Sentinel-5 Precursor Bromine Monoxide Level 2 Processor TCBRO

and its auxiliary processor BGBRO

Input / Output Definition Document

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Table of Signatures

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CHANGE RECORD

Issue	Date	Chapter	Change
0.1.0	2020-07-24	All	First draft
1.0.0	2022-01-12	All	Full description. Updates matching TCBRO processor version 1.1.1 and BGBRO auxiliary processor version 1.1.1.
1.1.0	2022-06-17	Section 2.4 Throughout	Updated description of processing selection rules. Several text and layout corrections
1.2.0	2023-12-24	 Section 1.3 Appendix	Updates in line with processor version 1.2.3 and use of Collection 3 L1b data. Updated references. Update of generated file structure examples.

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1. Introduction

1.1 Purpose

The purpose of the Input / Output Data Definition document (IODD) is to provide a precise description of the input and output files as used and generated by the L2 TCBRO processor and its auxiliary processor BGBRO for the retrieval of total BrO vertical column density from data obtained by the Sentinel-5 Precursor/TROPOMI instrument.

1.2 Scope

This document is part of the ESA S5P-PAL project. The sections presented here describe the S5P Level 1 and auxiliary input data as well as the S5P total BrO Level 2 (output data) products that are employed and generated, respectively, by the TCBRO processor and its auxiliary processor BGBRO. The descriptions of the algorithms used to generate the output products are addressed in the corresponding ATBD document [RD03]. The document at hand is based on the IODD for the UPAS processor [RD05], facilitating the S5P operational processors, but is specific for the TCBRO/BGBRO processor pair.

1.3 References

1.3.1 Applicable Documents

The following project documents contain provisions which, through reference in this text, become applicable to the extent specified in this document.

Document Title		Document ID	Issue	Date
[AD01]	Sentinel-5 Precursor L2 Processor Software System Requirements	S5P-L2-DLR-SSR-3001	1.2	2015-11-30
[AD02]	Input output data specification for TROPOMI L01b data processor	S5P-KNMI-L01B-0012-SD	7.0.0	2016-09-30
[AD03]	EO Ground Segment File Format Standard	PE-TN-ESA-GS-001	2.0	2012-05-03
[AD04]	Tailoring of the Earth Observation File Format Standard for the Sentinel 5-Precursor Ground Segment	S5P-TN-ESA-GS-106	2.2	2015-02-20
[AD05]	Sentinel-5 Precursor L2 UPAS Processor – Software User Manual	S5P-L2-DLR-SUM-3005	00.11.00	2016-11-15
[AD06]	Sentinel-5 Precursor L2 UPAS Processor – External ICD	S5P-L2-DLR-ICD-3003	1.0.0	2017-06-01
[AD07]	Sentinel-5 Precursor PDGS – Revision of PDGS Auxiliary Product Selection Rules	S5P-PDGS-DLR-TEC-3304	1.6.1	2019-05-23
[AD08]	Sentinel-5 Precursor PDGS Processor Generic ICD	S5P-PDGS-DLR-ICD-3015	1.0dr2	2014-07-31

Table 1: Applicable Documents

1.3.2 Reference Documents

The following standards or documents are referenced in this document. They have been used (in the sense of tailoring) to prepare the document at hand.

Title		Document ID/Reference	Issue	Date
[RD01]	Sentinel-5P Level 2 Processor Requirements Specifications	S5P-RS-ESA-GS-054	1.0	2012-03-02
[RD02]	S5p Product Algorithm Laboratory L2 Processor File Format Guidelines	ST-ESA-S5P_PAL-L2FFG-001	1.4	2023-03-27
[RD03]	S5p L2 TCBRO Algorithm Theoretical Basis Document	S5P-L2-BIRA-ATBD-TCBRO	1.2.0	2024-12-23
[RD04]	S5p/TROPOMI Cloud Products Algorithm Theoretical Basis Document	S5P-DLR-L2-ATBD-400I	2.3	2021-06-25

Title		Document ID/Reference	Issue	Date
[RD05]	Sentinel-5 Precursor Level 2 UPAS Processor Input / Output Definition Document	S5P-L2-DLR-IODD-3002	3.5.0	2019-08-09
[RD06]	S5p L2 TCBRO Product File Specification	S5P-L2-BIRA-PFS-TCBRO	01.02.00	2023-12-23

Table 2: Reference Documents

1.3.3 Electronic references

The following electronic links are referenced in this document.

Page Title		URL	Date visited
[ER01]	Unidata – NetCDF library and documentation	http://www.unidata.ucar.edu/software/netcdf/	2013-04-19
[ER02]	Brian Eaton, Jonathan Gregory, Bob Drach et al., NetCDF Climate and Forecast (CF) Metadata conventions - Version 1.6	http://cfconventions.org	2014-05-13
[ER03]	Infrastructure for Spatial Information in the European Community (INSPIRE) Directive 2007/2/EC	http://inspire.jrc.ec.europa.eu	2013-04-19
[ER04]	NetCDF Users Guide (2011)	http://www.unidata.ucar.edu/software/netcdf/docs/netcdf.html	2013-04-19
[ER05]	QDOAS User Manual	https://uv-vis.aeronomie.be/software/QDOAS/QDOAS_manual.pdf	2022-01-11

Table 3: Electronic references

1.4 Terms and Abbreviations

1.4.1 Terms

As far as possible the technical terms used in reference documents have been reused. It is assumed that the reader is familiar with the technical terms used in the domain of EO missions and payload data ground segments.

1.4.2 Abbreviations

Abbreviations used in this document are listed next.

Abbreviation	Meaning
BIRA	Royal Belgian Institute for Space Aeronomy
DLR	Deutsches Zentrum für Luft- und Raumfahrt
ESA	European Space Agency
GS	Ground Segment
I/O	Input /Output
IODD	Input / Output Data Definition
L1b	Level 1 b Product
L2	Level 2 Product
OFFL	Offline
PDGS	Payload Data Ground Segment
S5P	Sentinel-5 Precursor
S5P-PAL	S5P Product Algorithm Laboratory
UPAS	Universal Processor for UV/VIS Atmospheric Spectrometers
XML	Extensible Markup Language

Table 4: Abbreviations

2. S5P TCBRO processor overview

This chapter gives an overview of all the involved I/O files accounted from the processor and aims to show specific workflows of S5P TCBRO processor for different modalities and purposes.

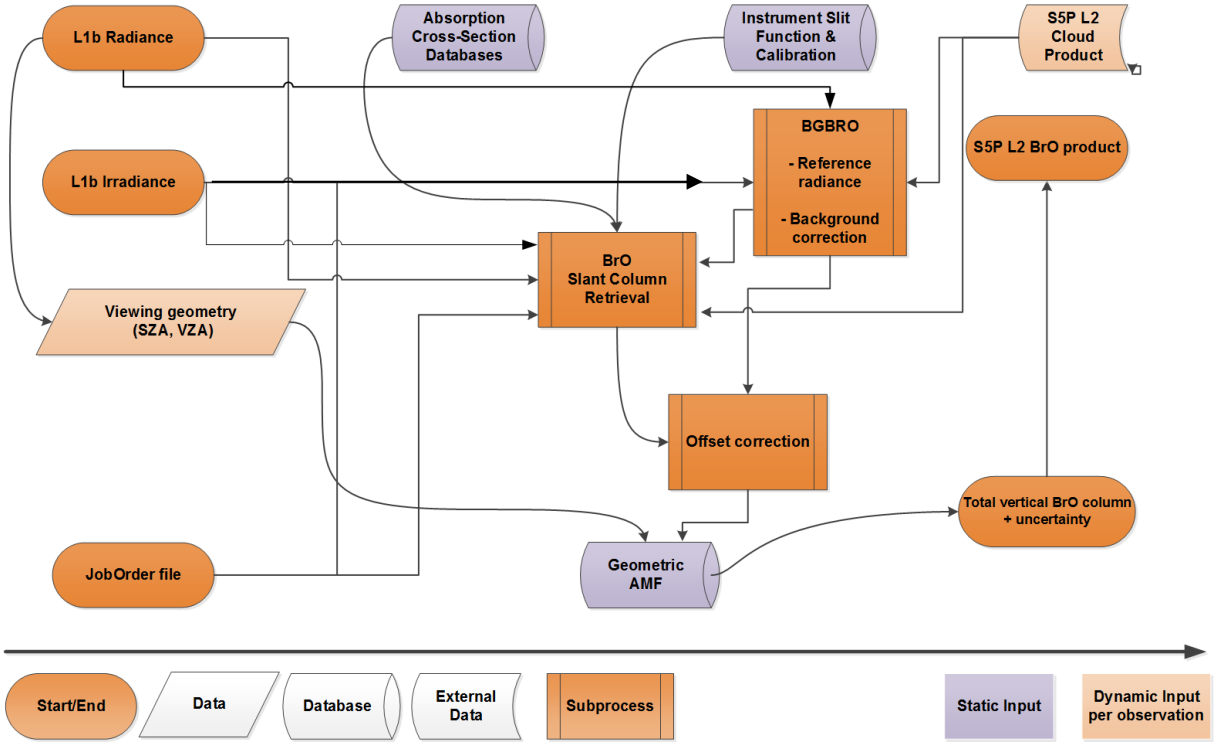

Figure 1: Schema of I/O files of the S5P TCBRO/BGBRO processor; for simplicity, the BGBRO processing is depicted as an element of the TCBRO workflow, to indicated that certain input product types are used in both processors. See also text.

2.1 High-level overview of S5P TCBRO processor

The BrO total column algorithm consists of two components: the main processor TCBRO (Total Column BrO) for the derivation of BrO total vertical column density (VCD) and the auxiliary processor BGBRO (BackGround BrO) for the generation of data related to the use of Earthshine radiance as spectral reference data in TCBRO and to the correction of background offset correction and destriping in the TCBRO slant column density (SCD) data. Both processors are intended to do processing on offline L1b data. TCBRO will use results from BGBRO as input data and selects files for the most recent date in the BGBRO output archive. For a detailed description of the use of radiance data as spectral reference and of the destriping and offset correction procedure, see [RD03].

