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**SeaWinds Processing and Analysis Center (SeaPAC)**

**Level 1B Data  
Software Interface Specification (SIS-2)**

**SeaWinds/ADEOS-II Era**

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# 1 INTRODUCTION

## 1.1 Identification

This is Version 2 of the Software Interface Specification (SIS2) for Level 1B data of the SeaWinds Processing and Analysis Center (SeaPAC). This document applies to any Level 1B Product that 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 1B Product. Its intent is to elucidate the Level 1B 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 1B data file contains one 'rev' or less of SeaWinds data. A complete rev includes all of the data that pertains to one full orbital revolution of the spacecraft. By convention, all SeaWinds revolutions begin and end at the southernmost orbital latitude.

The SeaWinds Level 1B Product specifies the value, the condition, the location and the uncertainty of normalized radar cross section ( $\sigma_0$ ) measurements that were acquired by the SeaWinds scatterometer. The Level 1B Product also includes measurements for eight of the twelve component 'slices' of each  $\sigma_0$  which the Linear Frequency Modulation Chirp (LFMC) function generates. The SeaWinds Level 1B Product lists the eight contiguous slices that best center about the peak gain for each  $\sigma_0$ .

The SeaWinds Level 1B Processor outputs the Level 1B Product. The Level 1B Processor reads relevant telemetry data from the SeaWinds Level 1A Product. Ephemeris and attitude data specify the spacecraft position and orientation at the time the measurements were taken. The spacecraft and antenna positions are then used to determine the location of the footprint of each backscatter power measurement on the earth's surface. The SeaWinds Level 1B Processor uses a tabular model of the radar equation to generate a normalized radar cross section ( $\sigma_0$ ) value for each backscatter power reading.

The SeaWinds Level 1B data are sorted in time order by telemetry frame. Each telemetry frame includes 100 scatterometer pulses. Based on the SeaWinds spacecraft orbital time of 101 minutes and the nominal SeaWinds instrument pulse rate of 187.5 Hz, one complete Level 1B Product should contain 11362 telemetry frames. These numbers translate to well over 1 million whole  $\sigma_0$  measurements and more than 8 million  $\sigma_0$  slice measurements in a single Level 1B Product file. To minimize storage space and still retain a meaningful as well as useful data product, the contents of the SeaWinds Level 1B Product are divided into three distinct subsets.

The first subset of Level 1B Product represents each telemetry frame. These data

apply to all 100 whole pulse sigma0s and all 800 sigma0 slices in each telemetry frame.

The second subset of the Level 1B Product are specific to each scatterometer pulse. These data elements apply to the whole pulse measurements as well as to each of their slice components.

The third and final subset of the Level 1B Product are specific to each slice. These data elements provide the specifics about each of the high frequency resolution slices that are listed in the 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 B, JPL D-20561, December 2002.

Level 2A Data Software Interface Specification, Project Document 686-644-2 Rev C, JPL D-20563, December 2002.

Level 2B Data Software Interface Specification, Project Document 686-644-3 Rev C, JPL D-20564, January 2003.

Level 3 Data Software Interface Specification, Project Document 686-644-23, JPL D-19147, April 2002.

AMSR Level 1B Data Software Interface Specification, Project Document 686-644-24, JPL D-19146, December 2002.

Processing Tables Software Interface Specification, Project Document 686-644-6, 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 UNIX<sup>TM</sup> 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 variable

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 at-

tributes 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 multidimensional 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 integers 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. However, some data elements, particularly when they do not reflect normal conditions over the ocean’s surface, may contain values which 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. However, some data elements, particularly when they do not reflect normal conditions over the ocean’s surface, may contain values which 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 thou-



sandth 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 on 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

The SeaWinds and QuikSCAT missions generate spacecraft ephemeris information from navigation data based on the Global Positioning System (GPS). Both missions utilize ground based spacecraft tracking and orbit determination calculations as backup. The position and velocity coordinates in the sources of ephemeris data for both missions are expressed in the Earth Centered Inertial (ECI) system. The ECI is a right handed system that is fixed relative to the celestial sphere. The origin of the ECI coordinate system is at the earth's center. The x-axis points to the vernal equinox and the z-axis points to the North Celestial Pole (NCP). The y-axis completes the right handed triad. The x-y plane is the equatorial plane of the earth. These definitions are based on J2000, which specifies the location of the equator and the vernal equinox at 00:00 UTC on January 1, 2000 as the standard.

The QuikSCAT and SeaWinds processors convert the ephemeris data to the Earth Centered Rotating (ECR) system. In the ECR system, position and velocity are expressed relative to geographic, earth-fixed coordinates. The ECR frame is geocentric and right handed. The x-axis points to the intersection of the equator and Greenwich prime meridian. The z-axis points to the North Celestial Pole. The y-axis completes the right handed triad. All of the ephemeris data in the SeaWinds and QuikSCAT Level Products are expressed in the ECR frame.

At any given instant, the only difference between the ECR and ECI frames is a positive rotation about the z-axis. This rotation is known as the Greenwich Hour Angle (GHA). The rotation is equivalent to the instantaneous angle between x-axis of the ECR frame and the x-axis of the ECI frame.

Spacecraft attitude is the combined displacement of the spacecraft body coordinate axes relative to a chosen local orientation frame. For both SeaWinds and QuikSCAT, the pitch axis of the spacecraft body coordinate system is perpendicular to the plane of orbital motion and points to the left of the forward moving spacecraft. The yaw axis points along the instrument antenna axis. The roll axis approximates the spacecraft direction of motion, forming a right handed triad with the pitch and yaw axes.

The local coordinate frame provides the basis for the measure of spacecraft body orientation. In the local coordinate frame, the z-axis points toward the earth. The frame may be geocentric, where the z-axis points to the center of the earth, or geodetic, where the z-axis points to local nadir. For SeaWinds, the y-axis is perpendicular to the spacecraft's orbit plane. The x-axis completes the right handed triad, and thus approximates the spacecraft direction of flight. For QuikSCAT, the definitions of

these two axes reverse. The x-axis is perpendicular to the spacecraft's orbit plane, and the y-axis approximates the spacecraft direction of flight.

The choice of a geocentric or geodetic local frame is arbitrary. The logical choice for SeaWinds is the geodetic local frame. This choice also applies to QuikSCAT data, where the input attitude measurements reference spacecraft nadir. The ADEOS-II attitude measurement system provides measurements relative to a geocentric coordinate system. SeaWinds processors use the orbit position, orbit velocity and corrections for the earth ellipsoid to convert the input earth centered values to nadir pointing values. The echo track process in the SeaWinds processors automatically generates attitudes in the geodetic frame. Thus, regardless of input, all attitude measures that are reported in the Level 1B Product are expressed relative to the geodetic frame.

### 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	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

The Level 1B Product includes two critical bit flags that identify the data elements that have acceptable quality. The two bit flags are the Data Quality Flag (bit 4) in the `frame_qual_flag` and the Sigma0 Usability Flag (bit 0) in the `sigma0_qual_flag`. If the Data Quality Flag in the `frame_qual_flag` is 0, then most, if not all of the data in the corresponding telemetry frame are valid. If the value of the Data Quality Flag in the `frame_qual_flag` is 1, then all of the data in the corresponding telemetry frame are suspect. If the Sigma0 Usability Flag in the `sigma0_qual_flag` is 0, then the data which pertain to the corresponding whole scatterometer pulse are valid. If the Sigma0 Usability Flag in the `sigma0_qual_flag` is set to 1, then most, if not all of the data associated with the corresponding telemetry pulse are suspect. The bit flags in the `slice_qual_flag` indicate whether the data that pertain to each individual slice are valid.

Some users may wish to investigate the Level 1B Product data that are denoted as questionable. Other users may want to investigate the quality of the data under certain adverse conditions. The remaining bit flags in the Level 1B Product provide ample information about adverse or unacceptable data conditions. In order to use these data properly, however, a Level 1B Product user should be familiar with the standard conventions that the SeaWinds processors use to set and clear bit flags.

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 1B Processor detects an anomalous condition which halts the processing for a particular pulse or slice sigma0, the bit flag that indicates the corresponding error condition remains set to 1. Since the processor curtails subsequent operations for the pulse or for the slice that failed the test, those bit flags which normally would be tested in later code also retain their initialized value. Thus, the order in which bit flags are processed determines whether their values are meaningful.

For example, if the `sigma0_qual_flag` for a particular pulse indicates an error in the determination of the cell location, the Level 1B Processor curtails all further process-

ing for that sigma0 and its component slices. Since further processing does not take place, most of the remaining bits in the sigma0\_qual\_flag and the slice\_qual\_flag associated with that pulse do not list valid values. Only four of the bits in the sigma0\_qual\_flag contain valid values. One of the valid bits indicates the quality of the scatterometer pulse which is used to calculate the sigma0. Two other valid bits indicate the quality of the ephemeris and attitude data which are used to locate the sigma0. Finally, the bit which specifies sigma0 usability indicates that this sigma0 is not usable for wind retrieval purposes. This bit flag value is valid.

The following table describes the bit flag dependencies for the sigma0\_qual\_flag and the slice\_qual\_flag in the Level 1B Product. The column on the left lists the pivotal bits in the sigma0\_qual\_flag and the slice\_qual\_flag. The column on the right indicates which of the remaining bits in the sigma0\_qual\_flag and the slice\_qual\_flag are meaningful when the bit in the corresponding left hand column has a value of 0.

The order of the bit flags listed in the left hand column parallels the processing order in the Level 1B Processor. Thus, the order of the blocks provides additional information. If a pivotal bit flag has a value of 0, then all of the bit flags listed in the right hand column of the same table block have meaningful values. If a pivotal bit flag has a value of 1, then all of the bit flags listed in both the left and the right hand columns of the previous table block have meaningful values.

