

Ocean Color Level-2 Browse Products

1.0 Introduction

This document describes the specifications of Ocean Color Level-2 browse products which are produced and distributed by the NASA Goddard Space Flight Center's Ocean Color Data Processing System (OCDPS). The products are implemented in the Hierarchical Data Format (HDF), and HDF terminology is used in this document.

These specifications are given in terms of the logical implementation of the products in HDF and are not a physical description of file contents. Therefore, HDF software must be used to create or read these products.

A Level-2 browse product is generated from a corresponding Level-2 product. The main data contents of the product are a subsampled version of the chlorophyll *a* image stored as one byte per pixel. Each Level-2 browse product corresponds exactly in geographical coverage (scan-line and pixel extent) to that of its parent Level-2 product and is stored in one physical HDF file.

2.0 Naming Convention

The form of a Level-2 browse file name is `iyyydddhhmmss.L2_ccc_BRS`, where *i* is the instrument identifier (S for SeaWiFS, A for MODIS/Aqua, O for OCTS), `yyydddhhmmss` are the GMT year, day of the year, hours, minutes, and seconds of the first scan line, and `ccc` is the coverage: GAC for Global Area Coverage (i.e., subsampled image data), LAC for Local Area Coverage (full-resolution data), `Hxxx` for HRPT direct-broadcast (where `xxx` is a station identifier, e.g., HNSG for the NASA SeaWiFS station), or MLAC for merged LAC (multiple scenes from a single orbit merged into a single product). Examples of browse file names are:

<code>S1998001180514.L2_GAC_BRS</code>	SeaWiFS GAC (4 km subsampled)
<code>A2004032163500.L2_LAC_BRS</code>	MODIS/Aqua LAC (1 km)
<code>O1997001130032.L2_GAC_BRS</code>	OCTS GAC (4 km subsampled)

3.0 Global Attributes

For global attributes that have constant values specific to this product type, the actual value is given.

3.1 Mission and Documentation

This section lists attributes which are common to all sensors, followed by sensor-specific attributes.

3.1.1 Common Attributes

Product Name (character): the name of the product file (without path).

Title (character): "SeaWiFS Level-2 Browse Data", "MODISA Level-2 Browse Data" or "OCTS Level-2 Browse Data".

Legend (character): Description of the product, for use as a label..

Sensor Name (character): "SeaWiFS", "MODISA" or "OCTS".

Replacement Flag (character): "ORIGINAL" if this is the first version of this product delivered to the DAAC; otherwise, it is set to the name of the product to be replaced (superseded) by the present product.

Software Name (character): "l2brsgen"; name of the software used to create this product.

Software Version (character): version of the software used to create this product.

Processing Time (character): local time of generation of this product; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDHMMSSFFF.

Processing Control (character): path and name of the file containing the control parameters. This information is stored in the product as part of its processing history.

Input Parameters (character): all input and processing control parameters used by the calling program to generate the product. Vertical bars or carriage return characters serve as parameter information delimiters. This information is stored in the product as part of its processing history.

Input Files (character): the names of the Level-1A or Level-1B file (without path; always listed first) from which the current product was created and of the ancillary (environmental) data files (without paths, each separated by one comma) used in the processing. This information is stored in the product as part of its processing history.

3.1.2 SeaWiFS-Specific Attributes

Data Center (character): "NASA/GSFC SeaWiFS Data Processing Center".

Station Name (character): "Wallops Flight Facility".

Station Latitude (4-byte real): 37.9272.

Station Longitude (4-byte real): -75.4753.

Mission (character): "SeaStar SeaWiFS".

Mission Characteristics (character): "Nominal orbit: inclination = 98.2 (Sun-synchronous); node = 12 noon local (descending); eccentricity = <0.002; altitude = 705 km; ground speed = 6.75 km/sec".

Sensor (character): "Sea-viewing Wide Field-of-view Sensor (SeaWiFS)".