Figure 1 shows the architecture of S5P TCBRO processor concerning the involved processing steps and I/O data. The output is limited to the L2 file product, containing the BrO retrieval results and auxiliary data and metadata. Input consists of the L1b radiance and irradiance spectra, L2 offline cloud product files, an a-priori calculated set of radiance reference spectra over a clean geographical region, background data to correct for striping and offsets, and a set of absorption cross sections. Radiance, irradiance and cloud data are also input to the BGBRO auxiliary processor. The BGBRO module is only shown in Figure 1 for simplicity, as it has input data in common with TCBRO. When operationally run, the BGBRO processor should deliver output before TCBRO is invoked, in order to provide background correction data for the same measurement day. When operated manually, this implies that a user may first generate BGBRO output data for a certain range of measurement days, and subsequently evoke TCBRO, using the BGBRO results as input. In an automated operational environment, the TCBRO/BGBRO operation needs to be orchestrated such that matching BGBRO output is available as closely as possible in time to the measurements to be treated by TCBRO.

2.2 Document Overview

The document is organized as follows: Chapter 1 outlines the purpose of this document and lists the references that have been used for creating this document. Chapter 2 then gives an overview about the involved input/output data as well as a high-level description of the S5P TCBRO/BGBRO processor architecture. Afterwards, the I/O data formats and definition for each I/O file are presented in greater detail in Chapter 3.

2.3 S5P TCBRO processor architecture and modes

The current version of S5P TCBRO processor works only in offline (OFFL) mode. In this mode, the processor generates L2 OFFL products based on the consolidated L1b orbit products. The processor has been tested and executed on the S5P-PAL system that mimics the processing environment of the S5P PDGS. Throughout this document, the term PDGS is used to indicate the PDGS proper or an operating environment where processors are operated in identical fashion as in the actual PDGS. An example of this is the S5P Product Algorithm Laboratory (S5P-PAL). The TCBRO processor was developed and tested in the S5P-PAL.

2.4 Selection rules

In order to precisely specify the input files that should be selected for any of the TCBRO/BGBRO processor modules, certain policies defined by the PDGS are used. These so-called Retrieval Modes are described in [AD07] in more detail. These selection rules ensure that the intended input files are collected for each invocation of the processor and help to avoid that files are collected that are not used by the processor or that a certain file is treated in multiple instances of the processor evocation. The TCBRO/BGBRO Retrieval Modes are listed below.

2.4.1 TCBRO

The L1B_RA_BD is the driving input for TCBRO and the intended evocation is to perform the L1b > L2 processing on a per-orbit basis. The time interval $[t_0, t_1]$ is the time interval of the product to be processed, i.e. the L1b file in this case.

The Retrieval Modes for the evocation of TCBRO ensure that for each L1b orbit radiance file, the processing environment collects a matching L2__CLOUD_ file, and an irradiance, reference radiance, and background correction file representing measurements that are closest in time to the measurement period of the L1b radiance file. An overview is given in Table 5.

Details on the available Retrieval Modes and their meaning can be found in [AD07].

Input	Retrieval Mode	dt_0	dt_1	
L1B_RA_BD3	ValCover	0	0	This mode gets all files that cover entirely time interval $[t_0 - dt_0, t_1 + dt_1]$.
L1B_IR_UVN	LatestValidityClosest	0	0	This mode gets the latest file which is nearest to $((t_0 - dt_0)+(t_1 + dt_1))/2$.
L2__CLOUD_	ValCover	0	0	This mode gets all files that cover entirely time interval $[t_0 - dt_0, t_1 + dt_1]$.
AUX_RARBD3	LatestValidityClosest	0	0	This mode gets the latest file which is nearest to $((t_0 - dt_0)+(t_1 + dt_1))/2$.
AUX_BGBRO_	LatestValidityClosest	0	0	This mode gets the latest file which is nearest to $((t_0 - dt_0)+(t_1 + dt_1))/2$.

Table 5: Overview of the Retrieval Modes that are used in the evocation of the TCBRO processor.

2.4.2 BGBRO

The selection rules for the auxiliary processor BGBRO a somewhat different then for TCBRO.

For both the calculation of average per-row background parameters and the average per-row radiance spectrum, calculations are done based on orbital measurements that geographically intersect with a reference region over the Pacific. For this, BGBRO considers all orbits that are included based on the specified file Retrieval Mode and internally only keeps those that ast least partly overlap with the reference region. The selection rules are somewhat looser than for TGBRO, as orbits that cross midnight at the beginning or end of the date under consideration are allowed to be included (ValIntersect Retrieval Mode). This assures sufficient measurements for the calculation of average values over the reference region. The BGBRO Retrieval Modes are listed in Table 6.

Input	Retrieval Mode	dt_0	dt_1	
L1B_RA_BD3	ValIntersect	0	0	This mode gets all files that cover partly time interval $[t_0 - dt_0 , t_1 + dt_1]$.
L1B_IR_UVN	LatestValidityClosest	0	0	This mode gets the latest file which is nearest to $((t_0 - dt_0)+(t_1 + dt_1))/2$.
L2__CLOUD_	ValIntersect	0	0	This mode gets all files that cover partly time interval $[t_0 - dt_0 , t_1 + dt_1]$.

Table 6: Overview of the Retrieval Modes that are used in the evocation of the BGBRO processor.

2.5 Input Data

This subsection explains in high level the purpose of the various input files (L1b and PDGS configuration) and data which is employed to configure the processor.

2.5.1 L1b radiance and irradiance product

L1b [AD02] is the basis for generating L2 products and it is the main input of the TCBRO L2 processor. TCBRO needs as input the irradiance and the radiance products in UVIS band 3. Required geolocation data is embedded in each radiance product. The entire set of S5P wavelength ranges as well as their respective spectral bands are given in Table 7. According to [AD02], the full series of available L1b products are distributed in different files; more specifically:

- A single netCDF-4 L1b file for the UVN module with the Irradiance Product
- 6 netCDF-4 L1b files for each band in the UVN with the Radiance Product

For the BrO processing, only the radiance from band 3 in Table 7 is used.

Instrument Model	UVN					
Spectral band	1	2	3	4	5	6
Spectral range [nm]	270-300	300-320	310-405	405-500	675-725	725-775

Table 7: Spectral bands and spectral range of the TROPOMI instrument. The gray-shaded band 3 is used for the BrO processing.

The S5P L1b products are in netCDF-4 format [ER01] following the guidelines of Inspire directive [ER03] and CF-Metadata [ER02] standards, as described in [AD02]. Fletcher32 for validating the integrity of the data is expected in the L1b products. PDGS side is responsible to provide the appropriate radiance and irradiance files to the L2 processor.

2.5.2 L2 cloud product

The TCBRO and BGBRO processors both ingest parameters from the the matching S5P L2 cloud parameter file as input for each orbit. For the main TCBRO output product, the included parameters on cloud and surface properties merely provide additional information on the physical circumstances during the measurements and allow the user to perform customized filtering of the results. For BGBRO, filtering on the cloud fraction is possible when calculating

the average rafiance values over the reference regions. The actual filtering criteria depend on the configuration settings (see [RD03]). A detailed description of the S5P L2 cloud product can be found in [RD04].

2.5.3 Static input

In addition the dynamical L1b and L2 input mentioned above, the TCBRO and BGBRO processor make use of a set of static input files related to configuration details of the processor operation or provide physical data relevant to the retrieval procedure. They are listed in Table 8 in Section 3.1.

2.5.4 PDGS Configuration

For TCBRO development and testing, the PDGS-simulating achitecture of the S5P_PAL environment was used.

The format and specifications of the JobOrder file are addressed in detail in [AD05].

Processing of the input measurements is done on a per-orbit basis (equivalent to treating one offline measurement file at a time), in order to optimize the use of the available processors.

2.6 TCBRO Input/Output

The workflow of the TCBRO processor is shown in Figure 2. The input elements “Background SCD AUX_BGBRO_” and “Reference Raduiance AUX_rarBD3” are output of the BGBRO auxiliary processor and are to be calculated once per day and ingested on the basis of the LatestValidityClosest mode If the proper background correction information is not found, the L2 processing is aborted and no L2 data is generated.

2.7 BGBRO Input/Output

The BGBRO processor is to be operated in such a way that its output results are timely available to serve as input for the TCBRO main processor. If operationally active, this means that the BGBRO results should be generated once per day. Both output data files are generated according to the ValIntersect mode with $\Delta t_0 = \Delta t_1 = 0$ hours.

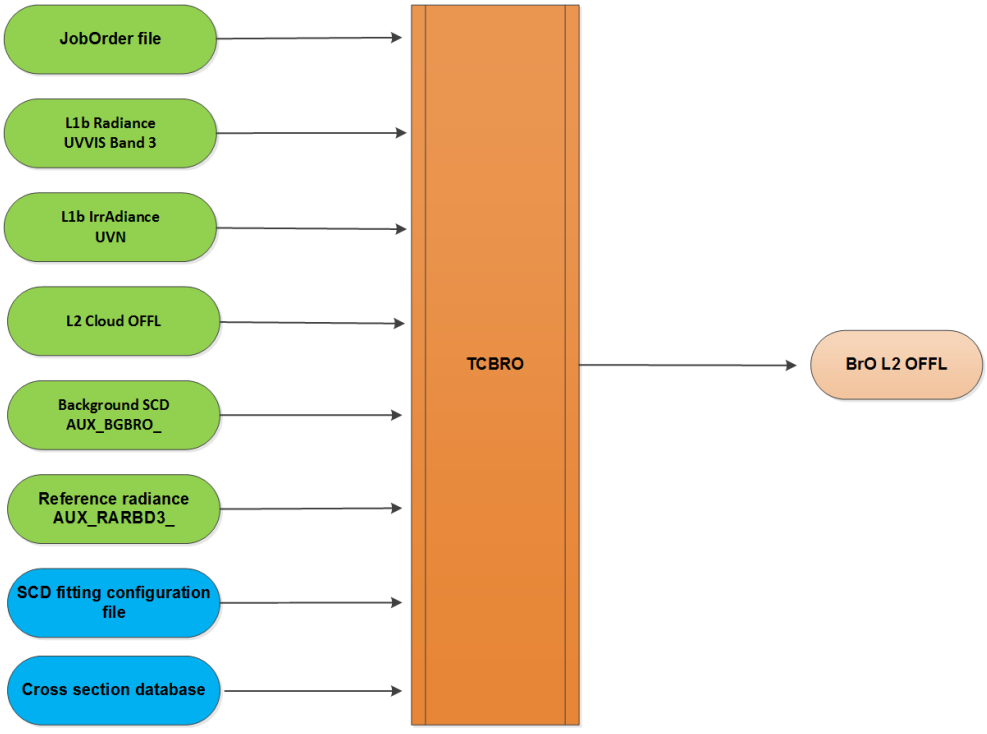

Figure 2 Schematic representation of the input/output of the TCBRO auxiliary processor. Green input is dynamic data; blue is static data.