For example, assume that data analysis is based on the value of the cell location flag. If the cell location flag for a particular pulse sigma0 is 0, then the eight bit flags in the same table block are valid. These include the sigma0 measurement usable flag, the low SNR flag, the pulse quality flag, the frequency shift flag, the attitude data flag, the ephemeris data flag, as well as the center location and low SNR flags for each slice. On the other hand, if the cell location flag for a particular pulse is 1, then the five bit flags listed in both columns of the preceding table block are valid. These include the sigma0 measurement usable flag, the pulse quality flag, the cell location flag, the attitude data flag, and the ephemeris data flag.

**Table 1: Bit Flag Dependencies**

Pivotal Bit Flag	Other Bit Flags With Meaningful Value when Pivotal Flag is 0
Pulse quality flag (sigma0_qual_flag bit 4)	Sigma0 measurement usable flag (sigma0_qual_flag bit 0)
	Ephemeris data flag (sigma0_qual_flag bit 9)
Ephemeris data flag (sigma0_qual_flag bit 9)	Sigma0 measurement usable flag (sigma0_qual_flag bit 0)
	Pulse quality flag (sigma0_qual_flag bit 4)
	Cell location flag (sigma0_qual_flag bit 5)
	Attitude data flag (sigma0_qual_flag bit 8)
Cell location flag (sigma0_qual_flag bit 5)	Sigma0 measurement usable flag (sigma0_qual_flag bit 0)
	Low SNR flag (sigma0_qual_flag bit 1)
	Pulse quality flag (sigma0_qual_flag bit 4)
	Frequency shift flag (sigma0_qual_flag bit 6)

**Table 1: Bit Flag Dependencies**

Pivotal Bit Flag	Other Bit Flags With Meaningful Value when Pivotal Flag is 0
Cell location flag (continued)	Attitude data flag (sigma0_qual_flag bit 8)
	Ephemeris data flag (sigma0_qual_flag bit 9)
	Center location flag for each slice (slice_qual_flag bits 3, 7, 11, 15, 19, 23, 27, 31)
	Low SNR flag for each slice (slice_qual_flag bits 2, 6, 10, 14, 18, 22, 26, 30)
Frequency shift flag (sigma0_qual_flag bit 6)	Sigma0 measurement usable flag (sigma0_qual_flag bit 0)
	Low SNR flag (sigma0_qual_flag bit 1)
	Negative sigma0 flag (sigma0_qual_flag bit 2)
	Sigma0 out of range flag (sigma0_qual_flag bit 3)
	Pulse quality flag (sigma0_qual_flag bit 4)
	Cell location flag (sigma0_qual_flag bit 5)
	Temperature range flag (sigma0_qual_flag bit 7)
	Attitude data flag (sigma0_qual_flag bit 8)
	Ephemeris data flag (sigma0_qual_flag bit 9)
	Best eight slices flag (sigma0_qual_flag bits 10 and 11)
	Center location flag for each slice (slice_qual_flag bits 3, 7, 11, 15, 19, 23, 27, 31)
	Low SNR flag for each slice (slice_qual_flag bits 2, 6, 10, 14, 18, 22, 26, 30)
	Peak gain flag for each slice (slice_qual_flag bits 0, 4, 8, 12, 16, 20, 24, 28)
Center location flag for slice (slice_qual_flag bits 3, 7, 11, 15, 19, 23, 27, 31)	Negative sigma0 flag for corresponding slice (slice_qual_flag bits 1, 5, 9, 13, 17, 21, 25, 29)

The Level 1B Processor sets the values of the sigma0\_mode\_flag before algorithmic processing begins. Thus, the values of the sigma0\_mode\_flag are valid for all sigma0s in the Level 1B Product.

### 1.6.8 Null Values

SeaWinds null values are listed as zeros in the Level 1B Product. The Level 1B Product does, however, contain adequate information so that users can distinguish null values from actual zeros.

Data element `num_pulses` in the Level 1B Product specifies the number of pulses in each telemetry frame. Under normal circumstances, this number should always be 100. When the Level 1B Processor does not process a telemetry frame, the value of `num_pulses` is zero. Thus, when `num_pulses` is zero, virtually all of the other elements in the telemetry frame are zero as well. These zeros represent null values.

If data values associated with a pulse create untenable algorithmic conditions, the Level 1B Processor may curtail processing for that pulse. When these conditions take place, the Level 1B Product displays whatever values the Processor was able to calculate. For example, the Sigma0 Measurement Usable Flag in the `sigma0_qual_flag` indicates whether the algorithmic process was successful for each pulse. Whenever the Sigma0 Measurement Usable Flag is set, some or all of the values associated with that pulse may be bad or unreliable. When zeros appear for data elements which represent a pulse where the Sigma0 Measurement Usable Flag is set, the Level 1B Processor most likely did not reach the point in the algorithm where that particular element is calculated. Thus, users should interpret zeros associated with “unusable” sigma0s as null values.

## 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 each of the major data components in the SeaWinds Level 1B Product file. The table indicates the anticipated disk space required to store each of the product components, as well as the entire file. The two columns on the right specify the overall storage space. One lists the maximum size of the Level 1B Product file, while the other lists the expected size of a typical file. The maximum total volume contains 13000 telemetry frames of data. This estimate is based on the SeaWinds instrument's maximum pulse rate of 212 Hz. The expected total volume contains 11362 telemetry frames. The smaller estimate is based on the nominal instrument pulse rate of 187.5 Hz.

Both of these data volume estimates include the spare SDS objects which do not appear in the standard Level 1B Product.

**Table 2: Data Volume Estimates**

Data Set	Number of Entries	Bytes Per Entry	Maximum Total Volume (KBytes)	Expected Total Volume (KBytes)
Level_1B_Header	1	19008	19.008	19.008
Telemetry_Frame_Header	13000	92	1196.000	1045.304
Pulse_Data	13000	3600	46800.000	40903.200
Slice_Data	13000	13200	171600.000	149978.400
Level_1B_Product			219615.008	191945.912

### 2.3 SeaWinds File Names

SeaWinds Level 1B data file names are 23 characters in length. Each file name consists of a two character alphabetic string followed by an underscore and eight additional alphanumeric characters, then a period and an eleven character numeric extension. The two characters that precede that underscore are always 'SW'. These characters specify that the data were generated by the SeaWinds Project. The three

characters that follow the underscore are always the character string 'S1B'. These characters identify the Level 1B Science Data Product. All alphabetical characters are upper case.

Specifically, SeaWinds Level 1B file names must conform to the following format:

SW\_S1Bnnnnn.yyyydddhhmm

where

nnnnn: The ADEOS-II spacecraft's orbital rev number.

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.

## 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 `sfattr` in FORTRAN) is very useful. `SDfindattr` requires two input parameters, the first is an HDF file identifier, while the second is a 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 elements 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 1B Product**

The Level 1B Processor generates the Level 1B Product. Each Level 1B file represents one satellite rev. The Level 1B Product lists the sigma0 and the sigma0 slice values for each radar backscatter measurement within the rev. In addition, the Level 1B Product includes data elements which specify the location and the quality of each backscatter measurement. The Level 1B Product also contains a few additional parameters which indicate particular conditions and uncertainties that the SeaWinds Level 2A and SeaWinds Level 2B Processors require.

#### **3.1.2 Level 1B Header**

The contents of the SeaWinds Level 1B header are metadata. Each header data set encompasses the entire contents of the file.

A set of HDF global attributes stores the entire Level 1B header. The name of each global attribute used for metadata storage matches the name of a 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 is 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 reference stored data granules within the system for processing as well as for locating data sets requested by scientific users.

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 1B Data**

The SeaWinds Level 1B data are grouped by telemetry frames. Within these telemetry frames, the Level 1B data are divided into three major subsets. These subsets are the Telemetry Frame Header, the Pulse Data and the Slice Data.

The Telemetry Frame Header data report the state of the SeaWinds instrument as well as indicate the spacecraft position, velocity, and attitude. The Telemetry Frame Header data also include algorithmic and instrument parameters which are common to all sigma0 cells within the same telemetry frame. All of the Telemetry Frame Header data correspond to the time listed in data element `frame_time`.

The Pulse Data list the outcome of the SeaWinds implementation of the radar equation for each entire scatterometer pulse. This data set includes parameters which locate each pulse's footprint on the earth's surface, as well as indicators of each measurement's quality and uncertainty.

Most of the Slice Data parameters are analogous to those found in the Pulse Data. The Slice Data elements, however, reference the individual sigma0 slices that are generated by the SeaWinds instrument's high resolution Linear Frequency Modulation Chirp (LFMC) function. The SeaWinds Level 1B Product lists the measurements of the eight contiguous slices in each pulse that best center about the peak gain of

the echo signal. The remaining two slices in the sigma0 pulse do not appear in the Level 1B Product.

An HDF Vdata object stores the frame\_time data element. An HDF SDS object stores all of the other data elements in the Level 1B Product. The first dimension index of every data object within the Level 1B Data references the telemetry frame. Thus, every data element with the same first dimension index relates to the same telemetry frame. Data element sc\_lat[6212] specifies the spacecraft latitude for the telemetry frame which begins at frame\_time[6212].

