

686-644-23 Rev A

SeaWinds Processing and Analysis Center (SeaPAC)

**Level 3 Data
Software Interface Specification (SIS-2)**

SeaWinds/ADEOS-II Era

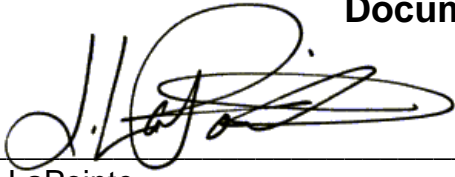
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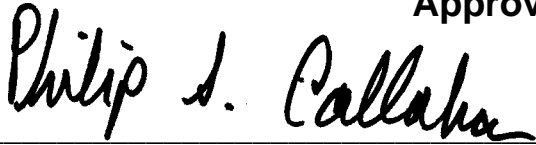
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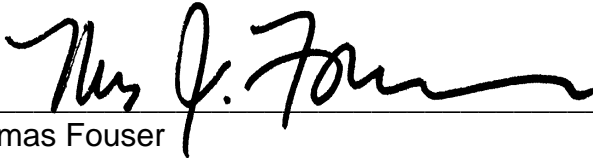
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1 INTRODUCTION

1.1 Identification

This is Version 2 of the Software Interface Specification (SIS-2) for Level 3 data of the SeaWinds Processing and Analysis Center (SeaPAC). This document applies to any Level 3 Product which is based on data acquired by the SeaWinds instrument on the Advanced Earth Observing Satellite II (ADEOS-II) spacecraft.

1.2 Scope

This SIS document describes the file format of the Level 3 Product. Its intent is to elucidate the Level 3 data structure and content for external software interfaces. The SeaWinds Science Data Product User's Manual provides a more comprehensive explanation of these data within the complete context of the SeaWinds instrument, algorithms and software.

1.3 Content Overview

Each SeaWinds Level 3 data file contains one day or less of SeaWinds data. A complete day includes data from all Level 2B wind vector cells (WVCs) whose row time matches the observation date. Level 2B data are rev based. A rev begins and ends at the southernmost orbital latitude, and constitutes one complete revolution of SeaWinds around Earth.

The SeaWinds Level 3 Processor reads SeaWinds Level 2B wind speeds and directions, and generates the Level 3 Product. The SeaWinds Level 3 Processor groups Level 2B WVCs by their location into a rectangular latitude/longitude grid of cells which span the entire globe. Each grid cell is 1/4 degree on each side.

The Level 3 Product further divides a rev into ascending and descending phases. Data acquired when the spacecraft is moving in a Northerly direction are in the ascending phase. Data acquired when the spacecraft is moving in a Southerly direction are in the descending phase. The Level 3 Processor separates the ascending and descending phases of orbit into separate grids.

Occasionally, two or more Level 2B WVCs will be located in the same Level 3 grid cell. In the case where the Level 2B WVCs come from different revs, data from the later rev overwrite data from a previous rev. In the case where the Level 2B WVCs come from the same rev, data from the Level 2B WVC which is closest to the center of the Level 3 grid cell are used. Thus, there is no averaging of quantities in Level 3 grid cells. Because of these data characteristics the values are called "representative". All flags correspond to the data selected for the grid cell.

In addition to wind speeds and directions, the Level 3 Product also grids attenuation correction, time, rain probability, and rain flagging data from the Level 2B Product.

The Level 3 Processor may use wind speed and direction data from one of the following three different sources in the Level 2B Product:

1. Wind speeds and directions based on the Direction Interval Retrieval (DIR) algorithm.
2. Wind speeds and directions based on the selected ambiguity.

3. Wind speeds and directions based on the first ambiguity.

Under nominal conditions, the Level 3 Processor uses wind speeds and directions based on the Direction Interval Retrieval (DIR) algorithm. The metadata element `wind_vector_source` indicates the source of the Level 2B wind vector data that are used for a particular Level 3 Product.

1.4 Related Interfaces

Level 0 Data Software Interface Specification, Project Document 686-644-4, JPL D-nnnnn, TBD.

Level 1A Data Software Interface Specification, Project Document 686-644-5 Rev C, JPL D-20561, October 2003.

Level 1B Data Software Interface Specification, Project Document 686-644-1 Rev C, JPL D-16077, October 2003.

Level 2A Data Software Interface Specification, Project Document 686-644-2 Rev D, JPL D-20563, October 2003.

Level 2B Data Software Interface Specification, Project Document 686-644-3 Rev D, JPL D-16079, October 2003.

AMSR Level 1B Data Software Interface Specification, Project Document 686-644-24 Rev A, JPL D-19146, October 2003.

Processing Tables Software Interface Specification, Project Document 686-644-6 Rev B, JPL D-nnnnn, TBD.

1.5 Applicable Documents

Interface Control Document Between SeaPAC and the Physical Oceanography Distributed Active Archive Center (PO.DAAC) in Support of SeaWinds on ADEOS-II, JPL D-21549, July 2002.

SeaWinds Science Data Product User's Manual and Overview and Geophysical Data Products, JPL D-21551, July 2002.

SeaWinds Experiment Implementation Plan, Volume III: Ground System Technical Management, JPL D-8743, PD 686-010, October 1994.

SeaWinds Experiment Functional Requirements, JPL D-TBD, PD 686-210A, April 1998.

SeaWinds Experiment Science and Mission Requirements, JPL D-10965, PD 686-050, January 1995.

SeaPAC System Functional Requirements, JPL D-23206, PD 686-610, September 2002.

Science Algorithm Specification for SeaWinds on QuikSCAT and SeaWinds on ADEOS-II, Jet Propulsion Laboratory, Pasadena, California, JPL D-21978, PD 686-631, October 2001.

Planetary Science Data Dictionary Document, JPL D-7116, Rev. D, V6 MGSO0099-05-00, July 1996.

Science Data Processing Segment (SDPS) Database Design Schema Specification for the ECS Project, EOS-DIS Core System Project, Hughes Information Technology Systems, Upper Marlboro, Maryland, 311-CD-002-004, December 1995.

Getting Started with HDF, Version 3.2, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, May, 1993.

HDF Reference Manual, Version 4.1r5, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, November 2001.

HDF User's Guide, Version 4.1r5, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, November 2001.

1.6 Conventions

1.6.1 Data Representation

Unless stated otherwise, all data are in binary format. The term byte is synonymous with the ISO term "octet". Appendix B describes byte format in greater detail.

1.6.2 File Organization

All SeaWinds standard products are in the Hierarchical Data Format (HDF). The National Center for Supercomputing Applications (NCSA) at the University of Illinois developed HDF to help scientists share data regardless of the source. HDF can store large varieties of data structures. HDF files are portable to a large number of computing platforms and are equally accessible to routines written either in Fortran or in C. All access to SeaWinds data products should utilize the NCSA HDF interface library routines.

All SeaWinds files are created under the UNIXTM operating system. Since these files are in HDF format, however, these data should be portable to most major computing devices, provided the requisite HDF software tools are available.

Each SeaWinds data product file includes a header. The product header contains multiple metadata elements. The conditions specified by the SeaWinds metadata apply to the entire set of data in the file. The remainder of the file contains either the data that were acquired over the spacecraft measurement swath, or data that were generated by SeaWinds software.

1.6.3 HDF Data Notation

HDF provides flexible models to store file contents. Within each model, HDF classifies data elements into one of four distinct data classes. These classes include unsigned integers, signed integers, floating point numbers and characters.

HDF class declarations employ the following symbols:

HDF Class	Class Definition
uint	unsigned integer
int	signed integer
float	floating point number
char	character string

Individual data element class declarations take the form:

class#

where a legal class is one of the symbols in the above table. The subsequent number, represented by the # sign, indicates the number of bits required to store each instance of the data element. Thus, uint16 designates an unsigned integer data element which requires 16 bits of storage space. Valid HDF classes include 8, 16 and 32 bit signed and unsigned integers, 32 and 64 bit floating point numbers, and character strings of variable length.

The HDF library supports six data models and their accompanying interfaces. The NCSA HDF objects which the SeaWinds Level Processors employ include scientific data sets (SDS), Vdata, and global attributes.

An HDF SDS is a fixed dimensional array. An HDF SDS may contain as many as 32,768 dimensions. All of the elements within an SDS must belong to the same data class, and must require the same amount of storage space. Permissible element classes of an SDS include 8, 16 or 32 bit signed or unsigned integers, and 32 or 64 bit floating point numbers. The HDF SDS model incorporates a set of attributes which describe the data object. Standard attributes specify labels, units, plot scales, display formats and maxima and minima for each data dimension within the SDS. Attributes can contain any descriptive information, including comments. One set of attributes is associated with each dimension of the SDS. An additional set of attributes describes the entire SDS object.

