Physical Oceanography DAAC

SeaWinds on QuikSCAT Level 3 Daily, Gridded Ocean Wind Vectors (JPL SeaWinds Project)

Guide Document

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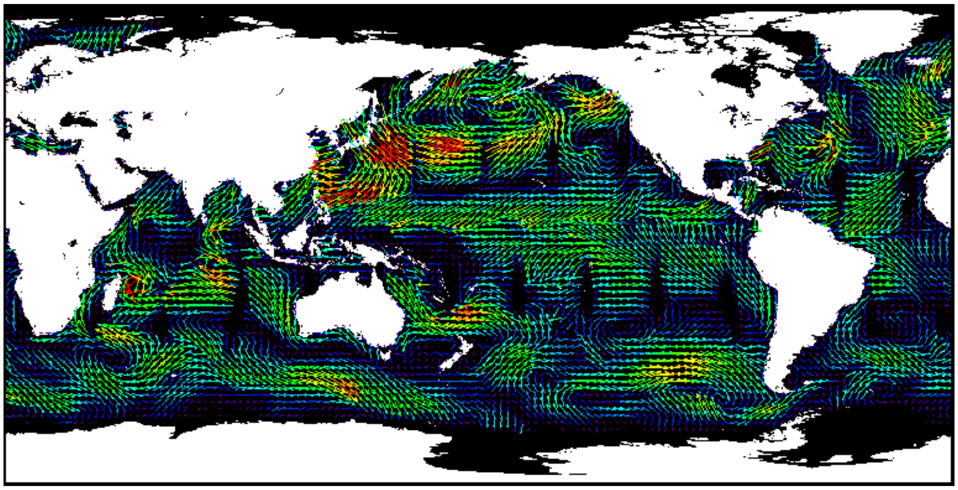
Jet Propulsion Laboratory
California Institute of Technology

SeaWinds on QuikSCAT Level 3 Daily, Gridded Ocean Wind Vectors (JPL SeaWinds Project)



Summary:

The SeaWinds on QuikSCAT Level 3 data set consists of gridded values of scalar wind speed, meridional and zonal components of wind velocity, wind speed squared and time given in fraction of a day. Rain probability determined using the Multidimensional Histogram (MUDH) Rain Flagging technique is also included as an indicator of wind values that may have degraded accuracy due to the presence of rain. Data are currently available in Hierarchical Data Format (HDF) and exist from 19 July 1999 to present.

The Level 3 data were obtained from the Direction Interval Retrieval with Threshold Nudging (DIRTH) wind vector solutions contained in the QuikSCAT Level 2B data and are provided on an approximately 0.25° x 0.25° global grid. Separate maps are provided for both the ascending pass (6AM LST equator crossing) and descending pass (6PM LST equator crossing). By maintaining the data at nearly the original Level 2B sampling resolution and separating the ascending and descending passes, very little overlap occurs in one day. However, when overlap between subsequent swaths does occur, the values are over-written, not averaged. Therefore, a SeaWinds on QuikSCAT Level 3 file contains only the latest measurement for each day.

This product is also referred to as JPL PO.DAAC product 109.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

SeaWinds on QuikSCAT Level 3 Daily, Gridded Ocean Wind Vectors (JPL SeaWinds Project)
JPL PO.DAAC Product 109

Data Set Introduction:

The NSCAT experience showed that there is no single, sophisticated gridding algorithm that satisfies every science user's need. As a result, this QuikSCAT Level 3 product was intended to be a very generic, gridded product which can easily be manipulated to fit the exact requirements necessary for multiple science topics.

For example, this product separates ascending and descending pass data in order to facilitate the use of this product in studies affected by diurnal trends. However, the ascending and descending maps may also be easily combined to obtain daily wind maps.

In addition, the Level 3 data are given on a global grid of 1440 pixels in longitude by 720 pixels in latitude (0.25° grid). This is nearly the same sampling resolution as the Level 2B. Therefore, users wishing to use their own interpolation schema to fill data gaps can do so easily. Users requiring lower resolution data (0.5° or 1° grids) can also easily average the scientific data sets contained in this product to their exact specifications.

A list of alternate QuikSCAT Level 3 products created by members of the QuikSCAT Science Working Team is available on the PO.DAAC QuikSCAT Links Page for those users who require lower resolution or gap-filled QuikSCAT data but do not wish to perform their own averaging or interpolation.

Objective/Purpose:

This data set was created in order to provide a simple, global, gridded map of the scatterometer wind vector data for use in research topics such as global climatic change and air-sea interaction.

The high-spatial resolution (1440 pixels longitude by 720 pixels latitude) of the Level 2B product was maintained in order to allow researchers to easily re-bin or average the data to lower resolutions as required by their individual research. The ascending and descending passes were kept separate in order to preserve the integrity of diurnal trends.

The high resolution and separation of passes generates little overlap of data within a day. As a result, this data set is also useful as a quick, browse reference for the QuikSCAT Level 2B data set.

Summary of Parameters:

The following parameters are available for both the ascending and descending passes:

- Wind Speed
- Wind Velocity (U and V components)
- Wind Speed Squared
- Number of Counts
- Time in fraction of a day
- Rain Probability
- Rain Flag

Discussion:

The Level 3 gridded wind vector processing bins the Direction Interval Retrieval with Threshold Nudging (DIRTH) wind vector solutions contained in the Level 2B data from the swath-based wind vector cell (WVC) grid to a 0.25° rectangular global map grid over a nominal UTC data day (i.e. between 00:00:00.000Z and 23:59:59.999Z). Separate maps are created for both the ascending and descending passes. The QuikSCAT orbit is such that the ascending and descending equator crossings are at local (mean sun) times of 6 AM and 6 PM, respectively. **Data which overlap on subsequent passes are overwritten, not averaged.** Therefore, a Level 3 file contains only the latest measurement for each day.

For simplicity, the time of each wind measurement is written as an HDF Scientific Data Set (SDS) in the Level 3 product instead of using a Vdata object as was done in the Level 2B data. To convert the Level 2B Vdata timetag to the Level 3 SDS representing time in fraction of a day, the following equation was used:

time_fraction=(HH*3600 + MM*60 + SS.SSS)/86400

where:			
where:	HH	=	hour of day out of 24 hours from the Level 2B measurement
	3600	=	seconds per hour
	MM	=	minute from the Level 2B measurement
	60	=	seconds per minute
	SS.SSS	=	second from the Level 2B measurement
	86400	=	seconds per day

Before writing a DIRTH wind value to the Level 3 daily grid, it was necessary to differentiate between NULL values and wind measurements which were actually 0 m/s. Two tests were performed in order to distinguish NULLs from zero wind speed. First, at least one ambiguity had to be present in the L2B wind vector cell (WVC). If the number of ambiguities in a Level 2B WVC was zero, then winds were not retrieved in that WVC. This was accomplished by checking the Level 2B num_ambigs SDS. Second, each Level 2B WVC wind retrieval flag (bit 9 of the wvc_quality_flag SDS) needed to be set to 0, indicating wind retrieval was, in fact, performed for the WVC. If a WVC measurement passed both criteria, the DIRTH wind value was written to the corresponding Level 3 wind grid cell, and the number of counts (asc_wvc_count or des_wvc_count) was set to 1. If one or both criteria were not met, no wind values were written to the Level 3 product, and the number of counts in the Level 3 product remained 0.

Similar to the Level 2B product, NULL values of wind speed must be differentiated from 0 m/s values of wind speed. However, as mentioned above, this can be done simply by looking at the number of counts value corresponding to each measurement. If the number of counts is 0, a zero wind measurement indicates a NULL value. If the number of counts is 1, a zero indicates a measurement with a value of 0.

The Level 3 product also contains four Scientific Data Sets to address possible rain contamination of the wind data. The Level 3 asc_rain_prob and des_rain_prob SDSs contain the corresponding values of the Level 2B mp_rain_probability SDS provided bit 12 of wvc_quality_flag was set to 0 (indicating the rain flag for the Level 2B wind vector cell was usable). More information pertaining to the use of mp_rain_probability in rain flagging can be obtained from Huddleston and Stiles [2000].

asc_rain_flag and des_rain_flag are also available in the Level 3 product in order to indicate whether or not rain is detected by a rain flag algorithm. asc_rain_flag and des_rain_flag are simply bits 12, 13, and 14 from the Level 2B wvc_quality_flag. The definition of each Level 3 rain flag and the corresponding values of bits 12, 13 and 14 in wvc_quality_flag are given in the following table.