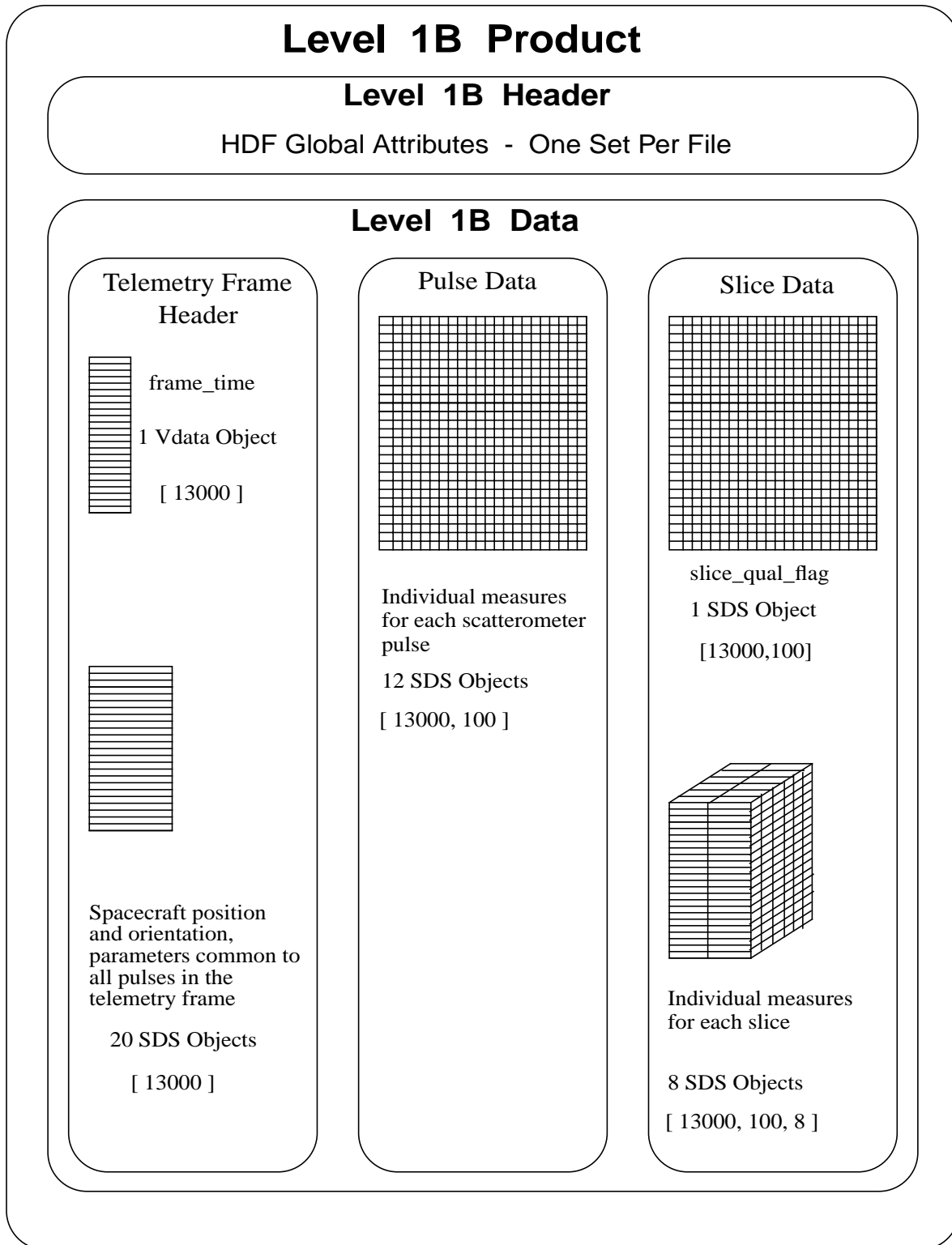
The elements in the Pulse and Slice Data contain a second data index. The second index in these arrays references one of the 100 scatterometer pulses in each telemetry frame. Thus, data element cell\_azimuth[6212,41] represents the azimuth of the sigma0 cell for the forty second scatterometer pulse in the telemetry frame which begins at frame\_time[6212].

Except for the slice\_qual\_flag, the data elements in the Slice Data contain a third data index. The third index in these arrays represents one of eight slices. For each pulse, the Level 1B Processor selects the set of eight contiguous slices that best center about the peak gain of the echo signal. By convention, slices are numbered from the one nearest the spacecraft to the one farthest away. Thus, data element slice\_sigma0[6212,41,3] contains the normalized radar cross section measurement for the fourth nearest among the selected slices of the forty second scatterometer pulse in the telemetry frame that begins at frame\_time[6212]. Data element slice\_qual\_flag folds all of the information about each slice into a single element. Thus, slice\_qual\_flag does not require the third dimension index.

For more information about the SeaWinds scatterometer's slice and pulse geometry as well as instrument timing, see the SeaWinds Data User's Guide.

### 3.2 File Structure

The following figure illustrates the internal structure of each SeaWinds Level 1B data product file. The SDS object count does not include the spare SDS objects since those objects are not included in the HDF file.



### 3.3 Header Structure

The following table lists all of the elements in the SeaWinds Level 1B 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.

All of the header elements except skip\_start\_time, skip\_stop\_time, skip\_start\_frame and skip\_stop\_frame must appear in every Level 1B Product file. These four optional elements delimit data gaps or regions of data which were not processed. These metadata elements appear only when otherwise expected sequences of data are missing from the Product file.

**Table 3: 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	[1]
ancillary_data_descriptors	[32]
OrbitParametersPointer	[5]
sis_id	[1]
build_id	[1]
HDF_version_id	[1]

Table 3: Header Structure

Element Name	Maximum Array Size
ParameterName	[1]
QAPercentOutOfBoundsData	[1]
QAPercentMissingData	[1]
StartOrbitNumber	[1]
StopOrbitNumber	[1]
EquatorCrossingLongitude	[1]
EquatorCrossingTime	[1]
EquatorCrossingDate	[1]
rev_orbit_period	[1]
orbit_inclination	[1]
orbit_semi_major_axis	[1]
orbit_eccentricity	[1]
rev_number	[1]
RangeBeginningDate	[1]
RangeEndingDate	[1]
RangeBeginningTime	[1]
RangeEndingTime	[1]
ProductionDateTime	[1]
skip_start_time	[10]
skip_stop_time	[10]
11b_expected_frames	[1]
11b_actual_frames	[1]
11b_algorithm_descriptor	[8]
ephemeris_type	[1]
attitude_type	[1]
maximum_pulses_per_frame	[1]
cell_kpc_b	[8,2]
slice_kpc_b	[8,2]
cell_kpc_c	[8,2]

**Table 3: Header Structure**

Element Name	Maximum Array Size
slice_kpc_c	[8,2]
num_slices_per_cell_sigma0	[1]
receiver_gain_ratio	[1]
OperationMode	[1]
skip_start_frame	[10]
skip_stop_frame	[10]

## 3.4 Data Structure

### 3.4.1 Telemetry Frame Header

These are the entries that pertain to an entire telemetry frame within the Level 1B data. Data element frame\_time is stored in an HDF Vdata object. All of the other data elements are stored in one dimensional HDF SDS objects. The array index for these SDS objects specifies the telemetry frame.

The table below lists the HDF objects in the Level 1B frame header:

**Table 4: Telemetry Frame Header**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
frame_time	time	char	[13000]	n/a	1993-001T00:00:00.000	2016-366T23:59:60.999
orbit_time	integer	uint32	[13000]	1	0	4294967295
frame_inst_status	enum	uint32	[13000]	1	0x00000000	0x3FFFFFFF
frame_err_status	enum	uint32	[13000]	1	0x00000000	0x0FFF3FFF
frame_qual_flag	enum	uint16	[13000]	1	0x0000	0x0013
num_pulses	integer	int8	[13000]	1	0	100
sc_lat	real	float32	[13000]	1	-90.000	90.000
sc_lon	real	float32	[13000]	1	0.000	359.999
sc_alt	real	float32	[13000]	1	700000	900000
x_pos	real	float32	[13000]	1	-9999999	9999999
y_pos	real	float32	[13000]	1	-9999999	9999999
z_pos	real	float32	[13000]	1	-9999999	9999999
x_vel	real	float32	[13000]	1	-8000.000	8000.000



**Table 4: Telemetry Frame Header**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
y_vel	real	float32	[13000]	1	-8000.000	8000.000
z_vel	real	float32	[13000]	1	-8000.000	8000.000
roll	real	int16	[13000]	0.001	-3.000	3.000
pitch	real	int16	[13000]	0.001	-3.000	3.000
yaw	real	int16	[13000]	0.001	-3.000	3.000
bandwidth_ratio	real	int16	[13000]	0.001	0	32.767
x_cal_A	real	int16	[13000]	0.01	-300.00	300.00
x_cal_B	real	int16	[13000]	0.01	-300.00	300.00

### 3.4.2 Pulse Data

The Pulse Data list individual values for each radar backscatter measurement. In some instances, the Pulse Data list instrument calibrations instead of measurements. The Calibration/Measurement Pulse bit flag in data element sigma0\_mode\_flag specifies whether the corresponding pulse is a calibration or a measurement.

A distinct SDS object stores each data element in the Pulse Data. The name of each SDS object matches the data element that it stores. All of the data elements in the Pulse Data are two dimensional arrays. The first dimension index specifies the telemetry frame. The second dimension index represents a particular sigma0 measurement. Data elements cell\_lon[4367,15] is the cell longitude and snr[4367,15] is the signal to noise ratio for the 16th sigma0 measurement in the 4368th telemetry frame.

