Ocean Science Data Product Format Specification

November 2017

1.0 Introduction

This document describes the specifications of the NASA Ocean Level-2 and Level-3 archive products. These products are produced by the NASA Goddard Space Flight Center's Ocean Data Processing System (ODPS) and distributed by the Ocean Biology Distributed Active Archive Center (OB.DAAC). The official archive and distribution center for the Aquarius data products is the Physical Oceanography DAAC (PO.DAAC).

The products are implemented in the Network Common Data Format Version 4 (NetCDF4), and NetCDF terminology is used in this document. These specifications are given in terms of the logical implementation of the products in NetCDF and are not a physical description of file contents. The format is also compatible with the Hierarchical Data Format Version 5 (HDF5). Therefore, NetCDF4 or HDF5 software can be used to read these products.

User support for the NASA ocean products is available at the Ocean Color Forum:

http://oceancolor.gsfc.nasa.gov/forum/oceancolor/forum_show.pl

2.0 References

1. EOS Data Products Handbook, ed. M.D. King, et al, NASA/GSFC, 2003.
2. NASA Goddard Space Flight Center Ocean Data Processing System Operations, Project Data and Software Management Plan (OPDSMP), September 2017
3. https://oceancolor.gsfc.nasa.gov/atbd/ocl2flags/
4. Aquarius Level-2 Data Product Format Specification, November 2017.
5. Ocean Level-3 Binned Data Products, 2010.

3.0 Sensors and Naming Conventions

The ODPS supports Level-2 and Level-3 data products for the following past, present and future missions and sensors, listed in chronological order by data acquisition start date.

- Nimbus-7 Coastal Zone Color Scanner (CZCS)
- Advanced Earth Observing Satellite (ADEOS) Ocean Color and Temperature Scanner (OCTS)
- OrbView-2 (OV-2) Sea-viewing Wide Field-of-view Sensor (SeaWiFS)
- Terra Moderate Resolution Imaging Spectroradiometer (MODIS) and Aqua MODIS
- Envisat Medium Resolution Imaging Spectrometer (MERIS)
- Satelite de Aplicaciones Científicas D (SAC-D) Aquarius
- Suomi National Polar-orbiting Partnership (SNPP) and Joint Polar Satellite System (JPSS) Visible and Infrared Imager Radiometer Suite (VIIRS)

Each mission and sensor is summarized in Reference 2. For Aquarius, this document describes only the Level-3 mapped product formats; the Aquarius Level-2 products are described in Reference 4, and the Level-3 binned products in Reference 5.

The naming convention for Level-2 products is **iyyyydddhhmmss.L2_ppp.nc**, where: **i** is the instrument identifier (S for SeaWiFS, A for Aqua MODIS, T for Terra MODIS, O for OCTS, C for CZCS, M for MERIS, Q for Aquarius and V for VIIRS); **yyyydddhhmmss** are the UTC year, day of the year, hours, minutes, and seconds of the first data line: and **ppp** is the product identifier. The last field consists of one or more strings separated by underscores, including the product suite and other optional subfield such as the resolution or mission.

The convention for Level-3 binned data products is **iyyyydddyyyyddd.L3b_ttt.nc**, where **i** is the instrument identifier, **yyyydddyyyyddd** are the concatenated digits for the GMT year and day of the year of the start and end days of the binning period, and **ttt** is a code for the binning period length and product suite. Binning period codes are DAY, 8D, MO, and YR. For daily products, only one year and day of the data are used; i.e., **yyyyddd**. Note that the "day of the year" represents the dataday.

The convention for Level-3 mapped data products is **iyyyydddyyyyddd.L3m_ttt.nc**, following the same overall convention as for the Level-3 binned products. For the mapped products, **ttt** includes the binning period length, product suite, geophysical parameter and map resolution.

4.0 Data Product Formats

The following sections summarize the format of the Ocean Level-2 and Level-3 science data products, including the product granule-level and object-level metadata, the data object dimensions, and the structure and content of each data product. All data object, attribute and dimension names are shown in bold type.