L3 Rain Flag	**L2B wvc_quality_flag**			**Definition**
	Rain Flag Usable (bit 12)	**Rain Flag (bit 13)**	**Avail. Data Flag (bit 14)**	
0	0	0	0	• Rain flag for the wind vector cell is usable • Rain flag algorithm does not detect rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT

				view forward and aft are available
1	1	0	0	• Rain flag for the wind vector cell is not usable • Rain flag algorithm does not detect rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
2	0	1	0	• Rain flag for the wind vector cell is usable • Rain flag algorithm detects rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
3	1	1	0	• Rain flag for the wind vector cell is not usable • Rain flag algorithm detects rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
4	0	0	1	• Rain flag for the wind vector cell is usable • Rain flag algorithm does not detect rain • Data from at least one of the four possible beam and view combinations are not available
5	1	0	1	• Rain flag for the wind vector cell is not usable • Rain flag algorithm does not detect rain • Data from at least one of the four possible beam and view combinations are not available
6	0	1	1	• Rain flag for the wind vector cell is usable • Rain flag algorithm detects rain • Data from at least one of the four possible beam and view combinations are not available
7	1	1	1	• Rain flag for the wind vector cell is not usable

				• Rain flag algorithm detects rain • Data from at least one of the four possible beam and view combinations are not available

Related Data Sets:

The following related data sets are available at the JPL PO.DAAC:

- SeaWinds on QuikSCAT Level 2B Ocean Wind Vectors in 25 Km Swath Grid (JPL SeaWinds Project)
  JPL PO.DAAC Product 108
- NSCAT Scatterometer Ocean Wind Products CD-ROM (JPL)
  JPL PO.DAAC Product 085
- NSCAT scatterometer global 25km Sigma-0 and Ocean Winds (Dunbar)
  JPL PO.DAAC Product 084
- NSCAT Scatterometer Science Product, Levels 1.7, 2, 3 (JPL)
  JPL PO.DAAC Product 066

In addition to the products mentioned above, several additional Level 3 products have been produced by members of the SeaWinds on QuikSCAT Science Working Team. Many of these products provide the QuikSCAT data on coarser grids (0.5° or 1°) or at smaller time intervals (6 or 12 hour maps). Advanced interpolation techniques may also be used to fill gaps in the wind fields. A list of the publicly available QuikSCAT Level 3 products produced by SeaWinds on QuikSCAT Science Working Team members can be found on the PO.DAAC SeaWinds on QuikSCAT Web Site Links Page, (http://podaac.jpl.nasa.gov/quikscat/qscat_links.html).

2. Investigator(s):

NOTE: Please refer all questions concerning the SeaWinds on QuikSCAT Level 3 product to the PO.DAAC QuikSCAT Data Team, qscat@podaac.jpl.nasa.gov, or the PO.DAAC User Services Office, podaac@podaac.jpl.nasa.gov.

The SeaWinds on QuikSCAT Project is a mission of the NASA Jet Propulsion Laboratory (JPL). Further information on the QuikSCAT Project is available on-line at http://winds.jpl.nasa.gov.

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3. Theory of Measurements:

"Spaceborne scatterometers transmit microwave pulses to the ocean surface and measure the backscattered power received at the instrument. Since the atmospheric motions themselves do not substantially affect the radiation emitted and received by the radar, scatterometers use an indirect technique to measure wind velocity over the ocean. Wind stress over the ocean generates ripples and small waves, which roughen the sea surface. These waves modify the radar cross-section (sigma-0) of the ocean surface and hence the magnitude of backscattered power. In order to extract wind velocity from these measurements, one must understand the relationship between sigma-0 and near-surface winds. This relationship is known as the geophysical model function." [*Dunbar et al*, 2000]

The QSCAT-1 model function was used to obtain the SeaWinds on QuikSCAT ocean wind data.

4. Equipment:

NOTE:	This section was obtained entirely from the **QuikSCAT Science Data Product User's Manual** [*Dunbar et al*, 2000]. Please refer to the User's Manual for more information.

Sensor/Instrument Description:

Collection Environment:

The SeaWinds instrument is a specialized microwave radar onboard the QuikSCAT satellite.

Source/Platform:

The QuikSCAT satellite was launched into a sun-synchronous, 803-kilometer, circular orbit on 19 June 2000. The local equator crossing time at the ascending node is 6:00 A.M. ± 30 minutes.

The nominal orbit for QuikSCAT is defined by the following parameters:

Nominal Orbital Parameters	
Recurrent Period	4 days (57 orbits)
Orbital Period	101 minutes (14.25 orbits/day)
Local Sun Time at Ascending Node	6:00 A.M. ± 30 minutes
Altitude above Equator	803 km
Inclination	98.616°

Source/Platform Mission Objectives:

The Satellite Surface Stress Working Group mission requirements are as follows:

Quantity	Requirement	Applicable Range
Wind Speed	2 m/s (rms)	3-20 m/s
	10%	20-30 m/s
Wind Direction	20° (rms) selected ambiguity	3-30 m/s
Spatial Resolution	25 km	sigma-0 cells
	25 km	Wind Vector Cells
Location Accuracy	25 km (rms)	Absolute
	10 km	Relative

Coverage	90% of ice-free ocean every day	
Mission Duration	36 months	

Key Variables:

The SeaWinds instrument on QuikSCAT is an active microwave radar designed to measure electromagnetic backscatter from wind roughened ocean surface.

Principles of Operation:

Spaceborne scatterometers transmit microwave pulses to the ocean surface and measure the backscattered power received at the instrument. Since the atmospheric motions themselves do not substantially affect the radiation emitted and received by the radar, scatterometers use an indirect technique to measure wind velocity over the ocean. Wind stress over the ocean generates ripples and small waves, which roughen the sea surface. These waves modify the radar cross section (sigma-0) of the ocean surface and hence the magnitude of backscattered power. In order to extract wind velocity from these measurements, one must understand the relationship between sigma-0 and near-surface winds. This relationship is known as the geophysical model function.

The QSCAT-1 model function was used to obtain the SeaWinds on QuikSCAT ocean wind data.

Sensor/Instrument Measurement Geometry:

The SeaWinds instrument uses a rotating dish antenna with two spot beams that sweep in a circular pattern. The antenna radiates microwave pulses at a frequency of 13.4 GHz across broad regions on Earth's surface. The instrument collects data over ocean, land, and ice in a continuous, 1,800-kilometer-wide band centered on the spacecraft's nadir subtrack, making approximately 1.1 million ocean surface wind measurements and covering 90% of Earth's surface each day.

Unlike the fan-beam scatterometers flown on previous missions (Seasat SASS and NSCAT), the SeaWinds instrument on QuikSCAT is a conically scanning pencil-beam scatterometer. QuikSCAT employs a single 1-meter parabolic antenna dish with twin offset feeds for vertical and horizontal polarization. The antenna spins at a rate of 18 rpm, scanning two pencil-beam footprint paths at incidence angles of 46° (H-pol) and 54° (V-pol). The transmitted radar pulse is modulated, or "chirped", and the received pulse (after Doppler compensation) is passed through an FFT stage to provide sub-footprint range resolution. The range resolution is commandable between 2 km and 10 km, with the nominal value set at about 6 km. The nominal pulse repetition frequency is 187.5 Hz (also commandable). Each telemetry frame contains data for 100 pulses. Signal and noise measurements are returned in the telemetry for each of the 12 sub-footprint "slices." Ground processing locates the pulse "egg" and "slice" centroids on the Earth's surface. The sigma-0 value is then computed for both the "egg" and the best 8 of the 12 "slices" (based on location within the antenna gain pattern).

Manufacturer of Sensor/Instrument:

Jet Propulsion Laboratory

Calibration:

Specifications:

The system must measure winds between 3 and 30 m/s with an accuracy better than (the greater of) 2 m/s or 10% in speed and 20° in direction with a spatial resolution of 50 km.

Frequency of Calibration:

QuikSCAT generates an internal calibration pulse and associated load pulse every half-scan of the antenna. In ground processing, the load pulses are averaged over a 20-minute window, and the cal pulses over a 10-pulse (approximately 18-second) window, to provide current instrument gain calibration needed to convert telemetry data numbers into power measurements for the sigma-0 calculation.

QuikSCAT "programmability" includes commanding of major mode selection and range resolution, antenna spin rate and PRF, and the ability to uplink new Doppler compensation and range tracking tables as changes in the orbit occur, or to conduct special engineering tests. Mode changes will be made periodically to obtain additional calibration data.

