Parasol Level-3 Product

Data Format and User Manual

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POLDER level-3 product

Data format and user manual

The concept of the POLDER instrument was imagined by several researchers from LERTS (Laboratoire d'Etudes et de Recherche en Télédétection Spatiale), CNES (Centre National d'Etudes Spatiales) and LOA (Laboratoire d'Optique Atmosphérique). The concept was then validated using an airborne version built and operated at LOA.

The spaceborne POLDER instrument has been developed by CNES in partnership with industrial contractors. It was flown on both ADEOS-I and ADEOS-II platforms. Unfortunately, the lifetime of both platforms was limited to less than a year following the failure of the solar paddle.
The Parasol instrument is similar to that of POLDER. It was launched in December 2004 to be part of the A-Train, flying is formation with Aqua, Calipso and Cloudsat. Significant changes concern:

- The orientation of the CCD matrix was changed. On POLDER, the long axis of the matrix was cross-track. On Parasol, it is along track. This results in a lower daily coverage of the Earth, but a larger directional sampling for the pixel that are in the instrument swath (up to 16 from 14 on POLDER).
- The shorter wavelength polarized channel is at 490 nm instead of 443 nm on POLDER.
- On POLDER there were two channels at 443 nm (for optimized dynamic and signal to noise). There is a single one on Parasol, but with an additional channel at 1020 nm. This channel may be used for optimized synergy with the Calipso measurements at 1060 nm.

Scientific algorithms are defined and validated by the following science laboratories:

- Laboratoire d'Optique Atmosphérique (LOA)
- Laboratoire des Sciences du Climat et de l'Environnement (LSCE)
- Medias-France
- Laboratoire de Météorologie Dynamique (LMD)

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Introduction

The POLDER-1 instrument was launched onboard the ADEOS platform in August 1996. The instrument acquired data almost continuously from October 1996 to June 1997 when the platform solar panel failure doomed all instruments onboard. Another similar instrument, POLDER-2, was launched in December 2002 but the ADEOS-II platform died in June 2003. The Parasol instrument, very much like POLDER, was launched on a micro-satellite in December 2004. All Parasol measurements are sent to CNES where they are processed. Level-1 consists of radiometric and geometric processing. It yields top-of-the-atmosphere geocoded radiances. The Parasol level-1 product is described in another document.

Level-2 processing generates atmospheric and surface properties from individual Level-1 products that cover the fraction of the Earth observed during one ADEOS orbit with adequate illumination conditions. The Parasol Level-2 products are described in another document.

Level-3 processing performs a spatial and temporal synthesis of Level-2 products. The period of composition is either 10 days or one month, whereas the area is global. The content and format of Parasol Level-3 products is described in the following.

Level-2 and 3 processing are separated in three processing lines referred to L (for "Land Surfaces"), O (for "Ocean") and R (for "Radiation Budget").

"Land Surfaces" processing line

The "Land Surfaces" processing line analyzes the measurements acquired over land surfaces that are recognized as clear by the first step of the processing. It generates an estimate of the aerosol optical thickness and a "best fit" aerosol model, as well as directional surface reflectances corrected for atmospheric absorption, molecular scattering and aerosol scattering. The later are limited to clear conditions (i.e. retrieved aerosol optical thickness smaller than a threshold).

The scientific rationale for the algorithm is described on the World Wide Web: http://smsc.cnes.fr/POLDER/SCIEPROD/ls_intro.htm

Level 3 processing uses Level-2 products to generate three products:

- "Atmospheric parameters" provides a ten-day and monthly synthesis of retrieved aerosol load and characteristics. The product is given on the Medium resolution grid (Appendix B-2) with a spatial resolution of approximately 19 km.
- "Albedo and vegetation parameters" provides a monthly synthesis of surface parameters such as spectral Albedo, NDVI, Leaf Area Index and Fraction of Vegetation Cover. The product is given on the full resolution grid (Appendix B-1) with a spatial resolution of approximately 6 km.
- "Directional Signature Parameters" provides a monthly synthesis of surface directional signatures in 5 spectral bands. The atmospheric-corrected reflectances are used to invert a 3 parameters BRDF model, and the retrieved coefficients are given in the product. The product is given on the full resolution grid (Appendix B-1) with a spatial resolution of approximately 6 km.

"Ocean" processing line

The "Ocean" processing line analyzes the measurements acquired over water surfaces that are recognized as clear by the first step of the processing. It generates an estimate of the aerosol optical thickness and a "best fit" aerosol model. Other algorithm generate information on the ocean color (i.e. Sea Spectral Reflectance) but these are no describe in this document. See the page http://www-loa.univ-lille1.fr/ocean_color/ for more information on ocean color from the Parasol instrument.

The aerosol retrieval algorithm is described at http://smsc.cnes.fr/POLDER/SCIEPROD/ae_intro.htm

The "Aerosol parameters" product provides a ten-day and monthly synthesis of retrieved aerosol load and characteristics. The product is generated on the Medium resolution grid (Appendix B-2) with a spatial resolution of approximately 19 km.

"Radiation Budget" processing line

The "Radiation Budget" processing line analyzes all measurements (clear and cloudy). It generates information on the cloud cover (amount, optical thickness, pressure, phase...), atmospheric water vapor, scene albedo, and some statistics on the spatial and directional variability of these parameters.

The advanced algorithms are described on the web at

http://smsc.cnes.fr/POLDER/SCIEPROD/rb_intro.htm

Level 3 product provides a monthly synthesis of the retrieved parameters. The product is given on the Medium resolution grid (Appendix B-2) with a spatial resolution of approximately 19 km.

The document first gives some general information on the data coding. It then describes in details the Level-3 data format. The appendices provide more information for an in-depth use of the Parasol Level-3 data. More information on the POLDER and Parsasol instrument and the Level-1 processing can be found in Deschamps et al. (IEEE TGARS, 1994).

Definitions

Parasol product identification

A POLDER/Parasol standard product is composed of two files : A *leader* file and a *data* file. The *leader* file provides some information on the instrument and the data processing. The *data* file contains the geophysical parameters, together with ancillary data.