4.1 Metadata

The metadata for the ocean data products are stored as NetCDF4/HDF5 attributes. The granule-level metadata are stored as attributes at the file level, while the object-level metadata are stored using attributes attached to the individual data objects.

Table 1 lists all of the granule-level metadata for the ocean data products. Not all metadata are stored in all data products, and the table indicates for which of the data objects each attribute is stored. In a few cases, metadata are duplicated in multiple attributes to meet specific system needs or maintain data continuity with heritage sensors.

Table 1 – Ocean data product granule-level metadata

Attribute Name	Example	Usage		
		L2	L3B	L3M
title	"VIIRS Level-2 Data"	X	X	X
platform	"Suomi NPP"	X	X	X
project	"Ocean Biology Processing Group (NASA/GSFC/OBPG)"	X	X	X
product_name	"V2013081085000.L1A_SNPP.nc"	X	X	X
id	"A2017283.L3b_DAY_RRS.nc/L3/ A2017283.L3b_DAY_RRS.nc"	X	X	X
instrument	"VIIRS"	X	X	X
Conventions	"CF-1.6"	X	X	X
Metadata_Conventions	"Unidata Dataset Discovery v1.0"	X	X	X
institution	"NASA Goddard Space Flight Center"	X	X	X
license	"http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/"	X	X	X
naming_authority	"gov.nasa.gsfc.sci.oceandata"	X	X	X
keywords_vocabulary	"NASA Global Change Master Directory (GCMD) Science Keywords"	X	X	X
keywords	"Oceans > Ocean Chemistry > Chlorophyll"	X		
standard_name_vocabulary	"NetCDF Climate and Forecast (CF) Metadata Convention"	X	X	X
creator_name	"NASA/GSFC"	X	X	X
creator_email	"MODAPSUSO@lists.nasa.gov"	X	X	X
creator_url	"http://laadsweb.nascom.nasa.gov"	X	X	X
date_created	"2013-12-03T21:17:31Z"	X	X	X
_lastModified	"2013-12-03T21:17:31Z"			X
publisher_name	"NASA/GSFC"	X	X	X
publisher_email	"MODAPSUSO@lists.nasa.gov"	X	X	X
publisher_url	"http://laadsweb.nascom.nasa.gov"	X	X	X
identifier_product_doi_authority	"http://dx.doi.org"	X	X	X
identifier_product_doi	"10.5067/AQUA/MODIS_OC.2014.0"	X	X	X
cdm_data_type	"swath"	X	X	X
processing_level	"L2"	X	X	X
processing_version	"2014.0"		X	X

history	Free text	X	X	X
time_coverage_start	"2013-03-21T08:48:00Z"	X	X	X
time_coverage_end	"2013-03-21T08:54:00Z"	X	X	X
temporal_range	“day”		X	X
spatialResolution	“1 km”			
start_center_longitude	-65.72161	X		
start_center_latitude	28.95987	X		
end_center_longitude	-71.26584	X		
end_center_latitude	46.98666	X		
latitude_units	“degrees_north”			X
longitude_units	“degrees_east”			X
northernmost_latitude	48.18504	X		
southernmost_latitude	26.73072	X		
easternmost_longitude	-53.78212	X		
westernmost_longitude	-85.54134	X		
geospatial_lat_units	“degrees_north”	X	X	X
geospatial_lon_units	“degrees_east”	X	X	X
geospatial_lat_max	48.18504	X	X	X
geospatial_lat_min	26.73072	X	X	X
geospatial_lon_max	-53.78212	X	X	X
geospatial_lon_min	-85.54134	X	X	X
geospatial_lon_resolution	0.041666667		X	
geospatial_lat_resolution	0.041666667		X	
orbit_number	12345	X		
start_orbit_number	12345		X	X
end_orbit_number	12356		X	X
equatorCrossingDateTime	"2013-03-21T08:51:023.456Z"	X		
startDirection	“Ascending”	X		
endDirection	“Ascending”	X		
day_night_flag	“Day”	X		
earth_sun_distance_correction	1.015935	X		
data_bins	1502610		X	X
percent_data_bins	15.789		X	
units	“Rrs_412:sr^-1,Rrs_443:sr^-1,…”		X	
binning_scheme	"Integerized Sinusoidal Grid"		X	
map_projection	"Equidistant Cylindrical"			X
grid_mapping_name	"latitude_longitude"			X
latitude_step	0.08333334			X
longitude_step	0.08333334			X
sw_point_latitude	89.95834			X
sw_point_longitude	179.9583			X
number_of_lines	2160			X
number_of_columns	4320			X
measure	“Mean”			X
data_minimum	0.0			X
data_maximum	.048			X
suggested_image_scaling_minimum	0.0			X
suggested_image_scaling_maximum	0.2			X
suggested_image_scaling_type	“LINEAR”			X
suggested_image_scaling_applied	“No”			X