Other Calibration Information:

Operating Modes

- Mode 0: Wind Observation Mode

  Wind observation mode is the primary science mode for QuikSCAT, and will be in effect more than 95% of the time.

- Mode 1: Receive-Only Mode

  In Receive-only mode, the transmitter is turned off while the receiver collects data at the antenna ports. This mode was used during Cal/Val to assess radio frequency interference and internal receiver biases. No science data is returned in this mode.

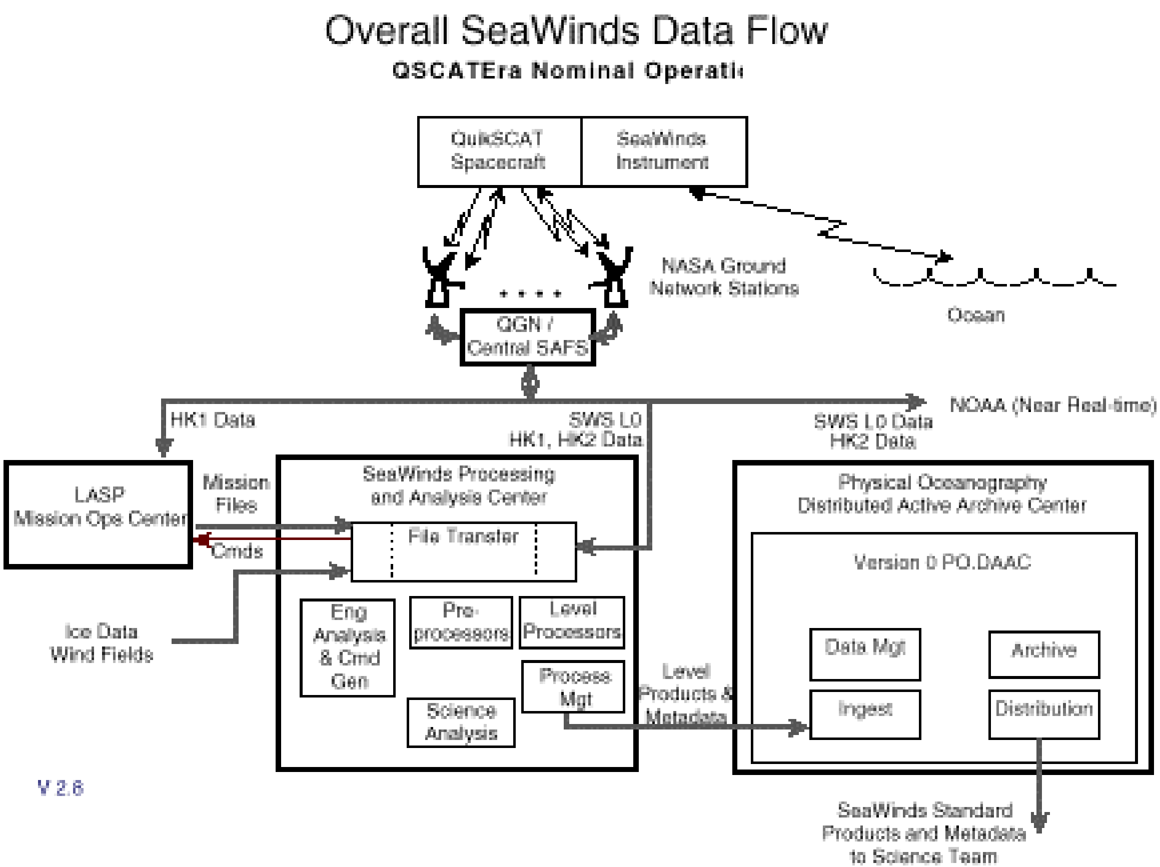
- Mode 2: Continuous Calibration Mode

  In Continuous Calibration mode, QuikSCAT performs only calibration/load cycles in place of normal pulse transmission cycles. This mode provides the most accurate receiver calibration data, and will be used periodically throughout the mission. No science data is returned in this mode.

5. Data Acquisition Methods:

NOTE: This section was obtained entirely from the **QuikSCAT Science Data Product User's Manual** [*Dunbar et al*, 2000]. Please refer to the User's Manual for more information.

The [below] data flow diagram shows the principal segments of the ground system, which consist of the NASA Ground Network, the Mission Operations Center (MOC), the SeaWinds Processing and Analysis Center (SeaPAC) at JPL, and the PO.DAAC.



5.1 NASA Ground Network and Mission Operations

The NASA Ground Network consists of four main receiving stations at Poker Flats, Alaska, Svalbard, Norway, McMurdo Station in Antarctica, and Wallops Flight Center in Virginia. The spacecraft and instrument telemetry is collected at these stations and forwarded via network to the Central SAFS at Goddard Space Flight Center. From Central SAFS, the spacecraft housekeeping (HK1) data are forwarded to the MOC at LASP in Boulder, Colorado, and the science telemetry (Level 0 and HK2) are sent to JPL and NOAA-NESDIS for science and near-real-time data processing.

5.2 Mission Operations Center

The Mission Operations Center at LASP has the principal responsibility for monitoring and commanding the QuikSCAT spacecraft. Instrument commands generated by Engineering Analysis at JPL are forwarded to the MOC for scheduling and uplinking. The MOC is responsible for assessing and maintaining the spacecraft orbit and pointing, sending commands for maneuvers as needed. Orbit predictions used for scheduling data downlinks and orbit determination from tracking data are performed by the MOC.

5.3 SeaWinds Processing and Analysis Center (SeaPAC)

The SeaWinds Processing and Analysis Center (SeaPAC) at JPL is responsible for the reception of telemetry data, production and analysis of the science data products, and for delivery of the science products to the PO.DAAC for distribution. The SeaPAC consists of six principal subsystems, described in the following sections.

5.3.1 File Transfer Subsystem (FX)

The FX subsystem is responsible for all external data transfers into the SeaPAC. These include the reception of the science telemetry data from the Central SAFS at GSFC, collection of ice edge data from the National Ice Center, and collection of NWP wind field data from NCEP. While the FX software can be run manually, most of its functions are completely automated.

5.3.2 Process Management Subsystem (PM)

The PM subsystem performs the database and automatic job scheduling functions for the SeaPAC, as well as providing a user interface for the SeaPAC operator. Using a rule-based algorithm PM is able to determine when all of the necessary input data for a particular job have become available, and can start that job automatically or inform the operator that the job is ready to be run manually.

5.3.3 Preprocessor Subsystem (PP)

The PP subsystem takes care of the initial processing of the HK2 and Level 0 science telemetry, creating the basic input products for initiating the main science data processing. PP creates time correlation, ephemeris, and attitude files from the HK2, creates the QuikSCAT Level 0 files that are the input to the Level 1A processor, and also extracts and converts NWP data to the format needed by the Level 2B processor

5.3.4 Level Processor Subsystem (LP)

The LP subsystem is the heart of the science processing, implementing the conversions from Level 0 telemetry up through the Level 2B wind vector products. LP consists of four main programs, one each to produce L1A, L1B, L2A, and L2B data in sequence. LP software incorporates and implements all of the science algorithms, and creates the HDF data products that are delivered to PO.DAAC and to the science community.

5.3.5 Engineering Analysis Subsystem (EA)

The EA subsystem has the primary responsibility to monitor the instrument health and safety. EA focuses mainly on the HK2 and Level 1A data to perform trend analyses on key instrument and spacecraft temperatures, voltages, and other engineering parameters.

5.3.6 Science Analysis Subsystem (SA)

The SA subsystem performs the primary QA and data analysis functions for the SeaPAC. SA is concerned with assuring that the science algorithms as implemented in the LP are performing correctly, and making algorithm corrections and refinements as needed. SA monitors the science data quality throughout the mission. QA reports are provided with all data products.

5.4 Physical Oceanography DAAC

The Physical Oceanography Distributed Active Archive Center, (PO.DAAC), receives the science data from the SeaPAC, archives the data, and distributes Level 1B, Level 2A, Level 2B and higher level data products to the QuikSCAT science community. PO.DAAC also acts as the principal long-term archive for all telemetry, Level 0, Level 1A and ancillary files collected during the QuikSCAT mission.

6. Observations:

Data Notes:

No additional notes.

Field Notes:

No additional notes.

