SeaWinds Processing and Analysis Center (SeaPAC)

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

QuikSCAT Era

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September 2006

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NASA

D-16079

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Document Log

Revision Date	Revised Pages	Description	Revised By
06/15/95	All	Original	B. Weiss
04/14/97	All	Revision for SeaWinds Version 1 Build 1	S. Merida
06/22/98	All	Draft revision for QuikSCAT Version 2 Build 2	B. Weiss
07/14/98	All	Draft for Science Team Review	B. Weiss

08/03/98	p. 20	Modified ephemeris_type data element entry.	B. Weiss
05/17/99	All	Modifications for Launch Delivery	B. Weiss
6/15/99	p. 25	Corrected definition of model_dir.	B. Weiss
10/11/99	p. 2, p.4, p.5, p.10, p. 15, p. 19, p. 21, p. 26, p. 29, p. 37, pp. 38-39, pp. 43-44	Modified references to other SISes, paraphrase in HDF Data Notation, corrected abbreviations in Data Definition Standards, modified the Data Volume Estimates, modified the number of SDSes in File Structure, added two new data elements to the Data Structure, corrected grammar in ephemeris_type, listed new valid_values and modified number_of_bytes for the nudging_method, listed new nominal value for Parameter_Name, added new Level L2B Product data elements wind_dir_selection and wind_speed_selection, and corrected abbreviations in Appendix A.	B. Weiss
01/11/00	p. 2, p. 10, p. 15, pp. 18-19, p. 26, pp. 26-27, pp. 41-42	Modified references to other SISes, updated the Data Volume Estimates, added new elements to the File Structure diagram, added new elements to Data Structure table, added entries for data elements mp_rain_probability and nof_rain_index, added defined bits to wvc_quality_flag.	B. Weiss
03/31/00	p. 1, p.2, p. 10, pp. 13-14, p. 15 pp. 18-19, p. 26, pp.41-42, p. 44	Mentioned the DIR algorithm in Content Overview, modified reference to other SISes, removed mention of wvc row omission from Data Volume Estimates, removed mention of wvc row omission and added location of DIR data to Level 2B Data, corrected the number of SDSes in the File Structure, modified wvc_quality_flag in Data Structure, modifed mp_rain_probability entry, modified wvc_quality_flag entry, added entry to Appendix A.	B. Weiss
7/20/01	p. 6, p. 20	Modified time designation to 24 hour clock, definition of atten_corr now specifies value is nadir attenuation	B. Weiss

9/26/06		Data volume estimate (table 2) modified to show estimates for all L2B products. Data structure table 4 has a new "units" column. Descriptions of WVC swath and products modified to include all resolutions/sigma0 types.	S. Dunbar

Distribution List

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1   INTRODUCTION

1.1   Identification

This is Version 2 of the Software Interface Specification (SIS2) for Level 2B
data of the SeaWinds Processing and Analysis Center (SeaPAC). This
document applies to any Level 2B 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 2B Product. Its intent
is to elucidate the Level 2B 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 2B 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 2B Processor processes QuikSCAT Level 2A
normalized radar cross section (sigma0) measurements and generates the
Level 2B Product. The QuikSCAT Level 2B Processor generates a grid of
wind vector cells (WVC) in alignment with the along-track and cross-track
axes of the spacecraft measurement swath. Each WVC is a square with
possible dimensions of 25, 20, or 12.5km. Every data element in the Level 2B
Product may be referenced by the wind vector cell's cross-track and
along-track indices.

The Level 2B Processor applies an empirically based model function to the
set of backscatter measurements in each WVC. Using the sigma0 values, the
azimuth angle, the incidence angle, the polarization and the model function,
the Level 2B Processor generates a Maximum Likelihood Estimator (MLE) for
a set of wind vector solutions. The Level 2B Product output may list as many
as four of the most likely wind vector solutions for each wind vector cell.
These potential solutions are known as 'ambiguities'. The ambiguity removal
algorithm then determines which of the potential solutions best estimates the
near surface wind conditions for each WVC.

Finally, the Direction Interval Retrieval (DIR) algorithm enhances the wind
solution selected by ambiguity removal. DIR calculates a range of wind
directions that is representative of the selected ambiguity in each wind vector

cell. DIR then employs a median filter over the entire swath to determine the optimal wind direction within the calculated range for each wind vector cell.

The Level 2B Processor can incorporate an atmospheric attenuation correction for the sigma0 measurements. These corrections are drawn from global climatological maps which list average atmospheric attenuations. The global climatological maps are based on SSM/I data. In nominal Level 2B Processor runs, the sigma0s are corrected for atmospheric attenuation.

The Level 2B Product specifies the number of sigma0 measurements which are located within each WVC. The product lists the potential wind vector solutions and MLEs that the model function generates, and specifies which of those solutions the ambiguity removal algorithm selects. The product includes uncertainty measures for each solution as well as overall quality indicators for the data set within each WVC.