SDS array notation is similar to the standards of the C programming language where indices are zero based. Thus, the first index in each dimension is zero. This convention is unlike Fortran, where the initial index in each dimension is one. In multidimen-

sional SDS arrays, the rightmost subscript index changes most rapidly. Thus, elements ARRAY[15,0,5] and ARRAY[15,0,6] are stored contiguously.

The Vdata model provides a framework to store customized data records. A Vdata object is a one dimensional array of records. Each record in a Vdata object contains a set of elements which adhere to a specifically defined template. The template may contain any number of data elements, so long as each element belongs to a standard HDF data class. Thus, every array member within a Vdata object conforms to the same structural definition. A unique character string can serve as an identifier for a specific Vdata structural template.

HDF global attributes function identically to the attributes associated with individual SDS objects. Global attributes, however, specify characteristics of the full set of data within the entire file instead of a single SDS object in the file.

1.6.4 Data Definition Standards

Section 3.5 of this document lists every data element stored in this SeaWinds level data product. Each entry describes the meaning and function of a particular data element. A list of data attributes follows each element description.

Below are explanations for the data attributes used in section 3.5. In most cases, these explanations include all of the potential values for each attribute. In some situations, a particular attribute may not apply to a data element. In those cases, the attribute field does not appear, or the listing contains the character string 'n/a'. Hexadecimal representation sometimes indicates data content more clearly. Numbers represented in hexadecimal begin with the character string '0x'.

HDF_model:	The HDF model which stores the data element. SeaWinds level data products use “scientific data sets”, “Vdatas”, and “global attributes”. Most SeaWinds data are stored in scientific data sets. Global attributes are descriptive entries which are used to store the SeaWinds metadata.
repetition:	Repetition count of the data element, when applicable. Array subscript expressions specify the element’s dimension. The number of subscripts indicates the number of dimensions. The value of each subscript represents the maximum number of members in the corresponding dimension.
conceptual_type:	The type identifier which reflects the data element in concept. This entry is critical, since SeaWinds data are often not stored in the form which matches the concept. Acceptable type values include “string”, “time”, “boolean”, “real”, “integer” and “enum”.
storage_type:	The data representation of the element within the storage medium. The storage class specification must conform to a valid HDF type. The valid HDF class strings are “int8”, “int16”, “int32”, “uint8”, “uint16”, “uint32”, “float32”, “float64”, and “char”.
number_of_bytes:	HDF classes indicate the storage space required to store inte-

	gers and floating point numbers. They do not, however, indicate the storage space required for character strings. This entry lists the number of bytes allocated to store data elements as character strings.
units:	Units of measure. Typical values include “deg”, “deg C”, “Kelvin”, “deg/sec”, “Watts”, “dB”, “m”, “m**2”, “m/s”, “sec”, “DN”, “frames”, “pulses” and “counts”. Appendix A includes references to important data measurement unit symbols.
minimum_value:	The expected minimum value for a data element in its conceptual type. In most instances, data element values never fall below this limit.
maximum_value:	The expected maximum value for a data element in its conceptual type. In most instances, data element values never exceed this limit.
scale_factor:	The factor used to convert the value of a non-string element from its conceptual type to its storage type. By convention, the conversion operation from conceptual type to storage type is always division. Users should remember to include the value of the high order bit when interpreting data elements which are stored as unsigned integers.
offset:	The component used to convert the value of a non-string element from its conceptual type to its storage type. By convention, the conversion operation from conceptual type to storage type is always subtraction. None of the data elements in the current release of the SeaWinds Level Products employ a storage offset.
valid_values:	Some data elements may store a restricted set of values. In these instances, this attribute appears in the data element entry. This attribute lists those values which the data element may store.
nominal_value:	The expected or typical value for a data element in its conceptual type.

SeaWinds time measurements are either character strings or double precision real values. SeaWinds character string time variables are in Coordinated Universal Time (UTC) format. Strings which specify both the date and the time contain 21 ASCII characters. The date/time format conforms to the ASCII Day Segmented Time Code B recommended by the Consultative Committee for Space Data Systems (CCSDS). The string format is yyyy-dddThh:mm:ss.sss. Time accuracy is to the nearest thousandth of a second. To accommodate leap years, the maximum value in the day of the year field is 366. A maximum value in the seconds field of 60.999 permits leap second addition.

SeaWinds double precision time variables contain measurements in International Atomic Time (TAI). TAI measurements represent the real number of Standard International (SI) compatible seconds since 00:00 January 1, 1993 UTC. This initial time is an Earth Observing System Data and Information System (EOSDIS) Core System

(ECS) standard. Although the SeaWinds Project does not work directly with the ECS, the SeaWinds Project uses this initial time to generate data which are compatible with data stored in the ECS.

1.6.5 Coordinate Systems

SeaWinds level data products employ the Earth Centered Rotating (ECR) Coordinate System to specify the location and velocity of the ADEOS-II spacecraft. The ECR coordinate system is right handed. The origin is at the earth's center. The positive x-axis extends from the origin through the intersection of the equator and the prime (Greenwich) meridian. The positive y-axis runs from the origin through the equator at 90 degrees East longitude. The z-axis extends from the origin through the North pole.

The spacecraft local coordinate system is also right handed. The origin is the center of mass of the spacecraft. The x-axis points approximately in the direction of flight, while the z-axis points in the nadir direction. Spacecraft attitude measurements employ a roll-pitch-yaw system relative to these axes. Positive rotations of attitude conform to the right hand rule.

The definition of the spacecraft local coordinate system for the SeaWinds mission differs from the QuikSCAT definition of the same coordinate system. For the QuikSCAT mission, the y-axis points in the approximate direction of flight. The z-axis points in the nadir direction for both missions.

1.6.6 Metadata

All of the entries in the SeaWinds level product header are metadata. HDF global attributes store the metadata. These global attributes function very much like an ASCII character scratch pad within the HDF file. Native HDF routines are used to write SeaWinds metadata entries into the product file.

The name of each global attribute which is used for metadata storage matches the name of the metadata element. The contents of each global attribute are ASCII characters. Global attributes which list SeaWinds metadata elements must contain at least three lines. Lines are delimited by the ASCII new-line character.

The first line indicates the metadata type. This entry may contain one of three possible strings:

Metadata Type	Definition
int	integer
char	character or character string
float	floating point

The second line indicates the array size. SeaWinds metadata must be single values, one dimensional arrays, or two dimensional arrays. For single valued metadata elements, this line lists the integer 1. For one dimensional arrays, this line contains a

single integer which specifies the number of elements in the array. For two dimensional arrays, this entry contains two integers which represent the extent of the array's dimensions. The two dimension specifiers are delimited by a comma.

The third line and all of the lines thereafter list the metadata contents. If the second line indicates that the metadata element is a two dimensional array, the contents of the array are listed in row major order. In other words, entries with matching first dimension indices and consecutive second dimension indices are listed on consecutive lines.

SeaWinds higher level data products may eventually be stored and distributed through the ECS. Thus, the full set of metadata in each distributable SeaWinds level product incorporates those elements which the ECS requires in order to locate data granules within the system.

ECS defined metadata can be distinguished from SeaWinds project specific metadata by examining the name of the metadata element. All metadata element names are composed of two or more words. The words in the name of an ECS metadata element are capitalized and are not separated by any characters or spaces. The words in the name of a SeaWinds metadata element are all in lower case and are separated by underscore characters.

Metadata elements are character strings which can easily vary in size. Any change in product specification can modify the total number of bytes which are needed to store all of the characters in a metadata element. The number of bytes which are listed for metadata elements in Section 3.5 of this document are estimates of the maximum number of characters required to store that data element. Software which reads SeaWinds product metadata may use these byte estimates to ensure that the complete content of the metadata element is extracted from the SeaWinds data product.

1.6.7 Bit Flag Conventions

At the start of processing, all SeaWinds bit flag values are initialized. The standard procedure for SeaWinds initialization of bit flags sets all defined bits to 1 and all undefined bits to 0. If the Level 3 Processor detects an anomalous condition which halts the processing for a particular grid cell, the appropriate bit flag which indicates the error condition remains set to 1. Since the processor may curtail subsequent operations for the grid cell that failed the test, those bit flags which normally would be tested in subsequent code also retain their initialized value. Thus, the order in which bit flags are processed determines whether their values are meaningful.