7. Data Description:

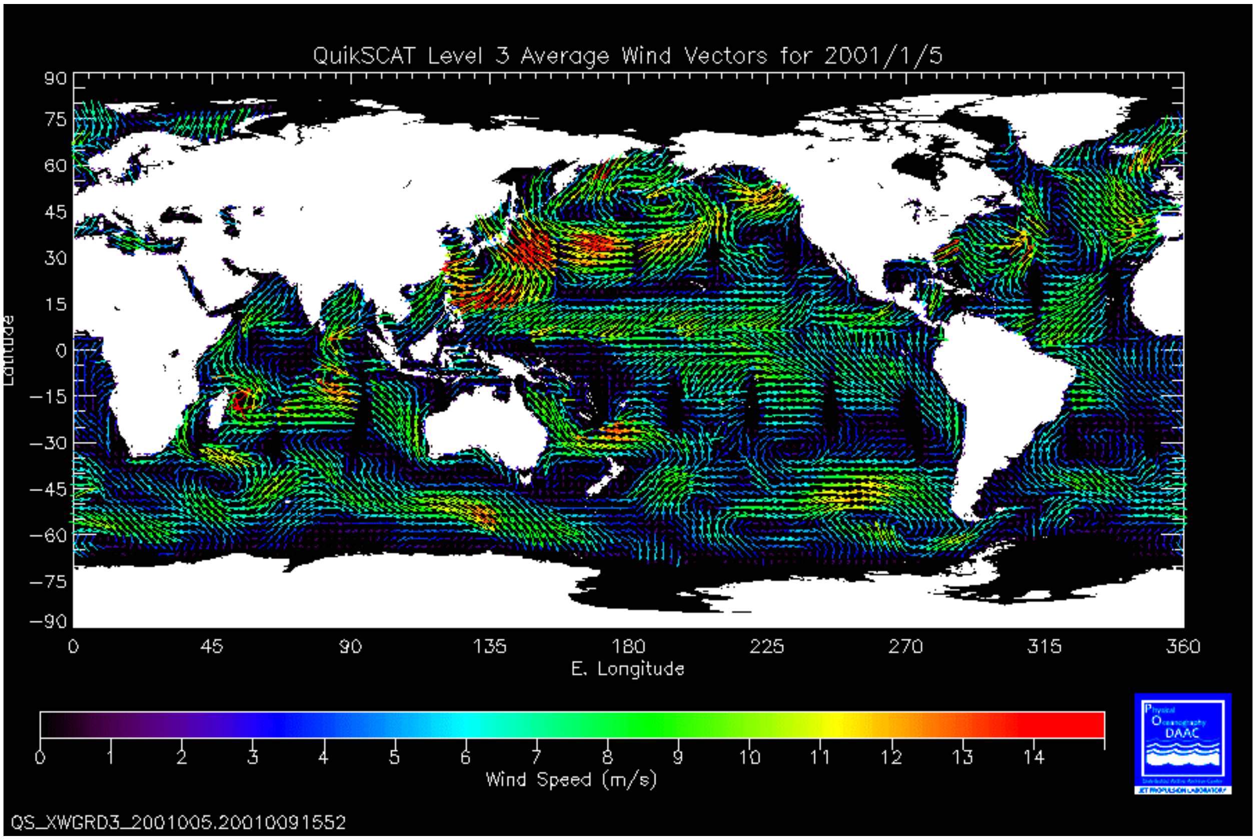
Spatial Characteristics:

Spatial Coverage:

Global Oceans
Approximately 90% of the ice-free ocean every day.

Spatial Coverage Map:

The following image shows a typical coverage for one day of SeaWinds on QuikSCAT Level 3 data. (Note: Image is the average of the descending and ascending passes for January 5, 2001.)



Spatial Resolution:

The QuikSCAT Level 3 data are provided on a global grid of 1440 pixels longitude by 720 pixels latitude or 0.25° by 0.25°.

Projection:

Global data are on a simple, 0.25° rectangular grid. Each grid contains 1440 pixels from east to west and 720 pixels from south to north.

Grid Description:

The QuikSCAT Level 3 data set is on a simple, rectangular grid of 1440 columns by 720 rows. Therefore, a grid element spans 0.25 degrees in longitude (360/1440) and latitude (180/720). Latitude and longitude coordinates are assigned to each grid element based on its center. To calculate the longitude and latitude of a grid point, the following equations can be used:

lon[i] = (360./XGRID) * (i+0.5) for i=0...XGRID-1

lat[j] = (180./YGRID) * (j+0.5) - 90. for j=0...YGRID-1

where:

XGRID = grid elements in the x-direction (1440)

YGRID = grid elements in the y-direction (720)

As shown by the above formulas, the latitude and longitude of the center of the first grid cell of each QuikSCAT Level 3 scientific data is -89.875° North (89.875° South) and 0.125° East. The latitude and longitude of the final grid cell of each data set is centered at 89.875° North and 359.875° East (0.125° West).

Temporal Characteristics:

Temporal Coverage:

Daily data exist from 19 July 1999 to approximately present. More recent data will be added to this data set as it becomes available.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Each file contains data for a given day, and each grid point within this file contains the latest measurement at that location. Ascending and descending measurements are contained in separate data fields within a file.

Data Characteristics:

There are 16 Scientific Data Sets within each QuikSCAT Level 3 HDF data file.

1. **asc_avg_wind_speed:** wind speed for the ascending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	0.00	50.00	m/s	16-bit unsigned integer

2. **des_avg_wind_speed:** wind speed for the descending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	0.00	50.00	m/s	16-bit unsigned integer

3. **asc_avg_wind_vel_u:** u-component of the wind velocity for the ascending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	-50.00	50.00	m/s	16-bit signed integer

4. **des_avg_wind_vel_u:** u-component of the wind velocity for the descending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	-50.00	50.00	m/s	16-bit signed integer

5. **asc_avg_wind_vel_v:** v-component of the wind velocity for the ascending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	-50.00	50.00	m/s	16-bit signed integer

6. **des_avg_wind_vel_v:** v-component of the wind velocity for the descending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	-50.00	50.00	m/s	16-bit signed integer

7. **asc_avg_wind_speed_sq:** square of the wind speed for the ascending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	0.00	2500.00	m^2/s^2	32-bit unsigned integer

8. **des_avg_wind_speed_sq:** square of the wind speed for the descending pass.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.01	0.00	0.00	2500.00	m^2/s^2	32-bit unsigned integer

9. **asc_wvc_count:** distinguishes NULL values from zero value of wind speed in the ascending pass data. If asc_wvc_count is 0 in a given cell, wind retrieval did not take, and wind speed values are NULL in that cell. If asc_wvc_count is 1, wind retrieval occurred, and a 0 value of wind speed indicates a measurement of 0 m/s.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	1.00	0.00	0.00	1.00	count	8-bit signed integer

10. **des_wvc_count:** distinguishes NULL values from zero value of wind speed in the descending pass data. If des_wvc_count is 0 in a given cell, wind retrieval did not take, and wind speed values are NULL in that cell. If des_wvc_count is 1, wind retrieval occurred, and a 0 value of wind speed indicates a measurement of 0 m/s.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type

[1440,720]	1.00	0.00	0.00	1.00	count	8-bit signed integer

11. **asc_time_frac:** time in fraction of a day at which ascending pass measurement was taken

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.00002	0.00	0.00	1.00	fraction of day	16-bit unsigned integer

12. **des_time_frac:** time in fraction of a day at which descending pass measurement was taken

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.00002	0.00	0.00	1.00	fraction of day	16-bit unsigned integer

13. **asc_rain_prob:** probability of columnar rain rate that is greater than 2 km*mm/hr for the ascending pass.

    This variable is similar to the mp_rain_probability SDS in the Level 2B product. Please refer to "Multidimensional Histogram (MUDH) Rain Flag" [Huddleston and Stiles, 2000] for more information.

    Please note that all values of mp_rain_probability which were less than 0 were set to 0. In particular, a -3.0 value of mp_rain_probability in the Level 2B product indicated an inability to calculate a probability value. This value is 0.0 in the Level 3 product.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.001	0.00	0.00	1.00	n/a	16-bit unsigned integer

14. **des_rain_prob:** probability of columnar rain rate that is greater than 2 km*mm/hr for the descending pass.

    This variable is similar to the mp_rain_probability SDS in the Level 2B product. Please refer to "Multidimensional Histogram (MUDH) Rain Flag" [Huddleston and Stiles, 2000] for more information.

Please note that all values of mp_rain_probability which were less than 0 were set to 0. In particular, a -3.0 value of mp_rain_probability in the Level 2B product indicated an inability to calculate a probability value. This value is 0.0 in the Level 3 product.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	0.001	0.00	0.00	1.00	n/a	16-bit unsigned integer

15. **asc_rain_flag:** indicates whether or not the rain flag algorithm detected the presence of rain in an ascending pass wind vector cell.

