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

**Level 2A 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 2A data of the SeaWinds Processing and Analysis Center (SeaPAC). This document applies to any Level 2A 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 2A Product. Its intent is to elucidate the Level 2A 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

The Level 2A data file organizes the QuikSCAT composites of normalized radar cross section ( $\sigma_0$ ) values by location. Each composite  $\sigma_0$  combines all of the high resolution slices which were generated from the same measurement pulse and which lie within the same wind vector cell.

The Level 2A Processor calculates, and the Level 2A Product includes, an estimated attenuation of scatterometer measurements due to atmospheric conditions for each composite  $\sigma_0$ . The estimated attenuations are based on global climatological maps generated from several years of SSM/I data.

The Level 2A Processor earmarks composite  $\sigma_0$  measurements which are located over land or significant quantities of sea ice. The Level 2A Product flags composite  $\sigma_0$ s which are unsuitable for sea surface wind investigations due to these conditions.

Each Level 2A data file contains one 'rev' or less of QuikSCAT data. A complete rev includes all of the data which were acquired during one full orbital revolution of the spacecraft. By convention, all QuikSCAT revolutions begin and end at the southernmost orbital latitude.

The Level 2A Processor generates a grid of wind vector cells (WVC) aligned with the along-track and cross-track axes of the SeaWinds instrument measurement swath. Level 2A WVCs are 25 km squares.

## 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, October 1999.

Level 1B Data Software Interface Specification, Project Document 686-644-1, JPL

D-16077, 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<sup>TM</sup> operating system. Since these files are in HDF format, however, these data should be portable to most major computing devices, provided the requisite HDF software tools are available.

Each 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

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 2A Processor detects an anomalous condition which halts the processing for a particular composite sigma0, the appropriate bit flag which indicates the error condition remains set to 1. Since the processor may curtail subsequent operations for a composite sigma0 that fails a test, those bit flag conditions which normally would be tested in the subsequent code could retain their initialized value. Thus, the order in which bit flags are processed often determines whether their values are meaningful.

For instance, if the surface\_flag for a particular composite sigma0 indicates that land is present, the Level 2A Processor does not test whether ice is present. Since the code does not test for ice, the value of the surface ice flag and ice map available flag remain set to 1. Clearly, these values for the surface ice flag and the ice map available flag are not indicative of the conditions for that composite sigma0.

On the other hand, the Level 2A Processor does attempt to calculate an attenuation for every composite sigma0 regardless of whether the measurement had been flagged for land or for ice. Thus, the value of the attenuation map available flag is always correct, regardless of previously flagged conditions.

The following table describes the bit flag dependencies for the surface\_flag in the Level 2A Product. The column on the left lists three pivotal bits in the surface\_flag. The middle column lists the possible values for those bits. The column on the right indicates which of the remaining bits in the surface\_flag are meaningful under the corresponding conditions.

**Table 1: Bit Flag Dependencies**

Bit Flag	Value	Other Bits with Meaningful Value
Surface land flag (bit 0)	0	Ice map data available flag (bit 10)
		Attenuation map data available flag (bit 11)
	1	Attenuation map data available flag (bit 11)
Surface ice flag determined by map (bit 1)	0	Surface land flag (bit 0)
		Ice map data available flag (bit 10)
		Attenuation map data available flag (bit 11)

**Table 1: Bit Flag Dependencies**

Bit Flag	Value	Other Bits with Meaningful Value
Surface ice flag determined by map (bit 1)	1	Surface land flag (bit 0)
		Attenuation map data available flag (bit 11)
Ice map data available flag (bit 10)	0	Surface land flag (bit 0)
		Surface ice flag determined by map (bit 1)
		Attenuation map data available flag (bit 11)
	1	Surface land flag (bit 0)
Attenuation map data available flag (bit 11)		

### 1.6.8 Null Values

QuikSCAT null values are listed as zeros in the Level 2A Product. The Level 2A Product does, however, contain adequate information so that users can easily distinguish null values from actual zeros.

The Level 2A Product lists null values whenever the maximum number of composite sigma0s in a wind vector cell row is less than the maximum 3240. As an example, assume the SDS num\_sigma0 indicates that there are 2500 composite sigma0 records in a particular wind vector cell row. For that wind vector cell row, each SDS contains exactly 2500 valid second dimension entries. The Level 2A Product lists zeros for every data element which represents a composite sigma0 with a second dimension index which is greater than or equal to 2500 for that wind vector cell row. Clearly, all of those zeros should be interpreted as null values.