Sensor Characteristics (character): "Number of bands = 8; number of active bands = 8; wavelengths per band (nm) = 412, 443, 490, 510, 555, 670, 765, 865; bits per pixel = 10; instantaneous field-of-view = 1.5835 mrad; pixels per scan = 1285; scan rate = 6/sec; sample rate = 7710/sec".

Data Type (character): "GAC", "LAC" or "HRPT"..

3.2 Parent Product Information

The following attributes refer to the parent Level-2 product.

Parent Input Files (character): the names of the Level-1 file (without path) from which the parent product was created and of the ancillary (environmental) data files (without paths, each separated by one comma) used in the processing.

Parent Pixels per Scan Line (4-byte integer): 248.

Parent Number of Scan Lines (4-byte integer): number of scan lines in the scene.

Scene Center Scan Line (4-byte integer): number of the center scan line (1-relative) of the scene, relative to first scan line.

Flag Percentages (4-byte real, array size 32): percentages of pixels in the scene for which a bit in **I2_flags** is set; values corresponds to one of the 32 bits (from lowest to highest) in **I2_flags**.

3.3 Data Time

The values of the following attributes are identical to those of the parent Level-2 GAC product.

Start Time (character): start GMT of the first scan line of the scene; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDDDHHMMSSFFF.

End Time (character): start GMT of the last scan line of the scene; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDDDHHMMSSFFF.

Scene Center Time (character): start GMT of the center scan line of the scene; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDDDHHMMSSFFF.

Node Crossing Time (character): GMT of descending node crossing; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDDDHHMMSSFFF.

Start Year (2-byte integer): GMT year of first scan line of the scene.

Start Day (2-byte integer): GMT day-of-year of first scan line of the scene.

Start Millisec (4-byte integer): GMT milliseconds-of-day of start of the first scan line of the scene.

End Year (2-byte integer): GMT year of last scan line of the scene.

End Day (2-byte integer): GMT day-of-year of last scan line of the scene.

End Millisec (4-byte integer): GMT milliseconds-of-day of start of the last scan line of the scene.

Start Node (character): "Ascending" or "Descending"; describes node direction at the start of the scene.

End Node (character): "Ascending" or "Descending"; describes node direction at the end of the scene.

Orbit Number (4-byte integer): orbit number of the scene.

3.4 Scene Coordinates

The values of the following attributes are identical to those of the parent Level-2 GAC product.

Latitude Units (character): "degrees North"; units used for all latitude values in this product.

Longitude Units (character): "degrees East"; units used for all longitude values in this product.

Scene Center Latitude (4-byte real): latitude of the nadir point of the scene's center scan line.

Scene Center Longitude (4-byte real): longitude of the nadir point of the scene's center scan line.

Scene Center Solar Zenith (4-byte real): solar zenith angle of the nadir point of the scene's center scan line.

Upper Left Latitude (4-byte real): latitude of the upper left scene corner.

Upper Left Longitude (4-byte real): longitude of the upper left scene corner.

Upper Right Latitude (4-byte real): latitude of the upper right scene corner.

Upper Right Longitude (4-byte real): longitude of the upper right scene corner.

Lower Left Latitude (4-byte real): latitude of the lower left scene corner.

Lower Left Longitude (4-byte real): longitude of the lower left scene corner.

Lower Right Latitude (4-byte real): latitude of the lower right scene corner.

Lower Right Longitude (4-byte real): longitude of the lower right scene corner.

Northernmost Latitude (4-byte real): northernmost latitude of all scan line end points.

Southernmost Latitude (4-byte real): southernmost latitude of all scan line end points.

Westernmost Longitude (4-byte real): westernmost longitude of all scan line end points.

Easternmost Longitude (4-byte real): easternmost longitude of all scan line end points.

Start Center Latitude (4-byte real): latitude of center pixel for first scan line.

Start Center Longitude (4-byte real): longitude of center pixel for first scan line.