1.4 Related Interfaces

Level 0 Data Software Interface Specification, Project Document 686-644-4, JPL D-16075, June 1998.

Level 1A Data Software Interface Specification, Project Document 686-644-5, JPL D-16076 Rev A, April 2000.

Level 1B Data Software Interface Specification, Project Document 686-644-1, JPL D-16077 Rev B, September 2006.

Level 2A Data Software Interface Specification, Project Document 686-644-2, JPL D-16078 Rev C, September 2006.

Processing Tables Software Interface Specification, Project Document 686-644-6, JPL D-16080 Rev A, May 2000.

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, October 2001, JPL D-21978.

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, EOS-DIS 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 (HDFv4). 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^{TM} 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 typical conditions over the ocean 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 typical conditions over the ocean 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 00:00 on January 1, 1993 UTC. This initial time is an Earth Observing System Data and Information System (EOSDIS) Core System (ECS) standard. Although the 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 2B Processor detects an anomalous condition which halts the processing for a particular wind vector cell, the appropriate bit flag which indicates the error condition remains set to 1. Since the processor may curtail subsequent operations for the wind vector cell that failed the test, those bit flags which normally would be tested in subsequent code also retain their initialized value. Thus, the order in which bit flags are processed determines whether their values are meaningful.

For instance, if wvc_quality_flag indicates that there is poor azimuth diversity among the sigma0s in a wind vector cell, the Level 2B Processor does not retrieve winds for that cell. Since wind retrieval does not take place, the code can not determine whether wind solutions for that wind vector cell are within or outside of the optimal range. Thus, the bits which represent the presence of either high and low wind speeds in the wind vector cell remain set to 1. These settings indicate neither a high nor a low wind speed. Users should ignore these values. On the other hand, the remaining bits in the wvc_quality_flag do contain valid values. These bits are valid because they were determined before the Level 2B Processor halted processing for the associated wind vector cell.

The following table lists the wvc_quality_flag bit flag dependencies. The column on the left lists the pivotal Wind Retrieval Flag. The middle column lists the two possible values for that bit. The column on the right indicates which of the remaining bits in the wvc_quality_flag are meaningful under the specified conditions.

Table 1: Bit Flag Dependencies

Bit Flag	Value	Other Bits with Meaningful Value
Wind Retrieval flag (bit 9)	0	Adequate Sigma0 Flag (bit 0)
		Adequate Azimuth Diversity Flag (bit 1)
		Coastal Flag (bit 7)
		Ice Edge Flag (bit 8)
		High Wind Speed Flag (bit 10)
		Low Wind Speed Flag (bit 11)
	1	Adequate Sigma0 Flag (bit 0)
		Adequate Azimuth Diversity Flag (bit 1)
		Coastal Flag (bit 7)
		Ice Edge Flag (bit 8)

1.6.8   Null Values

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

The Level 2B Product contains null values whenever a wind vector cell has fewer than four ambiguities. In those situations, the Level 2B Product lists zeros for all of the data elements associated with each unneeded ambiguity in that wind vector cell. Clearly, these zero values should be interpreted as null values.

For example, if all the wind_dir values for the WVC at array location [210,34] are equal to zero, and num_ambigs is equal to 3, then the wind_dir[210,34,0], wind_dir[210,34,1] and wind_dir[210,34,2] are true zero values. On the other hand, wind_dir[210,34,3] is a null value. The SDS objects for wind_speed, wind_speed_err, wind_dir_err and max_likelihood_est should be interpreted similarly.

The wind retrieval flag in the wvc_quality_flag distinguishes null values from zero values for certain SDS objects. If the wvc_quality_flag indicates that wind retrieval did not take place, then the listed zero values for model_speed, model_dir, num_ambigs, wind_speed, wind_dir, wind_speed_err, wind_dir_err, max_likelihood_est and wvc_selection are 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 the estimated volumes of the four possible QuikSCAT Level 2B Products. For each resolution/sigma0 type, the parameters (nrows, nwvc) size the major arrays in the products. A maximum of 4 wind vector ambiguities is retained in all of the products.

Currently (Sept 2006) only the L2B 25km pulse and L2B 12.5km composite products are being routinely generated.

Table 2: Data Volume Estimates

Data Set	WVC grid resolution (km)	Number of WVC rows (**nrows**)	Number of WVC per row (**nwvc**)	Total Volume including header (KBytes)
Level 2B 25km Pulse	25	1624	76	8463.1
Level 2B 25km Composite (CP25)	25	1624	76	8463.1
Level 2B 20km Composite (CP20)	20	2030	94	13084.3
Level 2B 12.5km Composite (CP12)	12.5	3248	152	33679.1

2.3   SeaWinds File Names

QuikSCAT Level 2B Product file names are 23 to 28 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 composite sigma0-based product have an additional extension to indicate both the sigma0 type anv WVC grid resolution of the product.