Based on this example, assume that num\_sigma0[400] is 2500. If cell\_lat[400,2499] and cell\_lat[400,2500] are both equal to zero, cell\_lat[400,2499] is a true zero value. The associated composite sigma0 is located on the equator. On the other hand, cell\_lat[400,2500] is a null value. This data interpretation method applies to all of the data objects in the Level 2A Product where the second dimension index represents a composite sigma0.

The data element cell\_index verifies the existence of null entries. Every composite sigma0 must lie within a wind vector cell. Thus, if the cell\_index for a particular pair of indices is zero, no associated composite sigma0 exists. All data associated with that pair of indices are null. For example, if cell\_index[400,2500]=0, then the index pair [400,2500] references null values for all Level 2A Product SDS objects.

The attenuation map available bit in the surface\_flag also distinguishes zero from null values in the Level 2A Product. If the surface\_flag indicates that the attenuation data are not available, then the sigma0\_attn\_map data element with matching array indices is zero. That zero represents a null value.

## 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 the major data components of a QuikSCAT Level 2A 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 side of the table specify the overall storage space. One column lists the maximum size of the Level 2A Product file, while the other lists the expected size of the Level 2A Product. The maximum total volume provides for 1702 WVC rows of data and 3240 composite sigma0 cells in each WVC row.

The expected total volume includes 1702 WVC rows and 2700 composite sigma0 cells per WVC row. The smaller number of composite sigma0 cells is based on two likely, but not certain outcomes. First, the SeaWinds instrument acquires data at the nominal pulse rate of 187.5 Hz, and not at the maximum pulse rate of 212 Hz. Second, the Level 2A Product can allocate space for fewer than four composites per scatterometer pulse without losing any data.

Both of these data volume estimates include the wvc\_sigma0\_spare SDS which does not appear in the standard Level 2A Product.

**Table 2: Data Volume Estimates**

Data Set	Number of Entries	Bytes Per Entry	Maximum Total Volume (KBytes)	Expected Total Volume (KBytes)
Level 2A Header	1	7440	7.440	7.440
Level 2A Data	1702	107021	182149.742	151820.102
Level 2A Product			182157.182	151827.420

### 2.3 SeaWinds File Names

QuikSCAT Level 2A data file names are 23 characters in length. Each file name consists of a two character alphabetic string followed by an underscore and eight addi-



tional 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 'S2A'. These characters identify the Level 2A Science Data Product. All alphabetical characters are upper case.

Specifically, QuikSCAT Level 2A file names must conform to the following format:

QS\_S2Annnnn.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 the 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.

## 2.5 Data Correspondence with Level 2B Product

The Level 2B Processor uses the sigma0s in the Level 2A Product to generate winds over the ocean's surface. Since the organization of the Level 2A and Level 2B Products are considerably different, the correspondence between the sigma0s in the Level 2A Product and the winds generated from those sigma0s in the Level 2B Product is not straightforward.

Two data elements in the Level 2A Product specify the Level 2B wind vector cell where each sigma0 lies. These elements are the row\_number and the cell\_index.

To demonstrate the use of these two data elements, assume a data element sigma0[i,j] that is located within the spacecraft rev which is designated in the name of a Level 2A Product file. Sigma0[i,j] is the (j-1)th sigma0 in the (i-1)th row of the Level 2A Product. Element row\_number[i] specifies the wind vector cell row where sigma0[i,j] is located. Element cell\_index[i,j] specifies the wind vector cell where sigma0[i,j] is located.

In other words, if

$$m = \text{row\_number}[i] - 1$$

and

$$n = \text{cell\_index}[i,j] - 1,$$

then the ordered pair [m,n] specifies the location of the elements in the Level 2B Product which were generated using sigma0[i,j]. Thus, wind\_speed[m,n,0] and wind\_dir[m,n,0] in the Level 2B Product are the wind speed and wind direction of the most likely ambiguity for the wind vector cell where sigma0[i,j] is located in the Level 2A Product. Users should note that sigma0[i,j] represents just one of several scatterometer measurements which contribute to the same wind vector solution.

This reasoning applies only for those sigma0s which lie within the rev which is designated in the name of the Level 2A Product file. The first 39 wind vector cell rows in each Level 2A file represent measurements which are located in the spacecraft rev that precedes the one specified in the file name. The final 39 wind vector cell rows in each Level 2A file represent measurements which are located in the spacecraft rev that follows the one specified in file name. Thus, the Level 2B Processor does not use any of the sigma0s in the first 39 or last 39 wind vector cell rows of the input Level 2A Product for wind retrieval.

