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SeaWinds Processing and Analysis Center (SeaPAC)

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

QuikSCAT 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 which is based on data acquired by the SeaWinds instrument on the NASA Quick Scatterometer (QuikSCAT) 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 QuikSCAT Science Data Product User's Manual provides a more comprehensive explanation of these data within the complete context of the QuikSCAT instrument, algorithms, and software.

1.3 Content Overview

Each QuikSCAT Level 1B data file contains one 'rev' or less of QuikSCAT data. A complete rev includes all of the data which pertains to one full orbital revolution of the spacecraft. By convention, all QuikSCAT revolutions begin and end at the southernmost orbital latitude.

The QuikSCAT Level 1B Product specifies the value, the condition, the location and the uncertainty of normalized radar cross section (sigma0) measurements which were acquired by the SeaWinds scatterometer. The Level 1B Product also includes measurements for eight of the twelve component 'slices' of each sigma0 which the Linear Frequency Modulation Chirp (LFMC) function generates. The QuikSCAT Level 1B Product lists the eight center slices of each sigma0.

The QuikSCAT Level 1B Processor outputs the Level 1B Product. The Level 1B Processor reads relevant telemetry data from the QuikSCAT 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 QuikSCAT Level 1B Processor uses a tabular model of the radar equation to generate a normalized radar cross section (sigma0) value for each backscatter power reading.

The QuikSCAT Level 1B data are sorted in time order by telemetry frame. Each telemetry frame includes 100 scatterometer pulses. Based on nominal operating conditions, which include a QuikSCAT spacecraft orbital time of 101 minutes, and a 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 sigma0 measurements and more than 8 million sigma0 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 QuikSCAT 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 every high frequency resolution slice in the rev.

1.4 Related Interfaces

Level 0 Data Software Interface Specification, Project Document 686-644-4, JPL D-16075, January 1996.

Level 1A Data Software Interface Specification, Project Document 686-644-5, JPL D-16076, November 1999.

Level 2A Data Software Interface Specification, Project Document 686-644-2, JPL D-16078, January 2000..

Level 2B Data Software Interface Specification, Project Document 686-644-3, JPL D-16079, January 2000.

Processing Tables Software Interface Specification, Project Document 686-644-6, JPL D-16080, November 1999.

1.5 Applicable Documents

QuikSCAT Ground System Interface Control Document, Ball Aerospace and Technologies Corporation, Aerospace Systems Division, June, 1998, BASD 545460.

QuikSCAT Science Data Product User's Manual, TBD.

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

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

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

SeaWinds - PO.DAAC Interface Control Document, TBD.

SeaPAC System Functional Requirements, September 1997, JPL D-16073, PD

686-610.

Science Algorithm Specification for SeaWinds, Jet Propulsion Laboratory, Pasadena, California, update due for release in June 1999.

Planetary Science Data Dictionary Document, July 15, 1996, JPL D-7116, Rev. D, V6 MGSO0099-05-00.

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

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

HDF Reference Manual, Version 4.1r2, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, June, 1998.

HDF User's Guide, Version 4.1r2, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, June, 1998.

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 QuikSCAT 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 QuikSCAT data products should utilize the NCSA HDF interface library routines.

All QuikSCAT files are created under the UNIX™ 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 of the QuikSCAT level data products are divided into discrete files which are defined by spacecraft 'revs'. One rev includes all of the data acquired during a single orbital revolution of the spacecraft.

Each QuikSCAT data product file includes a header. The product header contains multiple metadata elements. The conditions specified by the QuikSCAT metadata apply to the entire set of data in the file. The remainder of the file contains either those data acquired by the SeaWinds instrument over the spacecraft measurement swath, or those data which were generated by QuikSCAT 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 QuikSCAT Level Processors employ include Scientific Data Sets (SDS), Vdata, and Global Attributes.

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

SDS array notation is similar to the standards of the C programming language where indices are zero based. Thus, the first index in each dimension is zero. This convention is unlike Fortran, where the initial index in each dimension is one. In 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 QuikSCAT 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. QuikSCAT level data products use “scientific data sets”, “Vdatas”, and “global attributes”. Most QuikSCAT data are stored in scientific data sets. Global attributes are descriptive entries which are used to store the QuikSCAT 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 QuikSCAT 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”, “deg K”, “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 QuikSCAT 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.