End Center Latitude (4-byte real): latitude of center pixel for last scan line.

End Center Longitude (4-byte real): longitude of center pixel for last scan line.

Orbit Node Longitude (4-byte real): longitude of scene's orbit descending node (longitude at equatorial crossing of day-side node).

3.5 Browse Image Information

Parameter (character): "Chlorophyll a concentration".

Units (character): "mg m⁻³".

Start Pixel (4-byte integer): the first pixel of each scan line in the parent product used to create this product; values are 1-relative; normally, 1.

LAC Pixel Start Number (4-byte integer): normally, 147; the LAC pixel number corresponding to the first pixel in scan lines of this product.

Pixel Subsampling Rate (4-byte integer): the pixel subsampling rate (starting with **Start Pixel**) used on parent product to create this product; normally, 2.

LAC Pixel Subsampling (4-byte integer): the subsampling rate for the pixels in this product relative to LAC scan lines; equals **Pixel Subsampling Rate** * the parent's **LAC Pixel Subsampling**; normally, 8.

Pixels per Scan Line (4-byte integer): number of pixels per each scan line in this product; equals the integer portion of $((\text{Parent Pixels per Scan Line} - \text{Start Pixel}) / \text{Pixel Subsampling Rate}) + 1$.

Start Scan (4-byte integer): the first scan line in the parent product used to create this product; values are 1-relative; normally, 1.

Scan Subsampling Rate (4-byte integer): the scan-line subsampling rate (starting with **Start Scan**) used on parent product to create this product; normally, 2.

Number of Scan Lines (4-byte integer): number of scan lines in this product; equals the integer portion of $((\text{Parent Number of Scan Lines} - \text{Start Scan}) / \text{Scan Subsampling Rate}) + 1$.

Pixel Coordinates (4-byte integer): number of values in **px_ll_first** and **px_ll_last**; normally equals **Pixels per Scan Line**.

Scan Coordinates (4-byte integer): number of values in **sc_ll_first** and **sc_ll_last**; normally equals **Number of Scan Lines**.

Scaling (character): "logarithmic".

Scaling Equation (character): "Base**((Slope*brs_data) + Intercept) = chlorophyll a".

Base (4-byte real): 10.0; used to convert the byte values (0-250) of **brs_data** into mg m^{-3} of chlorophyll a: $\text{Base}^{((\text{Slope} * \text{brs_data}) + \text{Intercept})} = \text{chlorophyll a}$.

Slope (4-byte real): 0.015; used to convert the byte values (0-250) of **brs_data** into mg m^{-3} of chlorophyll a: $\text{Base}^{((\text{Slope} * \text{brs_data}) + \text{Intercept})} = \text{chlorophyll a}$.

Intercept (4-byte real): -2.0; used to convert the byte values (0-250) of **brs_data** into mg m^{-3} of chlorophyll a: $\text{Base}^{((\text{Slope} * \text{brs_data}) + \text{Intercept})} = \text{chlorophyll a}$.

4.0 Data Objects

The following sections describe the data objects which contain the browse image and other data fields in the product.

4.1 Image Data and Coordinates

brs_data (byte, array size **Number of Scan Lines** x **Pixels per Scan Line**): raster image array of chlorophyll a data; may be converted into real values using **Base**, **Slope**, and **Intercept**; has an associated palette (byte, array size 3 x 256) of red, green, and blue weights for each of 256 (0 to 255, respectively) possible **brs_data** byte values. Byte values 251 to 255 in the raster image are reserved to indicate certain conditions (in the order of highest to lowest priority): 255 for pixels in scan lines for which, in the parent Level-2 product, **s_flags** (Vgroup "Scan-Line Attributes") indicates any missing bands or **nflag** (Vgroup "Navigation") indicates invalid navigation, 253 for pixels whose associated **I2_flags** in the parent Level-2 product have the land flag (bit 2) set, 254 for those with the **I2_flags** cloud and ice flag (bit 10) set, 252 for those with the **I2_flags** glint flag (bit 4) set, and 251 if any other **I2_flags** bits used as masks are set.