    This variable is obtained from bits 12, 13 and 14 of wvc_quality_flag in the Level 2B product.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	1.00	0.00	0.00	7.000	n/a	8-bit signed integer

L3 asc_rain_flag	L2B wvc_quality_flag			Definition
	Rain Flag Usable (bit 12)	Rain Flag (bit 13)	Avail. Data Flag (bit 14)	
0	0	0	0	• Rain flag for the wind vector cell is usable • Rain flag algorithm does not detect rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
1	1	0	0	• Rain flag for the wind vector cell is not usable • Rain flag algorithm does not detect rain

				• Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
2	0	1	0	• Rain flag for the wind vector cell is usable • Rain flag algorithm detects rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
3	1	1	0	• Rain flag for the wind vector cell is not usable • Rain flag algorithm detects rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
4	0	0	1	• Rain flag for the wind vector cell is usable • Rain flag algorithm does not detect rain • Data from at least one of the four possible beam and view combinations are not available
5	1	0	1	• Rain flag for the wind vector cell is not usable • Rain flag algorithm does not detect rain • Data from at least one of the four possible beam and view combinations are not available
6	0	1	1	• Rain flag for the wind vector cell is usable • Rain flag algorithm detects rain • Data from at least one of the four possible beam and view combinations are not

				available
7	1	1	1	• Rain flag for the wind vector cell is not usable • Rain flag algorithm detects rain • Data from at least one of the four possible beam and view combinations are not available

16. **des_rain_flag:** indicates whether or not the rain flag algorithm detected the presence of rain in a descending pass wind vector cell.

    This variable is obtained from bits 12, 13 and 14 of wvc_quality_flag in the Level 2B product.

Dimensions	Scale	Offset	Minimum	Maximum	Units	Storage Type
[1440,720]	1.00	0.00	0.00	7.000	n/a	8-bit signed integer

L3 des_rain_flag	L2B wvc_quality_flag			Definition
	Rain Flag Usable (bit 12)	Rain Flag (bit 13)	Avail. Data Flag (bit 14)	
0	0	0	0	• Rain flag for the wind vector cell is usable • Rain flag algorithm does not detect rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
1	1	0	0	• Rain flag for the wind vector cell is not usable • Rain flag algorithm does not detect rain

				• Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
2	0	1	0	• Rain flag for the wind vector cell is usable • Rain flag algorithm detects rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
3	1	1	0	• Rain flag for the wind vector cell is not usable • Rain flag algorithm detects rain • Inner beam data with QuikSCAT view forward and aft and outer beam data with QuikSCAT view forward and aft are available
4	0	0	1	• Rain flag for the wind vector cell is usable • Rain flag algorithm does not detect rain • Data from at least one of the four possible beam and view combinations are not available
5	1	0	1	• Rain flag for the wind vector cell is not usable • Rain flag algorithm does not detect rain • Data from at least one of the four possible beam and view combinations are not available
6	0	1	1	• Rain flag for the wind vector cell is usable • Rain flag algorithm detects rain • Data from at least one of the four possible beam and view combinations are not

				available
7	1	1	1	• Rain flag for the wind vector cell is not usable • Rain flag algorithm detects rain • Data from at least one of the four possible beam and view combinations are not available

Sample Data Record:

The following sample output was obtained using program read_qscat3.c. Data between latitudes 7 South and 10 South and longitudes between 200 East and 201 East were read from input file QS_XWGRD3_2000119.20001260453. Please note that all calibrations and offsets have been applied.

```
 ASCENDING PASS (DAYTIME)
LON        LAT         SPD     U      V      SPD2  COUNT  TIME     PROB  FLAG
200.12500  -9.87500    7.00   -6.77  -1.78   49.00  1   0.71562   0.311  6
200.12500  -9.62500    7.25   -6.99  -1.88   52.63  1   0.71568   0.591  6
200.12500  -9.37500    6.00   -5.98  -0.47   36.00  1   0.71570   0.508  6
200.12500  -9.12500    7.50   -7.50  -0.02   56.50  1   0.71576   0.501  6
200.12500  -8.87500    8.51   -8.51  -0.27   72.42  1   0.71582   1.000  6
200.12500  -8.62500    7.50   -7.50   0.13   56.25  1   0.71588   0.242  6
200.12500  -8.37500    7.00   -7.00  -0.26   49.00  1   0.71592   0.074  6
200.12500  -8.12500    6.50   -6.49  -0.38   42.25  1   0.71596   0.192  6
200.12500  -7.87500    7.35   -7.33  -0.56   54.02  1   0.71600   0.059  4
200.12500  -7.62500    7.00   -6.96  -0.71   49.00  1   0.71604   0.519  6
200.12500  -7.37500    7.00   -6.93  -1.02   49.00  1   0.71608   0.184  6
200.12500  -7.12500    6.00   -5.91  -1.01   36.00  1   0.71614   0.066  4
200.12500  -6.87500    6.00   -5.81  -1.49   36.00  1   0.71620   0.009  4
200.37500  -9.87500    7.00   -5.87  -3.81   49.00  1   0.71562   0.094  6
200.37500  -9.62500    6.00   -5.82  -1.45   36.00  1   0.71566   0.358  6
200.37500  -9.37500    6.00   -5.56   2.25   36.00  1   0.71570   0.050  4
200.37500  -9.12500    7.50   -6.68   3.40   56.25  1   0.71574   0.024  4
200.37500  -8.87500    8.00   -7.86   0.98   64.33  1   0.71580   0.697  6
200.37500  -8.62500    7.50   -7.50  -0.25   56.25  1   0.71588   0.443  6
200.37500  -8.37500    7.75   -7.75  -0.01   60.13  1   0.71590   0.144  6
200.37500  -8.12500    8.00   -7.99  -0.40   64.00  1   0.71596   0.144  6
200.37500  -7.87500    8.32   -8.29  -0.72   69.22  1   0.71600   0.200  6
200.37500  -7.62500    8.50   -8.46  -0.86   72.25  1   0.71604   0.237  6
200.62500  -9.87500    5.50   -4.77  -2.74   30.25  1   0.71562   0.164  6
200.62500  -9.62500    5.00   -4.76  -1.52   25.00  1   0.71566   0.174  6
200.62500  -9.37500    6.00   -5.93   0.94   36.00  1   0.71570   0.034  4
200.62500  -9.12500    7.50   -7.49   0.39   56.25  1   0.71574   0.000  4
200.62500  -8.87500    7.51   -7.51  -0.24   56.40  1   0.71578   0.095  6
200.62500  -8.62500    7.50   -7.49   0.39   56.25  1   0.71582   0.075  6
200.87500  -9.87500    4.00   -3.35  -2.19   16.00  1   0.71562   0.057  4
200.87500  -9.62500    4.50   -4.47  -0.55   20.25  1   0.71566   0.165  6

DESCENDING PASS (NIGHTTIME)
LON        LAT         SPD     U       V     SPD2  COUNT  TIME     PROB  FLAG
200.12500  -9.87500   11.27  -11.27  -0.17  127.55  1   0.19340   0.596  2
200.12500  -9.62500    9.77   -9.72  -0.80   97.07  1   0.19334   0.093  2
200.12500  -9.37500    8.50   -8.31  -1.77   72.25  1   0.19328   0.003  0
200.12500  -9.12500    9.50   -9.46  -0.90   90.25  1   0.19324   0.006  0
200.12500  -8.87500   10.50  -10.48  -0.60  110.25  1   0.19320   0.150  2
200.12500  -8.62500    9.00   -8.97  -0.78   81.00  1   0.19314   0.038  0
200.12500  -8.37500   10.00   -9.96  -0.87  100.00  1   0.19310   0.077  2
200.12500  -8.12500    8.50   -8.48  -0.59   72.25  1   0.19306   0.004  0
```