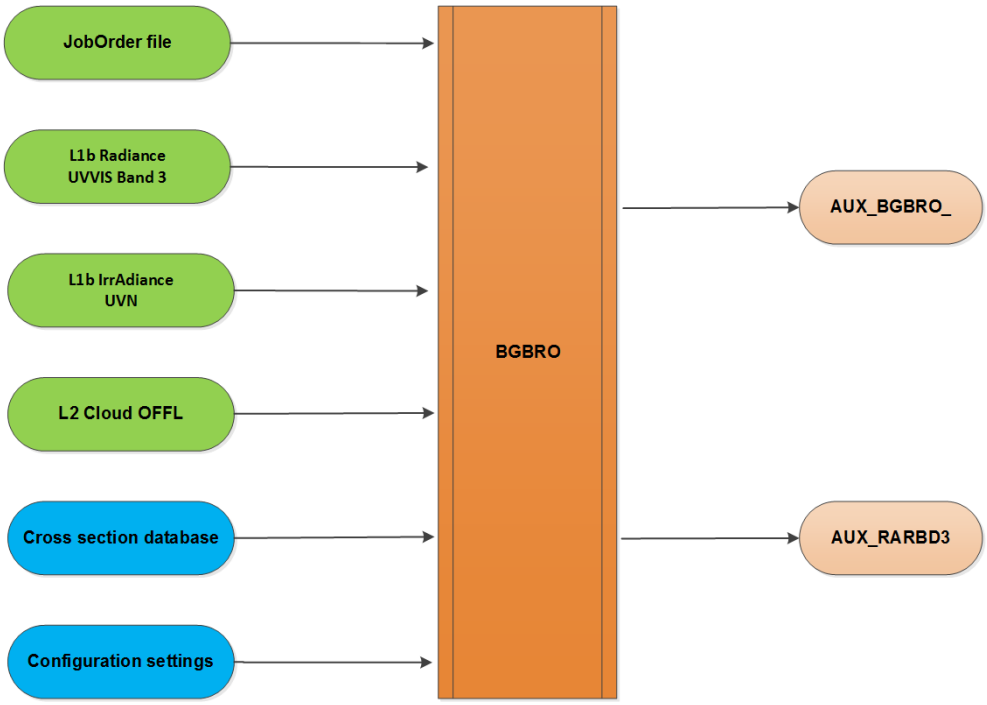

Figure 3 Schematic representation of the input/output of the BGBRO auxiliary processor. Green input is dynamic data; blue is static data.

2.8 Output Data

The final TCBRO L2 output data and metadata file product format and structure is defined according to the specifications outlined in [RD02]. These guidelines provide a further tailoring of the guidelines defined in [AD04], which in turns was based on definitions outlined in [AD03]. The guidelines from [RD02] are also used (where possible) in defining the output of the BGBRO S5P_AUX_BGBRO files type, whereas the BGBRO S5P_AUX_RARBD3 file structure is defined by the requirements of the QDOAS slant column derivation software [ER05].

The resulting output data files are in netCDF4 format. Wherever possible, the file structure follows the conventions outlined in [ER02] and [ER04]. A detailed description of file content of the TCBRO output and the intermediate BGBRO auxiliary output is given in the Product Format Specification document [RD06].

2.8.1 Metadata

The major implication of following [RD02] for the structure of the products described in the document at hand, is that it provides a simplified format. Here, several blocks with metadata are removed that are thought to be of less interest to the product user. Where necessary, a metadata variable is replaced by a global file attribute.

3. Detailed I/O Data Format

In this chapter, a summary of I/O files of the TCBRO and BGBRO processors is shown in Section 3.1. Moreover, for the dynamic input and output, there will be a sub-section for each I/O file employed (Sec. 0) and generated (Section 0) from the processor.

3.1 List of I/O Files

The following tables, Table 8 and Table 9, show a list of the involved I/O files. Two are the types of files specified in the table, i.e.:

- Products
- Auxiliary data files

Furthermore, all those files indicated as mandatory are necessary for the processing chain, i.e., they are needed in order to generate L2 output and to fulfil the expected compulsory requirements ([AD01], [RD01]).

TCBRO Dynamic Input/Output				
Name	**Type**	**I/O**	**Mandatory**	**ID**
PDGS Configuration	JobOrder	Input	Yes	JobOrder.XXXXXXXXX
L1b Irradiance Product UVN	Product	Input	Yes	L1B_IR_UVN
L1b Radiance Product UVIS band 3 [310-405 nm]	Product	Input	Yes	L1B_RA_BD3
L2 cloud Product	Product	Input	Yes	L2__CLOUD_
Background Correction parameters	Auxiliary	Input/ Output	Yes	AUX_BGBRO_
Reference radiance	Auxiliary	Input/ Output	Yes	AUX_RARBD3
TCBRO Static Input				
Name	**Type**	**I/O**	**Mandatory**	**ID**
Trace gas absorption cross sections for BrO, HCHO, NO_2, O_3, O_2-O_2, OClO, Ramann-scattering.	Auxiliary	Input	Yes	N/A
Configuration file for slant column fitting procedure.	Auxiliary	Input	Yes	N/A

Table 8: Involved I/O files of the TCBRO main processor

BGBRO Dynamic Input/Output				
Name	**Type**	**I/O**	**Mandatory**	**ID**
PDGS Configuration	JobOrder	Input	Yes	JobOrder.XXXXXXXXX
L1b Irradiance Product UVN	Product	Input	Yes	L1B_IR_UVN
L1b Radiance Product UVIS band 3 [310-405 nm]	Product	Input	Yes	L1B_RA_BD3
L2 cloud Product	Product	Input	Yes	L2__CLOUD_
Background Correction parameters	Product	Output	Yes	AUX_BGBRO_
Reference radiance	Product	Output	Yes	AUX_RARBD3
BGBRO Static Input				
Name	**Type**	**I/O**	**Mandatory**	**ID**
Trace gas absorption cross sections for BrO, HCHO, NO_2, O_3, O_2-O_2, OClO, Ramann-scattering.	Auxiliary	Input	Yes	N/A
Configuration file for reference and background data creation.	Auxiliary	Input	Yes	N/A

Table 9: Involved I/O files of the BGBRO auxiliary processor

Input Files

3.1.1 PDGS Configuration

Name
JobOrder.XXXXXXXXX.xml
Where XXXXXXXXX is a 9-digits counter starting from 000000001.

I/O
Input

Type
JobOrder file

Description
The specifications of the PDGS configuration file are detailed in the External ICD document [AD06].

Format
XML

Size
Not relevant.

Data Volume
<1MB

Remarks
N/A

3.1.2 L1b Irradiance Product UVN(L1B_IR_UVN)

Name

The file name conventions will follow the directives given by ESA in [AD04], chapter 4. A substring of the full file-name for this product is as follows:

L1B_IR_UVN

I/O

Input

Type

Product

Description

The input S5P L1b products are in netCDF-4format [ER04] following the guidelines of Inspire and CF-Metadata standards, as described in [AD02]. It covers the long wave ultraviolet combined with visual (UVIS) spectral range. The selection rule for TCBRO is LatestValIntersect policy with Δt_0 = 0 hours and Δt_1 = 0. If no files are found with this policy then use “LatestValidity”.

Format

netCDF-4

Size

One single scanline

Data Volume

0.02 GByte

3.1.3 L1b Radiance Product UVIS band 3 [310-405 nm](L1B_RA_BD3)

Name

The file name conventions will follow the directives given by ESA in [AD04], chapter 4. A substring of the full file-name for this product is as follows:

L1B_RA_BD3

I/O

Input

Type

L1b Product

Description

The S5P L1b products are in netCDF-4 format [ER04] following the guidelines of Inspire and CF-Metadata standards, as described in [AD02]. Geolocation is included in the product. It covers spectral band 3 ranging from 310 up to 405 nm.

Format

netCDF-4

Size

3246 scanlines

Data Volume

6.1 GB (Appendix A in [AD02])

3.1.4 L2 Clouds

Identifier
015_OU

Name
The file name conventions will follow the directives given by ESA in [AD08], chapter 4. The first digits iden-tifying the product are as follows:
S5P_L2__CLOUD_

I/O
Input

Type
Product

Description
L2 product containing retrieved clouds information. Geolocation is appended in the product as well.