For instance, if the `grid_cell_quality_flag` indicates that no wind vector data are available for a particular Level 3 grid cell, the Level 3 Processor does not clear bit 0 for that cell. Thus, the bits which represent Multiple Wind Vector Cells (bit 1) and Data Overwritten (bit 2) remain set to 1. These settings are not indicative of the conditions for that Level 3 grid cell. Users should ignore these values. Similarly, none of the other bits in the `grid_cell_quality_flag` contain useful data if bit 0 is set to 1.

The following table lists the `grid_cell_quality_flag` bit flag dependencies. The column on the left lists the pivotal flags. The middle column lists the two possible values for a flag. The column on the right indicates the effect of that flag's value on other bits

in the `grid_cell_quality_flag`.

Table 1: Bit Flag Dependencies

Bit Flag	Value	Effect on Other Bits
Data Exists Flag (bit 0)	0	All other bits are meaningful
	1	None of the other bits are meaningful
Multiple WVC Flag (bit 1)	0	Data Overwritten Flag (bit 2) is not meaningful
	1	Data Overwritten Flag (bit 2) is meaningful
Rain Flag Usable (bit 3)	0	Rain Flag (bit 4) is meaningful
	1	Rain Flag (bit 4) is not meaningful
Attenuation Correction Flag (bit 6)	0	Attenuation Source Flag (bits 7 and 8) is meaningful
	1	Attenuation Source Flag (bits 7 and 8) is not meaningful

1.6.8 Null Values

SeaWinds null values are listed as zeros in the Level 3 Product. The Level 3 Product does, however, contain adequate information so that users can easily distinguish null values from actual zero values.

The Level 3 Product contains null values whenever a grid cell is empty. A grid cell is empty if data element `null_data_indicator` is set to 1 for that cell. This flag distinguishes null values from zero values for certain SDS objects. If the `null_data_indicator` specifies that wind vector data does not exist for a particular Level 3 grid cell, then the listed zero values for that cell are null values.

In those situations, the Level 3 Product lists zeros for all of the data elements associated with that grid cell except for the `null_data_indicator` and the `grid_cell_quality_flag`. These zero values should be interpreted as null values.

For example, if the `rep_wind_speed` value for the grid cell at array location [210,34,0] is equal to zero, and the `null_data_indicator` is equal to 0, then `rep_wind_speed[210,34,0]` contains a true zero value. If, on the other hand, the `null_data_indicator` is equal to 1, then `rep_wind_speed[210,34,0]` contains a null value.

The SDS objects for rep_wind_velocity_u, rep_wind_velocity_v, rep_atten_corr, rep_time_of_day, rep_rain_probability, rep_amr_rain_indicator, and rain_flag should be interpreted similarly.

The Data Exists Flag (bit 0) in the grid_cell_quality_flag works identically to the null_data_indicator and may also be used to check for null values. Appendix D provides example code for extracting the value of bit 0 from the grid_cell_quality_flag.

Only the null_data_indicator or bit 0 of the grid_cell_quality_flag need to be checked, not both.

2 INTERFACE CHARACTERISTICS

2.1 Transfer Methods and Protocols

SeaWinds Level Processors write all level data product files directly to disk. The disk which stores these data may be mounted locally or remotely via the Network File System (NFS). The SeaWinds project transfers the data to the Physical Oceanography Distributed Active Archive Center (PO.DAAC) which creates a permanent archive of each SeaWinds data product and handles the external distribution of these products.

All SeaWinds standard data products are in HDF. Prospective users who are unfamiliar with HDF protocols should review appropriate documentation from NCSA before attempting to extract information from any of the SeaWinds standard data products.

2.2 Data Volume Estimates

The following table lists the two major data components of a SeaWinds Level 3 Product file. The table indicates the anticipated disk space required to store each of these product components, as well as the entire file. The column on the right side of the table specifies the overall required storage space. The total volume calculation is based upon 720 grid cell rows. The data volume estimate includes the spare SDS objects which do not appear in the standard Level 3 Product.

Table 2: Data Volume Estimates

Data Set	Number of Entries	Bytes Per Entry	Standard Total Volume (KBytes)
Level 3 Header	1	214696	214.696
Level 3 Data	720	69120	49766.400
Level 3 Product			49981.096

2.3 SeaWinds File Names

SeaWinds Level 3 Product file names are 25 characters in length. Each file name consists of a two character alphabetic string, an underscore, another two character alphabetic string, an underscore, seven numeric characters, a period, and an eleven character numeric extension. All alphabetical characters are upper case.

Specifically, SeaWinds Level 3 file names must conform to the following format:

SW_S3_YYYYDDD.yyyyddhhmm

where

YYYY: The year when the data in this product were acquired.

DDD: The day of year when the data in this product were acquired.

yyyy:	The calendar year when this product was generated.
ddd:	The day of the year when this product was generated.
hh:	The hour in twenty-four hour time when this product was generated.
mm:	The minute when this product was generated.

The two characters that precede the first underscore are always 'SW'. These characters specify that the data were generated by SeaWinds on ADEOS-II. The two characters that follow the first underscore are always the character string 'S3'. These characters identify the Level 3 Science Data Product.

2.4 Flexible Data Design

The NCSA HDF format gives the SeaWinds Level Products a high degree of flexibility. This flexibility in turn gives SeaWinds users the capability to write software which does not need to be modified to accommodate unforeseeable changes in the SeaWinds products. Since changes to the products are certain to take place over the life of the SeaWinds mission, users are encouraged to use software techniques which take advantage of some of the features in NCSA HDF.

For example, users can write a product reader which selects only those metadata elements they wish to read from a SeaWinds Level Product file. With the appropriate design, this software will not need to change, regardless of the number, size, or order of the current metadata entries. Indeed, the only changes users need to implement would take place if they should choose to read a newly defined metadata element after a product upgrade.

For those users who are interested in a specific subset of the metadata in a SeaWinds Product, the HDF routine `SDfindattr` (or `sffattr` in FORTRAN) is very useful. `SDfindattr` requires two input parameters, the first is an HDF file identifier, while the second is character string which contains the name of a global attribute. In all SeaWinds products, the name of the global attribute is identical to the name of the metadata element that it stores. `SDfindattr` returns the index of the specified global attribute in the product file. HDF routine `SDreadattr` (or `sfrnatt/sfrcatt` in FORTRAN) then uses the attribute index to fetch the contents of that global attribute. `SDreadattr` places the contents of the attribute in a specified output variable. For SeaWinds applications, the `SDreadattr` output variable is always a character string.

If the length of the character string is critical information, the HDF routine `SDattrinfo` (or `sfgainfo` in FORTRAN) provides that value.

Appendix C contains an example of a routine which uses the suggested flexible code logic.

Once the metadata element is located and read, users can generate standardized code which reads the metadata contents based on the description in section 1.6.6 of this document.

Users of the SeaWinds Level Products should employ similar methods to incorporate important information about the SDS elements. For example, several of the data el-

ements in the SeaWinds Level Products are stored as scaled integers. HDF incorporates a means to store the scale factor associated with each data element. SeaWinds products take advantage of this storage location. The HDF routine SDgetcal (or sfgcal in FORTRAN) returns this scale factor to the calling application program. Level Product users should incorporate SDgetcal into their reader code. Use of SDgetcal ensures access to the correct multiplier that converts the scaled integers which are stored in the Level Product into the intended floating point numbers.

3 DATA DEFINITION

3.1 Product Overview

3.1.1 Level 3 Product

The Level 3 Processor outputs the Level 3 Product. Each Level 3 file represents one full day's worth of Level 2B Data. The Level 3 Product contains wind vector solutions for each grid cell over open ocean.

3.1.2 Level 3 Header

The contents of the SeaWinds Level 3 header are metadata. The header data set covers the entire contents of the file.

A set of HDF global attributes stores the entire Level 3 header. The name of each global attribute used for metadata storage matches the name of the metadata element. Each global attribute consists of ASCII characters and contains at least three lines of data. The information specified in each global attribute indicates the data type, the array size and contents of the metadata element.

A sizable subset of the metadata elements are defined by the ECS. In the ECS environment, most of these elements are mandatory. In general, these elements specify critical information with regard to the accompanying data granule. The ECS utilizes these metadata elements to identify and to locate particular data granules within their system.

The remaining metadata elements describe the contents of the file, or list important constants which apply to the entire data set within the file.

3.1.3 Level 3 Data

Every data element in the Level 3 Data is stored in a separate SDS object. Every SDS is an array of three dimensions. The first SDS dimension represents the grid cell row. The second dimension represents a particular grid cell column within the row. The third dimension represents either the ascending or descending phase of the spacecraft's orbit.