Table 2 lists the object-level metadata that are used according to the CF metadata convention. They are stored in the data products as attributes attached to the data objects, and are used as appropriate. For example, the “units” attribute is only used for data objects which have defined units; the “scale_factor” and “add_offset” attributes are used for data which are computed as floating point values but stored as scaled integers; and the “flag_values”, “flag_masks” and “flag_meanings” attributes are used for integer data objects to specify meanings for a limited number of defined values. Other object-level attributes may be added as desired to better describe the data object or for backward compatibility.

Table 2 – Ocean data product standard object-level metadata

Attribute Name	Data Type	Example
long_name	Character	“Scan start time”
units	Character	“seconds”
_FillValue	Object[1]	-999.9
valid_min	Object[1]	0.d0
valid_max	Object[1]	100.d0
scale_factor[2]	Object[1]	1.d0
add_offset[2]	Object[1]	0.d0
flag_values[3]	Object[1]	(1, 2, 3, 4)
flag_masks[4]	Object[1]	(1, 2, 4, 8, 16)
flag_meanings[5]	Character	"ATMFAIL LAND PRODWARN HIGLINT HILT"
standard_name	Character	"mass_concentration_chlorophyll_concentration_in_sea_water"

[1]Same type as the associated data object
[2]Used for real data stored as scaled integers
[3]The flag_values are mutually exclusive.
[4]The flag_masks describe a number of independent Boolean conditions using bit fields. Any number of bits can be set.
[5]Indicates flag meanings for each value of flag_values or flag_masks

The fill value for each data object specified using the “_FillValue” attribute is, as much as possible, set to standard values according to the data object type. The standard fill values for each data type are listed in Table 3. Exceptions are noted for individual data fields. If the entire range of the data type is valid for a data object, no fill value is defined.

Table 3 – Standard fill Values for data object types

Data Type	Fill Value
Byte	-1
Unsigned Byte	255
2-byte Integer	-32767
4-byte Integer	-32767
4-byte Real	-999.9 or -32767.0

4.2 Object Dimensions

NetCDF supports the use of named dimensions to provide dimensions with meanings that are common across data objects. The dimension names and descriptions used in the Ocean Level-2 and 3 data products are presented in Table 4.

Table 4 – Data object dimension names, descriptions and sizes

Dimension Name	Description	Size
number_of_lines	Data lines in swath product	varies
pixels_per_line	Pixels in each data line	Varies
pixel_control_points	Control points per line for subsampled fields (e.g., lat/lon)	Varies
number_of_bands	Number of spectral bands	Varies
number_of_reflective_bands	Number of reflective solar bands	Varies
binListDim	Number of bins containing data in binned product	Varies
binDataDim	Number of bins containing data in binned product	Varies
binIndexDim	Number of rows in binned product	Varies
lat	Latitude rows in map product	varies
lon	Longitude columns in map product	varies
rgb	Red-green-blue color table dimension	3
eightbitcolor	Number of color table values	256

4.3 Common Groups

The Ocean Level-2 and Level-3 products use a common convention for storing information about control and input parameters in the data products. Each data product includes a group **processing_control**, and a sub-group, **input_parameters**, that contain this information. Both groups use NetCDF attributes to store information about the control and input parameters, and do not contain any data objects.