The table below lists all of the elements within the Pulse Data:

**Table 5: Pulse Data**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
cell_lat	real	float32	[13000,100]	1	-90.00	90.00
cell_lon	real	float32	[13000,100]	1	0.00	359.99
sigma0_mode_flag	enum	uint16	[13000,100]	1	0x0000	0x1FFE
sigma0_qual_flag	enum	uint16	[13000,100]	1	0x0000	0x0BFF
cell_sigma0	real	int16	[13000,100]	0.01	-300.00	20.00
frequency_shift	real	int16	[13000,100]	1	-25000	25000
cell_azimuth	real	uint16	[13000,100]	0.01	0.00	359.99
cell_incidence	real	int16	[13000,100]	0.01	40.00	60.00
antenna_azimuth	real	uint16	[13000,100]	0.01	0.00	359.99
cell_snr	real	int16	[13000,100]	0.01	-30.00	300.00
cell_kpc_a	real	int16	[13000,100]	0.0001	0.01	0.1

**Table 5: Pulse Data**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
sws_app_tb	real	int16	[13000,100]	0.1	0.0	350.0

### 3.4.3 Slice Data

The Slice Data reference the slices which are generated by the SeaWinds instrument's high resolution mode Linear Frequency Modulation Chirps (LFMC) function. The Level 1B Product lists the set of eight contiguous slices that best center about the peak gain of the echo signal. For each pulse, the sigma0\_qual\_flag indicates which set of eight out of the ten center slices appear in the product.

In some instances, the Slice Data list instrument calibrations instead of measurements. The Calibration/Measurement Pulse bit flag in data element sigma0\_mode\_flag specifies whether the corresponding pulse is a calibration or a measurement.

A distinct SDS stores each data element in the Slice Data. Except for the slice\_qual\_flag, all of these data elements are three dimensional arrays. The first dimension index specifies the telemetry frame. The second dimension index represents the sigma0 measurement. The third dimension index represents each of the slices of the sigma0 measurement. Thus, slice\_sigma0[2304,31,4] is the normalized backscatter measure and slice\_incidence[2304,31,4] is the beam incidence angle for the 5th slice of the 32nd pulse in the 2305th telemetry frame.

The slice\_qual\_flag is a two dimensional array. The first dimension index represents the telemetry frame. The second dimension index represents a scatterometer pulse. Individual bits within the slice\_qual\_flag represent the slices within the scatterometer pulse.

The table below lists all of the elements within the Slice Data:

**Table 6: Slice Data**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
slice_qual_flag	enum	uint32	[13000,100]	1	0x00000000	0xFFFFFFFF
slice_lat	real	int16	[13000,100,8]	0.0001	-3.2768	3.2767
slice_lon	real	int16	[13000,100,8]	0.0001	-3.2768	3.2767
slice_sigma0	real	int16	[13000,100,8]	0.01	-300.00	20.00
x_factor	real	int16	[13000,100,8]	0.01	-300.00	300.00

**Table 6: Slice Data**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
slice_azimuth	real	uint16	[13000,100,8]	0.01	0.00	359.99
slice_incidence	real	int16	[13000,100,8]	0.01	40.00	60.00
slice_snr	real	int16	[13000,100,8]	0.01	-30.00	300.00
slice_kpc_a	real	int16	[13000,100,8]	0.0001	0.01	0.1

## 3.5 Element Definitions

### 3.5.1 ancillary\_data\_descriptors

An array of file names that specifies all of the ancillary data files that 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: 8208  
 units: n/a  
 minimum\_value: n/a  
 maximum\_value: n/a

### 3.5.2 antenna\_azimuth

The antenna azimuth as indicated by the SeaWinds Antenna Subsystem (SAS) at the falling edge of each measurement pulse.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: uint16  
 number\_of\_bytes: 2  
 units: deg  
 minimum\_value: 0.00  
 maximum\_value: 359.99  
 scale\_factor: 0.01

### 3.5.3 attitude\_type

A character string that identifies the source of the spacecraft attitude data which were utilized in order to generate this data file. Possible values include:

Star Tracker	Attitude data extracted from ADEOS-II Star Tracker
Echo Tracking	Attitude data calculated in SeaWinds processing
PCD	Attitude data extracted from the Payload Correction Data (PCD) in the ADEOS-II Mission Telemetry
None	No attitude data were input. The value of all attitude data fields in the product is zero.

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  
 scale\_factor: n/a  
 valid\_values: 'Star Tracker', 'Echo Tracking', 'PCD' or 'None'

### 3.5.4 bandwidth\_ratio

The ratio of the rolling time average of a set of load calibration measurements through the noise filter to the rolling time average of the corresponding set of load calibration measurements through the echo filter.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	0
maximum_value:	32.767
scale_factor:	0.001

### 3.5.5 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

### 3.5.6 cell\_azimuth

The azimuth angle of the antenna boresight at the center of a sigma0 cell. The azimuth is defined as the clockwise angle from north to the projection of the line of sight on the earth's surface.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	uint16
number_of_bytes:	2
units:	deg
minimum_value:	0.00
maximum_value:	359.99
scale_factor:	0.01

### 3.5.7 cell\_incidence

The angle at the center of a sigma0 cell between the normal vector to the earth's sur-

face and the antenna boresight direction vector.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: int16  
 number\_of\_bytes: 2  
 units: deg  
 minimum\_value: 40.00  
 maximum\_value: 60.00  
 scale\_factor: 0.01

### 3.5.8 cell\_kpc\_a

The zero order coefficient in the inverse second order polynomial of the signal to noise ratio which yields  $k_{pc}$  for whole pulse measurements.  $K_{pc}$  is the normalized standard deviation of the sigma0 measurement due to statistical fluctuations in the echo signal.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: int16  
 number\_of\_bytes: 2  
 units: n/a  
 minimum\_value: 0.01  
 maximum\_value: 0.1  
 scale\_factor: 0.0001

### 3.5.9 cell\_kpc\_b

A two dimensional array which contains the first order coefficient of an inverse second order polynomial in the signal to noise ratio. Evaluation of the polynomial yields  $k_{pc}$  for whole pulse sigma0 measurements.  $K_{pc}$  is the normalized standard deviation of sigma0 measure due to statistical fluctuations in the echo signal.

The first dimension index represents the slice resolution mode. For all elements in the cell\_kpc\_b array, the significance of the first dimension index is as follows:

First Dimension Index	Slice Resolution
-----	-----
0	0.0 msec
1	0.1 msec
2	0.2 msec
3	0.3 msec
4	0.4 msec
5	0.5 msec
6	0.6 msec
7	none - modulation off



The second dimension index represents the scatterometer beam. For all elements in the cell\_kpc\_b array, the significance of the second dimension index is as follows:

Second Dimension Index	Definition
0	Scatterometer Inner Beam
1	Scatterometer Outer Beam

HDF\_model: global attributes  
conceptual\_type: real  
storage\_type: char  
number\_of\_bytes: 256  
units: n/a  
minimum\_value: 0.00  
maximum\_value: 1.00

### 3.5.10 cell\_kpc\_c

A two dimensional array which contains the second order coefficient of an inverse second order polynomial in the signal to noise ratio. Evaluation of the polynomial yields  $k_{pc}$  for whole pulse sigma0 measurements.  $K_{pc}$  is the normalized standard deviation of sigma0 measure due to statistical fluctuations in the echo signal.

The first dimension index represents the slice resolution mode. For all elements in the cell\_kpc\_c array, the significance of the first dimension index is as follows:

First Dimension Index	Slice Resolution
0	0.0 msec
1	0.1 msec
2	0.2 msec
3	0.3 msec
4	0.4 msec
5	0.5 msec
6	0.6 msec
7	none - modulation off

The second dimension index represents the scatterometer beam. For all elements in the cell\_kpc\_c array, the significance of the second dimension index is as follows:

Second Dimension Index	Definition
0	Scatterometer Inner Beam
1	Scatterometer Outer Beam

HDF\_model: global attributes  
conceptual\_type: real  
storage\_type: char

number_of_bytes:	256
units:	n/a
minimum_value:	0.00
maximum_value:	1.00

### 3.5.11 cell\_lat

The geodetic latitude of the center of a sigma0 cell.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	deg
minimum_value:	-90.00
maximum_value:	90.00
scale_factor:	1

### 3.5.12 cell\_lon

The longitude of the center of a sigma0 cell.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	deg
minimum_value:	0.00
maximum_value:	359.99
scale_factor:	1

### 3.5.13 cell\_sigma0

The normalized radar cross section calculated from the radar equation for a whole scatterometer pulse. This value has not been corrected for atmospheric attenuation.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-300.00
maximum_value:	20.00
scale_factor:	0.01

### 3.5.14 cell\_snr

The ratio of signal to noise based on spacecraft antenna power measurements for a whole scatterometer pulse.

HDF_model:	scientific data set
conceptual_type:	real

storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-30.00
maximum_value:	300.00
scale_factor:	0.01

### 3.5.15 data\_format\_type

A character string that 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'

### 3.5.16 ephemeris\_type

A character string that identifies the source of the spacecraft ephemeris data which were utilized in order to generate this data file. Possible values include:

GPS	GPS ephemeris extracted from the Payload Correction Data (PCD) in the ADEOS-II Mission Telemetry
EPHD	ADEOS-II determined ephemeris data file
EPHP	ADEOS-II predicted ephemeris data 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:	'GPS', 'EPHD' or 'EPHP'

### 3.5.17 EquatorCrossingDate

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

### 3.5.18 EquatorCrossingLongitude

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

HDF\_model: global attributes  
 conceptual\_type: real  
 storage\_type: char  
 number\_of\_bytes: 32  
 units: deg  
 minimum\_value: 0.000  
 maximum\_value: 359.999

### 3.5.19 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.

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

### 3.5.20 frame\_err\_status

Bit flags which indicate potential problems due to instrument error or poor communication with the spacecraft.