A Level-3 product generated from Parasol measurement is identified by `PwL3TyGzaammddv` where `y` identifies the processing line (`L`, `O` or `R`), `z` identifies the product (`A`, `B`, or `C`), aammdd is the reference date (year-month-day), and v identifies the reprocessing number (See Appendix A). The *leader file* and *data file* filenames are `pppL` and `pppD` respectively, where `ppp` is the 15 characters product identificator.

Coding

Most parameters of the leader file are written as formatted ASCII characters, whereas the data file has a binary structure.

In what follows, we make use of the following coding types :

`Ax` : indicates an ASCII field of length x bytes.

`Fx.y` indicates a real written on `x` characters with `y` digits after the floating point (as in FORTRAN). Ex: `F10.4` for `-1234.5678`

`Ex.y` indicates a real written in exponential form on `x` characters with `y` digits after the floating point (as in FORTRAN). Ex: `E14.4` for `-1234.5678E-08`

`Bx` indicates a succession of bits (for quality flags). `x` is the number of bytes used.

`I4` indicates a four-bytes unsigned Integer (from 0 to 2^{32}-1)

`SI2` indicates a two-bytes signed integer (from -32768 to +32767)

`I2` indicates a two-bytes unsigned Integer (from 0 to +65535)

`SI1` indicates a one-byte signed integer (from -128 to +127)

`I1` indicates a one-byte unsigned integer (from 0 to +255)

In the format description below, the special character "$" is used to indicate the space character. Upper-case letters are used for fixed fields, whereas lower-case letters are used for variable fields. Spare fields are filled with repetition of the "space" character.

For binary parameters, two values are reserved : "Non significant" and "Dummy". The "Non significant" value characterises out of range data. The "Dummy" value is used when the parameter was not estimated, for instance when no observation is available during the month.

	I1	I2
Dummy	255	65535
Non significant	254	65534

Leader File Format

General structure

The leader file is composed of 5 records of variable length. Its total length is 27720 Bytes.

Record Name	Record Length (Bytes)
Leader file descriptor	180
Header	360
Data processing parameters	720
Scaling factors	13140
Annotations	13320
Total	27720

Leader file descriptor

This record describes the data structure of the leader file.

Position	Type & Length	Content
1-4	I4	Record Number in the file : `1`
5-8	I4	Length of this record : `180`
9-20	A12	Reference Document Identification : `SPG9N122-316$ for PARASOL, PAST33131CN$ for POLDER1 and P2ST33131CN$ for POLDER2.`
21-26	A6	Reference Document Version Number : `aa/bb$`
27-32	A6	Software Version Number : `aabbcc.` aa, bb and cc correspond to different sections of the software
33-36	A4	File Number : `1$$$`
37-52	A16	File Name[1] : `PwL3TyGzaammddvL`
53-56	I4	Number of "header" record in the file : `1`
57-60	I4	Length of the "Header" record : `360`
61-64	I4	Number of "Spatio-Temporal Characteristics" records in the file : `0`
65-68	I4	Length of the "Spatio-Temporal Characteristics" record : `0`
69-72	I4	Number of "Instrument setting parameters" records in the file : `0`
73-76	I4	Length of the "Instrument setting parameters" record : `0`
77-80	I4	Number of "Technological parameters" records in the file : `0`
81-84	I4	Length of the "Technological parameters" record : `0`
85-88	I4	Number of "Data processing parameters" records in the file : `1`
89-92	I4	Length of the "Data processing parameters" record : `720`

[1] See Annexe A for the POLDER/Parasol standard for filenames

93-96	I4	Number of "Scaling factors" records in the file : 1
97-100	I4	Length of the "Scaling factors" record : 13140
101-104	I4	Number of "Annotation" records in the file : 1
105-108	I4	Length of the "Annotation" record : 13320
109-180	A72	Spare

Header

The "header" record gives general information on the product and the models used for data registration.

Position	Type & Length	Content
1-4	I4	Record Number in the file : 2
5-8	I4	Length of this record : 360
9-24	A16	Information Point Phone Number
25-40	A16	Product identification : PwL3TyGzyymmddv$
41-48	A8	Satellite identificator MYRIADE2 for PARASOL, ADEOS1 for POLDER1 and ADEOS2 for POLDER2
49-56	A8	Instrument identificator (x=1 or 2) : PARASOL1, POLDER$1 or POLDER$2
57-72	A16	Spatial Coverage : GLOBAL$COVERAGE$
73-80	A8	Pixel size of the POLDER/Parasol reference grid (km)
81-110	A30	Name of the ellipsoid used for the data registration : GEODETIC$REFERENCE$SYSTEM$1980
111-122	F12.4	Length of the ellipsoid minor axis (meter) : 6356752.3141
123-134	F12.4	Length of the ellipsoid major axis (meter) : 6378137.0000
135-164	A30	Name of the Digital Elevation Model (DEM) used for the data registration : TERRAIN-BASE(NOAA)$$$$$$$$$$$$
165-172	A8	Spatial resolution of the DEM along the latitudes (in degrees) : aaa.aaa$
173-180	A8	Spatial resolution of the DEM along the longitudes (in degrees) : aaa.aaa$
181-360	A180	Spare

Data processing parameters

This record provides information on input data and software version used to generate the Level-3 Parasol data.