The two characters that precede that underscore are always 'QS'. These characters specify that the data were generated by QuikSCAT. The three characters that follow the underscore are always the character string 'S2B'. These characters identify the Level 2B Science Data Product. All alphabetical characters are upper case.

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

QS_S2Bnnnnn.yyyydddhhmm[.CPxx]

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.

.CPxx   The additional file extension when slice-composite sigma0 are used. The "xx" can be one of {25, 20, 12} to indicate the WVC grid resolution used.

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.

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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 2A 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

$$m = row\_number[i] -1$$

and

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

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 one of several scatterometer measurements which contribute to the same wind speed 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 39-78 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 39-78 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 these wind vector cell rows of the input Level 2A Product for wind retrieval.

3   DATA DEFINITION

3.1   Product Overview

3.1.1   Level 2B Product

The Level 2B Processor outputs the Level 2B Product. Each Level 2B file represents one satellite rev. The Level 2B Product contains wind vector solutions for each wind vector cell (WVC) in the SeaWinds instrument's measurement swath over the open ocean. The Level 2B Processor may reduce the size of the Level 2B Product by removing entire rows of WVCs if every cell in the row is flagged for either the presence of land or significant quantities of ice.

3.1.2   Level 2B Header

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

A set of HDF global attributes stores the entire Level 2B header. The name of each global attribute used for metadata storage matches the name of the metadata element. Each global attribute consists of ASCII characters and contains at least three lines of data. The information specified in each global attribute indicates the data type, the array size and contents of the metadata element.

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

granule. The ECS utilizes these metadata elements to identify and to locate particular data granules within their system.

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

3.1.3 Level 2B Data

The Level 2B data are grouped by rows of wind vector cells (WVCs). Level 2B wind vector cells are squares of dimension 25km, 20km, or 12.5km depending on the choice of product. Each wind vector cell row corresponds to a single cross-track cut of the SeaWinds measurement swath. Full coverage of the earth's circumference requires 1624 wind vector cell rows at 25km resolution; similarly there are 2030 WVC rows in the 20km swath, and 3248 WVC rows in the 12.5km swath.

The SeaWinds instrument's measurement swath extends 900 km on either side of the satellite nadir track. Thus, each WVC row must contain at least 72 25km WVCs. To accommodate occasional measurements which lie outside of the 900 km swath, the Level 2B data design includes two additional WVCs at each end of each row. Each Level 2B WVC row therefore contains a total 76 25km WVCs.

Except for the wvc_row_time, an HDF SDS object stores every data element in the Level 2B Data. An HDF Vdata object stores the wvc_row_time. The number of wvc_row_time entries matches the number of WVC rows in the Level 2B Product.

Except for element wvc_row, every SDS is an array of at least two dimensions. The first SDS dimension represents the WVC row while the second dimension represents a particular WVC within the row.

The Level 2B Product numbers the wind vector cells from left to right when viewing the orbital swath in the direction of spacecraft flight. Thus, num_ambigs[203,15] lists the number of retrieved ambiguities for the 16th wind vector cell from the left hand side of the swath when facing the spacecraft's forward direction of motion in wvc_row[203].

Several of the Level 2B SDS objects are three dimensional arrays. For all of these SDS objects, the third array index represents a potential wind solution.

Each WVC includes up to four potential wind velocity solutions. These potential solutions are called 'ambiguities'. SDS objects wind_speed, wind_dir, wind_speed_err, wind_dir_err and max_likelihood_est list these ambiguities in descending likelihood order. Therefore, the value stored in wind_speed[210,34,0] is the wind speed solution with the greatest likelihood estimator for the wind vector cell stored at array location [210,34]. Likewise, if an entry exists in location wind_speed[210,34,3], its value represents the

wind speed solution with the smallest likelihood estimator for the same WVC. The SDS object wvc_selection indicates which of the ambiguities was selected by the ambiguity removal algorithm.

The DIR (Direction Interval Retrieval) algorithm enhances the solution selected by ambiguity removal. When the Level 2B Processor uses DIR, the metadata element l2b_algorithm_descriptor in the Level 2B Product indicates that the wind direction of the selected ambiguity has been enhanced.

When DIR is in use, the SDS objects wind_speed_selection and wind_dir_selection list the output from DIR processing. Users who have interest in the wind solution based on DIR should employ the data that are stored in these SDS objects. Users who are interested in wind solutions that have not been modified by the DIR algorithm should locate the data element that represents the selected ambiguity in the SDS objects wind_speed and wind_dir. For instance, if wvc_selection[204,30] indicates that the second ambiguity was selected, then the solutions that were not enhanced by DIR processing are located in data elements wind_speed[204,30,1] and wind_dir[204,30,1].