The significance of each bit is as follows:

Bit	Definition
-----	-----
0	Current Error Message Flag 0 - Current error message in telemetry indicates no errors 1 - Current error message in telemetry indicates errors
1	Equator Crossing Missed 0 - No miss of equator crossing reported 1 - Miss of equator crossing was reported
2	Misaligned Calibration Pulse Flag

- 0 - Most recent calibration pulse was where it was expected
  - 1 - Most recent calibration pulse was not where it was expected
- 3 Power On Reset
- 0 - Normal operations, no reset
  - 1 - Reset event noted
- 4 CDS Watchdog Timeout Reset
- 0 - Watchdog resets operating normally
  - 1 - Watchdog timeout
- 5 SES Watchdog Timer Event
- 0 - No watchdog timer event noted
  - 1 - Watchdog timer event took place
- 6 Fault Protection Event
- 0 - Normal operations
  - 1 - Fault protection event noted
- 7 Mission Telemetry or Serial Telemetry Error
- 0 - Normal operations
  - 1 - Telemetry error noted
- 8 Missing Spacecraft Time
- 0 - Normal operations, all spacecraft times available
  - 1 - Spacecraft time missing event noted
- 9 Reset Event
- 0 - No reset event noted
  - 1 - Reset took place
- 10 CDS System Reset
- 0 - Normal operations, no CDS reset
  - 1 - CDS reset event noted
- 11 TWTA Malfunction Flag
- 0 - The active TWTA unit reports no malfunctions
  - 1 - The active TWTA unit reports a malfunction
- 12 SES Data Overrun Flag
- 0 - No SES data overrun detected
  - 1 - SES data overrun detected
- 13 SES Data Underrun Flag
- 0 - No SES data underrun detected
  - 1 - SES data underrun detected
- 14-15 Spare

- Always clear (0)
- 16 A to D Transformer Couple Flag  
0 - A to D transformer couple voltage is in range  
1 - A to D transformer couple voltage is out of range
- 17 Excessive Interpolation of Antenna Position Flag  
0 - Fewer than 50 consecutive antenna positions were interpolated  
1 - 50 or more consecutive antenna positions were interpolated
- 18 Ignored Orbit Step Change Flag  
0 - Orbit step change is normal  
1 - Step change denoted, but orbit step is same as previous frame
- 19 Spontaneous Orbit Step Change Flag  
0 - Orbit step change is normal  
1 - Orbit step incremented, but step change was not denoted
- 20 Inconsistent Resolution Mode Flag  
0 - Resolution mode is consistent for both scatterometer beams  
1 - Scatterometer beam resolution modes are inconsistent
- 21 Unexpected Grid Inhibit Condition  
0 - Grid inhibit is in expected state  
1 - Grid inhibit is in unexpected state
- 22 Unexpected Receive Protect Condition  
0 - Receive protect is in expected state  
1 - Receive protect is in unexpected state
- 23 Attitude Data Flag  
0 - A usable attitude record was found for this telemetry frame  
1 - No usable attitude record was found for this telemetry frame
- 24 Ephemeris Data Flag  
0 - Interpolated ephemeris data are acceptable  
1 - Interpolated ephemeris data are unacceptable
- 25 Telemetry Time Tag Flag  
0 - Telemetry packet time tag is acceptable  
1 - Telemetry packet time tag is unreadable or out of range
- 26 Telemetry Error Message History Flag  
0 - Error message history and error count are consistent  
1 - Error message history and error count are inconsistent
- 27 Valid Operational Mode Flag  
0 - Operational mode is valid

1 - Operational mode in telemetry is not valid  
 28-31 Spare  
 Always clear (0)

HDF\_model: scientific data set  
 conceptual\_type: enum  
 storage\_type: uint32  
 number\_of\_bytes: 4  
 units: n/a  
 minimum\_value: 0x00000000  
 maximum\_value: 0x0FFF3FFF  
 scale\_factor: 1

### 3.5.21 frame\_inst\_status

Bit flags which indicate the status of the SeaWinds instrument over the time span of a single telemetry frame.

The significance of each bit is as follows:

Bit	Definition
0-1	Current Mode 0 - Wind observation mode 1 - Calibration mode 2 - Standby mode 3 - Receive only mode
2	First Pulse Count in Frame 0 - Inner beam (A) first 1 - Outer beam (B) first
3	Antenna Spin Rate 0 - Nominal rate - 18 rpm 1 - Alternate rate - 19.8 rpm
4-6	Slice Resolution Mode - Effective Gate Width 0 - 0.0 milliseconds 1 - 0.1 milliseconds 2 - 0.2 milliseconds 3 - 0.3 milliseconds 4 - 0.4 milliseconds 5 - 0.5 milliseconds 6 - 0.6 milliseconds 7 - none - modulation off

- 7 Data Acquisition Mode Flag
  - 0 - High resolution mode - slice data
  - 1 - Low resolution mode - whole pulse data
- 8 Cal Pulse Sequence Flag
  - 0 - A calibration pulse sequence begins in this telemetry frame
  - 1 - No calibration pulse sequence begins in this telemetry frame
- 9 Scatterometer Electronic Subsystem (SES) A/B Flag
  - 0 - SES A
  - 1 - SES B
- 10 SeaWinds Antenna Subsystem (SAS) A/B Flag
  - 0 - SAS A
  - 1 - SAS B
- 11 Travelling Wave Tube Amplifier (TWTA) 1/2 Flag
  - 0 - TWTA #1
  - 1 - TWTA #2
- 12 Travelling Wave Tube Amplifier (TWTA) Power Flag
  - 0 - TWTA Power On
  - 1 - TWTA Power Off
- 13 Grid Enable/Disable Flag
  - 0 - Grid normal for RF transmission
  - 1 - Grid disable, no RF transmission
- 14 Receive Protect On/Normal
  - 0 - Receive protect normal
  - 1 - Receive protect on
- 15 TWT Trip Override
  - 0 - TWT trip override off
  - 1 - TWT trip override on
- 16 TWT Body Overcurrent Trip Control
  - 0 - TWT body overcurrent trip enabled
  - 1 - TWT body overcurrent trip disabled
- 17 Receive Protect On/Off
  - 0 - Receiver not protected
  - 1 - Receiver protected
- 18 Instrument Mode Change
  - 0 - Instrument operations mode did not change
  - 1 - Instrument operations mode did change



- 19 Soft Reset Commanded
  - 0 - No flight software soft reset commanded
  - 1 - Flight software soft reset commanded
- 20 Relay Set/Reset Started
  - 0 - No change reported
  - 1 - Change from last packet
- 21 Internal PRF Clock
  - 0 - Internal PRF clock measure received from SES
  - 1 - CDS hardware generated PRF clock
- 22 Hard Reset Commanded
  - 0 - No hard reset commanded
  - 1 - Hard reset commanded
- 23 TWTA Monitor Enable/Disable
  - 0 - No change in the state of TWTA monitor
  - 1 - Change in the state of TWTA monitor
- 24 SES Parameter Table Change
  - 0 - No change in the SES parameter tables
  - 1 - Change in the SES parameter tables
- 25 Range Gate Table Change
  - 0 - No change in the Range Gate tables
  - 1 - Change in the Range Gate tables
- 26 Doppler Table Change
  - 0 - No change in the Doppler tables
  - 1 - Change in the Doppler tables
- 27 Serial Telemetry Table Change
  - 0 - No change in the Serial Telemetry tables
  - 1 - Change in the Serial Telemetry tables
- 28 Mission Telemetry Table Change
  - 0 - No change in the Mission Telemetry tables
  - 1 - Change in the Mission Telemetry tables
- 29 Resolution Mode Change
  - 0 - No change in the slice resolution mode
  - 1 - Change in the slice resolution mode
- 30-31 Spare
  - Always clear (0)

HDF\_model: scientific data set

```

conceptual_type:  enum
storage_type:    uint32
number_of_bytes: 4
units:          n/a
minimum_value:   0x00000000
maximum_value:   0x3FFFFFFF
scale_factor:    1

```

### 3.5.22 frame\_qual\_flag

Bit flags which indicate the character and the quality of the data acquired within a particular telemetry frame.

The significance of each bit is as follows:

Bit	Definition
-----	-----
0-1	Frame filler flag 0 - No filler in telemetry frame 1 - Filler only in packet 2 2 - Filler only in packet 3 3 - Filler in both packets 2 and 3
2-3	Spare Always clear (0)
4	Data quality flag 0 - Good data found in telemetry frame 1 - Questionable or bad data found in telemetry frame
5-15	Spare Always clear (0)

```

HDF_model:      scientific data set
conceptual_type: enum
storage_type:   uint16
number_of_bytes: 2
units:         n/a
minimum_value:  0x0000
maximum_value:  0x0013
scale_factor:   1

```

### 3.5.23 frame\_time

The time which the SeaWinds Command and Data Subsystem (CDS) assigns to the telemetry data packet. This time records the falling edge of the first Scatterometer Electronic Subsystem (SES) pulse in the telemetry frame. This time value also corresponds with the spacecraft state and attitude vectors in the SeaWinds Level data product. This time character string expression uses UTC format.

HDF_model:	Vdata
conceptual_type:	time
storage_type:	char
number_of_bytes:	21
units:	n/a
minimum_value:	1993-001T00:00:00.000
maximum_value:	2016-366T23:59:60.999
scale_factor:	n/a

### 3.5.24 frequency\_shift

The shift in the baseband frequency of a scatterometer pulse due to various measurement conditions. Possible conditions that might create this shift include errors in the Doppler Binning Table, non-zero spacecraft attitude measurements, changes in the nominal orbit, or surface topography effects.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	Hz
minimum_value:	-25000
maximum_value:	25000
scale_factor:	1

### 3.5.25 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

### 3.5.26 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

### 3.5.27 InputPointer

A pointer to one data granule or a set of data granules that provide the major input data that 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 names of the major input 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:	5136
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

### 3.5.28 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'

### 3.5.29 l1b\_actual\_frames

A value that indicates the number of telemetry frames which are listed in the Level 1B Product. In most cases, this number should match the value of l1b\_expected\_frames.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	frames
minimum_value:	1
maximum_value:	13000

### 3.5.30 I1b\_algorithm\_descriptor

A set of character strings which list important details about the implementation of the Level 1B 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

### 3.5.31 I1b\_expected\_frames

The expected number of telemetry frames in the Level 1B Product file. Under nominal operating conditions, this number will be 11362. This outcome results from instrument and product specifications as well as physical constraints.