Position	Type & Length	Content
1-4	I4	Record Number in the file : 3
5-8	I4	Length of this record : 720

9-16	A8	Level-3 data creation country : FRANCE$$
17-24	A8	Level-3 data creation agency : CNES$$$$
25-40	A16	Level-3 data creation facility : CST-PGS$$$$$$$$$
41-56	A16	Level-3 data creation date and UT time yyyymmddhhmmss$$
57-72	A16	Processing line identification: either LAND$SURFACES$$$ or OCEAN$COLOUR$$$$ or RADIATION$CLOUDS
73-104	A32	Product thematic identification. Either MARINE$PARAMETERS or ATMOSPHERIC$PARAMETERS or AEROSOL$PARAMETERS or ALBEDOANDVEGETATION$PARAMETERS or DIRECTIONAL$SIGNATURE$PARAMETERS or SYNTHESIS
105-112	A8	Level-3 processing software version : aabbcc$$
113-128	A16	Identificator of Parasol Level-2 data type used as input : PwL2TyGz$$$$$$$$
129-144	A16	Identificator of another Parasol Level-2 data type used as input (if any) : PwL2TyGz$$$$$$$$
145-160	A16	Spare
161-176	A16	Reference date and UT time of the earliest Level-2 product potentially used for the synthesis: yyyymmddhhmmss$$
177-192	A16	Reference date and UT time of the latest Level-2 product potentially used for the synthesis: yyyymmddhhmmss$$
193-208	A16	Reference date for the synthesis : yyyymmdd000000$$. dd is 15 for the "Ocean Color" "Aerosol" and "Radiation Budget" products, either 05, 15, or 25 for the "Land Surfaces" product.
209-212	A4	Number of Level-2 products of the type identified in field 113-128 which are used in the synthesis : N2prod
213-216	A4	Number of Level-2 products of the type identified in field 129-144 which are used in the synthesis.
217-220	A4	Spare
221-224	B4	Product Confidence Data (PCD), for internal use.
225-232	A8	Processing line version number : aabbcc$$
233-720	A488	Spare

Scaling factors

This record describes the coding of the parameters in the data file. Most parameters are given using integer binary coding with either 1 or 2 bytes. The physical values (PV) can be computed from the Binary Values (BV) through :

$$PV = Slope \times BV + Offset$$

The Slope and the Offset are given for each parameter in this record.

Position	Type & Length	Content

1-4	I4	Record Number in the file : `4`
5-8	I4	Length of this record : `13140`
9-16	A8	Interleaving indicator : `BIP$$$$$`
17-32	A16	Byte ordering standard (`BIG ENDIAN` or `LITTLE ENDIAN`): `BIG$ENDIAN$$$$$$` (as on IBM mainframes)
33-36	A4	Number of parameters per pixel : `Npar`
37-44	A8	Number of bytes per pixel : `Nbytes`[2]
26 ip + 19[3] 26 ip + 20	A2	Number of bytes for parameter `#ip : nn`
26 ip + 21 26 ip + 32	E12.5	Slope for the computation of physical value for parameter `#ip :` `±s.sssssE±bb`
26 ip + 33 26 ip + 44	E12.5	Offset for the computation of physical value for parameter `#ip :` `±o.oooooE±cc`
26 `Npar` + 45 9000	A	Spare
8993 + 8 ip[4] 9000 + 8 ip	A8	Identificator of each level 2 product used as input of Level 3 processing : `cccooov$o`. `ccc` and `ooo` are cycle and orbit numbers. See appendix A
9001+8 N2prod 13140	A	Spare

Annotations

This record gives some statistical information on the results of the level-3 processing. The percentages of “land”, “water” and “mixed” pixels in the viewing segment are given. This record also gives the number of pixels for each line of the POLDER/Parasol grid used for the product.

Position	Type	Content
1-4	I4	Record Number in the file : `5`
5-8	I4	Length of this record : `13320`
9-12	A4	Percentage of “Dummy” data in level-3 product: `ppp$` `(0≤ppp≤100)`
13-16	A4	Percentage of “non significant” data in level-3 product : `ppp$`
17-20	A4	Percentage of “land” pixels in the level-3 product : `ppp$` `(0≤ppp≤100)`
21-24	A4	Percentage of “ocean” pixels in the level-3 product : `ppp$` `(0≤ppp≤100)`
25-28	A4	Percentage of “coast” pixels in the level-3 product : `ppp$`

[2] `Npar` and `Nbytes` vary with the thematic and product type.

[3] `ip` is the parameter number. `1 ≤ ip ≤ Npar.`

[4] ip is the level 2 product number. `1 ≤ ip ≤ N2prod, where N2prod is defined in the previous record (position 209-212)`

		(0≤ppp≤100)
29-200	A172	Spare
201-204	A4	Number of lines in the POLDER/Parasol grid for which at least one pixel is present in the data file: nnnn
4 il + 201[5] 4 il + 204	A4	Number of pixels (or records) in the data file for line #il (1≤il≤Nlin[6], from North to South) : nnnn
205 + 4 Nlin 13320	A156	Spare

[5] il is the line number in the POLDER/Parasol reference grid. 1 ≤ il ≤ Nlin

[6] Nlin is the number of line in the POLDER/Parasol grid used for the product. It is either 3240 (full resolution grid) or 1080 (medium resolution grid).

Data File Format

The Data file is composed of a first record of length 180 bytes, and a variable number (Npixels) of records equal to the number of pixels in the product.

Record Name	Number of records	Record Length (Bytes)
Data file descriptor	1	180
Data record	Npixels	Nbytes

Data file descriptor

This record describes the data structure of the data file.

Position	Type & Length	Content
1-4	I4	Record Number in the file : `1`
5-8	I4	Length of this record : `180`
9-20	A12	Reference Document Identification : `PAST33131CN for PARASOL and POLDER`
21-26	A6	Reference Document Version Number : `aa/bb$`
27-32	A6	Software Version Number : `aabbcc.` aa, bb and cc correspond to different sections of the software
33-36	A4	File Number : `2$$$`
37-52	A16	File Name[7] : `PwL3TyGzaammddvD`
53-56	I4	Number of "data" records in the file : (1 ≤ Npixels ≤ 13 10^6)
57-60	I4	Length of one "data" record : `Nbytes`
61-100	A40	Spare
101-104	I4	Length of the prefix in the "data" record (bytes) : 7
105-108	I4	Length of data in the "data" record[8] : nnnn
109-112	I4	Length of the suffix in the "data" record (bytes) : `0`
113-180	A68	Spare

Data record. Generalities

There are 6 different level-3 products. Each of them is a synthesis of Level-2 products which have been derived from Parasol measurements.