The **processing_control** group contains a high-level summary of the processing run used to generate the product. A list of attribute contained in this group for each products is shown in Table 5. The **input_parameters** sub-group contains the complete list of input parameters used for the processing run, with each parameter stored in a separate string attribute.

Table 5 – Attributes in the processing_control group

Attribute Name	Example	Usage		
		L2	**L3B**	**L3M**
software_name	“l2gen”	X	X	X
software_version	"9.0.2-V2016.4.6"	X	X	X
source	"A2017306174000.L1B_LAC,A2017306174000.GEO,…”	X	X	X
calibration_data	"A2017306174000.L1A_LAC, MYD02_Reflective_LUTs.V6.1.37.6_OC2.hdf,…”	X		
mask_names	"ATMFAIL,LAND,CLDICE,HILT"	X		
l2_flag_names	"ATMFAIL,LAND,HILT,HISATZEN,STRAYLIGHT,CLDICE”		X	X

4.4 Level-2 Data Product

A Level-2 data product is generated from either a Level-1A (e.g., SeaWiFS, OCTS or CZCS) or Level 1B (e.g., MODIS, MERIS, or VIIRS) product. The main data contents of the product are the geophysical values for each pixel, derived from the Level-1 radiance by applying the sensor calibration (for Level-1A), atmospheric corrections, and geophysical parameter algorithms. Each Level-2 product corresponds exactly in geographical coverage (data line and pixel extent) to that of its parent Level-1 product and is stored in one physical NetCDF file.

In addition to the control and input parameter groups described above, a Level-2 data product contains the following groups: **scan_line_attributes**, **sensor_band_parameters**, **geophysical_data**, **navigation_data**, and **flag_percentages**. The data objects in each group are described below.

4.4.1 **scan_line_attributes**

The **scan_line_attributes** group contains the following scan- or line-level data objects.

year (4-byte integer, dimension **number_of_lines**); **long_name** = "Scan year"; year of time for each data line.

day (4-byte integer, dimension **number_of_lines**); **long_name** = "Scan day of year"; day-of-year of time for each data line.

msec (4-byte integer, dimension **number_of_lines**); **long_name** = "Scan-line time, milliseconds of day"; time-of-day in milliseconds for each data line.

detnum (unsigned byte, dimension **number_of_lines**); **long_name** = " Mirror side (zero-based)"; instrument detector number for each data line.

mside (unsigned byte, dimension **number_of_lines**); **long_name** = "Scan-line time, milliseconds of day"; instrument mirror side for each data line.

slat (4-byte real, dimension **number_of_lines**); **long_name** = "Starting Latitude"; latitude of first pixel in each data line.

slon (4-byte real, dimension **number_of_lines**); **long_name** = "Starting Longitude"; longitude of first pixel in each data line.

clat (4-byte real, dimension **number_of_lines**); **long_name** = "Center Latitude"; latitude of center pixel in each data line.

clon (4-byte real, dimension **number_of_lines**); **long_name** = "Center Longitude"; longitude of center pixel in each data line.

elat (4-byte real, dimension **number_of_lines**); **long_name** = "Ending Latitude"; latitude of last pixel in each data line.

elon (4-byte real, dimension **number_of_lines**); **long_name** = "Ending Longitude"; longitude of last pixel in each data line.

csol_z (4-byte real, dimension **number_of_lines**); **long_name** = "Center Solar Zenith Angle"; solar zenith angle for center pixel in each data line.

4.4.2 **sensor_band_parameters**

The **sensor_band_parameters** group is used to store information about the spectral bands represented in each data products.

wavelength (4-byte integer, dimension **number_of_bands**); **long_name** = "Wavelengths"; band center wavelength for each band.

vcal_gain (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Vicarious Calibration Gain".

vcal_offset (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Vicarious Calibration Offset"; calibration offset (if determined) used with **vcal_gain**.