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

QuikSCAT double precision time variables contain measurements in International

Atomic Time (TAI). TAI measurements represent the real number of Standard International (SI) compatible seconds since 12:00 AM January 1, 1993 UTC. This initial time is an Earth Observing System Data and Information System (EOSDIS) Core System (ECS) standard. Although the QuikSCAT Project does not work directly with the ECS, the QuikSCAT Project uses this initial time to generate data which are compatible with data stored in the ECS.

1.6.5 Coordinate Systems

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

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

1.6.6 Metadata

All of the entries in the QuikSCAT 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 QuikSCAT 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 QuikSCAT 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. QuikSCAT 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.

QuikSCAT higher level data products may eventually be stored and distributed through the ECS. Thus, the full set of metadata in each distributable QuikSCAT 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 QuikSCAT 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 QuikSCAT 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 QuikSCAT product metadata may use these byte estimates to insure that the complete content of the metadata element is extracted from the QuikSCAT 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. The bit flags in the slice_qual_flag indicate whether the data that pertain to each individual slice are valid as well. 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.

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 QuikSCAT processors use to set and clear bit flags.

At the start of processing, all QuikSCAT bit flag values are initialized. The standard procedure for QuikSCAT 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 appropriate bit flag which indicates the 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 processing 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 bits in the sigma0_qual_flag contain valid values. One valid bit 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, the center location flags for each slice and the 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)

Table 1: Bit Flag Dependencies

Pivotal Bit Flag	Other Bit Flags With Meaningful Value when Pivotal Flag is 0
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)
	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)
	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)

Table 1: Bit Flag Dependencies

Pivotal Bit Flag	Other Bit Flags With Meaningful Value when Pivotal Flag is 0
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

QuikSCAT 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.

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 in the 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

QuikSCAT 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 QuikSCAT project transfers the data to the Physical Oceanography Distributed Active Archive Center (PO.DAAC) which creates a permanent archive of each QuikSCAT level data product and handles the external distribution of these products.

All QuikSCAT 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 QuikSCAT standard data products.

2.2 Data Volume Estimates

The following table lists each of the major data components in the QuikSCAT 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	14104	14.104	14.104
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			219610.104	191941.008

2.3 SeaWinds File Names

QuikSCAT 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 'QS'. These characters specify that the data were generated by the QuikSCAT 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, QuikSCAT Level 1B file names must conform to the following format:

QS_S1Bnnnnn.yyyydddhhmm

where

nnnnn:	The QuikSCAT satellite 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 QuikSCAT Level Products a high degree of flexibility. This flexibility in turn gives QuikSCAT users the capability to write software which does not need to be modified to accommodate unforeseeable changes in the QuikSCAT products. Since changes to the products are certain to take place over the life of the QuikSCAT and SeaWinds missions, 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 QuikSCAT 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 QuikSCAT Product, the HDF routine SDfindattr is very useful. SDfindattr requires two input parameters, the first is an HDF file identifier, while the second is character string which contains the name of a global attribute. In all QuikSCAT 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 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 QuikSCAT and 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 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 QuikSCAT Level Products should employ similar methods to incorporate important information about the SDS elements. For example, several of the data elements in the QuikSCAT Level Products are stored as scaled integers. HDF incorporates a means to store the scale factor associated with each data element. QuikSCAT products take advantage of this storage location. The HDF routine SDgetcal returns this scale factor to the calling application program. Level Product users should incorporate SDgetcal into their reader code. Use of SDgetcal insures 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 Level 2A and Level 2B QuikSCAT 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 QuikSCAT 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 QuikSCAT 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 which are generated by the SeaWinds instrument’s high resolution Linear Frequency Modulation Chirp (LFMC) function. The QuikSCAT Level 1B Product lists measurements for the eight center slices of each sigma0. The two slices at either end of 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].

