Ocean Level-3 Standard Mapped Image Products

1.0   Introduction

This document describes the specifications of Ocean Level-3 binned archive products that are produced and distributed by the NASA Goddard Space Flight Center's Ocean Data Processing System (ODPS). 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. HDF software must be used to create or read these products.

The Level-3 standard mapped image (SMI) products are image representations of binned data products generated from SeaWiFS, MODIS, OCTS or CZCS data. The data object, **l3m_data**, in each SMI product represents an image of the parameter specified by the global attribute **Parameter**. This object is a two-dimensional array of an Equidistant Cylindrical (also known as Platte Carre) projection of the globe. The values can be stored as bytes, 2-byte integers, or 4-byte floats. The first two are scaled real values and may be converted to geophysical values using the global attributes **Scaling**, **Scaling Equation**, **Base**, **Slope**, and **Intercept**.

The standard SMI products are generated from binned data products, one for each of the following geophysical parameters: chlorophyll *a* concentration, angstrom coefficient, normalized water-leaving radiance at each visible wavelength, aerosol optical thickness, epsilon, and diffuse attenuation coefficient at 490 nm. For MODIS, products are generated for sea surface temperature (SST), 4 micron SST (SST4) and nighttime SST (NSST). Thus, each SMI product represents data binned over the period covered by the parent product. The mean is used in each case to obtain the values for the SMI grid points from the binned data products. Each SMI product contains one image of a geophysical parameter and is stored in one physical HDF file.

2.0   Naming Convention

The root file names of SMI products correspond to those of their parent binned data products, indicating the binning periods as part of the names. The first character is the instrument identifier (S for SeaWiFS, A for Aqua MODIS, T for Terra MODIS, O for OCTS, C for CZCS). The file name extensions are of the form L3m_ttt_pppp_r, where ttt represents the binning period length, pppp is a code for the geophysical parameter of the product, and r is the resolution in km (4 or 9). From each binned data product, SMI products are generated with the following parameter codes: CHLO for chlor_a, AWWW for angstrom_WWW, LWWW for nLw_WWW, TWWW for tau_WWW, EPS78 for epsilon, K490 for K_490, SST, SST4 and NSST, where WWW is a sensor-specific band-center wavelength for each parameter (see Table 2). The MODIS product codes have an additional extension of _9 or _4, indicating the geographic resolution (9.2 or 4.7 km).

For the sample SeawiFS binned data product names given in the Ocean Level-3 Binned Product description, the following SMI products would be generated:

day: S1998001.L3m_DAY_CHLO
S1998001.L3m_DAY_A510
S1998001.L3m_DAY_L412
S1998001.L3m_DAY_L443
S1998001.L3m_DAY_L490
S1998001.L3m_DAY_L510
S1998001.L3m_DAY_L555
S1998001.L3m_DAY_L670
S1998001.L3m_DAY_T865
S1998001.L3m_DAY_EPS78
S1998001.L3m_DAY_K490

and similarly for the 8-day, monthly, seasonal and yearly files.

3.0 Global Attributes

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

3.1 Mission and Documentation

This section lists common attributes for 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): "sssss Level-3 Standard Mapped Image", where sssss is "SeaWiFS", "MODISA", "MODIST", "OCTS" or "CZCS".

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

Product Type (character): "day", "8-day", "month", "seasonal" or "year".

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): "smigen"; 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 YYYYDDDHHMMSSFFF.

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 name of the Level-3 binned data product (main file name without path) from which the current product was created. This information is stored in the product as part of its processing history.

L2 Flag Names (character): same as for parent Level-3 binned product.

3.1.2 SeaWiFS-Specific Attributes

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

Station Name (character): data collection site.

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". Note: Pixels per scan, scan rate, and sample rate are given for the sensor; effective rates for GAC data are lower due to subsampling.

3.2 Data Time

Period Start Year (2-byte integer): binning period start year (cf. **Start Year**) of parent product.

Period Start Day (2-byte integer): UTC day-of-year of start of binning period (cf. **Start Day**) of the parent product.

Period End Year (2-byte integer): binning period end year (cf. **End Year**) of the parent product.

Period End Day (2-byte integer): UTC day-of-year of end of binning period (cf. **End Day**) of the parent product.

Start Time (character): data start UTC as read from the parent product; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDDHHMMSSFFF.

End Time (character): data end UTC as read from parent product; concatenated digits for year, day-of-year, hours, minutes, seconds, and fraction of seconds in the format of YYYYDDDHHMMSSFFF.

Start Year (2-byte integer): UTC year of data start from parent product.

Start Day (2-byte integer): UTC day-of-year of data start from parent product.

Start Millisec (4-byte integer): UTC milliseconds-of-day of data start from parent product.

End Year (2-byte integer): UTC year of data end from parent product.

End Day (2-byte integer): UTC day-of-year of data end from parent product.

End Millisec (4-byte integer): UTC milliseconds-of-day of data end from parent product.

Orbit (4-byte integer): number of the orbit crossing 180° longitude closest to equator at the start, from parent product (SeaWiFS only).

Start Orbit (4-byte integer): first orbit that may have contributed data, from parent product (SeaWiFS only).