### **3 DATA DEFINITION**

#### **3.1 Product Overview**

##### **3.1.1 Level 2A Product**

The Level 2A Processor outputs the Level 2A Product. Each Level 2A Product file contains all of the data which were acquired during one satellite rev. The Level 2A Product lists composites of sigma0 slices for every radar backscatter measurement within the rev. Each composite combines all of the high resolution slices from a single scatterometer pulse which lie in the same wind vector cell. The Level 2A Product file also contains ancillary data elements which correspond to each of the composite sigma0s. Among the ancillary data elements are entries which list the location, the quality and the uncertainty of the composite sigma0s.

##### **3.1.2 Level 2A Header**

The contents of the QuikSCAT Level 2A header are metadata. The header data set covers the entire contents of the file.

A set of HDF global attributes stores the entire Level 2A 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 character strings in each global attribute specify the data type, the array size and the value of the metadata element.

A sizable subset of the metadata elements are defined by the ECS. In the ECS environment, most of these elements are mandatory. In general, these elements specify critical information with regard to the accompanying data granule. The ECS utilizes these metadata elements to 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 2A Data**

The Level 2A Product lists the composites of sigma0 slices. Each composite incorporates all of the high resolution slices from the same scatterometer pulse which lie in the same wind vector cell. The Level 2A composites are grouped by wind vector cell (WVC) rows. Each WVC row corresponds to a single cross-track cut of the SeaWinds instrument measurement swath. Each Level 2A WVC is a 25 km square. Thus, 1624 WVC rows are adequate to cover one complete circumference of the earth.

The Level 2A Processor passes the full set of data which lie within the input Level 1B Product into the output Level 2A Product. The Level 1B Product is in temporal order and therefore defined by time boundaries. The Level 2A Product is in spatial order and defined by spatial boundaries. To insure that all data are transferred from the input to the output product, the Level 2A Processor design must consider the data acquisition pattern of the SeaWinds instrument's rotating antenna. As the spacecraft approaches and passes a rev boundary, the SeaWinds instrument acquires data on either side of that boundary. Thus, the Level 2A Product must include wind vector cell rows which extend beyond the 1624 which comprise one complete earth circumference. To cover those composite sigma0s which lie beyond the spatial

boundaries of the rev, the Level 2A Product includes 39 additional wind vector cell rows before the start and after the end of each rev. These additional wind vector cell rows cover 975 km at each end of the rev. Thus, the nominal Level 2A Product contains a total of 1702 wind vector cell rows.

The nominal instrument measurement swath extends for 900 km to either side of the satellite nadir track. Thus, a total of 72 WVCs, with 36 on either side of the nadir track, should accommodate nearly every composite sigma0 measurement. The attitude of the QuikSCAT spacecraft and the shape of the earth influence the ultimate location of each backscatter footprint on the earth's surface. Due to these variations, some composite sigma0 cells fall outside of the nominal 900 km SeaWinds instrument measurement swath. Few if any composite sigma0 cells, however, lie further than 950 km from the spacecraft nadir track. Thus, the Level 2A Product design includes 4 additional cell indices per WVC row. The Level 2A data entry cell\_index indicates the location of each composite sigma0 within the WVC row.

Since the SeaWinds pencil beam antenna rotates as the spacecraft travels, the number of composite sigma0 measurements which fall within each particular WVC is highly dependent on the cell's cross-track location. Studies indicate that a few cells located about 700 km from spacecraft nadir track may contain 40 or more scatterometer pulses. Most cells in the swath, however, are likely to contain between 12 and 30 scatterometer pulses. Clearly, a data design which assigns adequate space for the maximum number of expected pulses to every WVC in the grid is wasteful.

Using the spacecraft velocity and the instrument telemetry pulse rate, a simple calculation determines the expected number of measurement pulses which the SeaWinds instrument can acquire over its full swath as it travels between two along-track locations. Nominal instrument specifications indicate that the SeaWinds instrument pulses approximately 709 times as the spacecraft travels a distance of 25 km. This distance is the width of one Level 2A WVC row.

The Level 2A data design takes advantage of this constant pattern. The Level 2A Product groups composite sigma0 cells by WVC row.