When the Level 2B Processor does not use the DIR algorithm, the SDS objects wind_speed_selection and wind_dir_selection list the wind speed vector that was selected by ambiguity removal. Thus, if DIR is not in use, and data element wvc_selection[612,54] indicates that the first ambiguity was selected, then wind_speed_selection is equal to wind_speed[612,54,0], and wind_dir_selection is equal to wind_dir[612,54,0].

3.2 File Structure

The following figure illustrates the internal structure of each QuikSCAT Level 2B data product file. The SDS object count does not include the spare SDS objects because these objects are not included in the HDF file.

Level 2B Product

Level 2B Header
HDF Global Attributes - One Set Per File

Level 2B Data
25 HDF Objects

wvc_row_time

1 Vdata Object

[nrows]

wvc_row

1 SDS Object

[nrows]

Wind Vector
Cell Data

18 SDS Objects

[nrows,nwvc]

Ambiguities

5 SDS Objects

[nrows,nwvc,4]
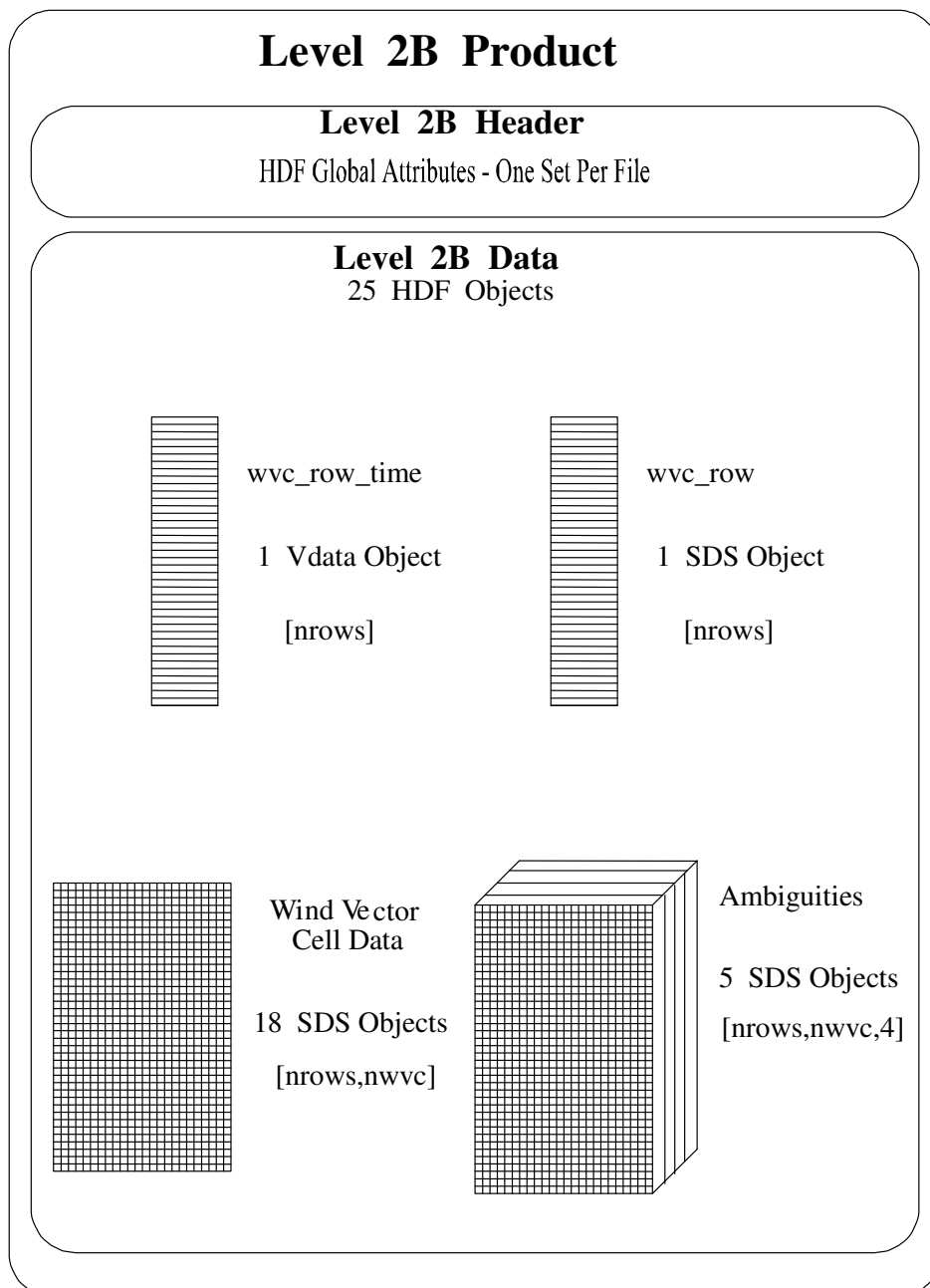
3.3 Header Structure

The following table lists all of the elements in the QuikSCAT Level 2B 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 2B Product file. These two optional elements delimit data gaps or regions of data which were not processed. These metadata elements appear only when sequences of data were missing from Level 2A data which were used to generate the Level 2B Product.