In the tables below, the parameter number is the number used in the "scaling factor" record of the leader file. The Offset and Slope to be used for the conversion to physical values are given as of September 2003. At this time, there is no plan to change these values; nevertheless a careful user

[7] See Annexe A for the POLDER standard for filenames

[8] The data record length is nnnn+13. 13 bytes are kept for record number, record length and prefix.

should verify that they agree with the values given in the leader file (scaling factors record). The offset is only given (in parenthesis) when different than 0.

Data record. LS processing line, Directional signature parameters

This product describes the surface reflectance directional signature, as derived from PARASOL multidirectional measurements. A three parameters directional reflectance model has been inverted from the atmospheric-corrected measurements. The inverted parameters are given in the product.

Position	Param #	Type & Length	Slope & (Interc.)	Content
1-4		I4		Record Number in the file : `2≤RecNum≤Nrec+1`
5-6		I2		Length of this record (bytes): `90`
7-8		I2		Line Number of the pixel in the POLDER grid
9-10		I2		Column Number of the pixel in the POLDER grid
11-12		SI2		Pixel altitude from the DEM (meters)
13		I1		Land (100), Water (0) or Mixed (50) indicator : `100`
14-29	1	B 16	1	Pixel Confidence Data. See Appendix C1.
30	2	I1	0.5	Mean Solar Zenith Angle (°) : θ_0
For λ = 443 nm				
31-32	3	I2[9]	10^{-3} (-1)	First parameter of the model : K_0
33-34	4	I2	10^{-3} (-1)	Second parameter of the model : K_1
35-36	5	I2	10^{-3} (-1)	Third parameter of the model : K_2
37-38	6	I2	10^{-3}	Estimated uncertainty for K_0
39-40	7	I2	10^{-3}	Estimated uncertainty for K_1
41-42	8	I2	10^{-3}	Estimated uncertainty for K_2
43-54	9-14	**Same for λ = 565 nm**		
55-66	15-20	**Same for λ = 670 nm**		
67-78	21-26	**Same for λ = 765 nm**		
79-90	27-32	**Same for λ = 865 nm**		

[9] Special coding for values found outside of plausible range : 65533 (resp 65534) for values below (resp. over) range. Applies to all geophysical parameters of this product

Data record. LS processing line, Albedo and Vegetation parameters

This product gives the surface directional albedo, in five spectral bands, derived from the synthesis of multidirectional measurements. These measurements have been acquired with a limited range of solar zenith angle. Therefore, the directional albedos are given for the median value of the solar zenith angle. The NDVI, computed from the 670 and 865 nm directional albedos is also given. Finally, the LAI and the Fraction of Vegetation Cover are estimates based on a Neural Network processing.

Position	Param #	Type & Length	Slope & (Interc.)	Content
1-4		I4		Record Number in the file : `2≤RecNum≤Nrec+1`
5-6		I2		Length of this record (bytes): `46`
7-8		I2		Line Number of the pixel in the POLDER grid
9-10		I2		Column Number of the pixel in the POLDER grid
11-12		SI2		Pixel altitude from the DEM (meters)
13		I1		Land (100), Water (0) or Mixed (50) indicator : `100`
14-29	1	B 16	1	Pixel Confidence Data. See Appendix C1.
30	2	I1	0.5	Mean Solar Zenith Angle (°) : θ_0
31	3	I1[10]	0.005	Hemispheric reflectance, λ=443 nm for $\theta_s = \theta_0$.
32	4	I1	0.001	Estimated uncertainty on hemis. Reflec., λ=443 nm
33	5	I1	0.005	Hemispheric reflectance, λ=565 nm for $\theta_s = \theta_0$.
34	6	I1	0.001	Estimated uncertainty on hemis. Reflec., λ=565 nm
35	7	I1	0.005	Hemispheric reflectance, λ=670 nm for $\theta_s = \theta_0$.
36	8	I1	0.001	Estimated uncertainty on hemis. Reflec., λ=670 nm
37	9	I1	0.005	Hemispheric reflectance, λ=765 nm for $\theta_s = \theta_0$.
38	10	I1	0.001	Estimated uncertainty on hemis. Reflec., λ=765 nm
39	11	I1	0.005	Hemispheric reflectance, λ=865 nm for $\theta_s = \theta_0$.
40	12	I1	0.001	Estimated uncertainty on hemis. Reflec., λ=865 nm
41	13	I1	0.005 (-0.2)	Normalized Difference Vegetation Index (based on 670 and 865 measurements) : NDVI
42	14	I1	0.001	Estimated uncertainty on NDVI
43	15	I1	0.05	Leaf Area Index (LAI)
44	16	I1	0.05	Estimated uncertainty on LAI
45	17	I1	0.005	Vegetation cover
46	18	I1	0.001	Estimated uncertainty on vegetation cover

[10] Special coding for values found outside of plausible range : 253 (resp 254) for values below (resp. over) range. Applies to all geophysical parameters of this product

Data record. LS processing line, Atmospheric Parameters

This product is the synthesis of atmospheric parameter estimates from Level-2 products. It is given on the medium resolution grid described in appendix B-2. In this product, four different periods of synthesis are used, the three decades and the full month. In the inversion procedure, the optical thickness is estimated together with a "best fit" model. The aerosol index is the product of the optical thickness and the Angström coefficient of the model. It is representative of the accumulation mode load in the atmosphere. Another simpler inversion is based on a fixed aerosol model with constant polarization properties. The product also gives the mean values for this inversion. For the monthly synthesis, distributions are given together with the mean values.

