Description of Scatterometer Data Products

QuikScat is no longer operational - last data recorded: 2009-Nov-23

REMSS QuikScat data set currently ends on 2009-11-19; data after that date are not currently available.

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Introduction

The microwave scatterometer SeaWinds was launched on the QuikBird satellite in June 1999. We refer to this instrument as QuikScat (or QSCAT) to distinguish it from the nearly identical SeaWinds scatterometer on Midori-II (ADEOS-II), launched December, 2002. The primary mission of these SeaWinds scatterometers is to measure winds near the ocean surface. They are also useful for some land and sea ice applications. The SeaWinds instruments are the third in a series of NASA scatterometers that operate at Ku-band (i.e., a frequency near 14 GHz). The first Ku-Band scatterometer was flown on SeaSat in 1978. Eighteen years later, NSCAT was launched on Japan's Midori-I (ADEOS-I) spacecraft in August 1996. The Europeans also fly satellite scatterometers, which operate at C-band (approx. 5 GHz).

SeaWinds scatterometers are essentially radars that transmit microwave pulses down to the Earth's surface and then measure the power that is scattered back to the instrument. This "backscattered" power is related to surface roughness. For water surfaces, the surface roughness is highly correlated with the near-surface wind speed and direction. Hence, wind speed and direction at a height of 10 meters over the ocean surface are retrieved from measurements of the scatterometer's backscattered power.

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Scatterometer Data

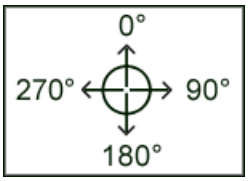
Using Microwave Radiometers to Improve Scatterometer Products

Scatterometer data processing uses contemporaneous microwave radiometer measurements for rain flagging and sea ice detection. Remote Sensing Systems processes both microwave scatterometer and radiometer data in a semi-operational, near-real-time (NRT) environment. Thus, the various data sets can be combined to obtain improvements in the individual products. For the case of QuikScat, we use 4 satellite microwave radiometers (F13 SSMI, F14 SSMI, F15 SSMI, and TMI) to determine if rain is present at the location of the QuikScat observation. In addition, all available SSMIs are used to detect sea ice. Using the SSMI daily observations of sea ice, the scatterometer observations can be properly flagged so that reliable wind vectors can be obtained immediately next to the marginal ice zone.

Scatterometer data files and browse images are overwritten until data is finalized, usually within 2 days of observation.

Geophysical Data Products

Surface Wind Speed	wind speed 10 meters above the water surface, derived from surface roughness (wind stress) roughly equivalent to an 8 - 10 minute mean surface wind
Surface Wind Direction	the angle of air movement (oceanographic convention)
Rain Information	Scatterometer data is less accurate in rain Data products include a scatterometer derived rain flag, and colocated radiometer columnar rain rates



Daily and Time Composite Data

Gridded data are organized according to observation date. All dates and times are Coordinated Universal Time (UTC), also known as Greenwich Mean Time (GMT), Zulu Time (Z), Universal Time (UT), and World Time.

Data products include daily and time averaged geophysical data as follows:

Daily	orbital data mapped to 0.25 degree grid divided into 2 maps based on ascending and descending passes early data may be overwritten by later data at high latitudes and daily "seam"
3-Day	average of 3 days ending on and including file date
Weekly	average of 7 days ending on and including the Saturday file date
Monthly	average of all data within the calendar month

For time averaged scatterometer data: **wind speeds are scalar averaged**
wind directions are vector averaged

Thus, if daily observations record strong winds blowing in opposing directions, the scalar speed average will reflect the high average speed, and the vector direction average will point out the prevailing direction.

A time composite grid cell will contain data if a minimum number of observations exist:

Averaging Time	Potential # observations	Typical # observations	Minimum # observations
3-Day	6	~4	2
Weekly	14	~10	5
Monthly	~60	~45	20

Missing Data

There are gaps within these data. Missing data generally affects Daily and 3-Day products, but can also reduce the number of observations in Weekly and Monthly averages.

When browsing imagery, the navigation may skip dates with no data, or you may see a blank map stating that no data is available for that time.

Binary data files for dates with completely missing data are not produced; they will be absent from our FTP server.

Data gaps are generally due to missing data upstream from our processing facility, such as the instrument being turned off. Occasionally, there are delays in obtaining and/or processing recently recorded data; beyond several weeks, it is unlikely that missing data will become available.