To accommodate the highest pulse rate in the Scatterometer Electronic Subsystem (SES) specifications, the product design assumes that space should be available for 810 measurements pulses per wind vector cell row. Composite studies indicate that the average scatterometer pulse divides into between three and four composite sigma0s. Based on these studies, the Level 2A Product design allocates adequate space for four composites per scatterometer pulse. The Level 2A Product therefore can contain as many as 3240 composite sigma0s per wind vector cell row.

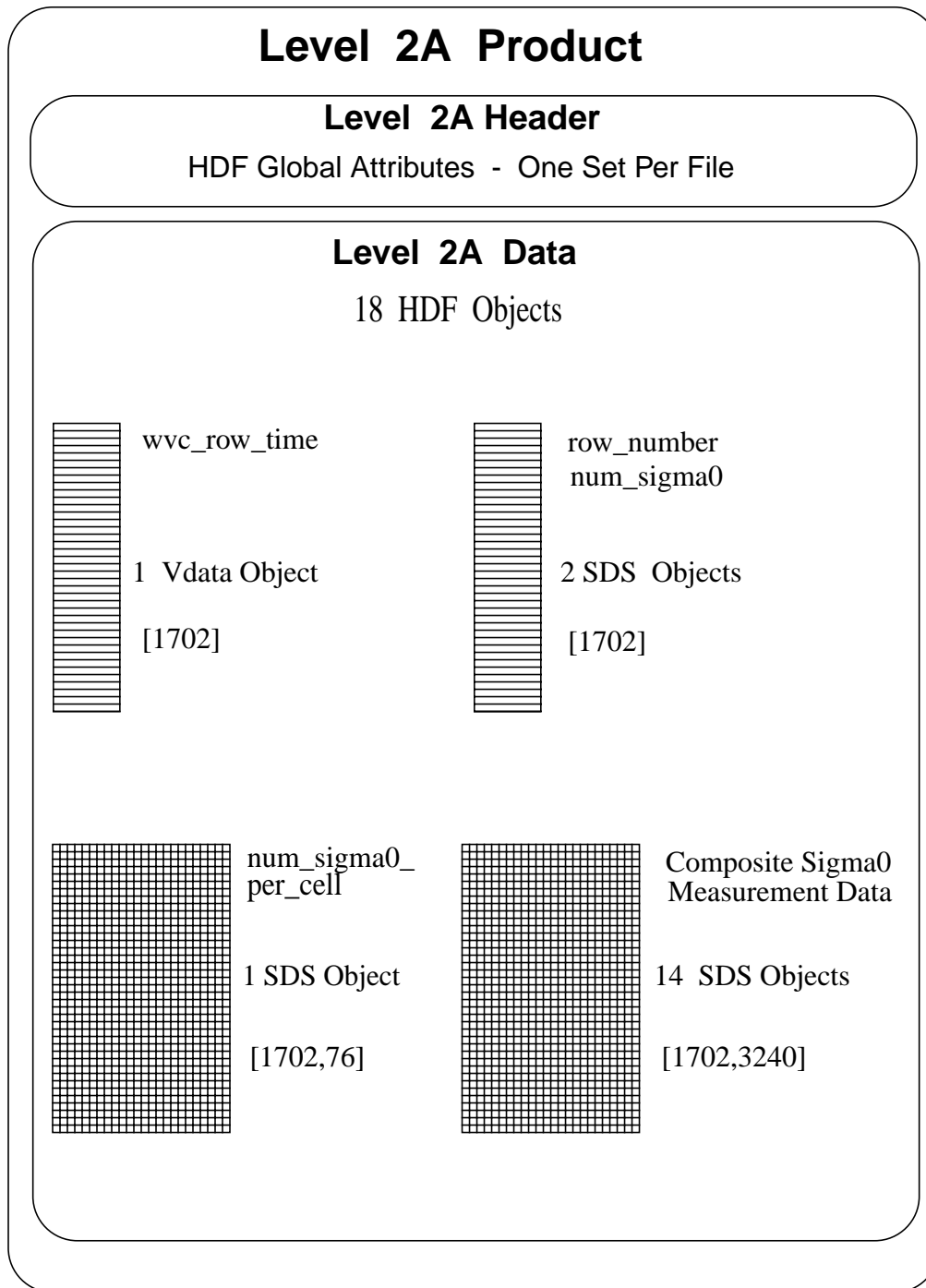
Almost all of the elements in the Level 2A Data are stored in HDF SDS data objects. The only exception is the wvc\_row\_time, which is stored in an HDF Vdata object.

Among the SDS objects in the Level 2A Product, only row\_number and num\_sigma0 are one dimensional arrays. Every element in both of these arrays is representative of an entire WVC row.