Under nominal conditions, the acquisition of the 100 pulses in each telemetry frame completes in 0.53 seconds. Every SeaWinds Level 1B Product file contains data for one rev. The maximum number of telemetry frames within a single file is restricted by the number of frames acquired over one complete circumnavigation of the Earth. The estimated orbital time of the ADEOS-II spacecraft is very slightly more than 101 minutes. Thus, the expected number of frames should be 11362.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	frames
minimum_value:	1
maximum_value:	13000

### 3.5.32 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 1B Time-Ordered Earth-Located Sigma0s'

### 3.5.33 maximum\_pulses\_per\_frame

The maximum number of scatterometer pulses among all of the telemetry frames in

this SeaWinds level product file. This entry provides the size of the second dimension for two and three dimensional data arrays in the Pulse Data and the Slice Data of the Level 1B Product file.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	pulses
minimum_value:	1
maximum_value:	100

### 3.5.34 num\_pulses

The total number of Scatterometer Electronic Subsystem (SES) science data pulses which were transmitted within a single telemetry frame. This sum is equivalent to the number of pulse data sets within the Level 1B Product telemetry frame. This value does not, however, represent the number of sigma0 measurements. Some of the scatterometer pulse data slots may contain calibration data instead of measurement data.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	int8
number_of_bytes:	1
units:	pulses
minimum_value:	0
maximum_value:	100
scale_factor:	1

### 3.5.35 num\_slices\_per\_cell\_sigma0

The number of slices in the normalized radar cross section that the Level 1B Processor uses to determine measures for the entire pulse.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	80
units:	counts
minimum_value:	1
maximum_value:	12

### 3.5.36 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'. Data element frame\_inst\_status includes an indicator of the active operation mode for each telemetry frame within the product.

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', 'Receive Only', 'Calibration' and 'Standby'

### 3.5.37 orbit\_eccentricity

The eccentricity of the spacecraft orbital path. SeaWinds Level Processors determine this value using ephemeris data which are representative of the rev ascending node crossing.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	32
units:	n/a
minimum_value:	0.0000
maximum_value:	1.0000

### 3.5.38 orbit\_inclination

The angle between the plane of the spacecraft's orbital path and the earth's equatorial plane. An orbit\_inclination which is greater than 90 degrees indicates a retrograde orbital path. SeaWinds Level Processors determine this value using ephemeris data which are representative of the rev ascending node crossing.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	32
units:	deg
minimum_value:	0.000
maximum_value:	180.000

### 3.5.39 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:	1296
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

### 3.5.40 orbit\_semi\_major\_axis

The length of the semimajor axis of the ADEOS-II spacecraft orbit. SeaWinds Level Processors determine this value using ephemeris data which are representative of the rev ascending node crossing.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	32
units:	m
minimum_value:	n/a
maximum_value:	n/a

### 3.5.41 orbit\_time

The time of each telemetry data packet relative to the time of the most recent ascending node crossing. The representative time for each telemetry packet takes place when the SeaWinds Command and Data Subsystem (CDS) records the falling edge of the first Scatterometer Electronic Subsystem (SES) pulse in the telemetry frame. The orbit\_time specifies the number of clock counts as they are reported in the telemetry packet.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	uint32
number_of_bytes:	4
units:	counts
minimum_value:	0
maximum_value:	4294967295
scale_factor:	1

### 3.5.42 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
nominal_value:	'slice_sigma0'

### 3.5.43 pitch

The angular rotation of the spacecraft body coordinates about the spacecraft local coordinate system axis that runs perpendicular to the orbital plane. For the SeaWinds Mission, the right handed spacecraft local coordinate system defines the x-axis in the approximate direction of flight and the z-axis in the nadir direction. Thus, pitch is rotation about the y-axis of the spacecraft local coordinate system. Positive pitch direction conforms to the right hand rule. The element in frame\_time with a matching array index specifies the time of the pitch measurement.

Level 1B attitude data are always relative to the spacecraft local coordinate system with a geodetic z-axis vector.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	deg
minimum_value:	-3.000
maximum_value:	3.000
scale_factor:	0.001

### 3.5.44 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'

### 3.5.45 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'

### 3.5.46 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'

### 3.5.47 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'

### 3.5.48 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'

### 3.5.49 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

### 3.5.50 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'

### 3.5.51 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

### 3.5.52 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

### 3.5.53 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

### 3.5.54 RangeBeginningDate

The initial date for data coverage within this SeaWinds data product. 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

### 3.5.55 RangeBeginningTime

The initial time for data coverage within this SeaWinds data product. This time is equivalent to the moment the spacecraft passes over the southernmost point in its orbital path. 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

### 3.5.56 RangeEndingDate

The final date for data coverage within this SeaWinds data product. 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

### 3.5.57 RangeEndingTime

The final time for data coverage within this SeaWinds data product. This time is equivalent to the moment the spacecraft passes over the southernmost point in its orbital path. 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

### 3.5.58 receiver\_gain\_ratio

The gain ratio of the echo filter frequency response function to the noise filter frequency response function.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	80
units:	dB
minimum_value:	n/a
maximum_value:	n/a
nominal_value:	4.65

### 3.5.59 rev\_number

An assigned revolution number based on the spacecraft orbital history. Each revolution begins and ends at the southernmost orbital latitude.

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

### 3.5.60 rev\_orbit\_period

The time span between two consecutive ascending node crossings in the spacecraft orbital path.

HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	32
units:	sec
minimum_value:	n/a
maximum_value:	n/a

### 3.5.61 roll

The angular rotation of the spacecraft body coordinates about the spacecraft local coordinate system axis that represents the direction of spacecraft motion. For the SeaWinds Mission, the right handed spacecraft local coordinate system defines the x-axis in the approximate direction of flight and the z-axis in the nadir direction. Positive roll direction conforms to the right hand rule. The element in frame\_time with a matching array index specifies the time of the roll measurement.

Level 1B attitude data are always relative to the spacecraft local coordinate system with a geodetic z-axis vector.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	deg
minimum_value:	-3.000
maximum_value:	3.000
scale_factor:	0.001

### 3.5.62 sc\_alt

The spacecraft nadir altitude relative to the reference ellipsoid at the time specified in data element frame\_time with the corresponding array index.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	m
minimum_value:	700000
maximum_value:	900000
scale_factor:	1

### 3.5.63 sc\_lat

The geodetic latitude of the location on the spacecraft nadir track at the time specified in data element frame\_time with the corresponding array index.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: float32  
 number\_of\_bytes: 4  
 units: deg  
 minimum\_value: -90.000  
 maximum\_value: 90.000  
 scale\_factor: 1

### 3.5.64 sc\_lon

The east longitude of the location on the spacecraft nadir track at the time specified in the data element frame\_time with the corresponding array index.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: float32  
 number\_of\_bytes: 4  
 units: deg  
 minimum\_value: 0.000  
 maximum\_value: 359.999  
 scale\_factor: 1

### 3.5.65 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: 36  
 units: n/a  
 minimum\_value: n/a  
 maximum\_value: n/a  
 valid\_values: 'SWSL1B'

### 3.5.66 sigma0\_mode\_flag

Bit flags that indicate the SeaWinds instrument mode and status at the time the sigma0 measurement was acquired.

The significance of each bit is as follows:

Bit	Definition
-----	-----
0-1	Calibration/Measurement Pulse Flag
	0 - Measurement pulse
	1 - Loop back calibration pulse

- 2 - Cold load calibration pulse
- 3 - N/A
- 2     Antenna Beam Flag
  - 0 - Inner antenna beam
  - 1 - Outer antenna beam
- 3     Sigma0 Location Flag
  - 0 - Sigma0 cell is forward of spacecraft
  - 1 - Sigma0 cell is aft of spacecraft
- 4-5    Current Mode
  - 0 - Wind Observation Mode
  - 1 - Calibration Mode
  - 2 - Standby Mode
  - 3 - Receive Only Mode
- 6-8    Effective Gate Width - Slice Resolution
  - 0 - 0.0 milliseconds
  - 1 - 0.1 milliseconds
  - 2 - 0.2 milliseconds
  - 3 - 0.3 milliseconds
  - 4 - 0.4 milliseconds
  - 5 - 0.5 milliseconds
  - 6 - 0.6 milliseconds
  - 7 - none - chirp modulation off
- 9     Data Acquisition Mode Flag
  - 0 - High resolution mode - slice data
  - 1 - Low resolution mode - whole pulse data
- 10    Scatterometer Electronic Subsystem (SES) A/B Flag
  - 0 - SES A
  - 1 - SES B
- 11    Antenna Spin Rate
  - 0 - Nominal rate - 18 rpm
  - 1 - Alternate rate - 19.8 rpm
- 12    Receive Protect On/Off
  - 0 - Receiver not protected
  - 1 - Receiver protected
- 13-15   Spare
  - Always clear (0)



HDF\_model: scientific data set  
conceptual\_type: enum  
storage\_type: uint16  
number\_of\_bytes: 2  
units: n/a  
minimum\_value: 0x0000  
maximum\_value: 0x1FFE  
scale\_factor: 1

### 3.5.67 sigma0\_qual\_flag

Bit flags that indicate the quality of the data which generate the sigma0 measurement.