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]
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]
sigma0_attenuation_method	[1]
median_filter_method	[1]
nudging_method	[1]
ephemeris_type	[1]
l2b_algorithm_descriptor	[8]
l2b_actual_wvc_rows	[1]
l2b_expected_wvc_rows	[1]
sigma0_granularity	[1]

3.4 Data Structure

Except for the wvc_row_time, each entry in this table represents a unique HDF SDS object. The wvc_row_time is stored in an HDF Vdata object. The name of each Level 2B HDF object is the same as the name of the data element that the HDF object stores.

With the exception of wvc_row, every SDS object is an array of at least two dimensions. In every case, the first array index specifies the wind vector cell row while the second array index specifies a wind vector cell in that row. For all three dimensional SDSes in the Level 2B Product, the third dimension represents one of the wind solution ambiguities.

For example, data elements wvc_row[256] and wvc_row_time[256] reference the same wind vector cell row. Data elements wvc_lon[256,12] and num_ambigs[256,12] represent the same wind vector cell. Data elements wind_dir[256,12,1] and wind_speed[256,12,1] represent the same ambiguity in the same wind vector cell.

The following table lists each element in the Level 2B Data.

Table 4: Data Structure

Element Name	Conceptual Type	Storage Type	Repetition	Scale	Minimum	Maximum	Units
wvc_row_time	time	char	[nrows]	n/a	1993-001T00:00: 00.000	2008-366T23:59: 60.999	UTC time
wvc_row	integer	int16	[nrows]	1	1	[nrows]	count
wvc_lat	real	int16	[nrows,nwvc]	0.01	-90.00	90.00	deg
wvc_lon	real	uint16	[nrows,nwvc]	0.01	0.00	359.99	degE
wvc_index	integer	uint8	[nrows,nwvc]	1	1	[nwvc]	count

num_in_fore	integer	int8	[nrows,nwvc]	1	0	127	count
num_in_aft	integer	int8	[nrows,nwvc]	1	0	127	count
num_out_fore	integer	int8	[nrows,nwvc]	1	0	127	count
num_out_aft	integer	int8	[nrows,nwvc]	1	0	127	count
wvc_quality_flag	enum	uint16	[nrows,nwvc]	1	0X0000	0X7F83	bit field
atten_corr	real	int16	[nrows,nwvc]	0.001	0	32.767	dB (nadir)
model_speed	real	int16	[nrows,nwvc]	0.01	0.00	70.00	m/s
model_dir	real	uint16	[nrows,nwvc]	0.01	0.00	359.99	deg from N
num_ambigs	integer	int8	[nrows,nwvc]	1	0	4	count
wind_speed	real	int16	[nrows,nwvc,4]	0.01	0.00	50.00	m/s
wind_dir	real	uint16	[nrows,nwvc,4]	0.01	0.00	359.99	deg from N
wind_speed_err	real	int16	[nrows,nwvc,4]	0.01	0.00	50.00	m/s
wind_dir_err	real	int16	[nrows,nwvc,4]	0.01	0.00	180.00	deg
max_likelihood_est	real	int16	[nrows,nwvc,4]	0.001	-30.0	0.0	n/s

wvc_selection	integer	int8	[nrows,nwvc]	1	0	4	count
wind_speed_selection	real	int16	[nrows,nwvc]	0.01	0.00	50.00	m/s
wind_dir_selection	real	uint16	[nrows,nwvc]	0.01	0.00	359.99	deg from N
mp_rain_probability	real	int16	[nrows,nwvc]	0.001	-3.000	1.000	n/a
nof_rain_index	unsigned integer	uint8	[nrows,nwvc]	1	0	250	n/a
srad_rain_rate	real	int16	[nrows,nwvc]	0.01	0.00	300.00	km-mm/hr

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 atten_corr

The representative atmospheric nadir attenuation value for all of the sigma0s in a single wind vector cell. Under nominal processing conditions, the Level 2B Processor adds attenuation corrections to each sigma0 measurement before wind retrieval begins. Atten_corr contains an average attenuation correction value for all of the sigma0s in a single wind vector cell. Thus, the attenuation value which the Level 2B Processor applies to individual sigma0s may differ somewhat from the corresponding value listed in atten_corr.

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

3.5.3 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

3.5.4 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'

3.5.5 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'

3.5.6 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

3.5.7 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

3.5.8 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

3.5.9 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

3.5.10 HDF_version_id

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

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

3.5.11 InputPointer

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

3.5.12 InstrumentShortName

The name of the instrument which collected the telemetry data.

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

3.5.13 l2b_actual_wvc_rows

This value indicates the number of wind vector cell (WVC) rows in the Level 2B Product.