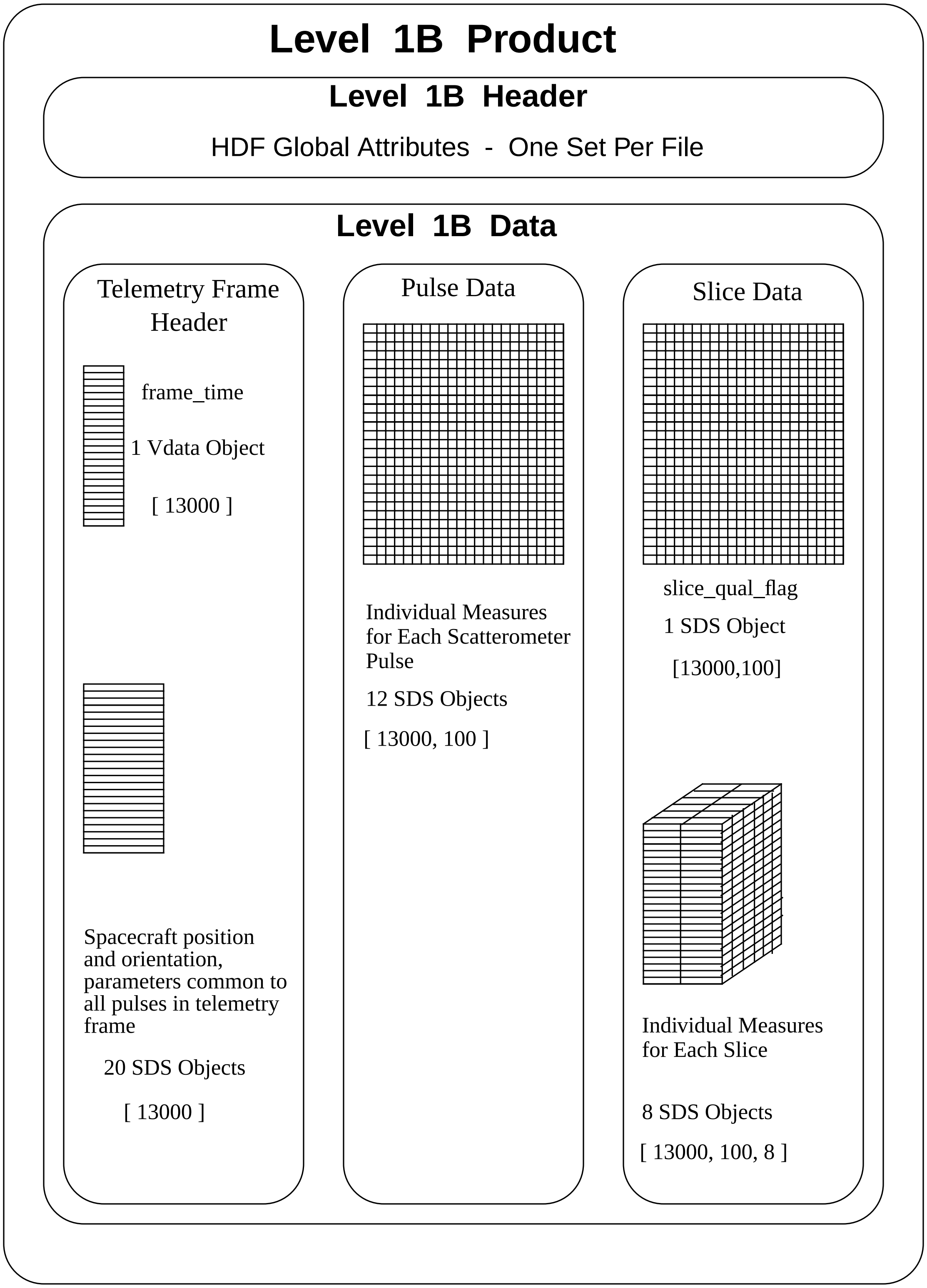
The elements in the Pulse and Slice Data contain a second data index. The second index in these arrays references one of the 100 scatterometer pulses in each telemetry frame. Thus, data element cell_azimuth[6212,41] represents the azimuth of the sigma0 cell for the forty second scatterometer pulse in 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 the slices in each pulse. 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 slice of the forty second scatterometer pulse in the telemetry frame which 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 QuikSCAT scatterometer's slice and pulse geometry as well as instrument timing, see the QuikSCAT 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 because these objects are not included in the HDF file.



3.3 Header Structure

The following table lists all of the elements in the QuikSCAT 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. QuikSCAT 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 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]

Table 3: Header Structure

Element Name	Maximum Array Size
HDF_version_id	[1]
ParameterName	[1]
QAPercentOutOfBoundsData	[1]
QAPercentMissingData	[1]
OperationMode	[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]
l1b_expected_frames	[1]
l1b_actual_frames	[1]
l1b_algorithm_descriptor	[8]
ephemeris_type	[1]
attitude_type	[1]
maximum_pulses_per_frame	[1]
cell_kpc_b	[8,2]