Format
NetCDF-4

Size
4172 scanlines

Data Volume

0.3 GB

4. Appendix

Example of the structure of a BGBRO AUX_BGBRO_ output file.

```
netcdf S5P_PAL__AUX_BGBRO__20190323T232458_20190325T004733_20231213T115616 {
dimensions:
        ground_pixel = 450 ;
variables:
        int ground_pixel(ground_pixel) ;
                ground_pixel:axis = "X" ;
                ground_pixel:comment = "This coordinate variable defines the indices across track, from west to east; index starts at 0" ;
                ground_pixel:long_name = "across-track dimension index" ;
        int count_row(ground_pixel) ;
                count_row:comment = "Number of measurements used in calculating the average SCD over the reference sector" ;
        float brominemonoxide_slant_column_average_background(ground_pixel) ;
                brominemonoxide_slant_column_average_background:comment = "Average BrO slant column over the reference sector,
calculated per row" ;
                brominemonoxide_slant_column_average_background:multiplication_factor_to_convert_to_DU = 2241.15f ;
                brominemonoxide_slant_column_average_background:multiplication_factor_to_convert_to_molecules_percm2 =
6.02214e+19f ;
                brominemonoxide_slant_column_average_background:units = "mol m-2" ;
        float brominemonoxide_total_vertical_column_background(ground_pixel) ;
                brominemonoxide_total_vertical_column_background:comment = "Adopted background vertical column value" ;
                brominemonoxide_total_vertical_column_background:multiplication_factor_to_convert_to_DU = 2241.15f ;
                brominemonoxide_total_vertical_column_background:multiplication_factor_to_convert_to_molecules_percm2 =
6.02214e+19f ;
                brominemonoxide_total_vertical_column_background:units = "mol m-2" ;
        float brominemonoxide_geometric_air_mass_factor_background(ground_pixel) ;
                brominemonoxide_geometric_air_mass_factor_background:comment = "Average AMF per row over the reference sector" ;
                brominemonoxide_geometric_air_mass_factor_background:units = "1" ;

// global attributes:
                :Conventions = "CF-1.7" ;
                :institution = "BIRA-IASB" ;
                :history = "2023-12-13T11:56:16Z /processor/bin/run_bgbro /workspace/pal-q9st5gi1/JobOrder.0.xml" ;
                :source = "Sentinel 5 precursor, TROPOMI, space-borne remote sensing, L2" ;
                :summary = "TROPOMI/S5P BrO L2 Background correction parameters" ;
                :id = "S5P_PAL__AUX_BGBRO__20190323T232458_20190325T004733_20231213T115616" ;
                :lat_bound = -15., 15. ;
                :lon_bound = 160., 240. ;
                :time_coverage_start = "2019-03-23T23:46:32.708Z" ;
                :time_coverage_end = "2019-03-24T00:26:01.078Z" ;
                :processor_name = "BGBRO" ;
                :processor_version = "01.02.02" ;
                :processing_center = "S5P-PAL" ;
                :file_class = "PAL_" ;
                string :input_files = "JobOrder.0.xml", "configuration.ini",
"S5P_RPRO_L1B_RA_BD3_20190323T232458_20190324T010628_07471_03_020100_20220718T201925.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T010628_20190324T024759_07472_03_020100_20220718T202341.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T024759_20190324T042929_07473_03_020100_20220718T202739.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T042929_20190324T061059_07474_03_020100_20220718T203129.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T061059_20190324T075230_07475_03_020100_20220718T203634.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T075230_20190324T093400_07476_03_020100_20220718T204053.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T093400_20190324T111531_07477_03_020100_20220718T204457.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T111531_20190324T125701_07478_03_020100_20220718T204853.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T125701_20190324T143831_07479_03_020100_20220718T205356.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T143831_20190324T162002_07480_03_020100_20220718T205814.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T162002_20190324T180132_07481_03_020100_20220718T210204.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T180132_20190324T194302_07482_03_020100_20220718T210708.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T194302_20190324T212433_07483_03_020100_20220718T211109.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T212433_20190324T230603_07484_03_020100_20220718T211506.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T230603_20190325T004733_07485_03_020100_20220718T211906.nc",
"S5P_RPRO_L1B_IR_UVN_20190324T194302_20190324T212433_07483_03_020100_20220718T211109.nc",
"S5P_RPRO_L2__CLOUD__20190323T232458_20190324T010628_07471_03_020401_20221002T140955.nc",
"S5P_RPRO_L2__CLOUD__20190324T010628_20190324T024759_07472_03_020401_20221002T140956.nc",
"S5P_RPRO_L2__CLOUD__20190324T024759_20190324T042929_07473_03_020401_20221002T140958.nc",
"S5P_RPRO_L2__CLOUD__20190324T042929_20190324T061059_07474_03_020401_20221002T140959.nc",
"S5P_RPRO_L2__CLOUD__20190324T061059_20190324T075230_07475_03_020401_20221002T141000.nc",
"S5P_RPRO_L2__CLOUD__20190324T075230_20190324T093400_07476_03_020401_20221002T141002.nc",
"S5P_RPRO_L2__CLOUD__20190324T093400_20190324T111531_07477_03_020401_20221002T141004.nc",
```

"S5P_RPRO_L2__CLOUD__20190324T111531_20190324T125701_07478_03_020401_20221002T141812.nc",
"S5P_RPRO_L2__CLOUD__20190324T125701_20190324T143831_07479_03_020401_20221002T141813.nc",
"S5P_RPRO_L2__CLOUD__20190324T143831_20190324T162002_07480_03_020401_20221002T141815.nc",
"S5P_RPRO_L2__CLOUD__20190324T162002_20190324T180132_07481_03_020401_20221002T141816.nc",
"S5P_RPRO_L2__CLOUD__20190324T180132_20190324T194302_07482_03_020401_20221002T141817.nc",
"S5P_RPRO_L2__CLOUD__20190324T194302_20190324T212433_07483_03_020401_20221002T141819.nc",
"S5P_RPRO_L2__CLOUD__20190324T212433_20190324T230603_07484_03_020401_20221002T141820.nc",
"S5P_RPRO_L2__CLOUD__20190324T230603_20190325T004733_07485_03_020401_20221002T141822.nc" ;
}

Example of the structure of a BGBRO AUX_RARBD3 output file.

```
netcdf S5P_PAL__AUX_RARBD3_20190323T232458_20190325T004733_20231213T101638 {
dimensions:
        col_dim = 450 ;
        spectral_dim = 9533 ;
variables:
        double reference_radiance(col_dim, spectral_dim) ;
                reference_radiance:units = "mol.m-2.nm-1.sr-1.s-1" ;
        double reference_wavelength(col_dim, spectral_dim) ;
                reference_wavelength:units = "nm" ;
        byte use_row(col_dim) ;
                use_row:valid_max = 1b ;
                use_row:valid_min = 0b ;
        short number_radiances(col_dim) ;

// global attributes:
                :Conventions = "CF-1.7" ;
                :institution = "BIRA-IASB" ;
                :processor_name = "BGBRO" ;
                :file_class = "OFFL" ;
                :summary = "Radiance as reference file in APEX format for QDOAS based on daily averaged radiances" ;
                :history = "2023-12-13T10:16:38 /processor/bin/run_bgbro /workspace/pal-q9st5gi1/JobOrder.0.xml" ;
                :time_reference = "2019-03-23T00:00:00Z" ;
                :time_coverage_start = "2019-03-23T23:46:32.708Z" ;
                :time_coverage_end = "2019-03-24T00:26:01.078Z" ;
                :processor_version = "01.02.02" ;
                :processing_center = "S5P-PAL" ;
                :id = "S5P_PAL__AUX_RARBD3_20190323T232458_20190325T004733_20231213T101638" ;
                :lat_bound = -15., 15. ;
                :lon_bound = 160., 240. ;
                string :input_files = "JobOrder.0.xml", "configuration.ini",
"S5P_RPRO_L1B_RA_BD3_20190323T232458_20190324T010628_07471_03_020100_20220718T201925.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T010628_20190324T024759_07472_03_020100_20220718T202341.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T024759_20190324T042929_07473_03_020100_20220718T202739.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T042929_20190324T061059_07474_03_020100_20220718T203129.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T061059_20190324T075230_07475_03_020100_20220718T203634.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T075230_20190324T093400_07476_03_020100_20220718T204053.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T093400_20190324T111531_07477_03_020100_20220718T204457.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T111531_20190324T125701_07478_03_020100_20220718T204853.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T125701_20190324T143831_07479_03_020100_20220718T205356.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T143831_20190324T162002_07480_03_020100_20220718T205814.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T162002_20190324T180132_07481_03_020100_20220718T210204.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T180132_20190324T194302_07482_03_020100_20220718T210708.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T194302_20190324T212433_07483_03_020100_20220718T211109.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T212433_20190324T230603_07484_03_020100_20220718T211506.nc",
"S5P_RPRO_L1B_RA_BD3_20190324T230603_20190325T004733_07485_03_020100_20220718T211906.nc",
"S5P_RPRO_L2__CLOUD__20190323T232458_20190324T010628_07471_03_020401_20221002T140955.nc",
"S5P_RPRO_L2__CLOUD__20190324T010628_20190324T024759_07472_03_020401_20221002T140956.nc",
"S5P_RPRO_L2__CLOUD__20190324T024759_20190324T042929_07473_03_020401_20221002T140958.nc",
"S5P_RPRO_L2__CLOUD__20190324T042929_20190324T061059_07474_03_020401_20221002T140959.nc",
"S5P_RPRO_L2__CLOUD__20190324T061059_20190324T075230_07475_03_020401_20221002T141000.nc",
"S5P_RPRO_L2__CLOUD__20190324T075230_20190324T093400_07476_03_020401_20221002T141002.nc",
"S5P_RPRO_L2__CLOUD__20190324T093400_20190324T111531_07477_03_020401_20221002T141004.nc",
"S5P_RPRO_L2__CLOUD__20190324T111531_20190324T125701_07478_03_020401_20221002T141812.nc",
"S5P_RPRO_L2__CLOUD__20190324T125701_20190324T143831_07479_03_020401_20221002T141813.nc",
"S5P_RPRO_L2__CLOUD__20190324T143831_20190324T162002_07480_03_020401_20221002T141815.nc",
"S5P_RPRO_L2__CLOUD__20190324T162002_20190324T180132_07481_03_020401_20221002T141816.nc",
"S5P_RPRO_L2__CLOUD__20190324T180132_20190324T194302_07482_03_020401_20221002T141817.nc",
"S5P_RPRO_L2__CLOUD__20190324T194302_20190324T212433_07483_03_020401_20221002T141819.nc",
"S5P_RPRO_L2__CLOUD__20190324T212433_20190324T230603_07484_03_020401_20221002T141820.nc",
"S5P_RPRO_L2__CLOUD__20190324T230603_20190325T004733_07485_03_020401_20221002T141822.nc" ;
                :measurement_date = "2019-03-23" ;
}
```

Example of the structure of an S5P_L2__BRO___ output file.

netcdf S5P_PAL__L2__BRO____20231010T222007_20231011T000136_31050_03_010203_20231222T135039 {

// global attributes:

:Conventions = "CF-1.7" ;
:institution = "BIRA-IASB" ;
:source = "Sentinel 5 precursor, TROPOMI, space-borne remote sensing, L2" ;
:history = "2023-12-22T13:50:39Z /processor/bin/run_tcbro /workspace/pal-pfu_cmh7/JobOrder.0.xml" ;
:summary = "TROPOMI/S5P BrO L2 Swath 5.5x3.5km" ;
:id = "S5P_PAL__L2__BRO____20231010T222007_20231011T000136_31050_03_010203_20231222T135039" ;
:collection_identifier = "03" ;
:time_reference = "2023-10-10T00:00:00Z" ;
:time_coverage_start = "2023-10-10T22:41:41.975Z" ;
:time_coverage_end = "2023-10-10T23:40:05.536Z" ;
:time_coverage_resolution = "PT0.840S" ;
:orbit = 31050 ;
:processor_name = "TCBRO" ;
:processor_version = "01.02.03" ;
:processing_center = "S5P-PAL" ;
:file_class = "PAL_" ;
:footprint =
"{\"type\":\"Polygon\",\"coordinates\":[[[93.90519,67.05409],[97.54691,67.61272],[101.35408,68.08283],[105.30545,68.459465],[109.3748,68.736855],[113.52846,68.91196],[117.7289,68.98148],[121.93592,68.94466],[126.108116,68.80225],[130.20709,68.55589],[134.19801,68.20956],[138.05206,67.76785],[141.74669,67.23604],[145.26633,66.620415],[148.60165,65.9275],[151.7491,65.16363],[154.7093,64.33524],[157.48657,63.448174],[160.08798,62.50816],[162.52176,61.520294],[164.79852,60.489758],[166.92784,59.420635],[168.91988,58.316647],[170.7851,57.181602],[172.53299,56.018494],[174.1724,54.829895],[175.71216,53.61845],[177.16025,52.38631],[178.5241,51.13555],[179.81042,49.867874],[-178.97478,48.584637],[-177.8258,47.287365],[-176.73741,45.977333],[-175.70491,44.655594],[-174.72409,43.32314],[-173.791,41.980927],[-172.9023,40.62955],[-172.05452,39.269936],[-171.24481,37.902702],[-170.47037,36.528446],[-169.72919,35.14763],[-169.01825,33.76084],[-168.33626,32.36843],[-167.68102,30.970865],[-167.051,29.568485],[-166.44444,28.16166],[-165.85994,26.7507],[-165.29597,25.336033],[-164.75192,23.917635],[-164.22601,22.495998],[-163.7176,21.071274],[-163.22562,19.643717],[-162.74892,18.21361],[-162.28731,16.780931],[-161.8395,15.3460245],[-161.40498,13.909028],[-160.98329,12.469994],[-160.57355,11.029276],[-160.1754,9.586838],[-159.78821,8.142971],[-159.41151,6.6976495],[-159.04492,5.251202],[-158.6882,3.803491],[-158.34071,2.354841],[-158.00235,0.9051621],[-157.67262,-0.54522204],[-157.3512,-1.9963233],[-157.03804,-3.4480417],[-156.73279,-4.9002867],[-156.43515,-6.35291],[-156.14505,-7.805875],[-155.86246,-9.259221],[-155.58679,-10.712681],[-155.31844,-12.166264],[-155.05698,-13.619927],[-154.80252,-15.073478],[-154.55441,-16.526945],[-154.3134,-17.980236],[-154.07892,-19.43333],[-153.85101,-20.886038],[-153.63008,-22.338463],[-153.41579,-23.79048],[-153.20815,-25.241968],[-153.00772,-26.693031],[-152.81407,-28.143444],[-152.62746,-29.59327],[-152.44824,-31.042406],[-152.27641,-32.490826],[-152.11246,-33.938488],[-151.95654,-35.385406],[-151.8089,-36.831387],[-151.66977,-38.27645],[-151.54019,-39.720707],[-151.42003,-41.163864],[-151.31017,-42.60612],[-151.2111,-44.04724],[-151.124,-45.48732],[-151.04958,-46.926296],[-150.9884,-48.364],[-150.942,-49.800526],[-150.91187,-51.235718],[-150.89906,-52.669582],[-150.9061,-54.10204],[-150.93475,-55.533005],[-150.98772,-56.96243],[-151.06761,-58.390137],[-151.17853,-59.816128],[-151.32477,-61.240208],[-151.51082,-62.662098],[-151.74368,-64.08174],[-152.03078,-65.498856],[-152.38173,-66.91306],[-152.80885,-68.32392],[-153.327,-69.731026],[-153.9568,-71.13357],[-154.72394,-72.53069],[-155.66272,-73.92119],[-156.82104,-75.30331],[-158.26639,-76.674614],[-160.09108,-78.031715],[-162.43436,-79.36917],[-165.50648,-80.67899],[-169.63426,-81.94778],[-175.339,-83.152756],[176.56648,-84.254166],[164.92992,-85.180565],[148.77103,-85.814445],[129.05843,-86.01396],[109.81534,-85.717804],[94.587135,-85.01375],[83.76504,-84.04504],[76.23327,-82.91909],[70.90175,-81.699646],[67.01984,-80.42237],[64.115845,-79.10753],[61.88972,-77.76723],[60.151436,-76.408615],[58.769627,-75.03694],[57.659195,-73.65518],[56.75759,-72.26556],[56.70345,-72.17274],[56.42683,-72.20058],[51.24578,-72.637024],[42.47491,-73.031105],[36.900433,-73.063545],[31.949509,-72.943634],[28.433308,-72.765564],[25.045986,-72.51255],[22.473757,-72.26093],[19.85128,-71.94534],[17.756174,-71.645676],[15.701038,-71.30613],[15.519603,-71.27383],[13.654019,-70.91797],[11.579129,-70.467316],[9.777514,-70.02328],[7.691123,-69.43942],[5.8012204,-68.83741],[3.5076175,-68.00014],[1.3129336,-67.074455],[-1.5460333,-65.65871],[-4.5711217,-63.86138],[-6.877844,-62.251335],[-9.434757,-63.192562],[-12.162916,-64.082535],[-15.069304,-64.91558],[-18.15833,-65.68615],[-21.431808,-66.38797],[-24.886633,-67.01475],[-28.51516,-67.56016],[-32.30339,-68.01829],[-36.23086,-68.38364],[-40.270935,-68.65106],[-44.391327,-68.81729],[-48.55488,-68.87986],[-52.72233,-68.837524],[-56.85429,-68.69122],[-60.91325,-68.44295],[-64.86528,-68.09615],[-68.68323,-67.65555],[-72.34466,-67.1262],[-75.83501,-66.51429],[-79.14486,-65.82614],[-82.27054,-65.0679],[-85.21308,-64.24596],[-87.97583,-63.365704],[-90.56613,-62.43313],[-92.99196,-61.453274],[-95.262596,-60.430656],[-97.38818,-59.369488],[-99.37831,-58.27385],[-101.24297,-57.14696],[-102.99144,-55.991985],[-104.6329,-54.811626],[-106.175446,-53.60836],[-107.62698,-52.38426],[-108.99542,-51.141544],[-110.286385,-49.881542],[-111.506165,-48.606003],[-112.660545,-47.316338],[-113.75484,-46.013775],[-114.79299,-44.699226],[-115.7799,-43.373894],[-116.719154,-42.03863],[-117.61405,-40.69413],[-118.46846,-39.341312],[-119.28464,-37.980606],[-120.065384,-36.612675],[-120.81329,-35.23812],[-121.530365,-33.85735],[-122.21914,-32.47095],[-122.88077,-31.079187],[-123.51737,-29.68251],[-124.13076,-28.281244],[-124.72179,-26.875715],[-125.292274,-25.466232],[-125.84307,-24.053024],[-126.37552,-22.63628],[-126.89063,-21.216469],[-127.38939,-19.793663],[-127.872505,-18.368052],[-128.34103,-16.93982],[-128.79558,-15.509182],[-129.23668,-14.07634],[-129.6654,-12.641427],[-130.08214,-11.204572],[-130.4872,-9.765973],[-130.88153,-8.325681],[-131.26517,-6.8839126],[-131.63881,-5.4406667],[-132.00313,-3.9962637],[-132.35805,-2.550639],[-132.70387,-1.1039978],[-133.04128,0.34360224],[-133.37044,1.7920909],[-133.69159,3.2412577],[-134.00494,4.691195],[-134.31064,6.1416636],[-134.60928,7.59263],[-134.90051,9.044085],[-135.18497,10.495819],[-135.46242,11.947795],[-

135.73334,13.400019],[-135.9976,14.852388],[-136.25537,16.304815],[-136.50676,17.757208],[-136.75166,19.209608],[-136.99014,20.661917],[-137.22258,22.11402],[-137.44865,23.565914],[-137.66801,25.017593],[-137.88138,26.468874],[-138.08804,27.919884],[-138.28821,29.37046],[-138.48172,30.820627],[-138.66817,32.270218],[-138.84772,33.71938],[-139.0199,35.167934],[-139.1846,36.615913],[-139.34131,38.063267],[-139.48982,39.509964],[-139.62975,40.955906],[-139.76062,42.401203],[-139.88165,43.84573],[-139.99225,45.289413],[-140.09163,46.73228],[-140.17923,48.174362],[-140.25375,49.615513],[-140.31386,51.055706],[-140.35912,52.495007],[-140.38705,53.933212],[-140.39569,55.370384],[-140.38329,56.806374],[-140.34685,58.24118],[-140.2839,59.674694],[-140.19049,61.106834],[-140.06203,62.53745],[-139.89247,63.966366],[-139.67578,65.39345],[-139.40309,66.818375],[-139.06415,68.24094],[-138.6452,69.660645],[-138.12883,71.077065],[-137.49141,72.48937],[-136.70277,73.89675],[-135.71962,75.29785],[-134.48198,76.69074],[-132.904,78.07274],[-130.85526,79.4396],[-128.13847,80.784874],[-124.43049,82.09749],[-119.19633,83.35822],[-111.51901,84.531044],[-99.91529,85.54641],[-82.6339,86.2731],[-60.183918,86.5249],[-38.155582,86.20598],[-21.625229,85.434586],[-10.596415,84.39435],[-3.2846742,83.20745],[1.725566,81.93843],[5.288557,80.62037],[5.4892945,80.53128],[5.984315,80.54739],[16.081669,80.72123],[31.005178,80.46248],[39.71758,80.00932],[46.85104,79.44295],[51.592983,78.95334],[55.942635,78.41381],[59.127266,77.957924],[62.29077,77.44899],[64.7715,77.00731],[67.175995,76.5404],[67.38725,76.49745],[69.55319,76.038246],[71.95616,75.48639],[74.04674,74.96717],[76.48334,74.31189],[78.713066,73.6599],[81.454636,72.77957],[84.11425,71.8274],[87.617065,70.38863],[91.33266,68.56092],[93.90519,67.05409],[93.90519,67.05409]]]}" ;

string :input_files = "S5P_OFFL_L1B_RA_BD3_20231010T222007_20231011T000136_31050_03_020100_20231011T014329.nc", "S5P_OFFL_L1B_IR_UVN_20231010T185708_20231010T203837_31048_03_020100_20231010T222150.nc", "S5P_OFFL_L2__CLOUD__20231010T222007_20231011T000136_31050_03_020500_20231012T134453.nc", "S5P_PAL__AUX_RARBD3_20231009T223915_20231011T000136_20231222T112224.nc", "S5P_PAL__AUX_BGBRO__20231009T223915_20231011T000136_20231222T130941.nc", "bro_Fleischmann(2004)_223K_300-385nm_S5P_OPT_SFP.xs", "o4_thalman_volkamer_293K_S5P_OPT_SFP_extended.xs", "ch2o_MellerMoortgat(2000)_298K_224.56-376.00nm(0.01nm)_S5P_OPT_SFP.xs", "oclo_bogumil_S5P_OPT_SFP.xs", "o3lambda_serdyunchenko_223_S5P_OPT_SFP.xs", "O3223_Serdyuchenko(2014)_223K_213-1100nm(2013 version)_S5P_OPT_SFP.xs", "no2_VANDAELE_1998_220K_S5P_OPT_SFP.xs", "O3243_Serdyuchenko(2014)_243K_213-1100nm(2013 version)_S5P_OPT_SFP.xs", "ring_sao2010_hr_norm_raman_S5P_OPT_SFP.xs", "ring_sao2010_norm_ratioramansolar_S5P_OPT_SFP.xs", "o3squared_serdyunchenko_223_S5P_OPT_SFP.xs", "ring_sao2010_hr_norm_solar_S5P_OPT_SFP.xs" ;