All of the remaining Level 2A Data entries are two dimensional SDS objects. In each case, the first array index represents the WVC row. With the exception of data element num\_sigma0\_per\_cell, the second array index represents a specific composite sigma0 within the WVC row. For element num\_sigma0\_per\_cell, the second array index represents one of the wind vector cells within the row.

### 3.2 File Structure

The following figure illustrates the internal structure of each QuikSCAT Level 2A Product file. The SDS object count does not include any 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 2A 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 and skip\_stop\_time must appear in every Level 2A Product file. These two 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	[10]
OrbitParametersPointer	[5]
sis_id	[1]
build_id	[1]
HDF_version_id	[1]

Table 3: Header Structure

Element Name	Maximum Array Size
ParameterName	[1]
QAPercentOutOfBoundsData	[1]
QAPercentMissingData	[1]
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]
maximum_sigma0s_per_row	[1]
ephemeris_type	[1]
l2a_algorithm_descriptor	[8]
l2a_actual_wvc_rows	[1]
l2a_expected_wvc_rows	[1]
sigma0_granularity	[1]

### 3.4 Data Structure

With the exception of `wvc_row_time`, every entry in the Level 2A Data is stored in an HDF scientific data set (SDS) object. An HDF Vdata object stores the `wvc_row_time`. The name of each Level 2A HDF data object matches the name of the data element which it stores. For all Level 2A Data HDF objects, the first array index identifies the wind vector cell row.

Objects `wvc_row_time`, `row_number` and `num_sigma0` are one dimensional. Each entry of these arrays applies to an entire wind vector cell row.

All of the remaining Level 2A Data elements are two dimensional SDS objects. Except for data element `num_sigma0_per_cell`, the second array index specifies one particular composite sigma0 measurement. For example, `cell_lon[312,14]` is the longitude of the center of the 15th composite sigma0 cell in the 313th wind vector cell row. Likewise, `sigma0_qual_flag[523,1245]` contains quality information regarding the 1246th composite sigma0 cell in the 524th wind vector cell row.

`Cell_index` indicates the wind vector cell location of a composite sigma0 measurement within the wind vector cell row. The QuikSCAT standard numbers wind vector cells from left to right when viewing the orbital swath in the direction of spacecraft flight. Thus, if `cell_index[502,100]` is 14, then the 101st composite sigma0 in the 503rd wind vector cell row lies in the 14th wind vector cell from the left hand side of the orbital swath when facing the spacecraft's forward direction of motion.

Data element `num_sigma0_per_cell` is the only element in the Level 2A Product that does not conform to the above pattern. Like all of the other data elements, the first index of `num_sigma0_per_cell` represents the wind vector cell row. The second index, however, represents a wind vector cell. Thus, `num_sigma0_per_cell[390,70]` contains the number of composite sigma0 entries in the 71st wind vector cell of the 391st wind vector cell row.

The following table lists the data elements in the SeaWinds Level 2A Data.

**Table 4: Data Structure**

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
<code>wvc_row_time</code>	time	char	[1702]	n/a	1993-001T00:00:00.000	2008-366T23:59:60.999
<code>row_number</code>	integer	int16	[1702]	1	1	1624



Table 4: Data Structure

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum
num_sigma0	integer	int16	[1702]	1	0	3240
num_sigma0_per_cell	integer	uint8	[1702,76]	1	0	255
cell_lat	real	int16	[1702,3240]	0.01	-90.00	90.00
cell_lon	real	uint16	[1702,3240]	0.01	0.00	359.99
cell_azimuth	real	uint16	[1702,3240]	0.01	0.00	359.99
cell_incidence	real	int16	[1702,3240]	0.01	44.00	60.00
sigma0	real	int16	[1702,3240]	0.01	-300.00	20.00
sigma0_attn_amsr	real	int16	[1702,3240]	0.01	-50.00	30.00
sigma0_attn_map	real	int16	[1702,3240]	0.01	-50.00	30.00
kp_alpha	real	int16	[1702,3240]	0.001	0.100	2.000
kp_beta	real	uint16	[1702,3240]	1.0E-6	1.0E-5	1.0E-2
kp_gamma	real	float32	[1702,3240]	1.0	1.0E-10	1.0E-2
sigma0_qual_flag	enum	uint16	[1702,3240]	1	0x0000	0x03FF
sigma0_mode_flag	enum	uint16	[1702,3240]	1	0X0000	0XFFFE
surface_flag	enum	uint16	[1702,3240]	1	0x0000	0x0C03
cell_index	unsigned integer	uint8	[1702,3240]	1	0	76