Level 3 grid cells are 1/4 degree on each side. Each grid cell row corresponds to a single 1/4 degree slice in the latitudinal direction. Full coverage of Earth from pole to pole requires 720 grid cell rows. Each grid cell column corresponds to a single 1/4 degree slice in the longitudinal direction. Full coverage of Earth's circumference requires 1440 grid cell columns.

The Level 3 Product numbers the grid cell rows from south to north, starting at -90 degrees latitude. The grid cell columns are numbered from west to east, starting at 0 degrees longitude. The grids themselves are ordered from an ascending to a descending phase of orbit.

Thus, `rep_wind_speed[203,15,0]` lists the representative wind speed for the 16th grid cell column in the 204th grid cell row in the ascending phase of orbit.

`Rep_wind_speed[203,15,1]` lists the representative wind speed for the 16th grid cell column in the 204th grid cell row in the descending phase of orbit.

The center of a grid cell maps to latitude and longitude using the following equations:

$$\text{latitude} = -89.875 + (\text{grid_cell_row}/4)$$

$$\text{longitude} = (\text{grid_cell_column}/4) + 0.125$$

Using the example above, a grid cell location of [203,15] corresponds to a latitude of -39.125 degrees and a longitude of 3.875 degrees.

3.1.4 Data Correspondence with Level 2B Product

The Level 3 Processor uses the wind speeds and directions in the Level 2B Product to generate velocity vector information in the Level 3 Product. The speeds and directions used may come either from Level 2B elements `wind_speed` and `wind_dir`, or from Level 2B elements `wind_speed_selection` and `wind_dir_selection`.

The value of the metadata element `wind_vector_source` specifies which pair of Level 2B Product data elements is the source for the Level 3 Product. The table below lists the speed and direction sources for each of the three possible values of `wind_vector_source`.

Table 3: Speed and Direction Sources

Wind_Vector_Source Value	Level 2B Source
Direction Interval Retrieval	<code>wind_speed_selection</code> and <code>wind_dir_selection</code>
Selected Ambiguity	<code>wind_speed</code> and <code>wind_dir</code> (uses value of <code>wvc_selection</code> as an index)
First Ambiguity	<code>wind_speed</code> and <code>wind_dir</code> (uses a value of 1 as the index)

Occasionally, two or more Level 2B wind vector cells will be located in the same Level 3 grid cell. In the case where the Level 2B WVCs come from different revs, data from the later rev will overwrite data from a previous rev. In the case where multiple Level 2B WVCs come from the same rev, the data from the Level 2B WVC which is closest to the center will appear in the Level 3 grid cell.

The `grid_cell_quality_flag` contains two bits that indicate these conditions for a particular grid cell. The Multiple WVC Flag (bit 1) indicates whether one or more than one Level 2B wind vector cell was located in a Level 3 grid cell. The Data Overwritten Flag (bit 2) indicates whether data in a Level 3 grid cell was overwritten by a wind vector cell from a subsequent rev.

The `grid_cell_quality_flag` contains several bits that are carried over from the `wvc_quality_flag` in the Level 2B product. The following table shows the correspondence between the two product elements.

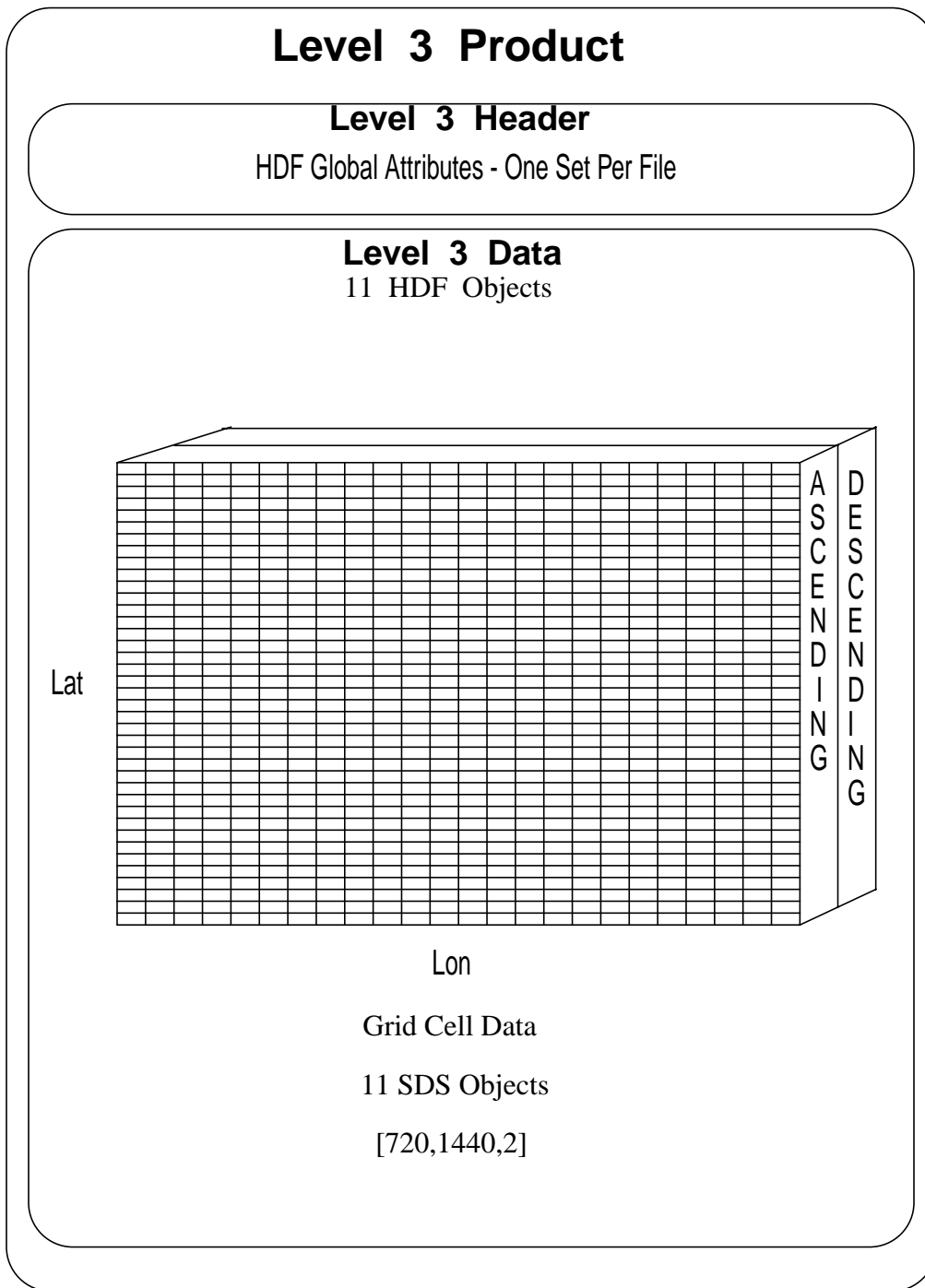
Table 4: L2B/L3 Bit Flag Correspondence

Flag Name	Grid_cell_quality_flag (L3)	Wvc_quality_flag (L2B)
Multidimensional Histogram (MUDH) Rain Flag Usable	Bit 3	Bit 12
Multidimensional Histogram (MUDH) Algorithm Rain Flag	Bit 4	Bit 13
Available Data Flag	Bit 5	Bit 14
Attenuation Method Data Flag	Bits 7-8	Bit 2
Coastal Flag	Bit 9	Bit 7
Ice Edge Flag	Bit 10	Bit 8
AMSR Rain Indicator Flag	Bit 11	Bit 15
AMSR Weather Condition Flag	Bits 12-13	Bits 5-6

Level 2B wind vector data which come from rows 0 through 811 are considered ascending phase data. Level 3 Product data calculated using these values have a third dimension index of 0. Level 2B wind vector data which come from rows 812 through 1623 are considered descending phase data. Level 3 Product data calculated using these values have a third dimension index of 1.

3.2 File Structure

The following figure illustrates the internal structure of each SeaWinds Level 3 data product file. The SDS object count does not include the spare SDS objects because these objects are not included in the HDF file.



3.3 Header Structure

The following table lists all of the elements in the SeaWinds Level 3 header. The table specifies the maximum number of entries for each header element. Each metadata element is stored in an HDF global attribute. Each global attribute contains three or more lines of ASCII characters describing the metadata element.

