NASA Scatterometer

High-Resolution Merged Geophysical Data Product

User's Guide

Version 1.1

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NSCAT High-Resolution Merged Geophysical Data Product

Product Overview

The NSCAT High-Resolution Merged Geophysical Data Product (HR-MGDR) provides both Earth-located radar backscatter and vector wind measurements collocated in 25 km x 25 km wind vector cells. The HR-MGDR includes coverage over land and ice as well as oceans; wind vectors are only retrieved in the ocean cells. The data set is designed to address the needs of investigators interested in coastal oceanography, land vegetation classification, and ice studies.

The data are organized in a swath-based format, with each record consisting of a cross-track row of 48 wind vector cells (24 on each side of the satellite subtrack). Each file covers one NSCAT revolution, and typically consists of 1624 data records. The data set is moderately large, with a weekly volume of 1.5 gigabytes. The HR-MGDR is produced from the standard Level 1.5 sensor data products generated by the NSCAT Science Data Processing System.

The HR-MGDR is designated as a "special" data product, produced by the NSCAT Project and available on request from the PO.DAAC. The NSCAT Project reserves the right to discontinue the production of this product at any time on the basis of either low user demand or data quality considerations. Suggestions from the users as to how we can improve this product are welcomed. Please send suggestions to either the PO.DAAC User Services Office or directly to Scott Dunbar (rsd@zephyr2.jpl.nasa.gov).

This product is also referred to as the NSCAT Global 25 km GDR and is designated by the PO.DAAC as JPL Product #084.

Technical Background

NSCAT Mission Overview

The primary mission of NSCAT is to acquire all-weather high-resolution measurements of near-surface winds over the global oceans. These measurements will help to determine atmospheric forcing, ocean response and air-sea interaction mechanisms on various spatial and temporal scales. Operational users will seek to develop improved methods of assimilating wind data into numerical weather and wave-prediction models. NSCAT wind data, combined with measurements from various scientific disciplines, will help to understand mechanisms of global climatic change and weather.

Satellite scatterometers are microwave radar instruments designed specifically to measure near-surface wind velocity (both speed and direction) over the global oceans under all weather conditions. Wind stress is the single largest source of momentum to the upper ocean, driving oceanic motions on scales ranging from surface waves to basin-wide current systems. Winds over the ocean modulate air-sea fluxes of heat, moisture, gases and particulates, regulating the crucial coupling between atmosphere and ocean that establishes and maintains global and regional climate. Measurements of surface wind velocity can be assimilated into regional and global numerical weather models, improving our ability to predict future weather. As the only remote sensing systems able to provide accurate, frequent, high-resolution measurements of ocean surface wind speed and direction under both clear sky and cloudy conditions, scatterometers will play an increasingly important role in oceanographic, meteorological and climatic studies during the 1990s and beyond. Scatterometers use a highly indirect technique to measure wind velocity over the ocean, since the atmospheric motions themselves do not substantially affect the radiation emitted and received by the radar. These instruments transmit microwave pulses and receive backscattered power from the ocean surface. Changes in wind velocity cause changes in ocean surface roughness, modifying the radar cross section of the ocean and the magnitude of the backscattered power. Scatterometers measure this backscattered power, allowing estimation of the normalized radar cross section (σ_o) of the sea surface. Backscatter cross section varies with both wind speed and direction when measured at moderate incidence angles. Multiple, collocated, nearly simultaneous σ_o measurements acquired from several directions can thus be used to solve simultaneously for wind speed and direction.

The NSCAT flight instrument is a specialized microwave radar designed to measure winds over the oceans. It was launched into a near-polar Sun-synchronous orbit on the Japanese Advanced Earth Observing Satellite (ADEOS), on 16 August 1996. Like its predecessor on the Seasat satellite, NSCAT uses an array of antennas that radiate microwave pulses at a frequency of 14 GHz across broad regions on Earth's surface. This array of six, 3-meter-long antennas will scan two 600 km bands of ocean, one band on each side of the instrument's orbital path, separated by a gap of approximately 400 km. Obtaining backscatter and wind vector information nearly continuously, NSCAT is able to make 190,000 wind measurements per day, more than 100 times the amount of ocean wind information presently available from ships.

