

# Ocean Color Level-3 Standard Mapped Image Products

## 1.0 Introduction

This document describes the specifications of Ocean Color Level-3 binned archive 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.

The Level-3 standard mapped image (SMI) products are image representations of binned data products generated from SeaWiFS, MODIS or OCTS data. The data object, **I3m-data**, in each SMI product represents an image of the parameter specified by the global attribute **Parameter**. This object is a byte-valued, two-dimensional array of an Equidistant Cylindrical (also known as Platte Carre) projection of the globe. The byte values are scaled real values and may be converted projected to geophysical values using the global attributes **Scaling**, **Scaling Equation**, **Base**, **Slope**, and **Intercept** (see Table 1).

Five standard SMI products are generated from each binned data product, one for each of the following geophysical parameters: chlorophyll *a* concentration, angstrom coefficient 510 to 865 nm, normalized water-leaving radiance at 555 nm, aerosol optical thickness at 865 nm, and diffuse attenuation coefficient at 490 nm. For MODIS, a sixth product is generated for sea surface temperature (SST). 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 MODIS/Aqua, O for OCTS). The file name extensions are of the form L3m\_ttt\_pppp, where ttt represents the binning period length and pppp is a code for the geophysical parameter of the product. From each binned data product, five SMI products are generated with the following parameter codes: CHLO for chlor\_ *a*, A510 for angstrom\_WWW, L555 for nLw\_WWW, T865 for tau\_WWW, and K490 for K\_490, where WWW is a sensor-specific band-center wavelength for each parameter (see Table 2).

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

day:	S1998001.L3m_DAY_CHLO
	S1998001.L3m_DAY_A510
	S1998001.L3m_DAY_L555

	S1998001.L3m_DAY_T865
	S1998001.L3m_DAY_K490
8-day:	S19980171998024.L3m_8D_CHLO
	S19980171998024.L3m_8D_A510
	S19980171998024.L3m_8D_L555
	S19980171998024.L3m_8D_T865
	S19980171998024.L3m_8D_K490
month:	S19980321998060.L3m_MO_CHLO
	S19980321998060.L3m_MO_A510
	S19980321998060.L3m_MO_L555
	S19980321998060.L3m_MO_T865
	S19980321998060.L3m_MO_K490
year:	S19980011998365.L3m_YR_CHLO
	S19980011998365.L3m_YR_A510
	S19980011998365.L3m_YR_L555
	S19980011998365.L3m_YR_T865
	S19980011998365.L3m_YR_K490

### 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", or "OCTS".

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

**Product Type** (character): "day", "8-day", "month", 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

YYYYDDDDHHMMSSFFF.

**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): "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". 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 the parent product.

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

**Start Time** (character): data start GMT 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 GMT 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): GMT year of data start from parent product.

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

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

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

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

**End Millisec** (4-byte integer): GMT 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.

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

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

### 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; equals  $(180./\mathbf{Number\ of\ Lines})$ .

**Longitude Step** (4-byte real): longitudinal distance between columns equals  $(360./\mathbf{Number\ of\ Columns})$ .

**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  $\mathbf{Southernmost\ Latitude} + (\mathbf{Latitude\ Step}/2.0)$ .

**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  $\mathbf{Westernmost\ Longitude} + (\mathbf{Longitude\ Step}/2.0)$ .

### 3.4 Data Description

**Data Bins** (4-byte integer): number of bins containing data in the parent product; ranges from 1 to a maximum of 5,940,422.

**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", "Diffuse attenuation coefficient at 490 nm", or "Sea Surface Temperature"; see Table 2 for definitions of WWW.

**Measure** (character): "Mean".

**Units** (character): "mg m<sup>-3</sup>", blank, "mW cm<sup>-2</sup> um<sup>-1</sup> sr<sup>-1</sup>", blank, or "m<sup>-1</sup>", corresponding, respectively, to the **Parameter** value.

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

**Scaling Equation** (character): "Base<sup>\*\*</sup>((Slope\*I3m\_data) + Intercept) = Parameter value", if **Scaling** = "logarithmic"; else, "(Slope\*I3m\_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 byte values (0-255) of **I3m\_data** into geophysical parameters by  $\mathbf{Base}^{**}((\mathbf{Slope}*\mathbf{I3m\_data}) + \mathbf{Intercept})$ ; see Table 17.

**Slope** (4-byte real): used to convert the byte values (0-255) of **I3m\_data** into geophysical values by  $\mathbf{Base}^{**}((\mathbf{Slope}*\mathbf{I3m\_data}) + \mathbf{Intercept})$ , if **Scaling** = "logarithmic", or  $(\mathbf{Slope}*\mathbf{I3m\_data}) + \mathbf{Intercept}$ , if **Scaling** = "linear"; see Table 1.

**Intercept** (4-byte real): used to convert the byte values (0-255) of **I3m\_data** into geophysical values by  $\mathbf{Base}^{**}((\mathbf{Slope}*\mathbf{I3m\_data}) + \mathbf{Intercept})$ , if **Scaling** = "logarithmic", or

(**Slope**\***I3m\_data**) + **Intercept**, if **Scaling** = "linear"; see Table 1.

**Data Minimum** (4-byte real): minimum value of the input data used to generate **I3m\_data**.

**Data Maximum** (4-byte real): maximum value of the input data used to generate **I3m\_data**.

#### 4.0 SDS and Palette Arrays

**I3m\_data** (byte, array size **Number of Lines** x **Number of Columns**): array of chlorophyll *a* data; may be converted into real values using **Base**, **Slope**, and **Intercept**; see Table 7. A **I3m\_data** value of 255 is reserved to indicate "no data"; i.e., a bin for this geographic location does not exist in the parent Level-3 binned product.

**palette** (byte, array size 3 x 256): red, green, and blue weights for each of 256 (0 to 255, respectively) possible **I3m\_data** byte values.

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

Parameter	Type	Slope	Intercept	Approximate Range	Units
chlor_a	log <sub>10</sub>	0.015	-2.0	0 - 64	mg m <sup>-3</sup>
angstrom_WWW	linear	0.02	-0.5	-0.5 - 4.6	none
nLw_WWW	linear	0.02	0	0 - 5.1	"mW cm <sup>-2</sup> um <sup>-1</sup> sr <sup>-1</sup> "
tau_WWW	linear	0.005	0	0 - 1.27	none
K_490	log <sub>10</sub>	0.011	-2.0	0 - 6.4	m <sup>-1</sup>
SST	linear	0.15	-2.0	-2.0 - 36	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
510 (2)	531 (2)	520 (2)
555 (1)	551 (1)	565 (1)
865 (3)	869 (3)	865 (3)

(1) Used for **nLw\_WWW**

(2) Used for **angstrom\_WWW**

(3) Used for **tau\_WWW**