## 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:	2576
units:	n/a
minimum_value:	n/a
maximum_value:	n/a

### 3.5.2 build\_id

A character string that identifies the version of the SeaPAC software 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

### 3.5.3 cell\_azimuth

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

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

### 3.5.4 cell\_incidence

The angle at the center of a 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

### 3.5.5 cell\_index

This index denotes the cross-track location of a measurement within the SeaWinds Level 2A wind vector cell (WVC) grid. Each wind vector cell is a 25 km square. Each wind vector cell row contains 76 cells. Wind vector cell numbers increase from left to right when viewing the instrument swath from the direction of spacecraft flight. Thus, from the perspective of the forward moving spacecraft, the left most cell in each wind vector cell row has a cell\_index of 1. The right most cell in each wind vector cell row has a cell\_index of 76.

HDF_model:	scientific data set
conceptual_type:	unsigned integer
storage_type:	uint8
number_of_bytes:	1
units:	counts
minimum_value:	0
maximum_value:	76
scale_factor:	1

### 3.5.6 cell\_lat

The geodetic latitude of the center of a sigma0 cell.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	deg
minimum_value:	-90.00
maximum_value:	90.00
scale_factor:	0.01

### 3.5.7 cell\_lon

The longitude of the center of a sigma0 cell.

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

### 3.5.8 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'

### 3.5.9 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'

### 3.5.10 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

### 3.5.11 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

### 3.5.12 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

### 3.5.13 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

### 3.5.14 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

### 3.5.15 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

### 3.5.16 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'

### 3.5.17 kp\_alpha

The second order coefficient of a second order polynomial expansion in  $\sigma_0$  which expresses the variance in  $\sigma_0$  measurement. This coefficient is one of several parameters which determine the wind retrieval Maximum Likelihood Estimator (MLE). This coefficient is different from the coefficient used by NSCAT. The relationship between the value used by QuikSCAT ( $kp\_alpha$ ) and the value used by NSCAT ( $alpha$ ) is defined as follows:

$$kp\_alpha = (1 + alpha) / (1 + (kpm * kpm))$$

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16

number_of_bytes:	2
units:	n/a
minimum_value:	0.100
maximum_value:	2.000
scale_factor:	0.001

### 3.5.18 kp\_beta

The first order coefficient of a second order polynomial expansion in sigma0 which expresses the variance in sigma0 measurement. This coefficient is one of several parameters which determine the wind retrieval Maximum Likelihood Estimator (MLE). This coefficient is the same as the coefficient used by NSCAT.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	uint16
number_of_bytes:	2
units:	n/a
minimum_value:	1.0E-5
maximum_value:	1.0E-2
scale_factor:	1.0E-6

### 3.5.19 kp\_gamma

The zero order coefficient of a second order polynomial expansion in sigma0 which expresses the variance in sigma0 measurement. This coefficient is one of several parameters which determine the wind retrieval Maximum Likelihood Estimator (MLE). This coefficient is the same as the coefficient used by NSCAT.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	n/a
minimum_value:	1.0E-10
maximum_value:	1.0E-2
scale_factor:	1.0

### 3.5.20 l2a\_actual\_wvc\_rows

This value indicates the number of wind vector cell rows in the Level 2A Product which contain valid sigma0 measurement data. In most cases, this number should match the value in l2a\_expected\_wvc\_rows.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	counts
minimum_value:	1
maximum_value:	1702

### 3.5.21 I2a\_algorithm\_descriptor

A set of character strings which list important details about the implementation of the Level 2A 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

### 3.5.22 I2a\_expected\_wvc\_rows

The expected number of wind vector cell (WVC) rows in the Level 2A Product file. For a full rev of data, this number is 1702. This outcome results from a combination of product specifications and physical constraints.

Each Level 2A WVC is a 25 km square. Each nominal QuikSCAT Level 2A file contains data for one full rev or 1624 WVC rows. The input time-ordered Level 1B file contains sigma0s which are located beyond the rev spatial boundaries. To accommodate these measurements, the Level 2A file allocates an additional 39 WVC rows before the start and after the end of the rev. This yields 1702 WVC rows per Level 2A Product file.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	counts
minimum_value:	1
maximum_value:	1702

### 3.5.23 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 2A Surface Flagged Sigma0s and Attenuations in 25 km Swath Grid'



### 3.5.24 maximum\_sigma0s\_per\_row

The maximum number of composite sigma0 measurements among all of the wind vector cell rows in the accompanying QuikSCAT level product file. If the QuikSCAT instrument pulse rate is set to the nominal value of 187.5 Hz, this number should be close to 2600.