HDF_model: global attributes
conceptual_type: integer
storage_type: char
number_of_bytes: 24
units: counts
minimum_value: 1
maximum_value: 3248 (CP12)

3.5.14 l2b_algorithm_descriptor

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

3.5.15 l2b_expected_wvc_rows

The expected number of wind vector cell (WVC) rows in the Level 2B Product file. In nearly every case, this number will be equal to [nrows]. This outcome

results from a simple combination of product specifications and physical constraints.

Each SeaWinds WVC is a 25 km square. Every QuikSCAT Level 2B Product file contains data for one rev. The maximum number of WVC rows within a single file must therefore be restricted by the number of rows which cover one complete circumference of the Earth. This restriction yields 1624 WVC rows per 25km Level 2B Product file.

HDF_model: global attributes
conceptual_type: integer
storage_type: char
number_of_bytes: 24
units: counts
minimum_value: 1
maximum_value: 3248 (CP12)

3.5.16 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 2B Ocean Wind Vectors in
                        {25, 20,12.5}km Swath Grid'

3.5.17 max_likelihood_est

This parameter indicates the relative likelihood that a particular wind vector solution is correct. The Level 2B Processor applies a Maximum Likelihood Estimator (MLE) to each of the potential wind vector solutions in each wind vector cell. These potential wind vector solutions are known as ambiguities. The greater the MLE output, the more probable its corresponding ambiguity is correct.

HDF_model: scientific data set
conceptual_type: real
storage_type: int16
number_of_bytes: 2

units:	n/a
minimum_value:	-30.0
maximum_value:	0.0
scale_factor:	0.001

3.5.18 median_filter_method

This character string indicates the mode of the median filter algorithm which was employed to generate the solutions in this 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:	'Wind direction median', 'Wind vector median'

3.5.19 model_dir

The wind direction value which reflects weather conditions at or near the location of the wind vector cell at the approximate time the spacecraft flew over the area. Wind flowing toward the North is defined as 0 degrees, with positive angles increasing in the clockwise direction. The Level Processor uses the Numerical Weather Product (NWP) from the National Center for Environmental Prediction (NCEP) to generate a representative model_dir for each wind vector 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

3.5.20 model_speed

The wind speed value which reflects weather conditions at or near the location of the wind vector cell at the approximate time the spacecraft flew over the area. The Level Processor uses the Numerical Weather Product (NWP) from the National Center for Environmental Prediction (NCEP) to generate a representative model_speed for each wind vector cell.

HDF_model:	scientific data set

conceptual_type: real
storage_type: int16
number_of_bytes: 2
units: m/s
minimum_value: 0.00
maximum_value: 70.00
scale_factor: 0.01

3.5.21 mp_rain_probability

The probability of a columnar rain rate that is greater than 2 km*mm/hr. This probability value is read directly from a table based on eight input parameters. The space spanned by these parameters can detect whether the set of sigma0s used in wind retrieval contain a noteworthy component created by some physical phenomenon other than wind over the ocean's surface. The most likely phenomenon is rain.

A value of -3.00 indicates an inability to calculate a probability value.

HDF_model: scientific data set
conceptual_type: real
storage_type: int16
number_of_bytes: 2
units: n/a
minimum_value: -3.000
maximum_value: 1.000
scale_factor: 0.001
valid_values: -3.000 and 0.000 through 1.000

3.5.22 nof_rain_index

An index based upon a simplified version of the standard model function to determine a maximum likelihood estimator and a wind speed for each wind vector cell. The maximum likelihood estimator is based upon the sum of the squared differences between the set of sigma0s that were used to retrieve winds and the corresponding model function sigma0s that would generate the ambiguity with the greatest maximum likelihood estimator. The wind speed is based upon a modified sigma0 which is specifically calculated to be less sensitive to rain. The simplified maximum likelihood estimator is normalized by a tabular empirical estimate for the 95th percentile of the squared difference distribution. These tabular values are indexed by beam polarization, cross track location in the measurement swath, and wind speed. The normalized maximum likelihood estimator is then divided by the number of sigma0s in the wind vector cell, multiplied by thirty, and rounded to the nearest integer value.

This metric is most effective for wind speeds under 10 m/sec. The metric is

not so effective for wind speeds which are greater than 15 m/sec. Users should employ this flag with caution in high wind speed regions.

HDF_model: scientific data set
conceptual_type: unsigned integer
storage_type: uint8
number_of_bytes: 1
units: n/a
minimum_value: 0
maximum_value: 250
scale_factor: 1

3.5.23 nudging_method

This header entry indicates the method of selecting initial ambiguities in order to improve the skill of the ambiguity removal algorithm.