200.12500	-7.87500	8.94	-8.92	-0.62	80.12	1	0.19302	0.056	0
200.12500	-7.62500	8.50	-8.47	0.74	72.25	1	0.19298	0.022	0
200.12500	-7.37500	7.50	-7.46	-0.78	56.25	1	0.19294	0.002	0
200.12500	-7.12500	6.75	-6.51	-1.73	45.63	1	0.19286	0.001	0
200.12500	-6.87500	6.00	-5.93	-0.86	36.00	1	0.19282	0.009	0
200.37500	-9.87500	9.00	-8.93	-1.10	81.00	1	0.19336	0.233	2
200.37500	-9.62500	8.74	-8.69	-0.95	76.39	1	0.19332	0.009	0
200.37500	-9.37500	9.50	-9.43	-1.16	90.25	1	0.19328	0.053	0
200.37500	-9.12500	9.19	-9.12	-1.11	84.46	1	0.19324	0.001	0
200.37500	-8.87500	11.50	-11.43	-1.23	132.73	1	0.19320	0.145	2
200.37500	-8.62500	12.50	-12.48	-0.65	156.25	1	0.19314	0.597	2
200.37500	-8.37500	10.00	-9.98	-0.70	100.00	1	0.19310	0.313	2
200.37500	-8.12500	10.00	-9.97	-0.82	100.00	1	0.19306	0.011	0
200.37500	-7.87500	12.00	-12.00	-0.21	144.00	1	0.19302	0.336	2
200.37500	-7.62500	8.85	-8.82	-0.68	78.32	1	0.19298	0.043	0
200.37500	-7.37500	8.91	-8.87	-0.80	79.65	1	0.19290	0.148	2
200.37500	-7.12500	9.50	-9.50	0.00	90.25	1	0.19284	0.123	2
200.37500	-6.87500	7.28	-7.25	-0.71	53.00	1	0.19280	0.000	0
200.62500	-9.87500	8.25	-8.12	-1.42	68.13	1	0.19336	0.011	0
200.62500	-9.62500	8.50	-8.44	-1.03	72.25	1	0.19332	0.008	0
200.62500	-9.37500	9.50	-9.43	-1.16	90.25	1	0.19328	0.050	0
200.62500	-9.12500	8.50	-8.31	-1.77	72.25	1	0.19324	0.010	0
200.62500	-8.87500	10.12	-10.02	-1.41	102.41	1	0.19320	0.185	2
200.62500	-8.62500	10.31	-10.22	-1.39	107.71	1	0.19314	0.000	0
200.62500	-8.37500	11.00	-10.92	-1.36	121.00	1	0.19310	0.031	0
200.62500	-8.12500	11.25	-11.15	-1.47	126.63	1	0.19304	0.164	2
200.62500	-7.87500	10.00	-9.90	-1.39	100.00	1	0.19298	0.154	2
200.62500	-7.62500	10.64	-10.58	-1.06	113.51	1	0.19296	0.481	2
200.62500	-7.37500	8.50	-8.45	-0.91	72.25	1	0.19288	0.377	2
200.62500	-7.12500	9.50	-9.50	-0.17	90.25	1	0.19284	0.183	2
200.62500	-6.87500	8.00	-7.95	-0.87	64.00	1	0.19280	0.025	0
200.87500	-9.87500	8.50	-8.43	-1.10	72.25	1	0.19336	0.007	0
200.87500	-9.62500	8.50	-8.43	-1.13	72.25	1	0.19332	0.002	0
200.87500	-9.37500	8.00	-7.91	-1.17	64.00	1	0.19328	0.024	0
200.87500	-9.12500	8.50	-8.41	-1.23	72.25	1	0.19324	0.013	0
200.87500	-8.87500	10.00	-9.89	-1.47	100.00	1	0.19320	0.060	0
200.87500	-8.62500	9.09	-8.99	-1.36	82.63	1	0.19314	0.085	2
200.87500	-8.37500	10.50	-10.47	-0.73	110.25	1	0.19310	0.046	0
200.87500	-8.12500	10.12	-10.01	-1.44	102.31	1	0.19304	0.263	2
200.87500	-7.87500	10.59	-10.47	-1.59	112.15	1	0.19298	0.318	2
200.87500	-7.62500	9.50	-9.41	-1.34	90.25	1	0.19294	0.003	0
200.87500	-7.37500	11.00	-11.00	0.00	121.00	1	0.19288	0.122	2
200.87500	-7.12500	7.50	-7.05	-2.57	56.25	1	0.19284	0.004	0
200.87500	-6.87500	8.50	-8.45	-0.93	72.25	1	0.19280	0.024	0
201.12500	-9.87500	10.00	-9.91	-1.36	100.00	1	0.19336	0.142	2
201.12500	-9.62500	10.00	-9.97	-0.57	101.00	1	0.19332	0.138	2
201.12500	-9.37500	8.00	-7.83	-1.66	64.00	1	0.19328	0.025	0
201.12500	-9.12500	8.08	-7.99	-1.22	65.29	1	0.19324	0.002	0
201.12500	-8.87500	8.32	-8.23	-1.28	69.38	1	0.19316	0.006	0
201.12500	-8.62500	8.50	-8.40	-1.33	72.25	1	0.19310	0.008	0
201.12500	-8.37500	9.50	-9.36	-1.65	90.25	1	0.19306	0.001	0
201.12500	-8.12500	9.00	-8.46	-3.08	81.00	1	0.19302	0.090	2
201.12500	-7.87500	11.50	-11.32	-2.01	132.25	1	0.19298	0.020	0
201.12500	-7.62500	9.69	-9.58	-1.27	93.93	1	0.19294	0.004	0
201.12500	-7.37500	10.50	-10.36	-1.70	110.25	1	0.19288	0.307	2
201.12500	-7.12500	9.50	-9.43	-1.16	90.25	1	0.19284	0.005	0
201.12500	-6.87500	8.50	-8.34	-1.62	72.25	1	0.19280	0.020	0

Sample Header/Attribute Information:

The following sample header was obtained using program read_qscat_info.c and QuikSCAT L3 file QS_XWGRD3_2000119.20001260453.

```
HDF info for file: QS_XWGRD3_2000119.20001260453
Number of Datasets = 16
Number of Global Attributes = 16
Dataset/Name             Rank  Dimensions    Scale       Offset      Data Type
---------------------------------------------------------------------------------------------
0 asc_avg_wind_speed      2    720  1440 0    0.010000000 0.000000000 16-bit unsigned integer
1 des_avg_wind_speed      2    720  1440 0    0.010000000 0.000000000 16-bit unsigned integer
2 asc_avg_wind_vel_u      2    720  1440 0    0.010000000 0.000000000 16-bit signed integer
3 des_avg_wind_vel_u      2    720  1440 0    0.010000000 0.000000000 16-bit signed integer
4 asc_avg_wind_vel_v      2    720  1440 0    0.010000000 0.000000000 16-bit signed integer
5 des_avg_wind_vel_v      2    720  1440 0    0.010000000 0.000000000 16-bit signed integer
6 asc_avg_wind_speed_sq   2    720  1440 0    0.010000000 0.000000000 32-bit unsigned integer
7 des_avg_wind_speed_sq   2    720  1440 0    0.010000000 0.000000000 32-bit unsigned integer
```

```
8 asc_wvc_count           2   720  1440 0    1.000000000 0.000000000  8-bit signed integer
9 des_wvc_count           2   720  1440 0    1.000000000 0.000000000  8-bit signed integer
10 asc_time_frac          2   720  1440 0    0.000020000 0.000000000 16-bit unsigned integer
11 des_time_frac          2   720  1440 0    0.000020000 0.000000000 16-bit unsigned integer
12 asc_rain_prob          2   720  1440 0    0.001000000 0.000000000 16-bit unsigned integer
13 des_rain_prob          2   720  1440 0    0.001000000 0.000000000 16-bit unsigned integer
14 asc_rain_flag          2   720  1440 0    1.000000000 0.000000000  8-bit signed integer
15 des_rain_flag          2   720  1440 0    1.000000000 0.000000000  8-bit signed integer

Index/Attribute Name          Value
-------------------------------------------------------------------------------------------
0 LongName                    QuikSCAT Level 3 Ocean Wind Vectors in 25km grid
1 ShortName                   QSCATL3
2 producer_agency             NASA
3 producer_institution        JPL
4 PlatformType                spacecraft
5 InstrumentShortName         SeaWinds
6 PlatformLongName            NASA Quick Scatterometer
7 PlatformShortName           QuikSCAT
8 project_id                  QuikSCAT
9 data_format_type            NCSA HDF
10 ProductionDateTime         2000-126T04:53:57.000
11 HDF_version_id             4.1r3
12 date_of_average            2000-119
13 l3_rows                    720
14 l3_columns                 1440
15 l2b_input_files            QS_S2B04466.20001191348
                              QS_S2B04467.20001191349
                              QS_S2B04468.20001191350
                              QS_S2B04469.20001191350
                              QS_S2B04470.20001192027
                              QS_S2B04471.20001192028
                              QS_S2B04472.20001192028
                              QS_S2B04473.20001201345
                              QS_S2B04474.20001201345
                              QS_S2B04475.20001201345
                              QS_S2B04476.20001201345
                              QS_S2B04477.20001201345
                              QS_S2B04478.20001201345
                              QS_S2B04479.20001201409
                              QS_S2B04480.20001201409
```

File Naming Convention:

QS_XWGRD3_yyyyddd.YYYYDDDHHMM

where:

	QS	=	QuikSCAT
	XWGRD3	=	Level 3 Gridded Product
	yyyy	=	Calendar Year Covered by Data in File
where:	ddd	=	Day of Year Covered by Data in File
	YYYY	=	Calendar Year Data were Produced
	DDD	=	Calendar Day Data were Produced
	HH	=	Hour in Twenty-Four Hour Time when Data were Produced
	MM	=	Minute Data were Produced

8. Data Organization:

Data Granularity:

The basic granule is one data file. Each data file contains the data for one day.