Table 3: Header Structure

Element Name	Maximum Array Size
slice_kpc_b	[8,2]
cell_kpc_c	[8,2]
slice_kpc_c	[8,2]
num_slices_per_sigma0	[1]
receiver_gain_ratio	[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	2008-366T23:59:60.999
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	0x01FFFFFF
frame_qual_flag	enum	uint16	[13000]	1	0X0000	0X001F
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

Table 4: Telemetry Frame Header

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
x_vel	real	float32	[13000]	1	-8000.00	8000.00
y_vel	real	float32	[13000]	1	-8000.00	8000.00
z_vel	real	float32	[13000]	1	-8000.00	8000.00
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	0x03FF
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	44.00	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
qscat_app_tb	real	int16	[13000,100]	0.1	0.0	350.0

3.4.3 Slice Data

The Slice Data reference each of the slices which are generated by the SeaWinds instrument's high resolution mode Linear Frequency Modulation Chirps (LFMC) function. 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
slice_azimuth	real	uint16	[13000,100,8]	0.01	0.00	359.99
slice_incidence	real	int16	[13000,100,8]	0.01	44.00	60.00

Table 6: Slice Data

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
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 which specifies all of the ancillary data files which were used to generate the output product. Ancillary data sets include all Level Processor input except for the primary input file.

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 calculated azimuth of the SeaWinds antenna at the instant when the radiation from the first scatterometer pulse in the telemetry frame impacts 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

3.5.3 attitude_type

A character string which 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 QuikSCAT HK2

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	80
units:	n/a
minimum_value:	n/a
maximum_value:	n/a
scale_factor:	n/a
valid_values:	'Star Tracker'

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 which was used to generate this data file. The build_id has the format x.y.z/yyyy-mm-dd where x.y.z is the version identification number and yyyy-mm-dd is the date that the software build was completed.

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 whole pulse 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 whole pulse sigma0 cell 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:	44.00
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 Kpc for whole pulse measurements. Kpc 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 kpc for whole pulse sigma0 measurements. Kpc 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 kpc for whole pulse sigma0 measurements. Kpc 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 whole pulse 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 whole pulse 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 which describes the internal format of the data product. This value indicates which software tools or which types of program language statements are necessary in order to read the data product file.

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

3.5.16 ephemeris_type

A character string which 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 QuikSCAT HK2
EPHD	QuikSCAT determined ephemeris data file
EPHP	QuikSCAT 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:	2008-366

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	Payload Bus Interface (PBI) Flag	
		0 - Payload Bus Interface is in expected state
		1 - Payload Bus Interface is in bad or unexpected state
15	Payload Bus Interface (PBI) Watchdog Timer Event Flag	
		0 - No watchdog timer event noted
		1 - Watchdog timer event noted
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 - An applicable attitude record was found for this telemetry frame
1 - No applicable 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:	0x0FFFFFFF
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 - Pulse A first
	1 - Pulse 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 state of TWTA monitor
		1 - Change in 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	Frame CRC flag 0 - No CRC errors in telemetry frame 1 - CRC errors only in packet 2 2 - CRC errors only in packet 3 3 - CRC errors in both packets 2 and 3
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: 0X001F
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:	sec
minimum_value:	1993-001T00:00:00.000
maximum_value:	2008-366T23:59:60.999
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 the major input data granule which was used to generate this product. The ECS requires this metadata element for all full class products. Users may employ this mandatory value to locate particular records within the ECS database. For products in the SeaPAC environment, this element contains the name of the input data 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

3.5.28 InstrumentShortName

The name of the instrument which collected the telemetry data.

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

3.5.29 l1b_actual_frames

A value which 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 l1b_algorithm_descriptor

A set of character strings which list important details about the implementation of the Level 1B Processor algorithm which were 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 l1b_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.

A nominal QuikSCAT telemetry frame encompasses 0.53 seconds of instrument measurements. Every QuikSCAT Level 1B Product file contains data for one rev. The maximum number of telemetry frames within a single file is restricted by the number frames acquired over one complete circumference of the Earth. The estimated orbital time of the QuikSCAT 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: ’QuikSCAT 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 Science Data in the Level 1A Product file as well as for two dimensional 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 or the number of science data entries within a Level 1A 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 high resolution slices which combine to determine a representative measurement for each complete scatterometer pulse. This value is not necessarily equivalent to the number of slices per pulse which are stored in the Level Product file.