The NSCAT scatterometer was designed to be an advanced version of the Seasat SASS. Both are Ku-band Doppler radars using a stick-type antenna design. However, there are three key design differences between the SASS and NSCAT instruments. First, NSCAT is designed to measure backscatter at 25 km resolution, and retrieve wind vectors at 50 km resolution; SASS resolutions were 50 km and 100 km, respectively. Second, the addition of a dual-polarized mid-beam antenna provides additional azimuth looks to improve the wind retrieval and ambiguity selection skill. The third difference is the use of digital Doppler filtering of the return signal, in which the cell power binning is a function of orbit position. The Doppler binning algorithm used by the on-board processor computes the frequency shifts for each cell as a function of time from the equator crossing, maintaining the cross-track locations and co-registration of the cells from the four antenna beams at all orbit latitudes.

NSCAT has six stick-type antennas generating fan beam footprints on the ground, oriented to make observations at three independent azimuths on each side of the satellite subtrack (see Figure 1). With the dual-polarized mid-beams, there are a total of eight independent antenna/polarization combinations. In order to achieve 25 km resolution in the along-track direction, the instrument must cycle through all eight beams in 3.74 seconds (the *antenna cycle* period), giving 468 msec per beam in which to obtain σ_o measurements. The radar return signal is received in four bandpass filter "channels", and divided by the on-board digital Doppler processor into 25 σ_o "cells" (24 science + 1 monitor) with cross-track resolution of 25 km. Each beam measurement period consists of a sequence of 29 *pulse cycles* 16 msec long, of which the first 25 cycles are transmit/receive cycles (5 msec transmit pulse length, 11 msec receive interval) and the last 4 are receive-only cycles, providing signal+noise and noise-only received power measurements respectively. Superimposed on these cycles is the *measurement cycle* sequence, consisting of 128 antenna cycles (about 8 minutes long), of which the first cycle is a calibration cycle. NSCAT carries a calibrated noise source which is used during the calibration cycles to update the receiver gain, which is needed to convert the received power data numbers into engineering units (watts). During a calibration cycle, the receiver looks only at the noise source through the sequence of antenna ports, so no ocean σ_o data can be obtained.

NSCAT "programmability" includes commanding of mode selection and beam sequences, and the ability to uplink new Doppler binning tables to track changes in the orbit or to conduct special engineering tests. Mode changes will be made periodically to obtain additional calibration data, and special beam sequences will be used during the Cal/Val campaign during overflights of the NSCAT ground calibration station.

High-Resolution Wind Retrieval

The term "wind retrieval" encompasses the process of inverting the geophysical model function for a given set of backscatter measurements to obtain (multiple) estimates of the wind speed and direction, and then selecting the final wind field from the derived solution set. The inversion process is performed in a point-wise fashion (assuming each wind vector cell to be independent of its neighbors), and yields multiple solutions (ambiguities) due to the azimuthal variation of the model function. The process of ambiguity removal is performed in a field-wise fashion; the baseline algorithm used by NSCAT is a vector median filter, as described in the NSCAT Science Algorithm Specifications.

The wind retrieval processing for the HR-MGDR is identical to that used for the standard 50 km resolution Level 2 (L2) products, with the exception that the σ_o measurements are grouped in 25 km resolution wind vector cells (WVC). There are nominally 4 measurements (one from each beam) in each WVC; in the standard L2 product 16 measurements are used. The HR-MGDR allows up to 6 measurements per WVC to accommodate variations in grouping due to attitude errors. Wind retrieval is performed if there is at least one measurement from each azimuth (i.e. fore, aft, and one of the mid-beam measurements). While no project requirements exist for the accuracy of the 25 km resolution wind vectors, we expect the overall performance to be slightly degraded from that of the 50 km products, primarily because of measurement noise for single measurements. We can also expect, for purely geophysical reasons, that the resulting wind fields will appear to be more "noisy" than the 50 km fields due to sampling at higher spatial frequencies (mesoscale variations).