px_ll_first (4-byte real, array size **Pixel Coordinates** x 2): **long_name** = "Lat/lon of pixels along first scan line".

px_ll_last (4-byte real, array size **Pixel Coordinates** x 2): **long_name** = "Lat/lon of pixels along last scan line".

sc_ll_first (4-byte real, array size **Scan Coordinates** x 2): **long_name** = "Lat/lon of starts of scan lines".

sc_ll_last (4-byte real, array size **Scan Coordinates** x 2): **long_name** = "Lat/lon of ends of scan lines".

4.2 Sensor Tilt (SeaWiFS only)

The following data objects are SDSes belonging to the Vgroup "Sensor Tilt". Attributes of the SDSs are shown in **bold**. Note that values relate to the parent Level-2 GAC data product. In particular, scan-line number values of **tilt_ranges** are those of the parent and must be converted to those of the browse product using **Start Scan** and **Scan Subsampling Rate**.

ntilts (4-byte integer): **long_name** = "Number of scene tilt states".

tilt_flags (2-byte integer, array size 20): **long_name** = "Tilt indicators"; **valid_range** = (-1,3); tilt flags corresponding to each tilt state in the scene; possible values are 0 for nadir tilt, 1 for forward tilt, 2 for aft tilt, and 3 to indicate a changing tilt angle; -1 indicates an unknown state; contains **ntilts** valid values.

tilt_ranges (2-byte integer, array size 20 x 2): **long_name** = "Scan-line number ranges of scene tilt states"; first and last scan line numbers (1-relative) corresponding to each tilt state in the scene; contains **ntilts** valid values.

4.3 Navigation (SeaWiFS only)

The following data objects are SDSes belonging to the Vgroup "Navigation". Attributes of the SDSs are shown in **bold**. See the *SeaWiFS Postlaunch Technical Report Series*, volume 16 for a description of methods used for the operational navigation of SeaWiFS data. The **Number of Scan Lines** dimension corresponds to that of **brs_data**.

orb_vec (4-byte real, array size **Number of Scan Lines** x 3): **long_name** = "Orbit position vector at scan line time"; orbit position vector interpolated to the time of the scan line; **valid_range** = (-7200.,7200.); **units** = "kilometers"; used to determine spacecraft position for geolocation.

sun_ref (4-byte real, array size **Number of Scan Lines** x 3): **long_name** = "Reference Sun vector in ECEF frame"; unit Sun vector in the Earth-centered, Earth-fixed (ECEF) frame; **valid_range** = (-1.,1.); used for computing solar zenith and azimuth angles.

att_ang (4-byte real, array size **Number of Scan Lines** x 3): **long_name** = "Computed yaw, roll, pitch"; **valid_range** = (-180.,180.); relates spacecraft position to orbit reference frame.

sen_mat (4-byte real, array size **Number of Scan Lines** x 3 x 3): **long_name** = "ECEF-to-sensor-frame matrix"; **valid_range** = (-1.,1.); relates sensor scan plane to Earth-fixed reference frame (3x3 matrix, in column-major order).

scan_ell (4-byte real, array size **Number of Scan Lines** x 6): **long_name** = "Scan-track ellipse coefficients"; defines scan-track geometry in sensor frame.

nflag (4-byte integer, array size **Number of Scan Lines** x 8): **long_name** = "Navigation flags"; in the 8-integer array, the integers represent, respectively: navigation failure flag; orbit flag; Sun sensor flag; Earth sensor flag; spacecraft attitude uncertainty flag; time code flag; tilt data flag; and navigation warning flag. All flags may have the value 0 for valid or 1 for invalid. The tilt data flag only may also have the value of 2 to indicate a changing tilt. Note that the failure flag is only to 1 if the orbit flag, time code flag or tilt data flag are set to 1.