HDF_model: global attributes
conceptual_type: string
storage_type: char
number_of_bytes: 64
units: n/a
minimum_value: n/a
maximum_value: n/a
valid_values: 'None', 'NWP Weather Map with first two
                               ambiguities', or 'NWP Weather Map probability
                               threshold nudging'

3.5.24 num_ambigs

The Level 2B Processor generates up to four potential wind vector solutions for each wind vector cell (WVC). Each of these potential wind vector solutions are known as ambiguities. This parameter indicates the number of ambiguities associated with the specified WVC. If num_ambigs is zero, then winds were not retrieved for the corresponding WVC.

HDF_model: scientific data set
conceptual_type: integer
storage_type: int8
number_of_bytes: 1
units: counts
minimum_value: 0
maximum_value: 4
scale_factor: 1

3.5.25 num_in_aft

The number of sigma0 measurements used for wind retrieval within the wind vector cell from the inner antenna beam directed toward a position on the Earth aft of the spacecraft.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	int8
number_of_bytes:	1
units:	counts
minimum_value:	0
maximum_value:	127
scale_factor:	1

3.5.26 num_in_fore

The number of sigma0 measurements used for wind retrieval within the wind vector cell from the inner antenna beam directed toward a position on the Earth forward of the spacecraft.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	int8
number_of_bytes:	1
units:	counts
minimum_value:	0
maximum_value:	127
scale_factor:	1

3.5.27 num_out_aft

The number of sigma0 measurements used for wind retrieval within the wind vector cell from the outer antenna beam directed toward a position on the Earth aft of the spacecraft.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	int8
number_of_bytes:	1
units:	counts
minimum_value:	0
maximum_value:	127
scale_factor:	1

3.5.28 num_out_fore

The number of sigma0 measurements used for wind retrieval within the wind vector cell from the outer antenna beam directed toward a position on the Earth forward of the spacecraft.

HDF_model:	scientific data set
conceptual_type:	integer
storage_type:	int8
number_of_bytes:	1
units:	counts
minimum_value:	0
maximum_value:	127
scale_factor:	1

3.5.29 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 and Level 2B 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'

3.5.30 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: 0.000
maximum_value: 1.000
scale_factor: n/a

3.5.31 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: 0.000
maximum_value: 180.000
scale_factor: n/a

3.5.32 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

3.5.33 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
```

3.5.34 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:          'wind_speed_selection'
```

3.5.35 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'
```

3.5.36 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'
```

3.5.37 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'
```

3.5.38 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'
```

3.5.39 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'
```

3.5.40 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

3.5.41 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'

3.5.42 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

3.5.43 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

3.5.44 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

3.5.45 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

3.5.46 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

3.5.47 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

3.5.48 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

3.5.49 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

3.5.50 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

3.5.51 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: 'QSCATL2B'

3.5.52 sigma0_attenuation_method

The source of the atmospheric attenuations of the scatterometer measurements which are used to correct the QuikSCAT sigma0s within the accompanying data granule.

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:	'Attenuation Map' or 'None'

3.5.53 sigma0_granularity

A character string which identifies the granularity of the sigma0 measurements which were used to generate the winds in the Level 2B 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:	'whole pulses' or 'slice composites'

3.5.54 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
```

3.5.55 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
```

3.5.56 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

3.5.57 srad_rain_rate

Columnar rain rate in km-mm/hr derived from the scatterometer brightness temperatures in the WVC, using the Ahmed-Jones algorithm (2006).

HDF_model:	scientific data set
conceptual_type:	real
storage_type:	int16
number_of_bytes:	2
units:	km-mm/hour
minimum_value:	0.00
maximum_value:	300.00
scale_factor:	0.01

3.5.58 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

3.5.59 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
```

3.5.60 wind_dir

The direction component of a wind vector solution for a wind vector cell (WVC). This value, along with its corresponding wind speed component, comprises one of up to four potential wind vector solutions for the WVC. Each of these potential solutions is called an ambiguity. Wind flowing toward the North is defined as 0 degrees, with positive angles increasing in the clockwise direction.

```
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
```

3.5.61 wind_dir_err

The rms uncertainty of the wind direction associated with each potential solution for the wind vector cell (WVC).

```
HDF_model:                 scientific data set
conceptual_type:           real
storage_type:              int16
number_of_bytes:           2
units:                     deg
minimum_value:             0.00
maximum_value:             180.00
scale_factor:              0.01
```

3.5.62 wind_dir_selection

The direction component of a wind vector solution for each wind vector cell (WVC). If the Level 2B Processor does not use Direction Interval Retrieval(DIR), this value is equal to the wind direction of the selected ambiguity. If DIR is used, the wind_dir_selection contains a wind direction solution that is based on the selected ambiguity.

```
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
```

3.5.63 wind_speed

The speed component of a wind vector solution for a wind vector cell (WVC). This value, along with its corresponding wind direction component, comprises one of up to four potential wind vector solutions for the WVC. Each of these potential solutions is called an ambiguity.

```
HDF_model:              scientific data set
conceptual_type:        real
storage_type:           int16
number_of_bytes:        2
units:                  m/s
minimum_value:          0.00
maximum_value:          50.00
scale_factor:           0.01
```