The name of the global attribute is the same as the name of the metadata element that the global attribute stores. Words within ECS metadata element names are capitalized and are not separated by any characters or spaces. SeaWinds metadata element names are all in lower case and words are separated by underscore characters.

Table 5: Header Structure

Element Name	Maximum Array Size
LongName	[1]
ShortName	[1]
producer_agency	[1]
producer_institution	[1]
InstrumentShortName	[1]
PlatformLongName	[1]
PlatformShortName	[1]
PlatformType	[1]
project_id	[1]
data_format_type	[1]
GranulePointer	[1]
QAGranulePointer	[1]
InputPointer	[16]
ancillary_data_descriptors	[10]
sis_id	[1]
build_id	[1]
HDF_version_id	[1]
ParameterName	[1]
QAPercentOutOfBoundsData	[1]
QAPercentMissingData	[1]
ProductionDateTime	[1]

Table 5: Header Structure

Element Name	Maximum Array Size
wind_vector_source	[1]
wind_vector_cell_resolution	[1]
observation_date	[1]
num_l3_rows	[1]
num_l3_columns	[1]
l3_actual_grid_cells	[1]
l3_actual_grid_cells_asc	[1]
l3_actual_grid_cells_dsc	[1]
l3_algorithm_descriptor	[8]
OperationMode	[1]
RangeBeginningDate	[1]
RangeEndingDate	[1]
RangeBeginningTime	[1]
RangeEndingTime	[1]
percent_rev_data_usage	[16]
OrbitParametersPointer	[32]
EquatorCrossingLongitude	[16]
EquatorCrossingTime	[16]
EquatorCrossingDate	[16]
StartOrbitNumber	[1]
StopOrbitNumber	[1]

3.4 Data Structure

Each entry in this table represents a unique HDF SDS object. The name of each Level 3 HDF object is the same as the name of the data element that the HDF object stores.

Every SDS object is an array of three dimensions. In every case, the first array index specifies the grid cell row, the second array index specifies a grid cell column in that row, and the third index specifies the orbital phase. A value of 0 for the third index indicates the ascending phase of the orbit while a value of 1 indicates the descending phase of the orbit.

For example, data elements rep_wind_speed[16,200,0] and rep_wind_velocity_u[16,200,0] reference the same grid cell in the same orbital phase.

The following table lists each element in the Level 3 Data.

Table 6: Data Structure

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
rep_wind_speed	real	uint16	[720,1440,2]	0.01	0.00	50.00
rep_wind_velocity_u	real	int16	[720,1440,2]	0.01	-50.00	50.00
rep_wind_velocity_v	real	int16	[720,1440,2]	0.01	-50.00	50.00
rep_atten_corr	real	int16	[720,1440,2]	0.001	0.000	32.767
rep_time_of_day	real	uint16	[720,1440,2]	0.0001	0.0000	1.0000
rep_rain_probability	real	uint16	[720,1440,2]	0.001	0.000	1.000
rep_srad_rain_rate	real	int16	[720,1440,2]	0.01	0.00	50.00
rep_amsr_rain_indicator	real	int16	[720,1440,2]	0.01	-20.00	100.00
rain_flag	integer	uint8	[720,1440,2]	1	0	3
null_data_indicator	integer	uint8	[720,1440,2]	1	0	1

Table 6: Data Structure

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
grid_cell_quality_flag	integer	uint16	[720,1440,2]	1	0x0000	0x3FFF
grid_cell_spare	integer	uint32	[720,1440,2]	1	n/a	n/a

3.5 Element Definitions

3.5.1 ancillary_data_descriptors

An array of file names which specifies all of the ancillary data files which were used to generate this output product. Ancillary data sets include all Level Processor input except for the primary input files.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	2576
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

3.5.2 build_id

A character string that identifies the version of the SeaPAC software that was used to generate this data file. The build_id has the format x.y.z.n-m/yyyy-mm-dd where x.y.z.n-m is the version identification number and yyyy-mm-dd is the date that the software build was completed.

The final four characters in the version identification number are optional. Thus, the form of the version identification number may be simply x.y.z or x.y.z.n.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	40
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

3.5.3 data_format_type

A character string which describes the internal format of the data product. This value indicates which software tools or which types of program language statements are necessary in order to read the data product file.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	32
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'NCSA HDF'

3.5.4 EquatorCrossingDate

The date of the equator crossing of the spacecraft nadir track in the ascending direc-

tion. The format of the date listing is YYYY-DDD, where YYYY represents the calendar year, and DDD represents the day of the year.

The Level 3 Product lists one EquatorCrossingDate value for each input rev file. The index of the EquatorCrossingDate value in the array corresponds to the index of the input file listed in the InputPointer metadata element.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	272
units:	n/a
minimum_value:	1993-001
maximum_value:	2016-366

3.5.5 EquatorCrossingLongitude

The interpolated longitude of the equator crossing of the spacecraft nadir track in the ascending direction.

The Level 3 Product lists one EquatorCrossingLongitude value for each input rev file. The index of the EquatorCrossingLongitude value in the array corresponds to the index of the input file listed in the InputPointer metadata element.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	272
units:	deg
minimum_value:	0.000
maximum_value:	359.999

3.5.6 EquatorCrossingTime

The interpolated time of the equator crossing of the spacecraft nadir track in the ascending direction. The format of the time listing is HH:MM:SS.ddd where HH represents the hour in twenty four hour time, MM represents the minutes, SS represents the seconds, and ddd represents thousandths of a second. To accommodate the possibility of leap seconds, the maximum value for the number of seconds is 60.999.

The Level 3 Product lists one EquatorCrossingTime value for each input rev file. The index of the EquatorCrossingTime value in the array corresponds to the index of the input file listed in the InputPointer metadata element.

HDF_model:	global attributes
conceptual_type:	time
storage_type:	char
number_of_bytes:	272
units:	n/a
minimum_value:	00:00:00.000
maximum_value:	23:59:60.999

3.5.7 GranulePointer

A pointer to the output data granule. The ECS requires this metadata element for all full class products. Users may employ this mandatory value to locate particular records within the ECS database. For products in the SeaPAC environment, this element contains the name of the output product. For those products which are delivered from an ECS environment, this element contains an ECS specific pointer.

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 272
 units: n/a
 minimum_value: n/a
 maximum_value: n/a

3.5.8 grid_cell_quality_flag

Bit flags which indicate the quality of a grid cell location.

The significance of each of the bit flags is as follows:

Bit	Definition
---	-----
0	Data Exists Flag
	0 - Data was located for this grid cell.
	1 - Data was not located for this grid cell.
1	Multiple WVC Flag
	0 - Only one data set was located within this grid cell.
	1 - More than one data set was located within this grid cell.
2	Data Overwritten Flag
	0 - Data in this grid cell was not overwritten.
	1 - Data in this grid cell was overwritten.
3	Multidimensional Histogram (MUDH) Rain Flag Usable
	0 - The rain flag is usable.
	1 - The rain flag is not usable.
4	Multidimensional Histogram (MUDH) Algorithm Rain Flag
	0 - Rain was not detected.
	1 - Rain was detected.
5	Available Data Flag
	0 - Inner beam data with SeaWinds view forward and aft and outer beam data with SeaWinds view forward and aft are available.
	1 - Data from at least one of the four possible beam and view

combinations are not available.

6 Attenuation Correction Flag

- 0 - Attenuation corrections were applied to sigma0s used to retrieve winds.
- 1 - Attenuation corrections were not applied to sigma0s used to retrieve winds.

7-8 Attenuation Method Data Flag

- 0 - AMSR brightness temperatures were used to correct sigma0s for atmospheric attenuation.
- 1 - The climatological attenuation map was used to correct sigma0s for atmospheric attenuation.
- 2 - N/A
- 3 - N/A

9 Coastal Flag

- 0 - No land mass was detected within this grid cell.
- 1 - Some portion of this grid cell is over land.

10 Ice Edge Flag

- 0 - No ice was detected within this grid cell.
- 1 - Some portion of this grid cell is over ice.

11 AMSR Rain Indicator Flag

- 0 - The reported AMSR rain indicator value is usable.
- 1 - The reported AMSR rain indicator value is not usable.

12-13 AMSR Weather Condition Flag

- 0 - Collocated AMSR brightness temperatures indicate clear weather within this grid cell.
- 1 - Collocated AMSR brightness temperatures indicate light rain within this grid cell.
- 2 - Collocated AMSR brightness temperatures indicate heavy rain within this grid cell.
- 3 - Unable to determine weather conditions with AMSR data.