F0 (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Mean Solar Flux"; **units** = "mW cm^-2 um^-1 sr^-1"; mean solar flux for each band.

aw (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Band-pass averaged absorption coefficient for seawater".

bbw (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Band-pass averaged backscattering coefficient for seawater".

k_oz (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Ozone Absorption Coefficient".

k_no2 (4-byte real, dimension **number_of_reflective_bands**); **long_name** = " NO2 Absorption cross-sections ".

Tau_r (4-byte real, dimension **number_of_reflective_bands**); **long_name** = "Rayleigh Optical Thickness".

4.4.3 **geophysical_data**

The **geophysical_data** group contains the retrieved geophysical parameters. A list of parameters included in the archive products is shown in Table 5, along with the data storage type values of the **long_name** attribute. All parameter data objects have dimensions **number_of_lines** x **pixels_per_line**. Most parameters are stored as 2-byte integers, which are scaled according to the attributes **slope** and i**ntercept**, except for those whose dynamic range cannot be supported by a scaled integer.

Parameters that are wavelength-specific (e.g., water-leaving radiance) have separate data objects for each band used to derive the parameter; a list of wavelengths for each sensor is given in Table 6. This section lists those parameters that are stored in the standard archive products. The sea surface temperature (SST) and SST4 are generated only for MODIS and VIIRS, and are stored in separate archive products with their respective quality fields.

The **geophysical_data** group also contains the **l2_flags** data object, a 4-byte integer with the same dimensions as the parameter data objects that stores the quality flag information for each pixel in the data product. This is a bit-mapped field with each bit indicating a mask, algorithm failure or warning condition. The specific meaning of each bit is defined using the **flag_masks** and **flag_meanings** attributes described in Table 2. The criteria used for each flag are described in Reference 3. The uses of the flags as masks in the Level-2 and Level-3 products are specified using the **mask_names** and **l2_flag_names** attributes, respectively, in the **processing-control** group for each product as shown in Table 4.

Table 6. Summary of geophysical parameters

Parameter	Data Type	Long Name
Rrs_WWW	2-byte integer	Remote sensing reflectance at WWW nm
chlor_a	4-byte real	Chlorophyll Concentration, OCI Algorithm
chl_ocx	4-byte real	Chlorophyll Concentration, OC[3,4] Algorithm
Kd_490	2-byte integer	Diffuse attenuation coefficient at 490 nm, KD2 algorithm
aot_WWW	2-byte integer	Aerosol optical thickness at WWW nm
angstrom	2-byte integer	Aerosol Angstrom exponent, 443 to 865 nm
pic	2-byte integer	Calcite Concentration, Balch and Gordon
poc	2-byte integer	Particulate Organic Carbon, D. Stramski, 2007 (443/555 version)
par	2-byte integer	Photosynthetically Available Radiation, R. Frouin
ipar	2-byte integer	Instantaneous Photosynthetically Available Radiation
nflh	2-byte integer	Normalized Fluorescence Line Height
sst	2-byte integer	Sea Surface Temperature
sst4	2-byte integer	4um Sea Surface Temperature
a_WWW_giop	2-byte integer	Total absorption at WWW nm, GIOP model
bb_WWW_giop	2-byte integer	Total backscattering at WWW nm, GIOP model
aph_443_giop	2-byte integer	Absorption due to phytoplankton at 443 nm, GIOP model
aph_unc_443_giop	2-byte integer	Uncertainty in absorption due to phytoplankton at 443 nm, GIOP model
adg_443_giop	4-byte real	Absorption due to gelbstoff and detrital material at 443 nm, GIOP model
adg_unc_443_giop	2-byte integer	Uncertainty in absorption due to gelbstoff and detrital material at 443 nm, GIOP model
adg_s_giop	2-byte integer	Detrital and gelbstoff absorption spectral parameter for GIOP model
bbp_443_giop	4-byte real	Particulate backscattering at 443 nm, GIOP model
bbp_unc_443_giop	2-byte integer	Uncertainty in particulate backscattering at 443 nm, GIOP model
bbp_s_giop	4-byte real	Backscattering spectral parameter for GIOP model
rsdiff_giop	2-byte integer	Fractional mean Rrs difference, GIOP model

Table 7. Band-center wavelengths by sensor (nm). These are used in the geophysical parameter names that are based on wavelength.