HDF_model:	global attributes
conceptual_type:	integer
storage_type:	char
number_of_bytes:	24
units:	pulses
minimum_value:	1
maximum_value:	3240

### 3.5.25 num\_sigma0

The total number of composite sigma0 measurements which fall within a single wind vector cell row.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	int16
number_of_bytes:	2
units:	counts
minimum_value:	0
maximum_value:	3240
scale_factor:	1

### 3.5.26 num\_sigma0\_per\_cell

The total number of composite sigma0 measurements which fall within a single wind vector cell.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	uint8
number_of_bytes:	1
units:	counts
minimum_value:	0
maximum_value:	255
scale_factor:	1

### 3.5.27 OperationMode

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

in the entire data granule records 'Wind Observation' mode, then the value of OperationMode is 'Wind Observation'.

The SeaPAC system does not run the Level 2A Processor unless some Wind Observation mode data are found in the input Level 1B data granule. Thus, the value of OperationMode for all Level 2A Product files should be 'Wind Observation'.

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

### 3.5.28 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

### 3.5.29 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

### 3.5.30 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 Sea-

PAC 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

### 3.5.31 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

### 3.5.32 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
maximum_value:	n/a
nominal_value:	'sigma0'

### 3.5.33 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'

### 3.5.34 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'

### 3.5.35 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'

### 3.5.36 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'

### 3.5.37 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'

### 3.5.38 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

### 3.5.39 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'

### 3.5.40 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

### 3.5.41 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

### 3.5.42 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

### 3.5.43 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

### 3.5.44 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

### 3.5.45 RangeEndingDate

The final 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

### 3.5.46 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

### 3.5.47 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

### 3.5.48 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

### 3.5.49 row\_number

This index denotes the along-track location of the wind vector cell (WVC) in the Sea-Winds instrument measurement swath. Each WVC in the QuikSCAT Level 2A Product is a 25 km square. Row number order corresponds with the direction of spacecraft flight. Thus, row number 1 is the first row that the spacecraft flies over in the rev. Row number 1624 is the final row that the spacecraft flies over in the rev. Since the Level 2A Product includes all of the sigma0 data which were provided in the input Level 1B Product, some of the composite sigma0s in the Level 2A Product are located in either the previous or the subsequent orbital rev. Thus, wind vector cell rows with row\_number values between 1 and 39 or row\_number values between 1586 and 1624 appear twice in each nominal Level 2A Product.

HDF\_model: scientific data set  
 conceptual\_type: integer  
 storage\_type: int16  
 number\_of\_bytes: 2  
 units: counts  
 minimum\_value: 1  
 maximum\_value: 1624  
 scale\_factor: 1

### 3.5.50 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: 'QSCATL2A'

### 3.5.51 sigma0

The normalized radar cross section calculated from the radar equation. This may be representative of an entire sigma0, a slice of a sigma0 or a composite of sigma0 slices. These sigma0 values have 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

### 3.5.52 sigma0\_attn\_amsr

A calculated nadir attenuation of the normalized radar cross section (sigma0) measurement due to atmospheric interference with scatterometer radiation. Algorithms based upon the brightness temperature measurements acquired by the Advanced Microwave Scanning Radiometer (AMSR) quantify anomalous scattering and attenuation of the SeaWinds scatterometer signal due to phenomena other than sea surface winds. Within the bandwidth of the SeaWinds scatterometer, the preponderance of this attenuation and scattering is due to liquid water in the atmosphere.

The QuikSCAT sigma0 data are not corrected for attenuations due to atmospheric effects with AMSR data. Thus, in all of the QuikSCAT Level 2A Product files, this data element contains zeros.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: int16  
 number\_of\_bytes: 2  
 units: dB  
 minimum\_value: -50.00  
 maximum\_value: 30.00  
 scale\_factor: 0.01

### 3.5.53 sigma0\_attn\_map

A nadir attenuation of the normalized radar cross section (sigma0) measurement due to atmospheric interference with scatterometer radiation. Within the bandwidth of the SeaWinds scatterometer, the preponderance of this attenuation and scattering is due to liquid water in the atmosphere. These values are based on maps which indicate average climatological attenuation of scatterometer measurements over the entire earth's surface. The QuikSCAT data base includes twelve of these maps, one for each month of the year.