As in the standard Level 2 products, the wind directions in the HR-MGDR are given in the "oceanographic" convention, *i.e.* the vector points in the direction of flow. The directions are measured clockwise from north. To convert the vectors from (speed,direction) = (U,ϕ) to zonal and meridional components (u,v):

$$u = U \sin \phi$$

$$v = U \cos \phi$$

As with the standard products, the ambiguity removal algorithm may be initialized with either the highest likelihood solutions (best-fits to the model function) or by comparison of the directions of the top two ambiguities against a numerical weather product (NWP) analysis field. The particular initialization algorithm used in the processing is indicated in the header record of each data file.

Land & Ice Applications

Although the primary focus of the NSCAT mission is on ocean winds, there has been considerable interest and research into applications of scatterometer data to land and ice surfaces. For instance, images generated from SASS and ERS-1 scatterometer data have demonstrated the ability to discriminate tropical vegetation types, and also have been very useful in polar ice studies. If the normalized radar cross section σ_o is expressed in the form σ_o(db)=A+B(θ-40), where θ is the incidence angle of the measurements, images of A and B can be created from the measurements. These images show local and seasonal variations in the surface scattering which can be related to real geophysical effects. NSCAT will make it possible to study interannual variations in the radar response and identify long-term changes in the key surface features. The HR-MGDR includes the collocated NSCAT backscatter data over land and ice surfaces, as well as ocean, to help investigators in these important research areas.

Data Content & Format

Each HR-MGDR data file contains data for one NSCAT revolution, defined as starting and ending at the southernmost latitude of the orbit (i.e. over Antarctica). By analogy with the NSCAT standard products, the filename convention used is "S25xxxxx.DAT", where xxxxx is the revolution number. Each file consists of one ASCII header record containing processing information, and up to 1624 binary data records. Both the header and data records are of fixed length, 9260 bytes, to facilitate direct-access reads in Fortran and IDL.

The header record is organized in 80-character sub-records ending in <CR><LF>, so that the header information may be easily viewed in a standard terminal window. Aside from certain processing information, the header data of interest to the user include the rev number, ascending equator crossing time and longitude, and the data start & end times.

File Organization of the NSCAT HR-MGDR

HEADER (9260 bytes)
Data Record 1 (9260 bytes)
Data Record 2 (9260 bytes)
▪▪▪
▪▪▪
Data Record 1624 (9260 bytes)

The contents of the HR-MGDR data record are listed in Table 1. Each data record contains the data for a cross-track row or strip of 48 wind vectors cells, 24 WVC's each from the left and right measurement swaths (see Figure 2). There is a "nadir" gap of 400 km between cells 24 and 25. The mean measurement time for the σ_o data in the record is the UTC time tag (Mean_Time), which roughly corresponds to the time that the spacecraft nadir crosses the midpoint of the WVC row. Wind vector data is in the first 2444 bytes of the record, followed by the σ_o data. For land and ice WVC's the wind vector data is zeroed out.

There are nominally four σ_o measurements, one from each beam, per WVC. Storage is allowed in the data record for up to six σ_o per WVC. For ocean cells containing σ_o from at least the three principal azimuths, up to four wind vector solutions (ambiguities) are provided. The vectors are given in descending order of "likelihood" (goodness of fit to the model function), and the vector selected by the ambiguity removal algorithm is indicated by the entry in WV_Selection. The technique used to perform the ambiguity removal is listed in the header [currently, "Baseline used" = first ambiguity initialization + median filter; "NWP-aided initial field used" = NWP initialization + median filter].