SeaWiFS	MODIS	OCTS	CZCS	MERIS	VIIRS
412 (1)	412 (1)	412 (1)		413 (1)	410 (1)
443 (1)	443 (1)	443 (1)	443 (1)	443 (1)	443 (1)
	469 (1),(3)				
490 (1)	488 (1)	490 (1)		490 (1)	486 (1)
510 (1)	531 (1)	520 (1)	520 (1)	510 (1)	
555 (1)	547 (1)	565 (1)	550 (1)	560 (1)	551 (1)
	555 (1),(3)				
	645 (1),(3)			620 (1)	
670 (1)	667 (1)	670 (1)	670 (1),(2)	665 (1)	671 (1)
	678 (1)			681 (1)	
765	748	765	750	754	747
865 (2)	869 (2)	865 (2)		865 (2)	862 (2)

(1) Used for **Rrs_WWW, a_WWW_giop** and **bb_WWW_giop**
(2) Used for **aot_WWW**
(3) Generated from MODIS 250m or 500m data aggregated to 1 km

4.4.4 **navigation_data**

The **navigation_data** group contains the control point data objects **latitude** and **longitude**, used for Level-3 processing and display. This group also contains control point arrays to allow the location fields to be subsampled with respect to the geophysical data.

cntl_pt_cols (4-byte integer, dimension **pixel_control_points**): **long_name** = "Pixel control points"; array of pixel indices corresponding to **latitude** and **longitude** data objects

cntl_pt_rows (4-byte integer, dimension **number_of_lines**): **long_name** = "Scan control points"; array of data line indices corresponding to **latitude** and **longitude** data objects.

longitude (4-byte real, dimensions **number_of_lines, pixel_control_points**): **long_name** = "Longitudes at control points".

latitude (4-byte real, dimensions **number_of_lines, pixel_control_points**): **long_name** = "Latitudes at control points".

tilt (4-byte real, dimension **number_of_lines**): **long_name =** "Tilt angle for data line".

4.4.5 **flag_percentages**

The **flag_percentages** group stores the percent of the data for which each of the quality flags is set, based on the l2_flags data object described in Section 4.4.3. It contains a set of attributes, one for each of the flags defined in the **l2_flags flag_meanings** attribute. Each attribute is named for the flag that it represents and has a value equal to the percent of data flagged.

4.5 Level-3 Binned Data Product

A Level-3 binned data product consists of the accumulated data for all Level-2 products, for the specified instrument and resolution, corresponding to a period of one day, 8 days, a calendar month, or a calendar year. The data are stored in a representation of a global, equal-area grid, with standard bin sizes of either 9.2 or 4.6 km. See the for a summary of the binning algorithm, the specification of the geographical and temporal specifications of the scheme, and the definition of a day with respect to data selected for daily binning — a "dataday." Briefly, a dataday is comprised of a contiguous set of data that spans the geographic range from 180 to -180 degrees of longitude, collected over slightly more than 24 hours. Note that the time range for a nighttime dataday is shifted 12 hours from the corresponding daytime dataday.

A pixel from a parent Level-2 product is excluded from binning if a bit in the parent Level-2 product's **l2_flags** corresponding to the pixel is set (equals 1) and the algorithm name for that bit has been specified to be used for exclusion, as indicated by the **l2_flag_names** attribute in the **processing_control** group.

The time binning step is used to combine bin products over progressively longer time scales. Time binning is used in turn to combine daily products into 8-day and monthly products and monthly bin products into yearly products.

The specific parameter names for each sensor vary according to the spectral bands for the sensor , and follow the same naming convention as the Level-2 products (Tables 6 and 7).