HDF_model:	global_attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	count
minimum_value:	1
maximum_value:	12
nominal_value:	10

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, Operation-

Mode 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'. Some of the Level Products contain more detailed information with regard to instrument mode over the span of the data granule. Specifically, the frame_inst_status of the Level 1A Product and the Level 1B Product does include 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. QuikSCAT 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
scale_factor: n/a

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. QuikSCAT 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: 0.0000
maximum_value: 180.0000
scale_factor: n/a

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 QuikSCAT spacecraft orbit. QuikSCAT 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
scale_factor: n/a

3.5.41 orbit_time

The spacecraft 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. Orbit_time records the 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 QuikSCAT Level Product.

The data element specified as the 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
valid_value:	’slice_sigma0’

3.5.43 pitch

The angular rotation about the x-axis of the QuikSCAT spacecraft fixed right handed coordinate system. The element in frame_time with a matching array index specifies the time of the pitch measurement. The QuikSCAT spacecraft fixed coordinate system defines the y-axis in the direction of flight and the z-axis in the nadir direction. Positive pitch direction conforms to the right hand rule.

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 test 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:	’NASA Quick Scatterometer’

3.5.45 PlatformShortName

A unique identifier for the platform associated with the test 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: 'QuikSCAT'

3.5.46 PlatformType

The type of platform associated with the test 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:	2008-366T23:59:60.999

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:	'QuikSCAT'

3.5.51 qscat_app_tb

The output from the QuikSCAT apparent brightness temperature algorithm. This algorithm utilizes QuikSCAT instrument noise energy levels to approximate the brightness temperature.

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

3.5.52 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

3.5.53 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

3.5.54 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

3.5.55 RangeBeginningDate

The initial time for data coverage within this QuikSCAT data product. The time is equivalent to the moment the spacecraft passes over the southernmost point in its orbital path. 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:	2008-366

3.5.56 RangeBeginningTime

The initial time for data coverage within this QuikSCAT 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

3.5.57 RangeEndingDate

The final time for data coverage within this QuikSCAT data product. This time is equivalent to the moment the spacecraft passes over the southernmost point in its orbital path. 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:	2008-366

3.5.58 RangeEndingTime

The final time for data coverage within this QuikSCAT 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

3.5.59 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:	24
units:	dB
minimum_value:	TBD
maximum_value:	TBD
nominal_value:	4.65

3.5.60 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

3.5.61 rev_orbit_period

The time between two consecutive ascending node crossings in the spacecraft orbital path. QuikSCAT 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:	80
units:	seconds
minimum_value:	n/a
maximum_value:	n/a
scale_factor:	n/a

3.5.62 roll

The angular rotation about the y-axis of the QuikSCAT spacecraft fixed right handed coordinate system. The element in frame_time with a matching array index specifies the time of the roll measurement. The QuikSCAT spacecraft fixed coordinate system defines the y-axis in the direction of flight and the z-axis in the nadir direction. Positive roll direction conforms to the right hand rule.

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

3.5.63 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

3.5.64 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

3.5.65 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

3.5.66 ShortName

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

HDF_model:	global attributes
conceptual_type:	string
storage_type:	char
number_of_bytes:	24

units:	n/a
minimum_value:	n/a
maximum_value:	n/a
valid_values:	'QSCATL1B'

3.5.67 sigma0_mode_flag

Bit flags which 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

3.5.68 sigma0_qual_flag

Bit flags which 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 (SNR >= TBD) 1 - SNR level is low (SNR < TBD)
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 - An applicable attitude record was found for this sigma0
		1 - No applicable attitude records were 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
10-15	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:	0x03FF
scale_factor:	1

3.5.69 sis_id

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

3.5.70 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 equal to -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:	integer
number_of_bytes:	96
units:	frames
minimum_value:	-1
maximum_value:	13000

3.5.71 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 user 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:	2008-366T23:59:60.999

3.5.72 skip_stop_frame

The array index of a telemetry frame which specifies where a nonexistent, unnecessary, 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 equal to -1, the final 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:	integer
storage_type:	integer
number_of_bytes:	96
units:	frames
minimum_value:	-1
maximum_value:	13000

3.5.73 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 user 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:	2008-366T23:59:60.999

3.5.74 slice_azimuth

The azimuth angle of the antenna boresight at the center of one of the high resolution cell slices. 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

3.5.75 slice_incidence

The angle at the center of one of the sigma0 high resolution slices 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:	44.00
maximum_value:	60.00
scale_factor:	0.01

