibrations are applied to the L1b data using SciaL1C (EnviView 2.2.7):

- memory effect
- wavelength
- pixel-to-pixel gain
- stray light
- etalon signature
- dark current

Selection criteria:

-the azimuthally-averaged SZA at 20 km is <90°

AND

-observed SCD uncertainty is <50% for at least one tangent height in the retrieval range

Analysis of observed spectra:

Fraunhofer reference: co-addition of limb spectra from same scan at tangent heights in ~33-70 km range.

Fitting window of observations: 357-381 nm

Absorption cross sections:

NO₂ - Bogumil *et al.* (2003) at 223 K

O₃: - Bogumil *et al.* (2003) at 223 K

BrO - Wilmouth *et al.* (1999) at 228 K

Closure polynomial: 3rd order

First guess OCIO vertical profile: from Strong *et al.* [2002]. Temperature and air density profiles are from the database of McLinden *et al.* [2002] and surface albedo is from Koelemeijer *et al.* [2003].

Pseudo-absorbers:

1) 'tilt' [Sioris *et al.*, 2003]

2) de-trended ratio of the spectral radiance at the lowest reference tangent height to the co-addition of all of the other normalizing radiances

Retrieval range: set to cloud top height, if cloud top > 15 km

Analysis of simulated spectra:

Fitting window of simulations: 358.0-381.0 nm in steps
Wavelength step size, simulations: 0.2 nm

Reference TH, simulations: ~38 km

Absorption cross-sections:

NO₂ - 221 K [Burrows *et al.*, 1998]

O₃ - 202 K [Burrows *et al.*, 1999]

BrO - 223 K [Wahner *et al.*, 1988]

OCIO - [Wahner *et al.*, 1987]

Closure polynomial: 3rd order

Convergence criteria: 3% (see Sioris *et al.* [2004] for more details)

List of known issues

Ideally, a high resolution O₃ cross section should be I₀-corrected rather than using a cross-section measured by the SCIAMACHY instrument in the fitting of the observations.

The L2 data does not include the geographical extent. This will be corrected in the next version of the data product.

Data quality assessment

This product has not been validated. It is a difficult product to validate, partly because of the sparseness of correlative measurements. Secondly, OCIO as retrieved from SCIAMACHY exhibits a diurnal variation at twilight which seems to disagree with photochemical model simulations. This could point to a problem with photochemical box models [McLinden *et al.* 2006] with respect to biased reaction rates or missing reactions. In any case, the diurnal variation is rapid and also depends on assumed BrO_x (BrO+BrCl) [Sessler *et al.*, 1995] which is not very well known at ~15 km. The precision (1σ) of retrievals is ≥25% at the OCIO number density peak and worsens above and below.

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