3.5.64 wind_speed_err

The rms uncertainty of the wind speed associated with each potential solution for the wind vector cell (WVC).

```
HDF_model:              scientific data set
conceptual_type:        real
storage_type:           int16
number_of_bytes:        2
units:                  m/s
minimum_value:          0.00
maximum_value:          50.00
scale_factor:           0.01
```

3.5.65 wind_speed_selection

The speed component of a wind vector solution for each wind vector cell (WVC). If the Level 2B Processor does not use Direction Interval Retrieval (DIR), this value is equal to the wind speed of the selected ambiguity. If DIR is used, the wind_speed_selection contains a wind speed solution that is based on the selected ambiguity.

```
HDF_model:              scientific data set
conceptual_type:        real
storage_type:           int16
number_of_bytes:        2
units:                  m/s
minimum_value:          0.00
maximum_value:          50.00
scale_factor:           0.01
```

3.5.66 wvc_index

This index denotes the cross-track location of the wind vector cell (WVC) in the spacecraft measurement swath. Each WVC is a 25 km square. Each WVC row contains 76 cells. 38 WVCs are located on either side of the spacecraft nadir track.   Wind vector cell indices increase from left to right when viewing the orbital swath in the direction of spacecraft flight. The index of the leftmost cell is 1. The index of the rightmost cell is 76.

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

3.5.67 wvc_lat

The geodetic latitude of the centroid of a wind vector cell based on the locations of the sigma0s which contribute to wind retrieval.

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

3.5.68 wvc_lon

The longitude of the centroid of a wind vector cell based on the locations of the sigma0s which contribute to wind retrieval.

```
HDF_model:                  scientific data set
```

conceptual_type: real
storage_type: uint16
number_of_bytes: 2
units: degrees
minimum_value: 0.00
maximum_value: 359.99
scale_factor: 0.01

3.5.69 wvc_quality_flag

This flag indicates the quality of wind retrieval within a given wind vector cell. Quality of wind retrieval is based on the number and the quality of the sigma0 measurements within the cell. If the Wind Retrieval Flag (bit 9) is set, then all of wind measurement parameters for the associated wind vector cell contain null values.

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

Bit	Definition
0	Adequate Sigma0 Flag
	0 – Adequate number of good sigma0s available for wind retrieval.
	1 - Not enough good sigma0s available for wind retrieval.
1	Adequate Azimuth Diversity Flag
	0 - Good azimuth diversity among sigma0s for wind retrieval.
	1 - Poor azimuth diversity among sigma0s for wind retrieval.
2-6	Reserved for future use
	Always clear (0)
7	Coastal Flag
	0 - No land mass was detected within the wind vector cell.
	1 - Some portion of the wind vector cell is over

land.

8   Ice Edge Flag

0 - No ice was detected within the wind vector cell.

1 - Some portion of the wind vector cell is over ice.

9   Wind Retrieval Flag

0 - Wind retrieval performed for wind vector cell.

1 - Wind retrieval not performed for wind vector cell.

10   High Wind Speed Flag

0 - Reported wind speed is less than or equal to 30 m/sec.

1 - Reported wind speed is greater than 30 m/sec.

11   Low Wind Speed Flag

0 - Reported wind speed is greater than or equal to 3 m/sec.

1 - Reported wind speed is less than 3 m/sec.

12   Rain Impact Flag Usable

0 - Rain impact flag for the wind vector cell is usable.

1 - Rain impact flag for the wind vector cell is not usable.

13   Rain Impact Flag

0 - Rain impact flag algorithm does not detect rain impact.

1 - Rain impact flag algorithm detects rain impact.

14   Available Data Flag

0 - Inner beam data with QuikSCAT view

forward and aft and outer beam data with QuikSCAT view forward and aft are available.

1 - Data from at least one of the four possible beam and view combinations are not available.

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:	0X7F83
scale_factor:	1

3.5.70 wvc_row

This data element denotes the along-track location index of the wind vector cell (WVC) rows in the spacecraft measurement swath. Each WVC is a 25 km square. Each rev can contain a maximum of 1624 WVC rows.

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

3.5.71 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

3.5.72 wvc_selection

This index specifies which of the potential wind vector cell (WVC) ambiguities was selected by the ambiguity removal algorithm. A value of zero indicates that none of the ambiguities were selected or there were no ambiguities to select.

HDF_model: scientific data set
conceptual_type: integer
storage_type: int8
number_of_bytes: 1
units: n/a
minimum_value: 0
maximum_value: 4
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/sec	degrees per second
deg C	degrees Celsius
deg K	Kelvin (degrees of absolute temperature)
DIR	Direction Interval Retrieval

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
GMST	Greenwich Mean Sidereal 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 */
```