A general description of data granularity as it applies to the Earth Observing System Data Gateway (EDG) appears in the EOSDIS Glossary.

Data Format:

The SeaWinds on QuikSCAT Level 3 data are provided in Hierarchical Data Format (HDF) version 4.1r3. The HDF library and further information about HDF may be obtained from the NCSA HDF web site at http://hdf.ncsa.uiuc.edu.

There are 16 scientific data sets and 16 global attributes in each SeaWinds on QuikSCAT Level 3 file. For a description of each scientific data set and global attribute, please refer to the Data Description portion (Section 7) of this document.

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

NOTE: This section is summarized from Section 5.3 of the **QuikSCAT Science Data Product User's Manual** [*Dunbar et al*, 2000]. Please refer to the User's Manual for more information.

Sigma-0 Grouping

The sigma-0 grouping algorithm prepares the SeaWinds sigma-0 data for wind retrieval processing. The data contained in the Level 1B product are grouped by geographic location into wind vector cells (WVC). The grouped sigma-0 data are saved in WVC rows in the L2A product.

Surface Flags

After the sigma-0 data have been assigned to a WVC, each cell is checked for land and sea ice. The land map used is the same CIA land-sea map used for NSCAT. The sea ice mask is generated from weekly National Ice Center ice edge data. Both the land and ice flagging algorithms check the center of the sigma-0 cell against the land-sea map and the ice mask.

SeaWinds on QuikSCAT Level 2B Processing

The Wind Vector Cell Preparation algorithm operates on a row of WVC values, passed from the Grouping algorithm, one WVC at a time. It then must determine if there is sufficient data of sufficient quality to perform wind retrieval. This algorithm checks each WVC to determine the data counts (total and by beam), quality flags, and surface flags. It then computes the centroid of the sigma-0 locations to give a WVC location (latitude/ longitude; the binning grid is essentially "thrown away" at this point), and passes the "good" data to the Wind Retrieval algorithm. Upon return from wind retrieval, the ambiguous wind vector data are placed in the Level 2B output buffer.

Wind Retrieval

An accurate model function is essential to deriving ocean wind vectors from scatterometer measurements. Varieties of Ku-band models exist, some of which are derived from scattering theory, and some which are empirically derived. The tabular form of the model function, using a table of real-space (non-dB) sigma-0 values, is used for SeaWinds, with modifications for the incidence angle range and the resolution of the table in azimuth and incidence angle. The model function used for SeaWinds is the QSCAT-1 model.

Ambiguity Removal

The SeaWinds ambiguity removal algorithm uses a modified median filter technique to select a unique wind vector out of a set of ambiguous wind vectors at each wind vector cell. The algorithm is a direct adaptation of the ambiguity removal algorithm used for NSCAT.

NWP Initialization of Ambiguity Removal

The baseline ambiguity removal algorithm for SeaWinds incorporates the Numerical Weather Product (NWP) initialization technique used for NSCAT-1 and NSCAT-2 processing. In this "nudging" technique, the median filter algorithm is initialized with either the first or the second ranked wind vector solution, whichever is closer to the direction of the NWP analysis field. The median filter algorithm then proceeds as described above to generate the final wind vector selections.

DIRTH Algorithms

At far swath, ambiguity removal skill is degraded due to the absence of inner beam measurements, limited azimuth diversity, and boundary effects. Near nadir, due to nonoptimal measurement geometry (fore and aft looking measurement azimuths approximately 180° apart), there is a marked decrease in directional accuracy even when ambiguity removal works correctly. Two algorithms were developed, direction interval retrieval (DIR) to address the nadir performance issue, and threshold nudging (TN) to improve ambiguity removal at far swath. The two algorithms work independently and need not be used together. However, both were used to obtain the DIRTH solutions, wind_speed_selection and wind_dir_selection, in the Level 2B product.

Please refer to Stiles [1999] for more information on the DIRTH algorithms.

Level 3

The Level 3 data were obtained from the Direction Interval Retrieval with Threshold Nudging (DIRTH) wind vector solutions contained in the QuikSCAT Level 2B product. Please refer to the Data Description portion of this document for more details pertaining to deriving the QuikSCAT Level 3 data product from the Level 2B.

Data Processing Sequence:

Processing Steps:

SeaWinds on QuikSCAT science processing proceeds through a well-defined series of level conversion stages, producing more refined products at each stage. The products are created in the following order:

- **Level 0**: Science Telemetry Processing
- **Level 1A**: Engineering Unit Converted Telemetry
- **Level 1B**: Time-Ordered Earth-Located Sigma-0's
- **Level 2A**: Surface Flagged Sigma-0's and Attenuations
- **Level 2B**: Ocean Wind Vectors in a 25km Swath Grid
- **Level 3**: Daily, Gridded Ocean Wind Vectors

Processing Changes:

None at this time.

Calculations:

Special Corrections/Adjustments:

Each QuikSCAT Level 3 parameter is stored as an integer. To convert to a real value, multiply the parameter by the scaling factor and add the offset. The scaling factor and offset for each parameter is given in the Data Characteristics section of this document and in the attributes of each Level 3 HDF file.

Calculated Variables:

The QuikSCAT Level 3 Product contains the following calculated variables:

- wind speed
- u and v components of wind velocity
- wind speed squared
- number of counts
- time in fraction of a day
- rain probability
- rain flag

Graphs and Plots:

No additional information.

10. Errors:

Sources of Error:

"When rain is present, measurements of the ocean surface sigma-0 [from which wind speed is derived] become contaminated for several reasons. Some of the transmitted energy is scattered back towards the scatterometer by the rain and never reaches the ocean surface. Energy backscattered from rain can constitute a significant but unknown portion of the measured echo energy. Some of the transmitted energy is scattered and/or absorbed by the rain and is never measured by the scatterometer. This has the effect of attenuating the echo energy from the ocean. Additionally, the rain roughens the ocean surface and changes its radar cross section." [Huddleston and Stiles, 2000]

The normalized standard deviation of sigma-0, known as Kp, is computed to give an estimate of the measurement uncertainty of the backscatter. There are three major sources of Kp in the scatterometer system:

- the uncertainty in the receiver noise, known as communication Kp or Kpc
- the uncertainties in the geometric and gain parameters, known as retrieval Kp or Kpr
- the uncertainty associated with the geophysical model function

Other sources of error include attitude pointing uncertainty, instrument processing, and various bias errors.

Quality Assessment:

Data Validation by Source:

"The SA subsystem performs the primary QA and data analysis functions for the SeaPAC. SA is concerned with assuring that the science algorithms as implemented in the LP are performing correctly, and making algorithm corrections and refinements as needed. SA monitors the science data quality throughout the mission. QA reports are provided with all data products." [Dunbar et al, 2000]

The QA reports are available on the PO.DAAC FTP site, podaac.jpl.nasa.gov, in the pub/ocean_wind/quikscat/mission_status_report directory.

Confidence Level/Accuracy Judgment:

Tests of the QuikSCAT ambiguity algorithm with simulated wind data show that the vectors closest to the true winds are selected 96% of the time, on average. [Dunbar et al, 2000]

Measurement Error for Parameters:

Information not currently available.

Additional Quality Assessments:

No additional notes.

Data Verification by Data Center:

None.

11. Notes:

Limitations of the Data:

Wind measurements may be contaminated when rain is present. The asc_rain_prob, asc_rain_flag, des_rain_prob and des_rain_flag Scientific Data Sets are included in this product to account for possible contamination.