group: PRODUCT {
dimensions:
corner = 4 ;
ground_pixel = 450 ;
scanline = 4172 ;
time = 1 ;
variables:
int corner(corner) ;
corner:Comment = "This coordinate variable defines the indices for the pixel corners; index starts a 0 (counter-clockwise, starting from south-western corner of the pixel in ascending part of the orbit)." ;
corner:long_name = "pixel corner index" ;
corner:units = "1" ;
int ground_pixel(ground_pixel) ;
ground_pixel:axis = "X" ;
ground_pixel:comment = "This coordinate variable defines the indices across track, from west to east; index starts at 0" ;
ground_pixel:long_name = "across-track dimension index" ;
ground_pixel:units = "1" ;
int scanline(scanline) ;
scanline:axis = "Y" ;
scanline:comment = "This coordinate variable defines the indices along track; index starts at 0" ;
scanline:long_name = "along-track dimension index" ;
scanline:units = "1" ;
int time(time) ;
time:axis = "T" ;
time:comment = "The time in this variable corresponds to the time in the time_reference global attribute" ;
time:long_name = "reference time for the measurements" ;
time:standard_name = "time" ;
time:units = "seconds since 2010-01-01 00:00:00" ;
float brominemonoxide_total_vertical_column(time, scanline, ground_pixel) ;
brominemonoxide_total_vertical_column:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_total_vertical_column:long_name = "vertical column of bromine monoxide" ;

brominemonoxide_total_vertical_column:multiplication_factor_to_convert_to_DU = 2241.15f ;
brominemonoxide_total_vertical_column:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
brominemonoxide_total_vertical_column:standard_name = "atmosphere mole content of bromine dioxide" ;
brominemonoxide_total_vertical_column:units = "mol m-2" ;
float brominemonoxide_total_vertical_column_precision(time, scanline, ground_pixel) ;
brominemonoxide_total_vertical_column_precision:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_total_vertical_column_precision:long_name = "random error of vertical column density" ;
brominemonoxide_total_vertical_column_precision:multiplication_factor_to_convert_to_DU = 2241.15f ;
brominemonoxide_total_vertical_column_precision:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
brominemonoxide_total_vertical_column_precision:standard_name = "atmosphere mole content of bromine monoxide standard_error" ;
brominemonoxide_total_vertical_column_precision:units = "mol m-2" ;
int delta_time(time, scanline) ;
delta_time:long_name = "offset from reference start time of measurement" ;
delta_time:units = "milliseconds since 2023-10-10 00:00:00" ;
float latitude(time, scanline, ground_pixel) ;
latitude:bounds = "/PRODUCT/SUPPORT_DATA/GEOLOCATIONS/latitude_bounds" ;
latitude:long_name = "pixel center latitude" ;
latitude:standard_name = "latitude" ;
latitude:units = "degrees_north" ;
latitude:valid_min = -90.f ;
latitude:valid_max = 90.f ;
float longitude(time, scanline, ground_pixel) ;
longitude:bounds = "/PRODUCT/SUPPORT_DATA/GEOLOCATIONS/longitude_bounds" ;
longitude:long_name = "pixel center longitude" ;
longitude:standard_name = "longitude" ;
longitude:units = "degrees_east" ;
longitude:valid_min = -180.f ;
longitude:valid_max = 180.f ;
ubyte qa_value(time, scanline, ground_pixel) ;
qa_value:comment = "A continuous quality descriptor, varying between 0 (no data) and 1 (full quality data). Recommended to ignore data with qa_value < 0.5" ;
qa_value:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
qa_value:long_name = "data quality value" ;
qa_value:scale_factor = 0.01f ;
qa_value:add_offset = 0.f ;
qa_value:units = "1" ;
qa_value:valid_min = 0UB ;
qa_value:valid_max = 100UB ;

group: SUPPORT_DATA {

group: DETAILED_RESULTS {
dimensions:
number_of_slant_columns = 10 ;
variables:
float brominemonoxide_geometric_air_mass_factor(time, scanline, ground_pixel) ;
brominemonoxide_geometric_air_mass_factor:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_geometric_air_mass_factor:long_name = "geometric air mass factor" ;
brominemonoxide_geometric_air_mass_factor:units = "1" ;
float brominemonoxide_slant_column_corrected(time, scanline, ground_pixel) ;
brominemonoxide_slant_column_corrected:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_slant_column_corrected:long_name = "corrected slant column density" ;
brominemonoxide_slant_column_corrected:multiplication_factor_to_convert_to_DU = 2241.15f ;

brominemonoxide_slant_column_corrected:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
brominemonoxide_slant_column_corrected:units = "mol m-2" ;
float brominemonoxide_slant_column_corrected_trueness(time, scanline, ground_pixel) ;
brominemonoxide_slant_column_corrected_trueness:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_slant_column_corrected_trueness:long_name = "systematic error of the slant column density" ;
brominemonoxide_slant_column_corrected_trueness:multiplication_factor_to_convert_to_DU = 2241.15f ;
brominemonoxide_slant_column_corrected_trueness:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
brominemonoxide_slant_column_corrected_trueness:units = "mol m-2" ;
ubyte brominemonoxide_slant_column_correction_flag(time, scanline, ground_pixel) ;
brominemonoxide_slant_column_correction_flag:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_slant_column_correction_flag:long_name = "slant column density background correction flag" ;
brominemonoxide_slant_column_correction_flag:flag_meanings = "not-corrected, corrected" ;
brominemonoxide_slant_column_correction_flag:flag_values = 0UB, 1UB ;
brominemonoxide_slant_column_correction_flag:units = "1" ;
float brominemonoxide_total_vertical_column_correction(time, scanline, ground_pixel) ;
brominemonoxide_total_vertical_column_correction:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_total_vertical_column_correction:long_name = "background correction value which is added to the vertical column density" ;
brominemonoxide_total_vertical_column_correction:multiplication_factor_to_convert_to_DU = 2241.15f ;
brominemonoxide_total_vertical_column_correction:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
brominemonoxide_total_vertical_column_correction:units = "mol m-2" ;
float brominemonoxide_total_vertical_column_trueness(time, scanline, ground_pixel) ;
brominemonoxide_total_vertical_column_trueness:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
brominemonoxide_total_vertical_column_trueness:long_name = "systematic error of vertical column density" ;
brominemonoxide_total_vertical_column_trueness:multiplication_factor_to_convert_to_DU = 2241.15f ;
brominemonoxide_total_vertical_column_trueness:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
brominemonoxide_total_vertical_column_trueness:units = "mol m-2" ;
float fitted_radiance_shift(time, scanline, ground_pixel) ;
fitted_radiance_shift:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
fitted_radiance_shift:long_name = "radiance wavelength shift from the doas fit" ;
fitted_radiance_shift:units = "nm" ;
float fitted_radiance_squeeze(time, scanline, ground_pixel) ;
fitted_radiance_squeeze:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
fitted_radiance_squeeze:long_name = "radiance wavelength squeeze/stretch from the doas fit" ;
fitted_radiance_squeeze:units = "1" ;
float fitted_root_mean_square(time, scanline, ground_pixel) ;
fitted_root_mean_square:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
fitted_root_mean_square:long_name = "root mean square from the doas fit" ;
fitted_root_mean_square:units = "1" ;
float fitted_slant_columns(time, scanline, ground_pixel, number_of_slant_columns) ;
fitted_slant_columns:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
fitted_slant_columns:long_name = "retrieved slant column values for all absorbing species." ;
fitted_slant_columns:multiplication_factor_to_convert_to_DU = 2241.15f ;
fitted_slant_columns:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
fitted_slant_columns:units = "mol m-2" ;
fitted_slant_columns:index_meaning = "brominemonoxide_slant_column formaldehyde_slant_column nitrogendioxide_slant_column chlorinedioxide_slant_column o2o2_slant_column ozone_slant_column_223K ozone_slant_column_243K ozone_lambda_slant_column ozone_squared_slant_column ring_fit " ;
float fitted_slant_columns_precision(time, scanline, ground_pixel, number_of_slant_columns) ;
fitted_slant_columns_precision:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
fitted_slant_columns_precision:long_name = "slant columns errors of all absorbers" ;
fitted_slant_columns_precision:multiplication_factor_to_convert_to_DU = 2241.15f ;

fitted_slant_columns_precision:multiplication_factor_to_convert_to_molecules_percm2 = 6.02214e+19f ;
fitted_slant_columns_precision:units = "mol m-2" ;
fitted_slant_columns_precision:index_meaning = "formaldehyde_slant_column_precision nitrogendioxide_slant_column_precision chlorinedioxide_slant_column_precision o2o2_slant_column_precision ozone_slant_column_223K_precision ozone_slant_column_243K_precision ozone_lambda_slant_column_precision ozone_squared_slant_column_precision ring_fit_precision " ;
int number_of_slant_columns(number_of_slant_columns) ;
number_of_slant_columns:long_name = "number_of_slant_columns dimension index" ;
number_of_slant_columns:units = "1" ;
int number_of_spectral_points_in_retrieval(time, scanline, ground_pixel) ;
number_of_spectral_points_in_retrieval:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
number_of_spectral_points_in_retrieval:long_name = "Number of spectral points used in the DOAS retrieval" ;
number_of_spectral_points_in_retrieval:units = "1" ;

group: WAVELENGTH_CALIBRATION {
dimensions:
degrees_of_polynomial_shift = 4 ;
number_of_calibrations = 450 ;
number_of_subwindows = 5 ;
variables:
int degrees_of_polynomial_shift(degrees_of_polynomial_shift) ;
degrees_of_polynomial_shift:long_name = "degrees_of_polynomial_shift dimension index" ;
degrees_of_polynomial_shift:units = "1" ;
int number_of_calibrations(number_of_calibrations) ;
number_of_calibrations:long_name = "number_of_calibrations dimension index" ;
number_of_calibrations:units = "1" ;
int number_of_subwindows(number_of_subwindows) ;
number_of_subwindows:long_name = "number_of_subwindows dimension index" ;
number_of_subwindows:units = "1" ;
float calibration_polynomial_coefficients(ground_pixel, degrees_of_polynomial_shift) ;
calibration_polynomial_coefficients:long_name = "computed coefficients of the polynomial function" ;
calibration_polynomial_coefficients:units = "1" ;
float calibration_subwindows_root_mean_square(ground_pixel, number_of_subwindows) ;
calibration_subwindows_root_mean_square:long_name = "calibration rms per subwindow" ;
calibration_subwindows_root_mean_square:units = "1" ;
float calibration_subwindows_shift(ground_pixel, number_of_subwindows) ;
calibration_subwindows_shift:long_name = "irradiance wavelengths shift fitted values per subwindow" ;
calibration_subwindows_shift:units = "nm" ;
float calibration_subwindows_squeeze(ground_pixel, number_of_subwindows) ;
calibration_subwindows_squeeze:long_name = "irradiance wavelengths squeeze fitted values per subwindow" ;
calibration_subwindows_squeeze:units = "1" ;
float calibration_subwindows_wavelength(ground_pixel, number_of_subwindows) ;
calibration_subwindows_wavelength:long_name = "calibration wavelength center in each subwindow" ;
calibration_subwindows_wavelength:units = "nm" ;
} // group WAVELENGTH_CALIBRATION
} // group DETAILED_RESULTS