Data File Header Example

```
Num_Hdr_Recs                 = 1                                              ;
Num_Hdr_Elements             = 41                                             ;
Producer_Agency              = NASA                                           ;
Producer_Institution         = JPL                                            ;
Sensor_Name                  = NSCAT                                          ;
Project_ID                   = NSCAT                                          ;
SIS_ID                       =                                                ;
Build_ID                     = L25 Special Product 1.1                        ;
ADEOS_Data_Package_ID        = S1                                             ;
ADEOS_Data_Package_Type      = S                                              ;
Product_Creation_Time        = 1994 -349T13:36:48.000                           ;
Data_Type                    = L25                                            ;
Data_Status                  = COMPLETE                                       ;
First_Rev_Number             = 0                                              ;
First_Rev_Eq_Crossing_Time   = 1996 -001T00:00:00.001                          ;
First_Rev_Eq_Crossing_Lon    = 0.000000                                       ;
First_Data_Time              = 1996 -033T01:41:58.042                          ;
Last_Data_Time               = 1996 -033T03:16:17.767                          ;
Num_Expected_Output_Records  = 1624                                           ;
Num_Actual_Output_Records    = 1624                                           ;
Ambig_Removal_Method         = Baseline used                                  ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Start_Time              =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
Skip_Stop_Time               =                                                ;
```

NSCAT High-Resolution Merged Geophysical Data Record Definition

VARIABLE	Definition	Storage Type	BYTES	Dimension	Total Size	Byte Offset	Scale	Units
Mean_Time	UTC time tag of WVC row	char	24	1	24	0	---	---
Rev	Revolution number	integer	2	1	2	24	1	---
WVC_Row	Along_track row number @25km	integer	2	1	2	26	1	---
WVC_Lat	Geodetic latitude of WVC	integer	2	48	96	28	0.01	deg
WVC_Lon	East longitude of WVC	unsigned int	2	48	96	124	0.01	deg
WVC_Col	Cross-track cell number @25km	byte	1	48	48	220	1	---
WVC_Quality_Flag	Quality flag (1=all ocean, 4=bad)	byte	1	48	48	268	1	---
Mean_Wind	Average speed of wind solutions	integer	2	48	96	316	0.01	m/sec
Num_Ambigs	Number of vector ambiguities	byte	1	48	48	412	1	---
WV_Selection	Index of selected wind vector	byte	1	48	48	460	1	---
Wind_Speed	Retrieved speeds of WV solutions	integer	2	[4,48]	384	508	0.01	m/sec
Error_Speed	Formal uncertainty in speed	integer	2	[4,48]	384	892	0.01	m/sec
Wind_Direction	Retrieved directions of WV sol'ns	unsigned int	2	[4,48]	384	1276	0.01	deg
Error_Dir	Formal uncertainty in direction	integer	2	[4,48]	384	1660	0.01	deg
MLE_Likelihood	Likelihood computed for solution	integer	2	[4,48]	384	2044	0.1	---
Low_Wind_Flags	Low speed (< 3 m/s) caution flag	logical	4	2	8	2428	---	---
High_Wind_Flags	High speed (> 30 m/s) flag	logical	4	2	8	2436	---	---
Num_Sigma0	Total number of σ_o measurements	byte	1	48	48	2444	1	---
Num_Good_Sigma0	Number of σ_o usable for wind	byte	1	48	48	2492	1	---
Num_Beam_FORE	Number of fore beam σ_o	byte	1	48	48	2540	1	---
Num_Beam_MIDV	Number of mid-beam V-pol σ_o	byte	1	48	48	2588	1	---
Num_Beam_MIDH	Number of mid-beam H-pol σ_o	byte	1	48	48	2636	1	---