Position	Param #	Type & Length	Slope & (Interc.)	Content
1-4		I4		Record Number in the file : `2≤RecNum≤Nrec+1`
5-6		I2		Length of this record (bytes): `83`
7-8		I2		Line Number of the pixel in the POLDER grid
9-10		I2		Column Number of the pixel in the POLDER grid
11-12		SI2		Pixel altitude from the DEM (meters)
13		I1		Land (100), Water (0) or Mixed (50) indicator : `100`
14-14	1	B 1	1	Pixel Confidence Data. See Appendix C2
For first decade in the month :				
15	2	I1	1	Number of valid observations
16-17	3	I2	$2\ 10^{-3}$	Mean Aerosol Optical Thickness at 865 nm
18	4	I1	0.014	Aerosol Angström coefficient, based on the means of optical thicknesses at 670 and 865 nm
19-20	5	I2	$2\ 10^{-3}$	Mean of Aerosol Index
21-22	6	I2	$2\ 10^{-3}$	Mean of aerosol optical thicknesses derived from fixed model inversion
23-30	7-11	**Same for second decade in the month**		
31-38	12-16	**Same for third decade in the month**		
Monthly synthesis:				
39	17	I1	1	Number of valid observations
40-41	18	I2	$2\ 10^{-3}$	Mean Aerosol Optical Thickness at 865 nm
42	19	I1	0.014	Aerosol Angström coefficient, based on the mean optical thicknesses at 670 and 865 nm
43-44	20	I2	$2\ 10^{-3}$	Mean Aerosol Index
45-46	21	I2	$2\ 10^{-3}$	Mean of aerosol optical thicknesses derived from fixed model inversion
Quartile distributions (min, 1st quartile, median, third quartile, max) for the month				
47-56	22-26	5 I2	$2\ 10^{-3}$	Aerosol Optical Thickness

57-66	27-31	5 I2	$2\ 10^{-3}$	Aerosol Index
67-76	32-36	5 I2	$2\ 10^{-3}$	Aerosol Optical Thickness, based on fixed model
Relative frequencies of occurence				
77-80	36-38	4 I1	10^{-2}	Angström coefficient (4 classes)
81-83	39-41	3 I1	10^{-2}	Refractive index (3 classes)

Data record. OC processing line, Aerosol Parameters

This product is a synthesis of atmospheric aerosol estimates during the period of synthesis (1 month). In this product, four different periods of synthesis are used, the three decades and the full month. The parameters are given on the medium resolution grid defined in Appendix B-2.

Position	Param #	Type & Length	Slope & (Interc.)	Content
1-4		I4		Record Number in the file : `2≤RecNum≤Nrec+1`
5-6		I2		Length of this record (bytes): `113`
7-8		I2		Line Number of the pixel in the POLDER grid
9-10		I2		Column Number of the pixel in the POLDER grid
11-12		SI2		Pixel altitude from the DEM (meters)
13		I1		Water indicator : `0`
14-17	1	B 4	1	Pixel Confidence Data. See Appendix D.
Decade # 1				
18	2	I1	1	Number of aerosol estimates during the decade
19-20	3	I2	$2\ 10^{-3}$	Mean of Aerosol optical thickness (AOT), λ=865 nm
21-22	4	I2	$2\ 10^{-3}$	Mean of AOT of the fine mode, λ=865 nm
23-24	5	I2	10^{-2} (-0.5)	Angström coefficient, computed from mean AOT at 670 and 865 nm
25-26	6	I2	10^{-2} (-0.5)	Angström coefficient of the fine mode, computed from mean AOT at 670 and 865 nm
27-28	7	I2	$2\ 10^{-3}$	Mean of aerosol index
29-39	8-13	**Same for Decade #2**		
40-50	14-19	**Same for Decade #3**		
Statistics for the month				
51	20	I1	1	Number of observations (bounded to 255)
52	21	I1	1	Number of observations with optimal viewing geometry
53-54	22	I2	$2\ 10^{-3}$	Mean of Aerosol optical thickness, λ=865 nm
55-56	23	I2	$2\ 10^{-3}$	Mean of AOT of the fine mode, λ=865 nm
57-58	24	I2	10^{-2} (-0.5)	Angström coefficient, computed from mean AOT at 670 and 865 nm
59-60	25	I2	10^{-2} (-0.5)	Angström coefficient of the fine mode, computed from mean AOT at 670 and 865 nm
61-62	26	I2	$2\ 10^{-3}$	Mean of aerosol index
63-64	27	I2	$2\ 10^{-3}$	Mean of AOT of fine mode at 865 nm, based on measurements with optimal viewing geometry
65-66	28	I2	$2\ 10^{-3}$	Mean of AOT of spherical coarse mode at 865 nm,

				based on measurements with optimal viewing geometry
67-68	29	I2	$2\ 10^{-3}$	Mean of AOT of non-spherical coarse mode at 865 nm, based on measurements with optimal viewing geometry
69-70	30	I2	$2\ 10^{-3}$	Mean of AOT of coarse mode at 865 nm, based on measurements with optimal viewing geometry
71	31	I1	$4\ 10^{-3}$	Mean relative contribution of non spherical particles to the coarse mode AOT, based on measurements with optimal viewing geometry
Monthly quartiles (Min, 1st quartile, median, 3rd quartile, max				
72-81	32-36	5 I2	$2\ 10^{-3}$	Aerosol Optical Thickness at 865 nm
82-91	37-41	5 I2	$2\ 10^{-3}$	AOT of fine mode at 865 nm
Normalized frequencies				
92-95	42-45	4 I1	10^{-2}	Angström coefficient
96-99	46-49	4 I1	10^{-2}	Angström coefficient of fine mode
100-102	50-52	3 I1	10^{-2}	Refractive index of fine mode, based on measurements with optimal viewing geometry
103-105	53-55	3 I1	10^{-2}	Refractive index of coarse mode, based on measurements with optimal viewing geometry
106-109	56-59	4 I1	10^{-2}	Effective radius
110-113	60-63	4 I1	10^{-2}	Effective radius of fine mode

Data record. RB processing line

The data pixel for the BR processing line corresponds to the medium Resolution Grid, described in Appendix B-2. The spatial resolution is about 19 km, i.e. approximately 3x3 Parasol pixels. Note that several orbits may be available for a given pixel and a given day. As a consequence, "Number of days" and "Number of observations" may be different. The period of synthesis is one month.