HDF\_model: scientific data set  
 conceptual\_type: real  
 storage\_type: int16  
 number\_of\_bytes: 2  
 units: dB  
 minimum\_value: -50.00  
 maximum\_value: 30.00  
 scale\_factor: 0.01

### 3.5.54 sigma0\_granularity

A character string which identifies the granularity of the sigma0 measurements in the associated Level 2A Product. Possible values include:

whole pulses	sigma0s based on whole scatterometer pulses,
slice composites	sigma0s based on all of the slices of one pulse which lie in same wind vector cell,
composites of composites	sigma0s based on composites of slice composites,
pulse slices	sigma0s based on pulse slices.

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: 'whole pulses', 'slice composites', 'composites of composites', 'pulse slices'  
 nominal\_value: 'slice composites'

### 3.5.55 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 Slices Per Composite Flag
  - 0 - One pulse slice contributes to this composite
  - 1 - Two pulse slices contribute to this composite
  - 2 - Three pulse slices contribute to this composite
  - 3 - Four pulse slices contribute to this composite
  - 4 - Five pulse slices contribute to this composite

- 5 - Six pulse slices contribute to this composite
- 6 - Seven pulse slices contribute to this composite
- 7 - Eight pulse slices contribute to this composite

```
HDF_model:      scientific data set
conceptual_type: enum
storage_type:   uint16
number_of_bytes: 2
units:         n/a
minimum_value:  0X0000
maximum_value:  0XFFFE
scale_factor:   1
```

### 3.5.56 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

### 3.5.57 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

### 3.5.58 skip\_start\_time

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

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

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

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

HDF_model:	global attributes
conceptual_type:	time
storage_type:	char
number_of_bytes:	256
units:	n/a
minimum_value:	1993-001T00:00:00.000
maximum_value:	2008-366T23:59:60.999

### 3.5.59 skip\_stop\_time

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

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

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

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

HDF_model:	global attributes
conceptual_type:	time
storage_type:	char
number_of_bytes:	256
units:	n/a
minimum_value:	1993-001T00:00:00.000
maximum_value:	2008-366T23:59:60.999

### 3.5.60 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

### 3.5.61 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

### 3.5.62 surface\_flag

Bit flags which indicate the effect of surface conditions upon the sigma0 data.

The significance of each bit is as follows:

Bit	Definition
---	-----
0	Surface land flag 0 - No land is present 1 - Land is present
1	Surface ice flag determined by map 0 - Map indicates no ice is present 1 - Map indicates ice is present
2-9	Reserved for future use Always clear (0)
10	Ice map data available flag 0 - Ice map data available for this sigma0 1 - Ice map data not available for this sigma0
11	Attenuation map data available flag 0 - Attenuation map data available for this sigma0 1 - Attenuation map data not available for this sigma0
12-15	Spare Always clear (0)

HDF\_model: scientific data set  
 conceptual\_type: enum  
 storage\_type: uint16  
 number\_of\_bytes: 2

units:	n/a
minimum_value:	0x0000
maximum_value:	0x0C03
scale_factor:	1

### 3.5.63 wvc\_row\_time

The time when the nadir path of the QuikSCAT instrument passed over the midpoint of the corresponding wind vector cell row. This value provides a representative time for the data which are stored in the same wind vector cell row. Users should note that this time is not equivalent to the time that the data were acquired. Due to the rotating antenna design of the SeaWinds instrument, the measurements in the row may have been acquired a few minutes before or after the specified wvc\_row\_time. This time character string expression uses UTC format.

HDF_model:	Vdata
conceptual_type:	time
storage_type:	char
number_of_bytes:	21
units:	n/a
minimum_value:	1993-001T00:00:00.000
maximum_value:	2008-366T23:59:60.999
scale_factor:	n/a

### 3.5.64 wvc\_sigma0\_spare

Spare area for sigma0 cell storage. These bytes are included in data product volume estimates. This element does not appear in the standard Level 2A Product.

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	float32
number_of_bytes:	4
units:	n/a
minimum_value:	0
maximum_value:	0
scale_factor:	n/a



## 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
dB <sub>i</sub>	decibels isotropic
dB <sub>m</sub>	decibels relative to 1 milliwatt
dB <sub>W</sub>	decibels relative to 1 watt
DDE	Data Dictionary Entry
deg	degrees
deg 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
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 */

```