Num_Beam_AFT	Number of aft beam σ_o	byte	1	48	48	2684	1	---
Beam_Ptr	Array of pointers to σ_o by beam	byte	1	[2,4,48]	384	2732	1	---
Center_Lat	Geodetic latitude of σ_o cell	integer	2	[6,48]	576	3116	0.01	deg
Center_Lon	East longitude of σ_o cell	unsigned int	2	[6,48]	576	3692	0.01	deg
Cell_Azimuth	Azimuth of σ_o cell w.r.t. North	unsigned int	2	[6,48]	576	4268	0.01	deg
Incidence_Angle	Incidence angle at σ_o cell	integer	2	[6,48]	576	4844	0.01	deg
Sigma0	Normalized radar cross section	integer	2	[6,48]	576	5420	0.01	dB
Coeff_A	Kp variance coefficient (α)	unsigned int	2	[6,48]	576	5996	0.000001	---
Coeff_B	Kp variance coefficient (β)	unsigned int	2	[6,48]	576	6572	0.0000001	---
Coeff_C	Kp variance coefficient (γ)	unsigned int	2	[6,48]	576	7148	0.000000001	---
Polarization	1 = V-pol, 2 = H-pol	byte	1	[6,48]	288	7724	1	---
Mean_Atmos_Atten	Attenuation correction on σ_o	unsigned byte	1	[6,48]	288	8012	0.004	---
Sigma0_Quality_Flag	Quality flags on σ_o measurements	integer	2	[6,48]	576	8300	---	---
Sigma0_Usable_Flag	Flag denoting usability for wind	byte	1	[2,48]	96	8876	---	---
Surface_Flags	Land/ice surface flags	byte	1	[6,48]	288	8972	---	---
TOTAL						**9260**		

Acquiring and Extracting the Data

The NSCAT HR-MGDR product is available to investigators upon request. The data are provided on 8mm Exabyte EXB -8200 (2-GB capacity) tapes in Unix "tar" format. Each tape contains the data for approximately 1 week of the NSCAT mission. Please note that the weekly data volume is about 1.5 GB.

Each data tape contains two tar files. The first tar file on the tape contains a README file, a PostScript copy of this user's guide, source code for the Fortran and IDL read routines and utilities, a rev start file, and a summary listing the data files on the tape. The second tar file contains all of the data files. This file is written such that the data files from a particular ADEOS batch (Snn) will be grouped together in the same subdirectory.

Files contained in the first tar file:

README.L25 - up-to-date information about the tape & data set (may change periodically as needed)
datafiles.<batch> - listing of the data files in tar file #2
revlist.<batch> - list of the rev start/stop & equator crossings for the revs in the directory ./<batch>/.

Documentation and code included in the ./doc/ directory:

L25UG.ps - PostScript copy of this User's Guide
fig1.ps, fig2.ps - attached figures for this User's Guide

mgdr_read.f - Fortran 77 subroutine for reading MGDR records
l20files.inc - include files for mgdr_read()
l20param.inc
mgdr_com.inc
mgdr_out.inc

getwind25.f - utility for extracting wind -only records from full data files

mgdr_all.pro - IDL structure definition file for MGDR records
mgdr_vec.pro - IDL program to display MGDR wind vectors
mgdr_view.pro - IDL program to dump wind and sigma0 data from selected records to screen
subextract.pro - IDL program to generate geographic subsets
grid25.pro - IDL program to generate a one -orbit WVC grid data file used by 'subextract'
plot_subset.pro - IDL program to plot wind vectors from a subset file

Due to the large volume of each weekly data set, it is useful to have the means to extract specific files from the tape. Here is a procedure for extracting only those selected files:

(1) Dump the first tar file to extract 'datafiles.Snn' (nn = batch number):

```
> tar xvf $TAPE datafiles.Snn
> mt rewind
```

(2) Execute the following 1 -line 'awk' program to make a list of the files by their filenames only:

```
> awk '{print $8}' datafiles.Snn > files.list
```

(3) Edit the file 'files.list' to make a list of selected files.