Position	Param #	Type & Length	Slope & (Interc.)	Content
1-4		I4		Record Number in the file : `2≤RecNum≤Nrec+1`
5-6		I2		Length of this record (bytes): `84`
7-8		I2		Line Num. of the pix. in POLDER medium res. grid
9-10		I2		Col. Num. of the pix. in POLDER medium res. grid
11-12		SI2		Mean pixel altitude from the DEM in the 3x3 super pixel (meters)
13		I1		Land, Water, Mixed indicator[11]
14	1	I1	1	Number of days with Parasol measurements
15-16	2	I2	1	Number of observations (there may be several observation within a single day at high latitudes)
17-18	3	I2	1	Number of observations with snow/ice indicator
19-20	4	I2	1	Number of observations with clear sky
21-22	5	I2	1	Number of observations with cloud presence.
23-24	6	I2	1	Number of cloud optical thickness estimates
25-26	7	I2	1	Number of oxygen pressure estimates
27-28	8	I2	1	Number of Rayleigh pressure estimates.
29-30	9	I2	1	Number of cloud phase estimates
31-32	10	I2	1	Number of water vapor column estimates
33	11	I1	$4\ 10^{-3}$ (0.2)	Monthly mean of the cosine of the solar zenith angle
34-35	12	I2	10^{-4}	Monthly mean of the narrowband[12] Albedo
36	13	I1	$2\ 10^{-3}$	Standard Deviation of the narrowband Albedo
37-38	14	I2	10^{-4}	Monthly Mean Clear Sky narrowband Albedo
39	15	I1	$2\ 10^{-3}$	Standard Dev. of the Clear Sky narrowband Albedo
40	16	I1	$5\ 10^{-3}$	Monthly mean of the Clear Sky narrowband albedo, based on radiative transfer simulations only
41-42	17	I2	10^{-4}	Monthly mean of the shortwave Albedo
43	18	I1	$2\ 10^{-3}$	Standard Deviation of the shortwave Albedo

[11] [0]: 100% water, [10]: >90% water, [50]: mixed, [90]: >90% Land, [100]: 100% Land

[12] The 670 nm channel is used over land surfaces, whereas 870 nm is used over the oceans

44-45	19	I2	10^{-4}	Monthly mean of the Clear Sky shortwave Albedo
46	20	I1	$2\ 10^{-3}$	Standard Deviation of the Clear Sky SW Albedo
47	21	I1	$4\ 10^{-3}$	Monthly mean of the Clear Sky shortwave albedo, based on radiative transfer simulations only
48-49	22	I2	0.1	TOA monthly-mean incoming solar Flux [$W.m^{-2}$]
50-51	23	I2	0.1	TOA monthly-mean reflectedsolar Flux [$W.m^{-2}$]
52-53	24	I2	0.1	Monthly-mean of the clear sky shortwave fluxes [$W.m^{-2}$]
54	25	I1	$5\ 10^{-3}$	Monthly mean cloud cover
55	26	I1	$5\ 10^{-3}$	Standard Deviation of cloud cover estimates
56	27	I1	1/15	CN_+ : Fraction of observations classified from "uncertain" to "cloudy" CN_-: Fraction of observations classified from "uncertain" to "clear" Four bit each: One byte contains 16 CN_+ + CN_-
57	28	I1	0.03	Monthly mean water vapor column [$g\ cm^{-2}$]
58	29	I1	0.03	Std. deviation water vapor column [$g\ cm^{-2}$]
59	30	I1	5	Cloud pressure based on oxygen channels (monthly mean weighted by cloud cover) [hPa]
60	31	I1	5	Standard Deviation of Oxygen Cloud pressure [hPa]
61	32	I1	5	Cloud pressure based on Rayleigh method (monthly mean weighted by cloud cover) [hPa]
62	33	I1	5	Std. deviation of Rayleigh cloud pressure [hPa]
63-64	34	I2	0.01	Mean cloud optical thickness
65	35	I1	0.4	Relative Std. Dev. of cloud optical thickness [%]
66-67	36	I2	0.01	Mean cloud optical thick., liquid phase occurences
68-69	37	I2	0.01	Mean cloud optical thick., ice phase occurences
70-71	38	I2	0.01	Mean cloud optical thick., mixed phase occurences
72	39	I1	0.004	Mean Spherical Albedo
73	40	I1	0.004	Standard deviation on spherical albedo
74-77	41	4 I1	0.004	Relative frequency of phase [%][13].. Bins are "Succesfull estimate", "Liquid", "Ice" and "Mixed"
78-84	42	7 I1	0.004	Relative frequency of ice cristal shapes [%]

[13] Note that the percentage of Liquid, Ice and Mixed are computed over succesfull estimate cases (their sum is 100)

Acronymes

ADEOS	Advanced Earth Observing Satellite
CCD	Charge Coupled Device
CESBIO	Centre d'Etudes Spatiales de la Biosphère
CNES	Centre National d'Etudes Spatiales
DEM	Digital Elevation Model
ERBE	Earth Radiation Budget Experiment
ISCCP	International Satellite Cloud Climatology Project
LERTS	Laboratoire d'Etudes et de Recherche en Télédétection Spatiale
LIA	Long Integration Acquisition
LOA	Laboratoire d'Optique Atmosphérique
LMCE	Laboratoire de Modélisation du Climat et de l'Environnement
LMD	Laboratoire de Météorologie Dynamique
LPCM	Laboratoire de Physique et Chimie Marines
NDVI	Normalized Difference Vegetation Index
NRE	Normalized Radiant Exitence
NWM	Numerical Weather Model
NASDA	National Space Development Agency of Japan
POLDER	Polarization and Directionality of the Earth Reflectances
SIA	Short Integration Acquisition
TOA	Top of the Atmosphere
TOMS	Total Ozone Mapping Spectrometer
UT	Universal Time

Appendix A : Product identification

A standard Parasol/POLDER product identificator (15 characters) takes the form :

`PwLxTyGzcccooov` (Browse, level 1 or level 2)

`PwLxTyGzaammddv` (level 3)

where `w` is the instrument number (1 for POLDER-1 on ADEOS-1, 2 for POLDER-2 on ADEOS-2, 3 for Parasol)