End Orbit (4-byte integer): last orbit that may have contributed data, from parent product (SeaWiFS only).

3.3   Scene Coordinates

Map Projection (character): "Equidistant Cylindrical".

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.

Northernmost Latitude (4-byte real): 90.0.

Southernmost Latitude (4-byte real): -90.0.

Westernmost Longitude (4-byte real): -180.0.

Easternmost Longitude (4-byte real): 180.0.

Latitude Step (4-byte real): latitudinal distance between lines (180./**Number of Lines**).

Longitude Step (4-byte real): longitudinal distance between columns (360./**Number of Columns**).

SW Point Latitude (4-byte real): latitude of data point for southwesternmost grid cell to indicate location of data center within each grid cell; equals **Southernmost Latitude** + (**Latitude Step**/2.0).

SW Point Longitude (4-byte real): longitude of data point for southwesternmost grid cell to indicate location of data center within each grid cell; equals **Westernmost Longitude** + (**Longitude Step**/2.0).

3.4   Data Description

Data Bins (4-byte integer): number of bins containing data in the parent product.

Number of Lines (4-byte integer): number of points in the vertical (longitudinal) direction.

Number of Columns (4-byte integer): number of points in the horizontal (latitudinal) direction.

Parameter (character): one of "Chlorophyll a concentration", "Angstrom coefficient, WWW to 865 nm", "Normalized water-leaving radiance at WWW nm", "Aerosol optical thickness at WWW nm", "Epsilon of aerosol correction at WWW and WWW nm", "Diffuse attenuation coefficient at 490 nm", or "Sea Surface Temperature"; see Table 2 for values of WWW.

Measure (character): "Mean".

Units (character): "mg m^-3", blank, "mW cm^-2 um^-1 sr^-1", blank, or "m^-1", corresponding, respectively, to the **Parameter** value; see Table 1.

Scaling (character): "logarithmic" or "linear"; see Table 1.

Scaling Equation (character): "Base**((Slope*l3m_data) + Intercept) = Parameter value", if **Scaling** = "logarithmic"; else, "(Slope*l3m_data) + Intercept = Parameter value"; see Table 1.

Base (4-byte real): 10.0, if **Scaling** = "logarithmic"; else, **Base** is not included as a global attribute; used to convert the values of **l3m_data** into geophysical parameters by **Base****((**Slope***l3m_data) + **Intercept**); see Table 1.

Slope (4-byte real): used to convert the values of **l3m_data** into geophysical values by **Base****((**Slope***l3m_data) + **Intercept**), if **Scaling** = "logarithmic", or (**Slope***l3m_data) + **Intercept**, if **Scaling** = "linear"; see Table 1.

Intercept (4-byte real): used to convert the values of **l3m_data** into geophysical values by **Base****((**Slope***l3m_data) + **Intercept**), if **Scaling** = "logarithmic", or (**Slope***l3m_data) + **Intercept**, if **Scaling** = "linear"; see Table 1.

Data Minimum (4-byte real): minimum value of the input data used to generate **l3m_data**.

Data Maximum (4-byte real): maximum value of the input data used to generate **l3m_data**.

Scaled Data Minimum (4-byte real): minimum value allowed by **Slope** and **Intercept**.

Scaled Data Maximum (4-byte real): maximum value allowed by **Slope** and **Intercept**.

4.0   Data Arrays

l3m_data (byte, 2-byte integer or 4-byte float, array size **Number of Lines** x **Number of Columns**): array of **Parameter** data; may be converted into real values using **Base**, **Slope**, and **Intercept**; see Table 7. A **l3m_data** value of 255 (byte), 65535 (integer) or 0.0 (float) is reserved to indicate "no data"; i.e., a bin for this geographic location does not exist in the parent Level-3 binned product.

l3m_qual (byte, array size **Number of Lines** x **Number of Columns**): array of quality levels associated with **Parameter** data (MODIS SST only); values of 0 (best quality) to 2.

Table 1. Summary of Level-3 standard mapped parameter scalings.

Parameter	Type	Approximate Range	Units
chlor_a	$\log_{10}$	0 - 64	mg m^{-3}
angstrom_WWW	linear	-0.5 - 4.6	none
nLw_WWW	linear	0 - 5.1	"mW cm^{-2} um^{-1} sr^{-1}"
tau_WWW	linear	0 - 1.27	none
epsilon	linear	0.85 - 1.23	none
K_490	$\log_{10}$	0 - 6.4	m^{-1}
SST	linear	-2.0 - 45	degrees C

Table 2. Band-center wavelengths by sensor (nm). These are used in the geophysical parameter names that are based on wavelength.

SeaWiFS	MODIS	OCTS	CZCS
412 (1)	412 (1)	412 (1)	
443 (1)	443 (1)	443 (1)	443 (1)
490 (1)	488 (1)	490 (1)	
510 (1), (2)	531 (1), (2)	520 (1), (2)	520 (1), (2)
555 (1)	551 (1)	565 (1)	550 (1)
670 (1)	667 (1)	670 (1)	
865 (3)	869 (3)	865 (3)	670 (3)

(1) Used for **nLw_WWW**
(2) Used for **angstrom_WWW**
(3) Used for **tau_WWW**