(4) Execute the following commands:

```
> mt -f $TAPE fsf 1              # skip the first file
> tar xvf $TAPE `cat files.list`    # take the list of
                                 # files from files.lst
```

Using the Data

When using HR-MGDR data files, it should be remembered that WVC 1-24 always represent data taken on the left side of the spacecraft and WVC 25-48 include data from the right side of the spacecraft.

Except in situations where there are actual data gaps, the HR-MGDR files will be "full" rev files, containing 1624 data records plus the header record in each. There are an average of 100 files per week.

Ocean Wind Vector Data

Ocean wind vector cells for which wind vectors have been retrieved can be identified quickly by non-zero values of **Num_Ambigs** and **WV_Selection**. Also, if the value of **WVC_Quality_Flag** is less than 4 (0 being the best), then the cell contains retrieved winds.

The primary data quality flag for the wind vector data is the WVC_Quality _Flag. The highest quality data have this set to 0. However, there may be some regions of interest where researchers will still want the wind data even though this flag is set to 1 (some σ_0's flagged for land or ice and not used) or 2 (some σ_0 flagged for absorption and not used). The quality of the wind retrieval with the minimum 3 σ_0's (WVC_Quality_Flag = 3) depends on which beam is missing from the retrieval. In all cases, wind retrieval is performed *only* if all three principal azmiuths (fore, mid, aft) are present. When no wind retrieval is possible, a value of WVC_Quality_Flag = 4 is assigned.

The low and high wind speed flags simply indicate that the derived wind speed is outside of the primary wind speed measurement range of 3-30 m/s specified in the NSCAT mission requirements (Freilich, 1985). Thus, it is possible that these wind speeds may not meet the same accuracy requirements. It is recommended that the low and high wind speed flags be used for informational purposes, unless there is a desire to exclude low and/or high wind speed solutions.

Collocated Sigma-0 Data

The HR-MGDR provides collocated backscatter data with their associated observing geometries for all surfaces. For those interested in the ocean backscatter, the criteria given above for finding wind vector data cells apply. For those who want to extract land or ice data, the first criterion should be to look at cells with WVC_Quality_Flag = 4, followed by a check of the **Surface_Flag** values of the individual σ_o data in the WVC. Surface_Flag = 1 for land cells, while Surface_Flag = 4 for ice cells (Surface_Flag = 0 indicates ocean).

In the HR-MGDR data set, the **Beam_Ptr** array provides an index with which to reference individual σ_o data by beam. This array is dimensioned by [σ_o entry in beam, beam, WVC#] = (2,4,48). The 'beam' index of the array is numbered (1,2,3,4) = [fore, mid-v, mid-h, aft]. For example, to use the Beam_Ptr array to find the first mid-H σ_o in WVC# 14, one selects:

$$\sigma_o = \text{Sigma0(Beam\_Ptr(1,3,14),14)}$$

The Beam_Ptr array contains references to *all* of the σ_o data in the WVC, regardless of surface type. The values of **Num_Beam[_Fore, _MidV, _MidH, _Aft]** for the WVC tell how many σ_o measurements there are for each beam, giving the useful range of the first index of Beam_Ptr. The Beam_Ptr references apply to all of the subsequent σ_o-related data in the record.

The **Sigma0_Quality_Flag** has 11 different (bits 0-10) quality indicators. For usable data, the first four bits (0-3) should be set to 0. The remaining indicators should be considered informational. The impact on data quality, if bits 4-9 are set, is not known prior to launch.

Bit 10, negative σ_0, denotes the sign of the normal (ratio) space σ_0. Any use of the σ_0's <u>must</u> take into account this bit flag. The σ_o measurements are provided in dB, so to properly use the data the following conversion must be used:

$$\sigma_o\,[\text{ratio}] = (-1)^{(\text{bit }10)}\ 10^{(0.1\sigma_o[\text{dB}])}$$

The **Sigma0_Usable_Flag** (s) are set to 0 for ocean cells usable for wind retrieval, and 1 for land/ice and "bad" cells indicated by non-zero bits 0-9 in the Sigma0_Quality_Flag.