`x` indicates the product level (1, 2, 3, or 1 for the Browse product)

`y` indicates the product thematic (B (as Basic) for level 1 and Browse products, R (as Radiation and clouds) L (as Land surfaces) or O (as Ocean Color) for Level 2 and 3 products)

`z` is a code for product type (see table below)

`ccc` is the satellite cycle number ($1 \le ccc \le 999$)

`ooo` is the orbit number in the cycle($1 \le ooo \le 585$ for POLDER-1; 057 for POLDER-2, 233 for Parasol)

`aammdd` is the reference date for the temporal synthesis (year-month-day)

`v` indicates the reprocessing number (from `A` to `Z`)

Level	Thematic	Product Type	x	y	z	Grid
Browse			1	B	B	
1			1	B	1	Full
2	Clouds & Rad. Budget		2	R	B	Medium
	Ocean & Atm.	Directional parameters (surface)	2	O	A	Full
		Non-Directional param. (surface)	2	O	B	Full
		Aerosols parameters	2	O	C	Medium
	Land & Atm.	Directional parameters (surface)	2	L	A	Full
		Aerosols parameters	2	L	C	Medium
3	Clouds & Rad. Budget	Synthesis	3	R	B	Medium
	Ocean & Atm.	Marine parameters	3	O	B	Full
		Aerosol parameters	3	O	C	Medium
	Land & Atm.	Directional signature param (surf.)	3	L	A	Full
		Albedo & Vegetation parameters	3	L	B	Full
		Atmospheric parameters	3	L	C	Medium

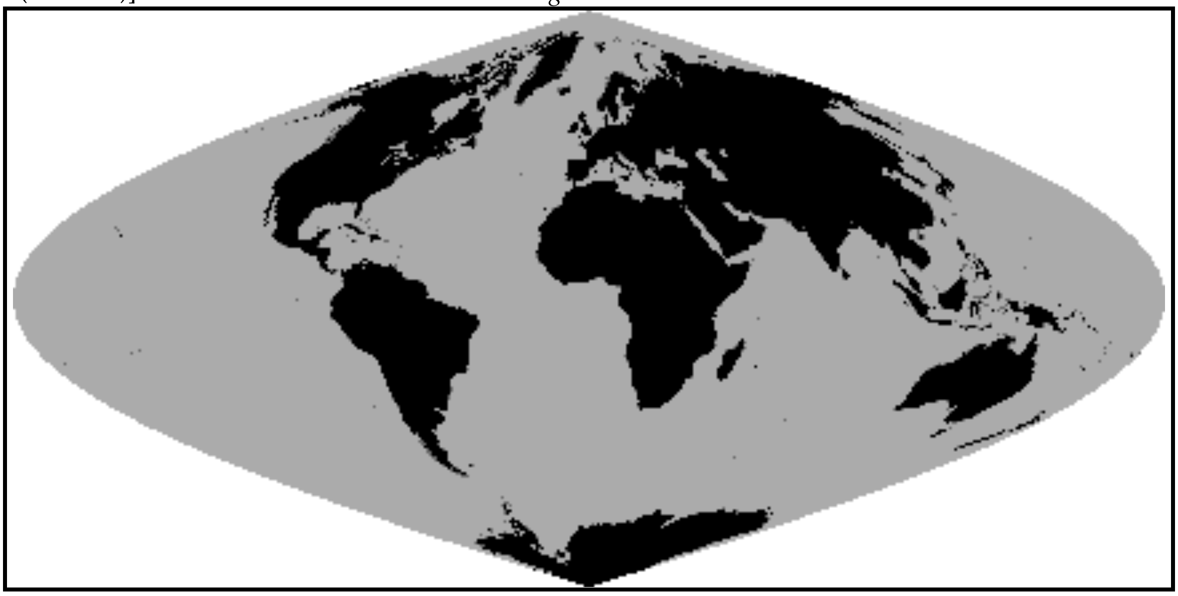
A product consists of two files. A *leader file* and a *data file*. The *leader file* filename takes the form aaaL where aaa is the product identificator (15 characters). Similarly, the *data file* filename is aaaD.

In the table above, the last column indicates the resolution of the grid used for the corresponding product (See the following appendices).

Appendix B-1 : POLDER Full resolution reference grid

The POLDER/Parasol Full resolution grid is used for level 1 products as well as surface parameters of the level 2 and 3 products.

The POLDER/Parasol reference grid is based on the sinusoidal equal area projection (Sanson-Flamsted). The step is constant along a meridian with a resolution of 1/18 degrees. Thus, there are 180x18 = 3240 lines from pole to pole. Along a parallel, the step is chosen in order to have a resolution as constant as possible. The number of pixels from 180 W to 180 E is chosen equal to 2 x NINT[3240 cos(latitude)] where NINT stands for *nearest integer*.



`lin` is 1 to 3240 from top to bottom

`col` is 1 to 6480 from left to right

Note that, in the real world, the coordinates of the neighbours of a given pixel (*lin* , *col*) are ***not*** necessarily given by (*lin* ± 1 , *col* ± 1). It is necessary to account for the deformation of the projection with the longitude.

The following equations yield the latitude and longitude of a pixel given by its (lin,col) coordinates in the POLDER reference grid :

$$lat = 90 - \frac{lin - 0.5}{18}$$

$$N_i = \mathrm{NINT}[3240 \cos(lat)]$$

$$lon = \frac{180}{N_i}\left(col - 3240.5\right)$$

The following equations yield the (lin,col) coordinates in the POLDER reference grid for a pixel of given latitude and longitude :

$$lin = \mathrm{NINT}[18(90 - lat) + 0.5]$$

$$N_i = \mathrm{NINT}[3240 \sin(\frac{lin - 0.5}{18})]$$
$$col = \mathrm{NINT}[3240.5 + \frac{N_i}{180} lon]$$