group: GEOLOCATIONS {
variables:
ubyte geolocation_flags(time, scanline, ground_pixel) ;
geolocation_flags:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
geolocation_flags:flag_masks = 0UB, 1UB, 2UB, 4UB, 8UB, 16UB, 128UB ;
geolocation_flags:flag_meanings = "no_error solar_eclipse sun_glint_possible descending night geo_boundary_crossing geolocation_error" ;
geolocation_flags:flag_values = 0UB, 1UB, 2UB, 4UB, 8UB, 16UB, 128UB ;

geolocation_flags:long_name = "ground_pixel_quality_flag" ;
geolocation_flags:valid_max = 128UB ;
geolocation_flags:valid_min = 0UB ;
geolocation_flags:units = "1" ;
float latitude_bounds(time, scanline, ground_pixel, corner) ;
latitude_bounds:units = "degrees_north" ;
float longitude_bounds(time, scanline, ground_pixel, corner) ;
longitude_bounds:units = "degrees_east" ;
float satellite_altitude(time, scanline) ;
satellite_altitude:comment = "The altitude of the satellite with respect to the geodetic sub satellite point on the WGS84 reference ellipsoid" ;
satellite_altitude:long_name = "satellite altitude" ;
satellite_altitude:units = "m" ;
satellite_altitude:valid_max = 900000.f ;
satellite_altitude:valid_min = 700000.f ;
float satellite_latitude(time, scanline) ;
satellite_latitude:comment = "Latitude of the geodetic sub satellite point on the WGS84 reference ellipsoid" ;
satellite_latitude:long_name = "sub satellite latitude" ;
satellite_latitude:units = "degree_north" ;
satellite_latitude:valid_max = 90.f ;
satellite_latitude:valid_min = -90.f ;
float satellite_longitude(time, scanline) ;
satellite_longitude:comment = "Longitude of the geodetic sub satellite point on the WGS84 reference ellipsoid" ;
satellite_longitude:long_name = "sub satellite longitude" ;
satellite_longitude:units = "degree_east" ;
satellite_longitude:valid_max = 180.f ;
satellite_longitude:valid_min = -180.f ;
float satellite_orbit_phase(time, scanline) ;
satellite_orbit_phase:comment = "Relative offset [0.0, ..., 1.0] of the measurement in the orbit" ;
satellite_orbit_phase:long_name = "fractional satellite orbit phase" ;
satellite_orbit_phase:units = "1" ;
satellite_orbit_phase:valid_max = 1.02f ;
satellite_orbit_phase:valid_min = -0.02f ;
double solar_azimuth_angle(time, scanline, ground_pixel) ;
solar_azimuth_angle:comment = "Solar azimuth angle at the ground pixel location on the reference ellipsoid. Angle is measured clockwise from the North (East = 90, South = 180, West = 270)" ;
solar_azimuth_angle:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
solar_azimuth_angle:long_name = "solar azimuth angle" ;
solar_azimuth_angle:standard_name = "solar azimuth angle" ;
solar_azimuth_angle:units = "degree" ;
solar_azimuth_angle:valid_max = 180. ;
solar_azimuth_angle:valid_min = -180. ;
double solar_zenith_angle(time, scanline, ground_pixel) ;
solar_zenith_angle:comment = "Solar zenith angle at the ground pixel location on the reference ellipsoid. Angle is measured away from the vertical" ;
solar_zenith_angle:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
solar_zenith_angle:long_name = "solar zenith angle" ;
solar_zenith_angle:standard_name = "solar zenith angle" ;
solar_zenith_angle:units = "degree" ;
solar_zenith_angle:valid_max = 180. ;
solar_zenith_angle:valid_min = 0. ;
double viewing_azimuth_angle(time, scanline, ground_pixel) ;
viewing_azimuth_angle:comment = "Sattellite azimuth angle at the ground pixel location on the reference ellipsoid. Angle is measured clockwise from the North (East = 90, South = 180, West = 270)" ;
viewing_azimuth_angle:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;

viewing_azimuth_angle:long_name = "viewing azimuth angle" ;
viewing_azimuth_angle:standard_name = "viewing azimuth angle" ;
viewing_azimuth_angle:units = "degree" ;
viewing_azimuth_angle:valid_max = 180. ;
viewing_azimuth_angle:valid_min = -180. ;
double viewing_zenith_angle(time, scanline, ground_pixel) ;
viewing_zenith_angle:comment = "Aenith angle of the satellite at the ground pixel location on the reference ellipsoid. Angle is measured away from the vertical" ;
viewing_zenith_angle:coordinates = "PRODUCT/longitude /PRODUCT/latitude" ;
viewing_zenith_angle:long_name = "viewing zenith angle" ;
viewing_zenith_angle:standard_name = "viewing zenith angle" ;
viewing_zenith_angle:units = "degree" ;
viewing_zenith_angle:valid_max = 180. ;
viewing_zenith_angle:valid_min = 0. ;
} // group GEOLOCATIONS

group: INPUT_DATA {
variables:
int instrument_configuration_identifier(time, scanline) ;
instrument_configuration_identifier:comment = "The Instrument Configuration ID defines the type of measurement and its purpose. The number of instrument configuration IDs will increase over the mission as new types of measurements are created and used" ;
instrument_configuration_identifier:long_name = "IcID" ;
short instrument_configuration_version(time, scanline) ;
instrument_configuration_version:comment = "Version of the instrument_configuration_identifier" ;
instrument_configuration_version:long_name = "IcVersion" ;
float cloud_fraction_crb(time, scanline, ground_pixel) ;
cloud_fraction_crb:units = "1" ;
cloud_fraction_crb:standard_name = "TBD" ;
cloud_fraction_crb:long_name = "effective radiometric cloud fraction from the CRB model" ;
cloud_fraction_crb:source = "crb" ;
cloud_fraction_crb:comment = "Coregistered effective radiometric cloud fraction using the OCRA/ROCINN CRB model." ;
cloud_fraction_crb:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_fraction_crb_precision(time, scanline, ground_pixel) ;
cloud_fraction_crb_precision:units = "1" ;
cloud_fraction_crb_precision:standard_name = "TBD" ;
cloud_fraction_crb_precision:long_name = "effective radiometric cloud fraction precision from the CRB model" ;
cloud_fraction_crb_precision:source = "crb" ;
cloud_fraction_crb_precision:comment = "Error of the coregistered effective radiometric cloud fraction using the OCRA/ROCINN CRB model." ;
cloud_fraction_crb_precision:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_pressure_crb(time, scanline, ground_pixel) ;
cloud_pressure_crb:units = "Pa" ;
cloud_pressure_crb:standard_name = "TBD" ;
cloud_pressure_crb:long_name = "cloud radiometric optical centroid pressure from the CRB model" ;
cloud_pressure_crb:source = "crb" ;
cloud_pressure_crb:comment = "Coregistered and converted atmospheric pressure at the level of cloud using the OCRA/ROCINN CRB model." ;
cloud_pressure_crb:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_pressure_crb_precision(time, scanline, ground_pixel) ;
cloud_pressure_crb_precision:units = "Pa" ;
cloud_pressure_crb_precision:standard_name = "TBD" ;
cloud_pressure_crb_precision:long_name = "cloud radiometric optical centroid pressure precision from the CRB model" ;
cloud_pressure_crb_precision:source = "crb" ;
cloud_pressure_crb_precision:comment = "Error of the coregistered and converted atmospheric pressure at the level of cloud using the OCRA/ROCINN CRB model." ;

cloud_pressure_crb_precision:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_height_crb(time, scanline, ground_pixel) ;
cloud_height_crb:units = "m" ;
cloud_height_crb:standard_name = "TBD" ;
cloud_height_crb:long_name = "cloud radiometric optical centroid height from the CRB model" ;
cloud_height_crb:source = "crb" ;
cloud_height_crb:comment = "Coregistered height at the level of cloud w.r.t. the geoid/MSL using the OCRA/ROCINN CRB model." ;
cloud_height_crb:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_height_crb_precision(time, scanline, ground_pixel) ;
cloud_height_crb_precision:units = "m" ;
cloud_height_crb_precision:standard_name = "TBD" ;
cloud_height_crb_precision:long_name = "cloud radiometric optical centroid height precision from the CRB model" ;
cloud_height_crb_precision:source = "crb" ;
cloud_height_crb_precision:comment = "Error of the coregistered height at the level of cloud w.r.t. the geoid/MSL using the OCRA/ROCINN CRB model." ;
cloud_height_crb_precision:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_albedo_crb(time, scanline, ground_pixel) ;
cloud_albedo_crb:units = "1" ;
cloud_albedo_crb:standard_name = "cloud_albedo" ;
cloud_albedo_crb:long_name = "cloud albedo from the CRB model" ;
cloud_albedo_crb:source = "crb" ;
cloud_albedo_crb:comment = "Coregistered cloud albedo based on the OCRA/ROCINN CRB model." ;
cloud_albedo_crb:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float cloud_albedo_crb_precision(time, scanline, ground_pixel) ;
cloud_albedo_crb_precision:units = "1" ;
cloud_albedo_crb_precision:standard_name = "cloud_albedo_standard_error" ;
cloud_albedo_crb_precision:long_name = "cloud albedo precision from the CRB model" ;
cloud_albedo_crb_precision:source = "crb" ;
cloud_albedo_crb_precision:comment = "Error of the coregistered cloud albedo based on the OCRA/ROCINN CRB model." ;
cloud_albedo_crb_precision:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
float surface_altitude(time, scanline, ground_pixel) ;
surface_altitude:long_name = "surface altitude" ;
surface_altitude:standard_name = "surface_altitude" ;
surface_altitude:units = "m" ;
surface_altitude:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
surface_altitude:source = "http://topotools.cr.usgs.gov/gmted_viewer/" ;
surface_altitude:comment = "The mean of the sub-pixels of the surface altitude above the reference geoid (WGS84) within the approximate field of view, based on the GMTED2010 surface elevation database" ;
float surface_altitude_precision(time, scanline, ground_pixel) ;
surface_altitude_precision:long_name = "surface altitude precision" ;
surface_altitude_precision:standard_name = "surface_altitude standard_error" ;
surface_altitude_precision:units = "m" ;
surface_altitude_precision:standard_error_multiplier = 1.f ;
surface_altitude_precision:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;
surface_altitude_precision:source = "http://topotools.cr.usgs.gov/gmted_viewer/" ;
surface_altitude_precision:comment = "The standard deviation of sub-pixels used in calculating the mean surface altitude above the reference geoid (WGS84) within the approximate field of view, based on the GMTED2010 surface elevation database" ;
ubyte surface_classification(time, scanline, ground_pixel) ;
surface_classification:units = "1" ;
surface_classification:long_name = "land-water mask" ;
surface_classification:comment = "flag indicating land/water and further surface classifications for the ground pixel" ;
surface_classification:source = "USGS (http://edc2.usgs.gov/glcc/globdoc2_0.php) and NASA SDP toolkit (http://newsroom.gsfc.nasa.gov/sdptoolkit/toolkit.html)" ;