Radar returns from land and ice correspond to different scattering processes than those over open ocean, and can contaminate wind vector estimates. A land mask has been applied to the QuikSCAT data in order to negate most contamination due to land and ice.

Known Problems with the Data:

The QSCAT-1 model function has a tendency to underestimate high winds. There is also insufficient information in its behavior in calm situations.

Usage Guidance:

Wind direction convention

The oceanographic, or flow vector, convention for wind direction is adopted for SeaWinds on QuikSCAT. Under this convention, a wind direction of 0° implies a flow *toward* the north.

Reference Height for Surface Winds

The adopted reference height for all wind vectors is 10 meters.

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

- global and regional climate studies
- atmospheric forcing, ocean response and air-sea interaction mechanism research
- input to numerical weather- and wave-prediction models

13. Future Modifications and Plans:

The SeaWinds instrument is also scheduled to fly on Japan's Advanced Earth Observing Satellite (ADEOS-II). ADEOS-II is currently scheduled to be launched in November 2001 from the Tanegashima Space Center, Japan.

For the most current information concerning the SeaWinds on ADEOS-II mission, please refer to the JPL SeaWinds on ADEOS-II web site, (http://winds/missions/seawinds/seaindex.html).

14. Software:

Software Description:

Sample read and display software for the SeaWinds on QuikSCAT Level 3 data are available in C, FORTRAN-77 and Interactive Data Language (IDL). These programs can be easily modified to meet the requirements of individual users.

The latest versions of the sample read and display software can be obtained via anonymous FTP to the PO.DAAC FTP site, podaac.jpl.nasa.gov, in the pub/ocean_wind/quikscat/L3/sw/ directory. These sample programs are also accessible through the PO.DAAC QuikSCAT Web Site, http://podaac.jpl.nasa.gov/quikscat/qscat_sw.html.

Program Name	Description	Notes
read_qscat3.c	C program to read the QuikSCAT Level 3 data	1
read_qscat_info.c	C program to read the attributes in QuikSCAT Levels 1B, 2A, 2B and 3 data	1
read_qscat3.f	FORTRAN-77 program to read the QuikSCAT Level 3 data	1
read_qscat_info.f	FORTRAN-77 program to read the attributes in QuikSCAT Levels 1B, 2A, 2B and 3 data	1
ave_vecmap.pro	IDL program to display a map of wind vectors from a QuikSCAT Level 3 file	2
read_qscat3.pro	IDL program to read the QuikSCAT Level 3 data	2
read_qscat_info.pro	IDL program to read the attributes in QuikSCAT Levels 1B, 2A, 2B and 3 data	2

Notes:

- The HDF library (version 4 ONLY) must be installed locally before the read software in C or FORTRAN will work properly. The HDF library and further information about HDF may be obtained from the NCSA HDF web site at http://hdf.ncsa.uiuc.edu.
- Caution should be used when interpreting the results produced by the IDL program ave_vecmap.pro; some artifacts may affect the map. Artifacts may be due to the following causes:

  - the binning algorithm leaves some isolated cells empty, because grid size and data spacing are almost, but not exactly, identical. Variables affected are asc_u, des_u, asc_v, and des_v.
  - when the ascending and descending grids are averaged, a later empty cell in a later neighborhood acquires the wind vector of the earlier cell, about 1/2 day earlier. This happens because Level 3 files contain only the latest measurement for each day. Since QuikSCAT orbit is sun-synchronous, the local time of the samples is about the same every revisit.

  Easy 'solutions' to the problem would be to 'fill' the isolated empty cells with some average of their neighbors, or to discard cells for which either ascending or descending values are missing.

- IDL is a software tool used for the analysis and display of scientific data. It is a registered trademark of Research Systems, Inc. The installation of the HDF library is not necessary in order to use the IDL read software, because IDL already contains the HDF library.

Software Access:

The latest versions of the sample read and display software can be obtained via anonymous FTP to the PO.DAAC FTP site, podaac.jpl.nasa.gov, in the pub/ocean_wind/quikscat/L3/sw/ directory. These sample programs are also accessible through the PO.DAAC QuikSCAT Web Site, http://podaac.jpl.nasa.gov/quikscat/qscat_sw.html.

Please note that the global SeaWinds on QuikSCAT Level 3 data product is currently only available in Hierarchical Data Format (HDF). The HDF library (version 4 ONLY) must be installed before the C or FORTRAN read software will work properly. The HDF library and further information about HDF may be obtained from the National Center for Supercomputing Applications (NCSA) at http://hdf.ncsa.uiuc.edu.

15. Data Access

Contact Information:

Questions and comments concerning the QuikSCAT Science Data Products should be directed to the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA Jet Propulsion Laboratory (JPL). Please note that e-mail is always the preferred method of communication.

E-Mail: podaac@podaac.jpl.nasa.gov

WWW: http://podaac.jpl.nasa.gov/quikscat/

Phone: 626-744-5508

Fax: 626-744-5506

Mail: JPL PO.DAAC User Services Office
Jet Propulsion Laboratory
Mail Stop Raytheon-299
4800 Oak Grove Drive
Pasadena, CA 91109 U.S.A.

Data Center Identification:

Jet Propulsion Laboratory (JPL)
Physical Oceanography Archive Center (PO.DAAC)

Procedures for Obtaining Data:

The SeaWinds on QuikSCAT Level 3 Daily, Gridded Ocean Wind Vectors data set is available via anonymous FTP to podaac.jpl.nasa.gov in the pub/ocean_wind/quikscat/L3 directory.

This product is also available on CD-ROM or on 8mm Exabyte tape in UNIX TAR format. Orders may be placed using the PO.DAAC on-line order form, http://podaac.jpl.nasa.gov/order, or the Earth Observing System (EOS) Data Gateway, http://poseidon.jpl.nasa.gov/~imswww/pub/imswelcome/.

Further information about SeaWinds on QuikSCAT data is also available at the PO.DAAC QuikSCAT web site, http://podaac.jpl.nasa.gov/quikscat/.

Data Center Status/Plans:

Plans to provide the SeaWinds on QuikSCAT data on DVD are currently under consideration.

16. Output Products and Availability:

The SeaWinds on QuikSCAT Level 3 Daily, Gridded Ocean Wind Vectors data set is available via anonymous FTP to podaac.jpl.nasa.gov in the pub/ocean_wind/quikscat/L3 directory.

This product is also available on CD-ROM or on 8mm Exabyte tape in UNIX TAR format. Orders may be placed using the PO.DAAC on-line order form, http://podaac.jpl.nasa.gov/order, or the Earth Observing System (EOS) Data Gateway, http://poseidon.jpl.nasa.gov/~imswww/pub/imswelcome/.

Further information about SeaWinds on QuikSCAT data is also available at the PO.DAAC QuikSCAT web site, http://podaac.jpl.nasa.gov/quikscat/.

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18. Glossary of Terms:

Please refer to the EOSDIS Glossary for a more general listing of terms related to the Earth Observing System project.

19. List of Acronyms:

ADEOS: Advanced Earth Observing Satellite

EA: SeaPAC Engineering Analysis program set

EDG: Earth Observing System Data Gateway

EOS: Earth Observing System

EOSDIS: Earth Observing System Data and Information System

FTP: File Transfer Protocol

FX: SeaPAC File Transfer program set

GSFC: Goddard Space Flight Center

HDF: Hierarchical Data Format

IDL: Interactive Data Language

JPL: Jet Propulsion Laboratory

L1B: QuikSCAT Level 1B Product

L2A: QuikSCAT Level 2A Product

L2B: QuikSCAT Level 2B Product

L3: QuikSCAT Level 3 Product

LASP: Laboratory for Atmospheric and Space Physics at the University of Colorado

LP: SeaPAC Level Processor program set

MOC: Mission Operations Center

NASA: National Aeronautics and Space Administration

NCEP: National Center for Environmental Prediction

NCSA: National Center for Supercomputing Applications

NSCAT: NASA Scatterometer

NWP: Numerical Weather Prediction

PM: SeaPAC Process Management program set

PP: SeaPAC Preprocessor program set

PO.DAAC: Physical Oceanography Distributed Active Archive Center

QA: Quality Assurance

QuikSCAT: NASA Quick Scatterometer

SA: SeaPAC Science Analysis program set

SAFS: Standard Autonomous File Server

SDS: Scientific Data Set

SEAPAC: SeaWinds Processing and Analysis Center

SWT: Science Working Team

URL: Uniform Resource Locator

UTC: Universal Time Coordinated

WVC: Wind Vector Cell

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