The significance of each bit is as follows:

Bit	Definition
----	-----
0	Sigma0 Measurement Usable Flag 0 - Measurement is usable 1 - Measurement is not usable
1	Low SNR Flag 0 - SNR level is acceptable 1 - SNR level is low
2	Negative Sigma0 Flag 0 - Sigma0 >= 0 1 - Sigma0 < 0
3	Sigma0 Out of Range Flag 0 - Sigma0 is in acceptable range 1 - Sigma0 is outside of acceptable range
4	Pulse Quality Flag 0 - Scatterometer pulse quality is acceptable 1 - Scatterometer pulse quality is not acceptable
5	Cell Location Flag 0 - Sigma0 cell location algorithm converges 1 - Sigma0 cell location algorithm does not converge
6	Frequency Shift Flag 0 - Frequency shift is within the range of the x factor table 1 - Frequency shift lies beyond the range of the x factor table
7	Temperature Range Flag 0 - Spacecraft temperature is within calibration coefficient range

- 1 - Spacecraft temperature is beyond calibration coefficient range
- 8 Attitude Data Flag
  - 0 - A usable attitude record was found for this sigma0
  - 1 - No usable attitude record was found for this sigma0
- 9 Ephemeris Data Flag
  - 0 - Interpolated ephemeris data are acceptable for this sigma0
  - 1 - Interpolated ephemeris data are not acceptable for this sigma0
- 10-11 Best Eight Slices Flag
  - 0 - Slices 2 through 9
  - 1 - Slices 3 through 10
  - 2 - Slices 4 through 11
  - 3 - N/A
- 12-15 Spare
  - Always clear (0)

HDF\_model: scientific data set  
 conceptual\_type: enum  
 storage\_type: uint16  
 number\_of\_bytes: 2  
 units: n/a  
 minimum\_value: 0x0000  
 maximum\_value: 0x0BFF  
 scale\_factor: 1

### 3.5.68 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 document.

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

### 3.5.69 skip\_start\_frame

The array index of a telemetry frame which specifies where a nonexistent, unnecessary, spurious, questionable, or erroneous data segment begins. Each skip\_start\_frame corresponds with one specified skip\_stop\_frame in the same data file.

A skip\_start\_frame value of -1 indicates that the first data gap begins before the beginning of the file. Thus, when skip\_start\_frame is -1, the very first record in the file follows a gap.

If the data product contains no data gaps or skips, this metadata element does not appear.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	96
units:	frames
minimum_value:	-1
maximum_value:	13000

### 3.5.70 skip\_start\_time

A specific date and time which indicates where a nonexistent, unnecessary, spurious, questionable, or erroneous data segment begins. This value specifies the beginning of either a known data gap or a time range that the system operator requested that the processor bypass.

Each skip\_start\_time corresponds with one specified skip\_stop\_time in the same data file. This time character string expression uses UTC format.

If the skip\_start\_time is the same as the RangeBeginningTime in a rev based product, the first data gap begins either before or at the beginning of the file. Thus, when the skip\_start\_time is the same as the RangeBeginningTime, the very first record in the file follows a gap.

If the data product contains no data gaps or skips, this metadata element does not appear.

HDF_model:	global attributes
conceptual_type:	time
storage_type:	char
number_of_bytes:	256
units:	n/a
minimum_value:	1993-001T00:00:00.000
maximum_value:	2016-366T23:59:60.999

### 3.5.71 skip\_stop\_frame

The array index of a telemetry frame which specifies where a nonexistent, unneces-

sary, spurious, questionable, or erroneous data segment ends. Each skip\_stop\_frame corresponds with one specified skip\_start\_frame in the same data file.

A skip\_stop\_frame value of -1 indicates that the last data gap runs beyond the end of the file. Thus, when skip\_stop\_frame is -1, the very last record in the file immediately precedes the gap.

If the data product contains no data gaps or skips, this metadata element does not appear.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	96
units:	frames
minimum_value:	-1
maximum_value:	13000

### 3.5.72 skip\_stop\_time

A specific date and time which indicates where a nonexistent, unnecessary, spurious, questionable, or erroneous data segment ends. This value specifies the end of either a known data gap or a time range that the system operator requested that the processor bypass.

Each skip\_stop\_time corresponds with one specified skip\_start\_time in the same data file. This time character string expression uses UTC format.

If the skip\_stop\_time is the same as the RangeEndingTime in a rev based product, the last data gap runs either up to the end of the file or beyond the end of the file. Thus, when the skip\_stop\_time is the same as the RangeEndingTime, the very last record in the file immediately precedes a gap.

If the data product contains no data gaps or skips, this metadata element does not appear.

HDF_model:	global attributes
conceptual_type:	time
storage_type:	char
number_of_bytes:	256
units:	n/a
minimum_value:	1993-001T00:00:00.000
maximum_value:	2016-366T23:59:60.999

### 3.5.73 slice\_azimuth

The azimuth angle of the antenna boresight at the center of each high resolution cell slice. The azimuth is defined as the clockwise angle from north to the projection of the line of sight on the earth's surface.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	uint16

```

number_of_bytes: 2
units: deg
minimum_value: 0.00
maximum_value: 359.99
scale_factor: 0.01
    
```

### 3.5.74 slice\_incidence

The angle at the center of each sigma0 high resolution slice between the normal vector to the earth's surface and the antenna boresight direction vector.

```

HDF_model: scientific data set
conceptual_type: real
storage_type: int16
number_of_bytes: 2
units: deg
minimum_value: 40.00
maximum_value: 60.00
scale_factor: 0.01
    
```

### 3.5.75 slice\_kpc\_a

A representative  $k_{pc\_a}$  value for each slice in a scatterometer pulse.  $K_{pc\_a}$  is the zero order coefficient of the inverse second order polynomial in the signal to noise ratio which yields  $k_{pc}$ .  $K_{pc}$  is the normalized standard deviation of the sigma0 measurement due to statistical fluctuations in the echo signal.

```

HDF_model: scientific data set
conceptual_type: real
storage_type: int16
number_of_bytes: 2
units: n/a
minimum_value: 0.01
maximum_value: 0.1
scale_factor: 0.0001
    
```

### 3.5.76 slice\_kpc\_b

A two dimensional array which contains the first order coefficient of an inverse second order polynomial in the signal to noise ratio. Evaluation of the polynomial yields  $k_{pc}$  for slice sigma0 measurements.  $K_{pc}$  is the normalized standard deviation of sigma0 measure due to statistical fluctuations in the echo signal.

The first dimension index represents the slice resolution. For all elements in the slice\_kpc\_b array, the significance of the first dimension index is as follows:

First Dimension Index	Slice Resolution
-----	-----
0	0.0 msec
1	0.1 msec

2	0.2 msec
3	0.3 msec
4	0.4 msec
5	0.5 msec
6	0.6 msec
7	none - modulation off

The second dimension index represents the scatterometer beam. For all elements in the slice\_kpc\_b array, the significance of the second dimension index is as follows:

Second Dimension Index	Definition
-----	-----
0	Scatterometer Inner Beam
1	Scatterometer Outer Beam
HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	256
units:	n/a
minimum_value:	0.00
maximum_value:	3.00

### 3.5.77 slice\_kpc\_c

A two dimensional array which contains the second order coefficient of an inverse second order polynomial in the signal to noise ratio. Evaluation of the polynomial yields  $k_{pc}$  for slice sigma0 measurements.  $K_{pc}$  is the normalized standard deviation of sigma0 measure due to statistical fluctuations in the echo signal.

The first dimension index represents the slice resolution mode. For all elements in the slice\_kpc\_c array, the significance of the first dimension index is as follows:

First Dimension Index	Slice Resolution
-----	-----
0	0.0 msec
1	0.1 msec
2	0.2 msec
3	0.3 msec
4	0.4 msec
5	0.5 msec
6	0.6 msec
7	none - modulation off

The second dimension index represents the scatterometer beam. For all elements

in the slice\_kpc\_c array, the significance of the second dimension index is as follows:

Second Dimension Index	Definition
-----	-----
0	Scatterometer Inner Beam
1	Scatterometer Outer Beam
HDF_model:	global attributes
conceptual_type:	real
storage_type:	char
number_of_bytes:	256
units:	n/a
minimum_value:	0.00
maximum_value:	2.00

### 3.5.78 slice\_lat

The difference in geodetic latitude of the center of each high resolution slice in a sigma0 cell from the center of the entire sigma0 cell.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	deg
minimum_value:	-3.2768
maximum_value:	3.2767
scale_factor:	0.0001

### 3.5.79 slice\_lon

The quantity of the difference in longitude of the center of each high resolution slice of a sigma0 cell from the center of the entire sigma0 cell multiplied by the cosine of the latitude of the center of the entire sigma0 cell.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	deg
minimum_value:	-3.2768
maximum_value:	3.2767
scale_factor:	0.0001

### 3.5.80 slice\_qual\_flag

Bit flags which indicate the quality of the data which generate the sigma0 measurements for each of the frequency modulation chirps of the scatterometer pulse.