14-15 Spare

Always clear (0)

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	uint16
number_of_bytes:	2
units:	n/a
minimum_value:	0x0000
maximum_value:	0x3EFF
scale_factor:	1

3.5.9 grid_cell_spare

Spare bytes reserved for future product extension. This element does not appear in the standard Level 3 Product.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	uint32
number_of_bytes:	4
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
scale_factor:	1

3.5.10 HDF_version_id

A character string which identifies the version of the HDF (Hierarchical Data Format) software which was used to generate this data file. NCSA (National Center for Supercomputing Applications) at the University of Illinois develops HDF software.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	40
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

3.5.11 InputPointer

Pointers to the major input data granules which were used to generate this product. The ECS requires this metadata element for all full class products. Users may employ this mandatory value to locate particular records within the ECS database. For products in the SeaPAC environment, this element contains the name of the input data granules. For those products which are delivered from an ECS environment, this element contains ECS specific pointers.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	5136
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

3.5.12 InstrumentShortName

The name of the instrument which collected the telemetry data.

HDF_model:	global attributes
conceptual_type:	string

storage_type:	char
number_of_bytes:	36
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'SeaWinds'

3.5.13 I3_actual_grid_cells

The actual number of grid cells in the Level 3 Product for which wind vector data exists.

When computing this number the Level 3 Processor views one virtual grid which is composed of the ascending phase grid overlaid on top of the descending phase grid. Cells where the phases overlap are only counted once.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	grid cells
minimum_value:	0
maximum_value:	1036800

3.5.14 I3_actual_grid_cells_asc

The actual number of grid cells in the Level 3 Product for which ascending wind vector data exists.

When computing this number the Level 3 Processor views only the ascending phase grid.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	grid cells
minimum_value:	0
maximum_value:	1036800

3.5.15 I3_actual_grid_cells_dsc

The actual number of grid cells in the Level 3 Product for which descending wind vector data exists.

When computing this number the Level 3 Processor views only the descending phase grid.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	grid cells

minimum_value: 0
 maximum_value: 1036800

3.5.16 I3_algorithm_descriptor

A set of character strings that list important details about the implementation of the Level 3 Processor algorithm that was used to generate this product.

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 656
 units: n/a
 minimum_value: n/a
 maximum_value: n/a

3.5.17 LongName

A complete descriptive name for the product. The LongName serves as an ECS data set identifier. This character string identifies each Earth Science Data Type (ESDT) in the ECS library. The ECS requires this metadata element for all products.

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 96
 units: n/a
 minimum_value: n/a
 maximum_value: n/a
 valid_values: 'SeaWinds Level 3 Ocean Wind Vectors in a 0.25 Degree Global Grid'

3.5.18 null_data_indicator

A flag which indicates whether data at a Level 3 grid cell location is null. This flag parallels the Data Exists Flag (bit 0) in the grid_cell_quality_flag.

A value of 0 indicates that the data is usable. A value of 1 indicates that the data is null and should not be used.

HDF_model: scientific data set
 conceptual_type: integer
 storage_type: uint8
 number_of_bytes: 1
 units: n/a
 minimum_value: 0
 maximum_value: 1
 scale_factor: 1

3.5.19 num_I3_columns

The number of columns in the Level 3 Product grid.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	columns
minimum_value:	1
maximum_value:	1440
nominal_value:	1440

3.5.20 num_l3_rows

The number of rows in the Level 3 Product grid.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	rows
minimum_value:	1
maximum_value:	720
nominal_value:	720

3.5.21 observation_date

The date that the output data granule represents. The format of the date listing is YYYY-DDD, where YYYY represents the calendar year, and DDD represents the day of the year.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	32
units:	n/a
minimum_value:	1993-001
maximum_value:	2016-366

3.5.22 OperationMode

This character string specifies a SeaWinds instrument mode. The instrument mode can vary within a single data granule. To determine an appropriate listing, OperationMode views the SeaWinds instrument modes in a hierarchical order. 'Wind Observation' is the highest mode in the hierarchy, followed by 'Receive Only', 'Calibration' and 'Standby' in that order. OperationMode lists the highest level instrument mode which was recorded in the associated data granule. Thus, if a single telemetry frame in the entire data granule records 'Wind Observation' mode, then the value of OperationMode is 'Wind Observation'.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	40

units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'Wind Observation'

3.5.23 OrbitParametersPointer

A pointer to one data granule or a set of data granules that provide the orbit parameters which are used to generate the data in this product. For products in the SeaPAC environment, this element contains the names of the ephemeris data granules. For those products which are delivered from an ECS environment, this element contains one or several ECS specific pointers.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	2576
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

3.5.24 ParameterName

ParameterName specifies one of the data elements in a SeaWinds Level Product. The data element specified by ParameterName is the element that the Level Processor uses to calculate QAPercentOutOfBoundsData and QAPercentMissingData.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	40
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'rep_wind_speed'

3.5.25 percent_rev_data_usage

The percent of the product which contains data from a particular rev.

The Level 3 Product lists one percent_rev_data_usage value for each input rev file. The index of the percent_rev_data_usage value in the array corresponds to the index of the input file listed in the InputPointer metadata element.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	272
units:	n/a
minimum_value:	0.000
maximum_value:	100.000

3.5.26 PlatformLongName

The complete, descriptive name of the platform associated with the instrument.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	96
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'Advanced Earth Observing Satellite II'

3.5.27 PlatformShortName

A unique identifier for the platform associated with the instrument.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	24
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'ADEOS-II'

3.5.28 PlatformType

The type of platform associated with the instrument which acquires the accompanying data.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	32
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'spacecraft'

3.5.29 producer_agency

Identification of the agency which provides the project funding.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	24
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

valid_values: 'NASA'

3.5.30 producer_institution

Identification of the institution which provides project management.

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 24
 units: n/a
 minimum_value: n/a
 maximum_value: n/a
 valid_values: 'JPL'

3.5.31 ProductionDateTime

Wall clock time when this data file was created. This time character string expression uses UTC format.

HDF_model: global attributes
 conceptual_type: time
 storage_type: char
 number_of_bytes: 40
 units: n/a
 minimum_value: 1993-001T00:00:00.000
 maximum_value: 2016-366T23:59:60.999

3.5.32 project_id

The project identification string.

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 32
 units: n/a
 minimum_value: n/a
 maximum_value: n/a
 valid_values: 'SeaWinds'

3.5.33 QAGranulePointer

A pointer to the quality assurance granule which was generated with this product. Users may employ this mandatory metadata element to evaluate the quality of particular records within the ECS database. For products in the SeaPAC environment, this element contains the name of the quality assurance granule. For those products which are delivered from an ECS environment, this element contains an ECS specific pointer.

HDF_model: global attributes
 conceptual_type: string

storage_type: char
 number_of_bytes: 272
 units: n/a
 minimum_value: n/a
 maximum_value: n/a

3.5.34 QAPercentMissingData

The percent of instances when a particular data element within the data product is missing. This value is among the ECS mandatory quality assurance elements. Metadata element ParameterName specifies which data element within the product provides the basis to calculate QAPercentMissingData.

HDF_model: global attributes
 conceptual_type: integer
 storage_type: char
 number_of_bytes: 24
 units: percent
 minimum_value: 0
 maximum_value: 100

3.5.35 QAPercentOutOfBoundsData

The percent of instances when a particular data element within the data product is out of bounds. This value is among the ECS mandatory quality assurance elements. Metadata element ParameterName specifies which data element within the product provides the basis to calculate QAPercentOutOfBoundsData.

HDF_model: global attributes
 conceptual_type: integer
 storage_type: char
 number_of_bytes: 24
 units: percent
 minimum_value: 0
 maximum_value: 100

3.5.36 rain_flag

A flag which indicates whether rain was detected at a Level 3 grid cell location. This flag mimics the Rain Flag Usable (bit 3) and the Rain Flag (bit 4) in grid_cell_quality_flag. The following table explains the meaning of the four possible values of rain_flag.

Rain_flag	Grid_cell_quality_flag (Bits 3 and 4)	Remarks
0	Bit 4=0;Bit 3=0	Rain_flag is usable; rain was not detected
1	Bit 4=0;Bit 3=1	Rain_flag not usable; rain was not detected
2	Bit 4=1;Bit 3=0	Rain_flag is usable; rain was detected

Rain_flag	Grid_cell_quality_flag (Bits 3 and 4)	Remarks
3	Bit 4=1;Bit 3=1	Rain_flag not usable; rain was detected

When using the rain_flag to mask out those cells that have rain, it is suggested the user only consider the cell as having rain when rain_flag is equal to 2. For all other values, the rain_flag is either unusable or there was no rain detected.