The **Mean_Atmos_Atten** values are the rain-free attenuation corrections applied to the σ_o data based on the monthly Wentz-SSM/I climatology. The value includes the sec θ correction to the incidence angle θ of the measurement. It is stored as an *unsigned* byte (0-255), which is then scaled by a factor of 0.004.

Handling Unsigned Integers in Fortran & IDL

One common source of user questions arises from the fact that several key quantities in the NSCAT data (including the HR-MGDR) are stored as unsigned integers. Users who commonly program in C have no problem with this, since the C language recognizes unsigned data types. However, Fortran and IDL, in particular, do not have unsigned types, which can lead to some degree of confusion in reading the data. We have used unsigned types (2-byte and 1-byte integers) for storing some of the data in order to maximize the range of significant figures without resorting to the use of offsets. For example, the WVC_Lon (wind vector cell longitude) can range from 0.00 to 360.00 degrees; when scaled by 100 for storage as 2-byte integers, all values greater than 327.67 degrees $0.01*(2^{15} - 1)$ will appear in Fortran and IDL as negative numbers, since the sign bit (bit 15) is set.

A simple way to handle unsigned integers in Fortran and IDL is to copy the stored value into a long (4-byte) integer, test the sign of the resulting copy, and if the copy is negative add either 65536 $= 2^{16}$ (for 2-byte stored values) or $256 = 2^8$ (for 1-byte stored values). Then the modified 4-byte copy can be scaled to the desired floating point data value. For example, if the actual value of the Wind_Direction for some vector is equal to 345.25 degrees, the unsigned integer value as stored in the file is 34525 after scaling by 100. This will appear in Fortran and IDL as -31011, because the sign bit is set. After copying this to a 4-byte temporary integer variable and checking the sign, we add 65536 (-31011 + 65536 = 34525), and then multiply by 0.01 to recover the original direction value (345.25).

Points of Contact

Questions and comments concerning data distribution should be directed to PO.DAAC. Issues relating to data quality, data processing, or science should be brought to the attention of the appropriate NSCAT Project personnel. Specific points of contact are given below. Please note that e-mail is always the preferred method of communication.

PO.DAAC

Data distribution issues should be referred to PO.DAAC:

User Services Office, MS 300-320
JPL PO.DAAC
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109, U.S.A.

Telephone: (818) 354-9890
FAX: (818) 393-2718
e-mail: podaac@podaac.jpl.nasa.gov
Home Page: http://podaac.jpl.nasa.gov
IMS: http://eos.nasa.gov/eosdis
FTP: podaac.jpl.nasa.gov

NSCAT Project

Science Issues:

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Pasadena, CA 91109, U.S.A.

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Figure Captions

Figure 1. The NSCAT antenna beam footprint pattern results in two 600-km wide data swaths on each side of the spacecraft subtrack. The first science cells on the inner side of the swath are about 200 km from the subtrack, leaving a 400-km wide nadir gap. The fore and aft beams, at 45 ° and 135° azimuth relative to the spacecraft heading, are transmit in vertical polarization only. The mid-beams are dual-polarized (both V and H). Doppler frequency binning is used to control the co-registration of corresponding σ_o measurements from different beams.

The beams are numbered in the order of their nominal firing sequence. Beams 1-8 correspond to the antenna/polarization combinations {1V, 6V, 2V, 5V, 2H, 5H, 3V, 4V}. This leaves the odd-numbered beams on the right, and the even-numbered beams on the left. On each side of the spacecraft, the seqence of beam firings is always {fore, mid-V, mid-H, aft}.

Figure 2. Sigma-0 measurements from each beam are collocated in wind vector cells at 25-km resolution. The wind vector cells are arranged in cross-track rows of 48 cells (24 on each side). There are approximately 1624 25-km steps around the orbit; this is the typical number of WVC row-records in a HR-MGDR rev file. There are typically 4 σ_o measurements (one from each beam) in a 25-km WVC.