The significance of each bit is as follows:

Bit	Definition
-----	------------

---

0	Peak Gain Flag for slice 1 0 - Gain exceeds peak gain threshold 1 - Gain does not exceed peak gain threshold
1	Negative Sigma0 Flag for slice 1 0 - Sigma0 $\geq$ 0 1 - Sigma0 $<$ 0
2	Low SNR Flag for slice 1 0 - SNR level is acceptable 1 - SNR level is low
3	Center Location Flag for slice 1 0 - Slice center located 1 - Slice center not located
4	Peak Gain Flag for slice 2 0 - Gain exceeds peak gain threshold 1 - Gain does not exceed peak gain threshold
5	Negative Sigma0 Flag for slice 2 0 - Sigma0 $\geq$ 0 1 - Sigma0 $<$ 0
6	Low SNR Flag for slice 2 0 - SNR level is acceptable 1 - SNR level is low
7	Center Location Flag for slice 2 0 - Slice center located 1 - Slice center not located
8	Peak Gain Flag for slice 3 0 - Gain exceeds peak gain threshold 1 - Gain does not exceed peak gain threshold
9	Negative Sigma0 Flag for slice 3 0 - Sigma0 $\geq$ 0 1 - Sigma0 $<$ 0
10	Low SNR Flag for slice 3 0 - SNR level is acceptable 1 - SNR level is low
11	Center Location Flag for slice 3 0 - Slice center located



- 1 - Slice center not located
- 12 Peak Gain Flag for slice 4
  - 0 - Gain exceeds peak gain threshold
  - 1 - Gain does not exceed peak gain threshold
- 13 Negative Sigma0 Flag for slice 4
  - 0 - Sigma0  $\geq$  0
  - 1 - Sigma0  $<$  0
- 14 Low SNR Flag for slice 4
  - 0 - SNR level is acceptable
  - 1 - SNR level is low
- 15 Center Location Flag for slice 4
  - 0 - Slice center located
  - 1 - Slice center not located
- 16 Peak Gain Flag for slice 5
  - 0 - Gain exceeds peak gain threshold
  - 1 - Gain does not exceed peak gain threshold
- 17 Negative Sigma0 Flag for slice 5
  - 0 - Sigma0  $\geq$  0
  - 1 - Sigma0  $<$  0
- 18 Low SNR Flag for slice 5
  - 0 - SNR level is acceptable
  - 1 - SNR level is low
- 19 Center Location Flag for slice 5
  - 0 - Slice center located
  - 1 - Slice center not located
- 20 Peak Gain Flag for slice 6
  - 0 - Gain exceeds peak gain threshold
  - 1 - Gain does not exceed peak gain threshold
- 21 Negative Sigma0 Flag for slice 6
  - 0 - Sigma0  $\geq$  0
  - 1 - Sigma0  $<$  0
- 22 Low SNR Flag for slice 6
  - 0 - SNR level is acceptable
  - 1 - SNR level is low
- 23 Center Location Flag for slice 6
  - 0 - Slice center located

- 1 - Slice center not located
- 24 Peak Gain Flag for slice 7
  - 0 - Gain exceeds peak gain threshold
  - 1 - Gain does not exceed peak gain threshold
- 25 Negative Sigma0 Flag for slice 7
  - 0 - Sigma0  $\geq$  0
  - 1 - Sigma0  $<$  0
- 26 Low SNR Flag for slice 7
  - 0 - SNR level is acceptable
  - 1 - SNR level is low
- 27 Center Location Flag for slice 7
  - 0 - Slice center located
  - 1 - Slice center not located
- 28 Peak Gain Flag for slice 8
  - 0 - Gain exceeds peak gain threshold
  - 1 - Gain does not exceed peak gain threshold
- 29 Negative Sigma0 Flag for slice 8
  - 0 - Sigma0  $\geq$  0
  - 1 - Sigma0  $<$  0
- 30 Low SNR Flag for slice 8
  - 0 - SNR level is acceptable
  - 1 - SNR level is low
- 31 Center Location Flag for slice 8
  - 0 - Slice center located
  - 1 - Slice center not located

HDF\_model: scientific data set  
 conceptual\_type: enum  
 storage\_type: uint32  
 number\_of\_bytes: 4  
 units: n/a  
 minimum\_value: 0x00000000  
 maximum\_value: 0xFFFFFFFF  
 scale\_factor: 1

### 3.5.81 slice\_sigma0

The normalized radar cross section of a sigma0 slice. This value has not been corrected for atmospheric attenuation.

HDF\_model: scientific data set

conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-300.00
maximum_value:	20.00
scale_factor:	0.01

### 3.5.82 slice\_snr

The ratio of signal to noise for each slice of a scatterometer pulse.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-30.00
maximum_value:	300.00
scale_factor:	0.01

### 3.5.83 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

### 3.5.84 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

### 3.5.85 sws\_app\_tb

The output from the SeaWinds apparent brightness temperature algorithm. This al-

gorithm utilizes SeaWinds instrument noise energy levels to estimate brightness temperatures at 13.402 GHz.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	Kelvin
minimum_value:	0.0
maximum_value:	350.0
scale_factor:	0.1

### 3.5.86 tf\_header\_spare

Spare area for the telemetry frame header data. These bytes are included in data product volume estimates. This element does not appear in the standard Level 1B Product.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float64
number_of_bytes:	8
units:	n/a
minimum_value:	0
maximum_value:	0
scale_factor:	n/a

### 3.5.87 tf\_sigma0\_spare

Spare area for the telemetry frame sigma0 data storage. These bytes are included in data product volume estimates. This element does not appear in the standard Level 1B Product.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float64
number_of_bytes:	8
units:	n/a
minimum_value:	0
maximum_value:	0
scale_factor:	n/a

### 3.5.88 x\_cal\_A

The component of the x factor which is calculated in the SeaWinds algorithm and which applies to measurements from scatterometer beam A. X\_cal\_A includes the system and calibration loss factors, the antenna gain, as well as the representative loop back calibration pulse measure for the telemetry frame.

HDF_model:	scientific data set
conceptual_type:	real

storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-300.00
maximum_value:	300.00
scale_factor:	0.01

### 3.5.89 x\_cal\_B

The component of the x factor which is calculated in the SeaWinds algorithm and which applies to measurements from scatterometer beam B. X\_cal\_B includes the system and calibration loss factors, the antenna gain, as well as the representative loop back calibration pulse measure for the telemetry frame.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-300.00
maximum_value:	300.00
scale_factor:	0.01

### 3.5.90 x\_factor

The complete conversion factor from the energy measurement to the normalized radar cross section value for each of the slices of a whole scatterometer pulse. The x\_factor incorporates the tabular x value, as well as the radar equation factors which account for instrument loss and calibration.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	dB
minimum_value:	-300.00
maximum_value:	300.00
scale_factor:	0.01

### 3.5.91 x\_pos

The X component of spacecraft position in the Earth Centered Rotating (ECR) coordinate system. The element in frame\_time with a matching array index specifies the time of the position measurement. Spacecraft position measurements based on predictive ephemeris data are accurate to the nearest kilometer. Spacecraft position measurements based on definitive ephemeris data are accurate within 150 m.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4

units:	m
minimum_value:	-9999999
maximum_value:	9999999
scale_factor:	1

### 3.5.92 x\_vel

The X component of spacecraft velocity in the Earth Centered Rotating (ECR) coordinate system. The element in frame\_time with a matching array index specifies the time of the velocity measurement. Spacecraft velocity measurements based on predictive ephemeris data are accurate to the nearest meter per second. Spacecraft velocity measurements based on definitive ephemeris data are accurate within 0.015 meters per second.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	m/s
minimum_value:	-8000.000
maximum_value:	8000.000
scale_factor:	1

### 3.5.93 yaw

The angular rotation of the spacecraft body coordinates about the z-axis of the spacecraft local coordinate system. For the SeaWinds Mission, the right handed spacecraft local coordinate system defines the x-axis in the approximate direction of flight and the z-axis in the nadir direction. Positive yaw direction conforms to the right hand rule. The element in frame\_time with a matching array index specifies the time of the yaw measurement.

Level 1B attitude data are always relative to the spacecraft local coordinate system with a geodetic z-axis vector.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	deg
minimum_value:	-3.000
maximum_value:	3.000
scale_factor:	0.001

### 3.5.94 y\_pos

The Y component of spacecraft position in the Earth Centered Rotating (ECR) coordinate system. The element in frame\_time with a matching array index specifies the time of the position measurement. Spacecraft position measurements based on predictive ephemeris data are accurate to the nearest kilometer. Spacecraft position measurements based on definitive ephemeris data are accurate within 150 m.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	m
minimum_value:	-9999999
maximum_value:	9999999
scale_factor:	1

### 3.5.95 y\_vel

The Y component of spacecraft velocity in the Earth Centered Rotating (ECR) coordinate system. The element in frame\_time with a matching array index specifies the time of the velocity measurement. Spacecraft velocity measurements based on predictive ephemeris data are accurate to the nearest meter per second. Spacecraft velocity measurements based on definitive ephemeris data are accurate within 0.015 meters per second.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	m/s
minimum_value:	-8000.000
maximum_value:	8000.000
scale_factor:	1

### 3.5.96 z\_pos

The Z component of spacecraft position in Earth Centered Rotating (ECR) coordinate system. The element in frame\_time with a matching array index specifies the time of the position measurement. Spacecraft position measurements based on predictive ephemeris data are accurate to the nearest kilometer. Spacecraft position measurements based on definitive ephemeris data are accurate within 150 m.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	m
minimum_value:	-9999999
maximum_value:	9999999
scale_factor:	1

### 3.5.97 z\_vel

The Z component of spacecraft velocity in the Earth Centered Rotating (ECR) coordinate system. The element in frame\_time with a matching array index specifies the time of the velocity measurement. Spacecraft velocity measurements based on predictive ephemeris data are accurate to the nearest meter per second. Spacecraft ve-

locity measurements based on definitive ephemeris data are accurate within 0.015 meters per second.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	m/s
minimum_value:	-8000.000
maximum_value:	8000.000
scale_factor:	1



## 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
CDR	Critical Design Review
CDS	Command and Data Subsystem
CR	Change Request
CRC	Cyclic Redundancy Code
dB	decibels
dB <sub>i</sub>	decibels isotropic
dB <sub>m</sub>	decibels relative to 1 milliwatt
dB <sub>W</sub>	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
GHz	gigahertz
GPS	Global Positioning System
GHA	Greenwich Hour Angle
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
MHz	megahertz
MLE	Maximum Likelihood Estimator
m	meters
m/s	meters per second
μA	microamps
mA	milliamps
mGauss	milliGauss
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 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 function return status. */

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

        attr_index = SDFindattr( HDF_id, label );

    /* 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 unimpor-
    tant. */

        if ( attr_index >= 0 )
        {
            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 */

```