The contents of a Level-3 binned data products are stored in the group **level-3_binned_data**, described in the following subsection.

4.5.1 **level-3_binned_data**

The data in a Level-3 data product are stored in NetCDF *compound data types*. A compound type is a data structure which contains an arbitrary collection of other data types, and is equivalent to a structure as used in various programming languages. A binned data product includes three compound types:

The **binIndexType** contains one record of the following fields for each of the latitudinal bin rows in the geographic binning scheme. This type contains information needed for description of the geographic binning scheme. There is one instance of **binIndexType** named **BinIndex** in the data product, with dimension **binIndexDim**, containing the following fields.

start_num (4-byte integer): bin number of first bin in the grid for each row. This is defined by the equal-area binning scheme.

begin (4-byte integer): bin number of first data-containing bin for each row (cf. **start_num**).

extent (4-byte integer): number of bins actually stored (i.e., containing data) for each row.

max (4-byte integer): the maximum number of bins in the grid for each row; ranges from 3 for the two polar rows to the maximum value for the two equatorial rows.

The **binListType** contains one record of the following fields for each bin in which at least one Level-2 pixel was binned. Records for bins in which no pixels were binned are not included **binListDim**, containing the following fields.

bin_num (4-byte integer): the index number of the bin represented by this record and corresponding records in each of the instances of type **binDataType**.

nobs (2-byte integer): number of observations (pixels) binned in this bin.

nscenes (2-byte integer): number of scenes contributing data (at least one pixel) to this bin.

time_rec (4-byte real): represents the time distribution of the data for this bin.

weights (4-byte real): sum of the weights of the equivalent bins of the input products.

The **binDataType** contains the accumulated geophysical values from the Level-2 products that contributed to the binned data product. There is one instance of this type for each geophysical parameter stored in the data product, and the instances are named using the parameter names listed in Table 6. Each instance of **binDataType** has dimension **binDataDim** and contains the following fields:

sum (4-byte real): weighed sum of binned pixel values for corresponding geophysical parameter; used with **weights** to calculate the weighted mean of the binned values.

sum_sq (4-byte real): weighted sum of squares of binned pixel values for corresponding geophysical parameter; used to calculate standard deviation of binned values.

4.6 Level-3 Mapped Data Product

The Level-3 standard mapped image (SMI) data products are representations of the binned data products described in Section 4.5. Each SMI product normally contains data for a single geophysical parameter, although the format supports multiple parameters. The data object in each SMI product represents a mean of the selected parameter at each grid point of the map projection. This object is a two-dimensional array of an Equidistant Cylindrical (also known as Plate Carrée) projection of the globe. The values can be stored as bytes, 2-byte integers, or 4-byte floats. The first two are scaled from the real values and may be converted to geophysical values using the object-level scaling attributes.

The standard SMI products are generated from binned data products, one for each geophysical parameter stored in the binned products. 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.

The mean values in an SMI product are stored in a two-dimensional data object with the same name as the **binDataType** instances from the input Level-3 product. In addition, each product contains the following data objects that are used to display the geophysical values.

lat (4-byte real, dimension **lat**); **long_name** = "Latitude"; latitude corresponding to the center of each row in the product.

lon (4-byte real, dimension **lon**); **long_name** = "Longitude"; longitude corresponding to the center of each column in the product.

palette (unsigned byte, dimensions **rgb**, **eightbitcolor**); RGB palette for display of data.

The mapped parameters for Aquarius are sea surface salinity (SSS), scatterometer wind speed, density, spiciness, and ancillary SST. The Aquarius SMI data products use the same format with three exceptions:

1. For all products except the monthly SSS, the mean value data objects are named **l3m_data** regardless of the parameter stored in the product, following an earlier SMI product convention. The name of the parameter is contained in the data product file name as described in Section 3.
2. The Aquarius SMI products do not include the **lat** and **lon** data objects.
3. The Aquarius products do not include the **processing_control** group described in Section 4.3