HDF_model: scientific data set
conceptual_type: integer
storage_type: uint8
number_of_bytes: 1
units: n/a
minimum_value: 0
maximum_value: 3
scale_factor: 1

3.5.37 RangeBeginningDate

The initial date for data coverage within this SeaWinds data product. This date is equivalent to the RangeBeginningDate of the first input data granule. The format of the date listing is YYYY-DDD, where YYYY represents the calendar year, and DDD represents the day of the year.

HDF_model: global attributes
conceptual_type: string
storage_type: char
number_of_bytes: 32
units: n/a
minimum_value: 1993-001
maximum_value: 2016-366

3.5.38 RangeBeginningTime

The initial time for data coverage within this SeaWinds data product. This date is equivalent to the RangeBeginningTime of the first input data granule. The format of the time listing is HH:MM:SS.ddd where HH represents the hour in twenty four hour time, MM represents the minutes, SS represents the seconds, and ddd represents thousandths of a second. To accommodate the possibility of leap seconds, the maximum value for the number of seconds is 60.999.

HDF_model: global attributes
conceptual_type: time
storage_type: char
number_of_bytes: 32
units: n/a
minimum_value: 00:00:00.000
maximum_value: 23:59:60.999

3.5.39 RangeEndingDate

The final date for data coverage within this SeaWinds data product. This date is equivalent to the RangeEndingDate of the last input data granule. The format of the date listing is YYYY-DDD, where YYYY represents the calendar year, and DDD represents the day of the year.

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 32
 units: n/a
 minimum_value: 1993-001
 maximum_value: 2016-366

3.5.40 RangeEndingTime

The final time for data coverage within this SeaWinds data product. This date is equivalent to the RangeEndingTime of the last input data granule. The format of the time listing is HH:MM:SS.ddd where HH represents the hour in twenty four hour time, MM represents the minutes, SS represents the seconds, and ddd represents thousandths of a second. To accommodate the possibility of leap seconds, the maximum value for the number of seconds is 60.999.

HDF_model: global attributes
 conceptual_type: time
 storage_type: char
 number_of_bytes: 32
 units: n/a
 minimum_value: 00:00:00.000
 maximum_value: 23:59:60.999

3.5.41 rep_amsr_rain_indicator

The representative AMSR rain indicator for a Level 3 grid cell location. Rep_amsr_rain_indicator is a non-dimensional parameter that reflects the ambient atmospheric conditions.

The table below lists three ranges of rain indicator values, specifies the atmospheric conditions that are typical for those numerical ranges, and describes the relative effect of those conditions upon the backscatter signal detected by the SeaWinds instrument:

Rain Indicator Range	Atmospheric Condition and the Effect on the Scatterometer Echo Signal
Less than 0.5	Clear sky or cloudy conditions. Atmosphere attenuates the backscatter signal.

Rain Indicator Range	Atmospheric Condition and the Effect on the Scatterometer Echo Signal
From 0.5 up to 4.2	Light to moderate rain conditions. Atmospheric phenomena attenuate the backscatter signal. Most of the attenuation is due to precipitating hydrometeors.
Greater than or equal to 4.2	Heavy rain conditions. Backscatter generated by hydrometeors in the atmosphere dominates the surface echo signal. Phenomena that attenuate the backscatter signal are less important by comparison.

The value is retrieved using observations of the Advanced Microwave Scanning Radiometer (AMSR).

HDF_model: scientific data set
conceptual_type: real
storage_type: int16
number_of_bytes: 2
units: n/a
minimum_value: -20.00
maximum_value: 100.00
scale_factor: 0.01

3.5.42 rep_atten_corr

The representative atmospheric nadir attenuation for the Level 3 grid cell location.

HDF_model: scientific data set
conceptual_type: real
storage_type: int16
number_of_bytes: 2
units: dB
minimum_value: 0.000
maximum_value: 32.767
scale_factor: 0.001

3.5.43 rep_rain_probability

The rain probability for a Level 3 grid cell location. This value indicates the probability of a columnar rain rate that is greater than 2 km*mm/hr.

HDF_model: scientific data set
conceptual_type: real
storage_type: uint16
number_of_bytes: 2
units: n/a
minimum_value: 0.000
maximum_value: 1.000

scale_factor: 0.001

3.5.44 rep_srad_rain_rate

The representative rain rate for a Level 3 grid cell location. These rain rates are based on 13.402 GHz brightness temperatures that were generated using the noise energy level of the SeaWinds instrument.

HDF_model: scientific data set
 conceptual_type: real
 storage_type: int16
 number_of_bytes: 2
 units: km*mm/hr
 minimum_value: 0.00
 maximum_value: 50.00
 scale_factor: 0.01

3.5.45 rep_time_of_day

The time of day that data was acquired for a Level 3 grid cell location. The time is represented as a fraction of the day. A value of 0.0000 corresponds to 00:00:00.000 UTC. A value of 1.0000 corresponds to 23:59:60.999 UTC.

HDF_model: scientific data set
 conceptual_type: real
 storage_type: uint16
 number_of_bytes: 2
 units: n/a
 minimum_value: 0.0000
 maximum_value: 1.0000
 scale_factor: 0.0001

3.5.46 rep_wind_speed

The wind speed for a Level 3 grid cell location.

HDF_model: scientific data set
 conceptual_type: real
 storage_type: uint16
 number_of_bytes: 2
 units: m/sec
 minimum_value: 0.00
 maximum_value: 50.00
 scale_factor: 0.01

3.5.47 rep_wind_velocity_u

The U component of the wind velocity vector for a Level 3 grid cell location. This value represents zonal winds. Rep_wind_velocity_u is positive for winds blowing from the West to the East.

HDF_model: scientific data set

conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	m/sec
minimum_value:	-50.00
maximum_value:	50.00
scale_factor:	0.01

3.5.48 rep_wind_velocity_v

The V component of the wind velocity vector for a Level 3 grid cell location. This value represents meridional winds. Rep_wind_velocity_v is positive for winds blowing from the South to the North.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	m/sec
minimum_value:	-50.00
maximum_value:	50.00
scale_factor:	0.01

3.5.49 ShortName

The short name used to identify all data granules in a given data collection. The short name provides the official reference for all of the contents of a particular data collection.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	24
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'SWSL3'

3.5.50 sis_id

A character string that specifies which version of Software Interface Specification (SIS) document describes the organization and format of data in the file. The complete format of the sis_id is nnn-*nnn*-n-RevZ/yyyy-mm-dd.

The substring nnn-*nnn*-n represents the document identification number.

The substring '-RevZ' represents the level of the current revision. The revision string is optional. This string of characters does not appear in the sis_id of the first official release of a document. The sis_id of each subsequent official release does contain a revision string. The Z represents an upper case letter of the alphabet. Thus, a sis_id with the string '-RevC' represents the third revision of the original official doc-

ument.

The substring yyyy-mm-dd represents the date of issue.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	40
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

3.5.51 StartOrbitNumber

The orbit number which corresponds to the data at the beginning of the granule. Orbit numbers reflect spacecraft orbital history. Orbit numbers change at ascending node.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	counts
minimum_value:	1
maximum_value:	99999

3.5.52 StopOrbitNumber

The orbit number which corresponds to the data at the end of the granule. Orbit numbers reflect spacecraft orbital history. Orbit numbers change at ascending node.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	counts
minimum_value:	1
maximum_value:	99999

3.5.53 wind_vector_cell_resolution

The size of one side of the input wind vector cells used by the Level 3 Processor.

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	48
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'12.5km', '20.0km', '25.0km'
nominal value:	'25.0km'

3.5.54 wind_vector_source

The source of the wind vector data used by the Level 3 Processor.

The table below lists the speed and direction sources for each of the three possible values of wind_vector_source.

Wind_Vector_Source Value	Input Source
Direction Interval Retrieval	Wind speeds and directions based on the Direction Interval Retrieval (DIR) algorithm
Selected Ambiguity	Wind speeds and directions based on the selected ambiguity
First Ambiguity	Wind speeds and directions based on the first ambiguity

HDF_model: global attributes
 conceptual_type: string
 storage_type: char
 number_of_bytes: 32
 units: n/a
 minimum_value: n/a
 maximum_value: n/a
 valid_values: 'Direction Interval Retrieval',
 'Selected Ambiguity', 'First Ambiguity'

4 APPENDIX A - ACRONYMS AND ABBREVIATIONS

This is the standard SeaWinds Processing and Analysis System (SeaPAC) list of acronyms and abbreviations. Not all of these acronyms and abbreviations appear in every SeaWinds document.