surface_classification:flag_meanings = "land, water, some_water, coast, value_covers_majority_of_pixel, water+shallow_ocean, water+shallow_inland_water, water+ocean_coastline-lake_shoreline, water+intermittent_water, water+deep_inland_water, water+continental_shelf_ocean, water+deep_ocean, land+urban_and_built-up_land, land+dryland_cropland_and_pasture, land+irrigated_cropland_and_pasture, land+mixed_dryland-irrigated_cropland_and_pasture, land+cropland-grassland_mosaic, land+cropland-woodland_mosaic, land+grassland, land+shrubland, land+mixed_shrubland-grassland, land+savanna, land+deciduous_broadleaf_forest, land+deciduous_needleleaf_forest, land+evergreen_broadleaf_forest, land+evergreen_needleleaf_forest, land+mixed_forest, land+herbaceous_wetland, land+wooded_wetland, land+barren_or_sparsely_vegetated, land+herbaceous_tundra, land+wooded_tundra, land+mixed_tundra, land+bare_ground_tundra, land+snow_or_ice" ;

surface_classification:flag_values = 0UB, 1UB, 2UB, 3UB, 4UB, 9UB, 17UB, 25UB, 33UB, 41UB, 49UB, 57UB, 8UB, 16UB, 24UB, 32UB, 40UB, 48UB, 56UB, 64UB, 72UB, 80UB, 88UB, 96UB, 104UB, 112UB, 120UB, 128UB, 136UB, 144UB, 152UB, 160UB, 168UB, 176UB, 184UB ;

surface_classification:flag_masks = 3UB, 3UB, 3UB, 3UB, 4UB, 249UB ;

surface_classification:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

float surface_pressure(time, scanline, ground_pixel) ;

surface_pressure:units = "Pa" ;

surface_pressure:standard_name = "surface_air_pressure" ;

surface_pressure:long_name = "surface_air_pressure" ;

surface_pressure:source = "" ;

surface_pressure:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

float surface_temperature(time, scanline, ground_pixel) ;

surface_temperature:units = "K" ;

surface_temperature:standard_name = "surface_air_temperature" ;

surface_temperature:long_name = "surface_air_temperature" ;

surface_temperature:source = "" ;

surface_temperature:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

float northward_wind(time, scanline, ground_pixel) ;

northward_wind:units = "m s-1" ;

northward_wind:standard_name = "northward_wind" ;

northward_wind:long_name = "Northward wind from ECMWF at 10 meter height level" ;

northward_wind:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

float eastward_wind(time, scanline, ground_pixel) ;

eastward_wind:units = "m s-1" ;

eastward_wind:standard_name = "eastward_wind" ;

eastward_wind:long_name = "Eastward wind from ECMWF at 10 meter height level" ;

eastward_wind:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

ubyte snow_ice_flag_nise(time, scanline, ground_pixel) ;

snow_ice_flag_nise:units = "1" ;

snow_ice_flag_nise:long_name = "snow-ice mask" ;

snow_ice_flag_nise:comment = "flag indicating snow/ice at center of ground pixel" ;

snow_ice_flag_nise:source = "ECMWF" ;

snow_ice_flag_nise:flag_meanings = "snow-free_land sea_ice_1_percent sea_ice_2_percent sea_ice_3_percent sea_ice_4_percent sea_ice_5_percent sea_ice_6_percent sea_ice_7_percent sea_ice_8_percent sea_ice_9_percent sea_ice_10_percent sea_ice_11_percent sea_ice_12_percent sea_ice_13_percent sea_ice_14_percent sea_ice_15_percent sea_ice_16_percent sea_ice_17_percent sea_ice_18_percent sea_ice_19_percent sea_ice_20_percent sea_ice_21_percent sea_ice_22_percent sea_ice_23_percent sea_ice_24_percent sea_ice_25_percent sea_ice_26_percent sea_ice_27_percent sea_ice_28_percent sea_ice_29_percent sea_ice_30_percent sea_ice_31_percent sea_ice_32_percent sea_ice_33_percent sea_ice_34_percent sea_ice_35_percent sea_ice_36_percent sea_ice_37_percent sea_ice_38_percent sea_ice_39_percent sea_ice_40_percent sea_ice_41_percent sea_ice_42_percent sea_ice_43_percent sea_ice_44_percent sea_ice_45_percent sea_ice_46_percent sea_ice_47_percent sea_ice_48_percent sea_ice_49_percent sea_ice_50_percent sea_ice_51_percent sea_ice_52_percent sea_ice_53_percent sea_ice_54_percent sea_ice_55_percent sea_ice_56_percent sea_ice_57_percent sea_ice_58_percent sea_ice_59_percent sea_ice_60_percent sea_ice_61_percent sea_ice_62_percent sea_ice_63_percent sea_ice_64_percent sea_ice_65_percent sea_ice_66_percent sea_ice_67_percent sea_ice_68_percent sea_ice_69_percent sea_ice_70_percent sea_ice_71_percent sea_ice_72_percent sea_ice_73_percent sea_ice_74_percent sea_ice_75_percent sea_ice_76_percent sea_ice_77_percent sea_ice_78_percent sea_ice_79_percent sea_ice_80_percent sea_ice_81_percent sea_ice_82_percent sea_ice_83_percent sea_ice_84_percent sea_ice_85_percent sea_ice_86_percent sea_ice_87_percent sea_ice_88_percent sea_ice_89_percent sea_ice_90_percent sea_ice_91_percent sea_ice_92_percent sea_ice_93_percent sea_ice_94_percent sea_ice_95_percent sea_ice_96_percent sea_ice_97_percent sea_ice_98_percent sea_ice_99_percent sea_ice_100_percent permanent_ice snow mixed_pixels_at_coastlines suspect_ice_value corners ocean" ;

snow_ice_flag_nise:flag_values = 0UB, 1UB, 2UB, 3UB, 4UB, 5UB, 6UB, 7UB, 8UB, 9UB, 10UB, 11UB, 12UB, 13UB, 14UB, 15UB, 16UB, 17UB, 18UB, 19UB, 20UB, 21UB, 22UB, 23UB, 24UB, 25UB, 26UB, 27UB, 28UB, 29UB, 30UB, 31UB, 32UB, 33UB, 34UB, 35UB, 36UB, 37UB, 38UB, 39UB, 40UB, 41UB, 42UB, 43UB, 44UB, 45UB, 46UB, 47UB, 48UB, 49UB, 50UB, 51UB, 52UB, 53UB,

54UB, 55UB, 56UB, 57UB, 58UB, 59UB, 60UB, 61UB, 62UB, 63UB, 64UB, 65UB, 66UB, 67UB, 68UB, 69UB, 70UB, 71UB, 72UB, 73UB, 74UB, 75UB, 76UB, 77UB, 78UB, 79UB, 80UB, 81UB, 82UB, 83UB, 84UB, 85UB, 86UB, 87UB, 88UB, 89UB, 90UB, 91UB, 92UB, 93UB, 94UB, 95UB, 96UB, 97UB, 98UB, 99UB, 100UB, 101UB, 103UB, 252UB, 253UB, 254UB, 255UB ;

snow_ice_flag_nise:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

ubyte snow_ice_flag(time, scanline, ground_pixel) ;

snow_ice_flag:units = "1" ;

snow_ice_flag:threshold = "0.3" ;

snow_ice_flag:long_name = "snow-ice mask" ;

snow_ice_flag:comment = "flag indicating snow/ice at center of ground pixel" ;

snow_ice_flag:source = "ECMWF" ;

snow_ice_flag:flag_meanings = "snow_free snow_ice" ;

snow_ice_flag:flag_values = 0UB, 1UB ;

snow_ice_flag:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

float snow_cover(time, scanline, ground_pixel) ;

snow_cover:units = "1" ;

snow_cover:long_name = "snow-cover" ;

snow_cover:source = "ECMWF" ;

snow_cover:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

float sea_ice_cover(time, scanline, ground_pixel) ;

sea_ice_cover:units = "1" ;

sea_ice_cover:long_name = "sea-ice-cover" ;

sea_ice_cover:source = "ECMWF" ;

sea_ice_cover:coordinates = "/PRODUCT/longitude /PRODUCT/latitude" ;

group: BACKGROUND_CORRECTION {

dimensions:

wavelengths = 9533 ;

variables:

float earthshine_reference_radiance(ground_pixel, wavelengths) ;

earthshine_reference_radiance:units = "mol.m-2.nm-1.sr-1.s-1" ;

float earthshine_reference_wavelength(ground_pixel, wavelengths) ;

earthshine_reference_wavelength:units = "nm" ;

float amf_scd0_average(ground_pixel) ;

amf_scd0_average:units = "1" ;

float offsets(ground_pixel) ;

offsets:units = "mol m-2" ;

float offsets_scd0(ground_pixel) ;

offsets_scd0:units = "mol m-2" ;

int wavelengths(wavelengths) ;

// group attributes:

:reference_radiance_time_range = "20231009T223915_20231011T000136" ;

:background_scd_time_range = "20231009T223915_20231011T000136" ;

} // group BACKGROUND_CORRECTION

} // group INPUT_DATA

} // group SUPPORT_DATA

} // group PRODUCT

}