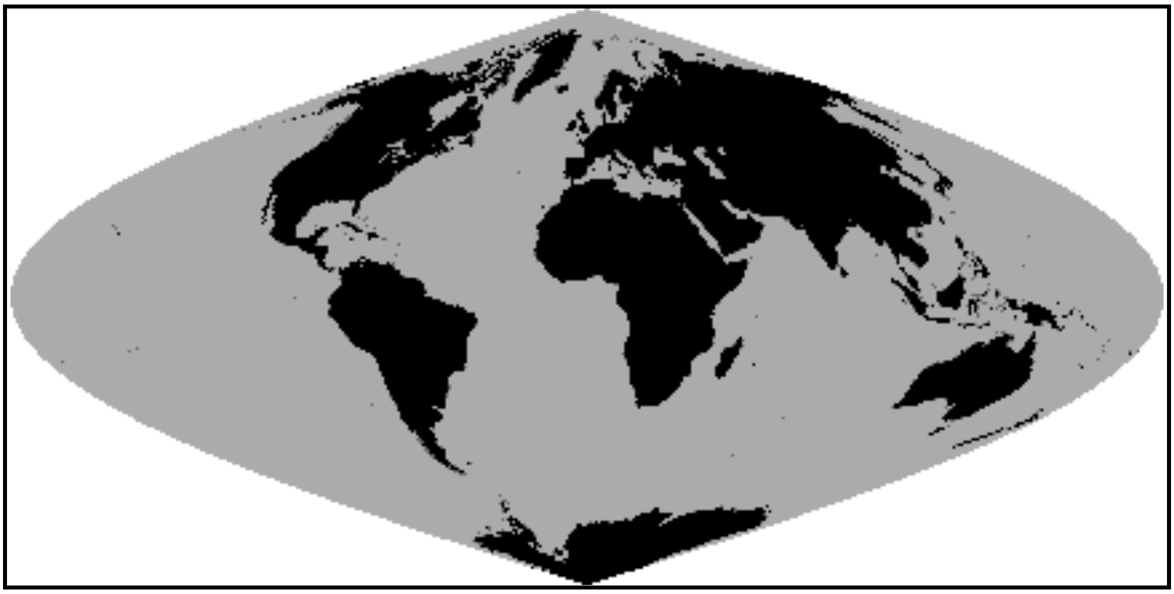
This POLDER reference grid is centered on the Greenwich meridian. For the extraction and visualisation of POLDER data close to the 180° longitude line, it may be easier to work with a similar grid centered on this meridian. A simple formula allows to switch from one (lin,col) coordinate system to the other (lin',col') :

$$lin' = lin$$
$$N_i \quad \mathrm{NINT}[3240 \sin(\frac{lin - 0.5}{18})]$$
$$col' = 3241 - N_i + \mathrm{MOD}_{2N_i}(col + 2N_i - 3241)$$

where MOD_{2N_i} returns the remainder of the integer division by $2N_i$.

Appendix B-2 : POLDER Medium resolution reference grid

The POLDER/Parasol Medium resolution grid is used for level 2 and 3 atmospheric products such as aerosol and water vapor. It is similar to the Full resolution grid, albeit with a resolution reduced by a factor of 3.



`lin` is 1 to 1080 from top to bottom

`col` is 1 to 2160 from left to right

The following equations yield the latitude and longitude of a pixel given by its (lin,col) coordinates in the POLDER/Parasol reference grid :

$$lat = 90 - \frac{lin - 0.5}{6}$$

$$N_i = \mathrm{NINT}[1080\cos(lat)]$$

$$lon = \frac{180}{N_i}(col - 1080.5)$$

The following equations yield the (lin,col) coordinates in the POLDER reference grid for a pixel of given latitude and longitude :

$$col = \mathrm{NINT}[1080.5 + \frac{N_i}{180} lon]$$

Appendix C : Pixel confidence data, Level-3 “Land” products

C1 : Surface parameters (used for both “Directional Signature Parameters” and “Albedo and Vegetation parameters”)

16 bytes are used for this Data Quality Index. In the table below, bit 1 is the most significative, and bit 128 is the least significative.

bit	Condition / parameter
01 - 14	Spare
15 - 22	Number of available LAI estimates during the month
23 - 30	Number of LAI estimates kept after consistency analysis
31 - 32	The distribution of LAI estimates is consistant (single mode in distribution). [0,0]:Yes (favourable case); [0,1]: No (degraded case); [1,1] Not significant (too few values)
33 - 34	Spare
35 - 40	Measurement-BRDF model correlation (R^2) at 490 nm. 64 levels. [0 :50] : R^2=0.01*CN+0.5 CN=63 is “undefined”.
41 - 46	Same for 565 nm
47 - 52	Same for 670 nm
53 - 58	Same for 765 nm
59 - 64	Same for 865 nm
65 - 66	Spare
67-72	RMS error after BRDF model fit for λ = 490 nm. 64 levels. [0 :62] : RMS = 0.00125*CN. CN=63 is reserved to “undefined”.
73 - 78	Same for 565 nm
79 - 84	Same for 670 nm
85 - 90	Same for 765 nm
91 - 96	Same for 865 nm
97	Spare
98 - 104	Number of Level-2 swaths inputs of Level-3 process line (minimum of the five spectral bands)
105 - 106	Snow cover : [0,1]: No snow, [1,0]: Snow; [0,0]:Mixed; [1,1] : Unknown
107 - 108	Snow variation : [0,0] : Stable, [0,1] : Increasing; [1,0] :Decreasing; [1,1] : Unknown
109 - 116	Number of Level-2 swaths rejected by the cloud detection filter
117 - 118	Cloud filter type: [0,0]: nominal; [0,1]: statistical; [1,1]: none
119 - 120	At least one measurement in central decade for monthly composite [0,0]: yes; [0,1]: no; [1,1] : unknown
121 - 128	Number of swaths after cloud filter available for BRDF model inversion

C2 : Atmospheric parameters

8 bits are used for this Data Quality Index. In the table below, bit 1 is the least significative, and bit 8 is the most significative. The bit is set to 1 when the condition is true

pos.	Condition
01	Less than 4 valid observation during the month.
02	Spare
03	At least one decade with no observations
04-08	Spare