3.5.76 slice_kpc_a

A representative kpc_a value for one of the slices of a scatterometer pulse. Kpc_a is the zero order coefficient of the inverse second order polynomial in the signal to noise ratio which yields Kpc. Kpc 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

3.5.77 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 kpc for slice sigma0 measurements. Kpc 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_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

3.5.78 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 kpc for slice sigma0 measurements. Kpc 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

3.5.79 slice_lat

The difference in geodetic latitude of the center of one of the high resolution slices of 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

3.5.80 slice_lon

The quantity of the difference of longitude of the center of one of the high resolution slices of a sigma0 cell from the center of the entire sigma0 cell multiplied by the co-sine 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

3.5.81 slice_qual_flag

Bit flags which indicate the quality of the data which generate the sigma0 measure-ments for each of the slices 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 >= 0 1 - Sigma0 < 0
2	Low SNR Flag for slice 1 0 - SNR level is acceptable (SNR >= TBD) 1 - SNR level is low (SNR < TBD)
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 >= 0 1 - Sigma0 < 0
6	Low SNR Flag for slice 2 0 - SNR level is acceptable (SNR >= TBD) 1 - SNR level is low (SNR < TBD)
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 >= 0 1 - Sigma0 < 0
10	Low SNR Flag for slice 3 0 - SNR level is acceptable (SNR >= TBD) 1 - SNR level is low (SNR < TBD)

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 >= 0
- 1 - Sigma0 < 0

14 Low SNR Flag for slice 4
- 0 - SNR level is acceptable (SNR >= TBD)
- 1 - SNR level is low (SNR < TBD)

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 >= 0
- 1 - Sigma0 < 0

18 Low SNR Flag for slice 5
- 0 - SNR level is acceptable (SNR >= TBD)
- 1 - SNR level is low (SNR < TBD)

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 >= 0
- 1 - Sigma0 < 0

22 Low SNR Flag for slice 6
- 0 - SNR level is acceptable (SNR >= TBD)
- 1 - SNR level is low (SNR < TBD)

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 >= 0 1 - Sigma0 < 0
26	Low SNR Flag for slice 7 0 - SNR level is acceptable (SNR >= TBD) 1 - SNR level is low (SNR < TBD)
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 >= 0 1 - Sigma0 < 0
30	Low SNR Flag for slice 8 0 - SNR level is acceptable (SNR >= TBD) 1 - SNR level is low (SNR < TBD)
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

3.5.82 slice_sigma0

The normalized radar cross section for one of the sigma0 slices. 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

3.5.83 slice_snr

The ratio of signal to noise for one of the slices 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

3.5.84 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

3.5.85 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

3.5.86 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/QuikSCAT 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/QuikSCAT 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: -8000.00
maximum_value: 8000.00
scale_factor: 1

3.5.93 yaw

The angular rotation about the z-axis of the spacecraft fixed right handed coordinate system. The element in frame_time with a matching array index specifies the time of the yaw measurement. The spacecraft fixed coordinate system defines the y-axis in the direction of flight and the z-axis in the nadir direction. Positive yaw direction conforms to the right hand rule.

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:	-8000.00
maximum_value:	8000.00
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 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:	-8000.00
maximum_value:	8000.00
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/QuikSCAT document.

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

EPHP	Predicted Ephemeris
ESDIS	Earth Science Data and Information System Project
ESDT	Earth Science Data Type
EU	Engineering Unit
FRB	Functional Requirements Baseline
FTP	File Transfer Protocol
FTS	File Transfer Server
FX	SeaPAC File Transfer program set
GPS	Global Positioning System
GHA	Greenwich Hour Angle
GMT	Greenwich Mean Time
HDF	Hierarchical Data Format
HK1	QuikSCAT Playback Spacecraft Housekeeping Data
HK2	SeaWinds on QuikSCAT Playback Instrument Housekeeping Data
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
LAN	Local Area Network
LOE	Level Of Effort
LFMC	Linear Frequency Modulation Chirp
LP	SeaPAC Level Processor program set
MLE	Maximum Likelihood Estimator
m	meters
m/s	meters per second
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NCEP	National Center for Environmental Prediction
NCSA	National Center for Supercomputing Applications
NERT	Near Real Time
NFS	Network File System/Server

NIC	National Ice Center
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
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
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
SCCLK	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 QuikSCAT 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 QuikSCAT/SeaWinds, all attributes
are stored as character strings. Thus, the value of num_type
is unimportant. */

   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 */
```