ADEOS-II	Advanced Earth Observing Satellite II
AMSR	Advanced Microwave Scanning Radiometer
ANSI	American National Standards Institute
APC	Antenna Pattern Correction
ASA	Antenna Switching Assembly
BPF	Band Pass Filter
CCB	Configuration Control Board
CCSDS	Consultative Committee on Space Data Systems
CDE	Cognizant Development Engineer
CDR	Critical Design Review
CDS	Command and Data Subsystem
CR	Change Request
CRC	Cyclic Redundancy Code
dB	decibels
dB _i	decibels isotropic
dB _m	decibels relative to 1 milliwatt
dB _W	decibels relative to 1 watt
DDE	Data Dictionary Entry
deg	degrees
deg/sec	degrees per second
deg C	degrees Celsius
DIU	Digital Interface Unit
DIR	Direction Interval Retrieval
DN	Data Number
DSS	Digital SubSystem
EA	SeaPAC Engineering Analysis program set
ECI	Earth Centered Inertial Coordinate System
ECR	Earth Centered Rotating Coordinate System
ECS	EOSDIS Core System
EOC	Earth Observation Center (Japan)
EOSDIS	Earth Observing System Data and Information System
EPHD	Determined Ephemeris

EPHP	Predicted Ephemeris
ESDIS	Earth Science Data and Information System Project
ESDT	Earth Science Data Type
EU	Engineering Unit
FRB	Functional Requirements Baseline
FTP	File Transfer Protocol
FTS	File Transfer Server
FX	SeaPAC File Transfer program set
GPS	Global Positioning System
GHA	Greenwich Hour Angle
GHz	gigahertz
GMT	Greenwich Mean Time
HDF	Hierarchical Data Format
HVPS	High Voltage Power Supply
Hz	Hertz
ICD	Interface Control Document
IDP	Instrument Data Processor
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
ISO	International Organization for Standardization
JPL	Jet Propulsion Laboratory
kHz	kilohertz
km	kilometers
LAN	Local Area Network
LOE	Level Of Effort
LFMC	Linear Frequency Modulation Chirp
LP	SeaPAC Level Processor program set
MLE	Maximum Likelihood Estimator
m	meters
m/s	meters per second
μA	microamps
mA	milliamps
mGauss	milliGauss
MHz	megahertz
ms	milliseconds

MTLM	Mission Telemetry Table
MUDH	Multidimensional Histogram
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NCEP	National Center for Environmental Prediction
NCP	North Celestial Pole
NCSA	National Center for Supercomputing Applications
NRT	Near Real Time
NFS	Network File System/Server
NIC	National Ice Center
Nm	Newton-meters
NOAA	National Oceanic and Atmospheric Administration
NOP	No Operation
NORDA	Naval Ocean Research Development Activity
NSCAT	NASA Scatterometer
NWP	Numerical Weather Prediction
n/a	not applicable
OCL	Operations Coordination Letter
ODL	Object Description Language
OIS	Operational Interface Specification
oz-in	ounce-inches
PBI	Payload Bus Interface
PCD	Payload Correction Data
PCU	Power Converter Unit
PEC	Precision External Clock
PM	SeaPAC Process Management program set
PO.DAAC	Physical Oceanography Distributed Active Archive Center
PP	SeaPAC Preprocessor program set
PR	Problem Report
PRF	Pulse Repetition Frequency
PROM	Programmable Read Only Memory
PSU	Power Switching Unit
PVL	Parameter Value Language
QuikSCAT	NASA Quick Scatterometer
rad	radians
RAM	Random Access Memory

RDD	Release Description Document
RF	Radio Frequency
RFA	Request For Action
RFS	Radio Frequency Subsystem
RIU	Remote Interface Unit
RMS	Root Mean Square
ROM	Read Only Memory
RPM	revolutions per minute
S/C	Spacecraft
SA	SeaPAC Science Analysis program set
SAA	Spin Actuator Assembly
SAPIENT	Science Algorithm Performance and Instrument Engineering Team
SAS	SeaWinds Antenna Subsystem
SCLK	Spacecraft Clock
SCF	Science Computing Facility
SDS	Scientific Data Set
SE	System Engineer
SeaPAC	SeaWinds Processing and Analysis Center
SES	Scatterometer Electronic Subsystem
SI	Standard International
sigma0	Normalized radar cross section
SIS	Software Interface Specification
SITP	System Integration and Test Plan
SNR	Signal to Noise Ratio
SOM	Software Operators Manual
SPARC	Scalable Processor Architecture
SRB	Software Requirements Baseline
SRD	Software Requirements Document
SRM	System for Resource Management
SSD	Software Specifications Document
SSM/I	Special Sensor Microwave/Imager
STALO	Stable Local Oscillator
STP	Software Test Plan
SWT	Science Working Team
sec	seconds
TAI	International Atomic Time

TBD	To Be Determined
TCP/IP	Transmission Control Protocol/Internet Protocol
TM	Trademark
TRS	Transmit/Receive Switch
TSR	Technical Status Review
TWT	Traveling Wave Tube
TWTA	Traveling Wave Tube Amplifier
UTC	Coordinated Universal Time
VTCW	Vehicle Time Code Word
WTS	Waveguide Transfer Switch
WVC	Wind Vector Cell

5 APPENDIX B - BIT AND BYTE FORMAT

The basic addressable unit is the 8-bit byte. Multi-byte quantities are addressed by the most significant byte, and hence bytes are stored in order of decreasing significance. A byte is 8 contiguous bits starting on an addressable byte boundary. The bits are numbered 0 through 7 starting from right to left.

Example:

Byte n	Byte n+1	Byte n+2	Byte n+3
31 .. 24	23 .. 16	15 .. 08	07 .. 00

The twos complement system is used for negative numbers. The twos complement representation of a negative number is formed by performing binary subtraction of each digit from 1 and then adding 1 to the least significant digit. For example, the twos complement of 11010011 is 00101101.

6 APPENDIX C - MODEL HDF CODE

The following routine provides a model for flexible access to the metadata elements in SeaWinds Level Products:

```
int Get_Attribute( int HDF_id, char *label, char *value )
{ /* Local declarations. */
  int attr_index; /* Attribute index within SDS. */
  long length; /* Length of the attribute value. */
  long num_type; /* HDF number type. */
  int return_status; /* Indicates return status of
                    function. */

  /* The label is a character string which contains the
     name of the metadata element. For instance, the
     label may be equal to 'RangeBeginningDate' or
     'observation_date'. */

  /* Seeks the index of the specified attribute. */
  attr_index = SDfindattr( HDF_id, label );
  if ( attr_index >= 0 )
  {
    /* An attribute index was found. The following code
       seeks the length of the attribute. In SeaWinds,
       all attributes are stored as character strings.
       Thus, the value of num_type is unimportant. */
    return_status = SDattrinfo( HDF_id, attr_index,
                                label, &num_type,
                                &length );

    /* The routine reads the contents of the
       attribute. */
    if ( return_status == HDF_SUCCESS )
      return_status = SDreadattr( HDF_id, attr_index,
                                  (void *)value );

    /* Delimits the end of the attribute with a null
       character. */
    if ( return_status == HDF_SUCCESS )
      *(value+length) = '\0';
  }
  return (return_status);
} /* End of Get_Attribute */
```

7 APPENDIX D - MODEL BIT EXTRACTION CODE

The following routine provides a model for extracting bits from the `grid_cell_quality_flag`. The routine takes two parameters as input. The first parameter, `flag_mask`, should be set to 2^n , where n is the bit number desired. The second parameter is the `grid_cell_quality_flag`, which contains the packed bits.

The routine returns the value of `flag_mask` if the bit is set to 1. The routine returns a 0 if the bit is set to 0.

```
unsigned int
Get_Bit_Flag(unsigned int flag_mask,
             unsigned int grid_cell_quality_flag)
{
    unsigned int flag_value = grid_cell_quality_flag &
                             flag_mask;

    return(flag_value);
} /* end Get_Bit_Flag */
```

The following code shows an example of how to use the above routine to extract the Data Exists Flag (bit 0) from the `grid_cell_quality_flag`.

```
unsigned int grid_cell_quality_flag;
unsigned int data_exists_flag_mask=1; /* 20=1 */
/* Add routines to read in the grid_cell_quality_flag
   from the Level 3 Product here. */
if (Get_Bit_Flag(data_exists_flag_mask,
                 grid_cell_quality_flag)==0)
{
    /* Bit is equal to 0. */
}
else
{
    /* Bit is equal to 1. */
}
```