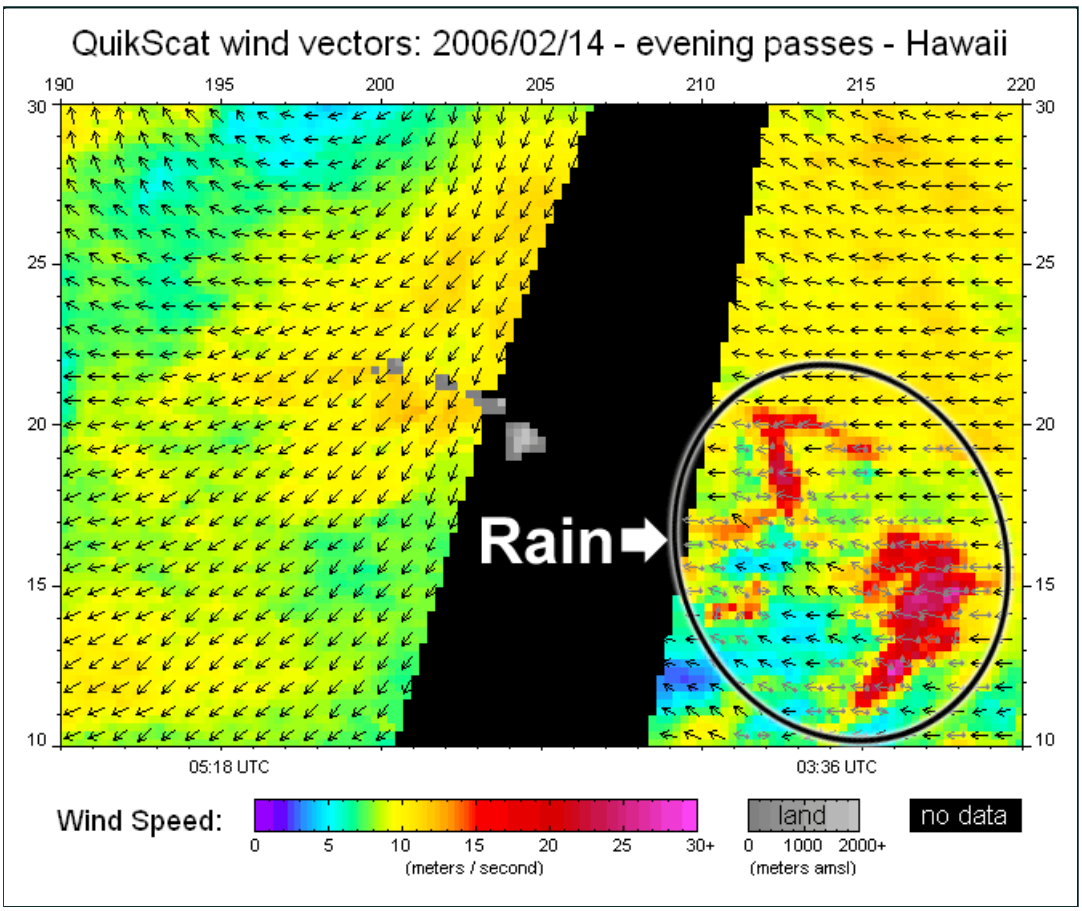
Official information on missing QuikScat and SeaWinds data can be found at:
http://podaac.jpl.nasa.gov/quikscat/qscat_prob.html#gaps
http://podaac.jpl.nasa.gov/seawinds/seawinds_prob.html#gaps

Known Problems

Rain Contamination

Rain is a well known problem affecting scatterometers. It tends to result in erroneous cross track vectors and/or unrealistically high speeds.

Here is an example:

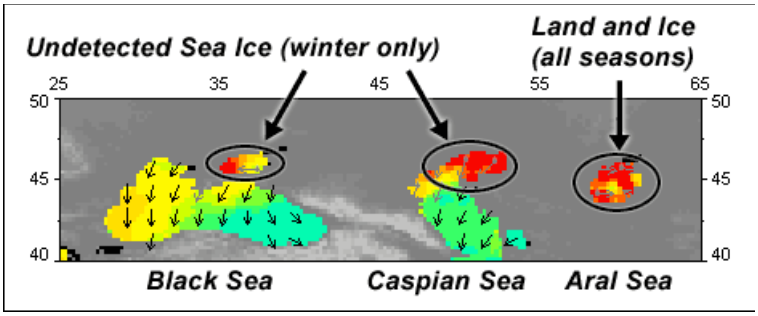


Note the rain contaminated data in the image. The scatterometer derived rainflag is used to draw the arrows grey instead of black. Collocated radiometer rain rates are also available in the data files. Scientists should use the rainflag and radiometer rain rates to help remove rain effects from the data files when doing research.

Regional Ice and Land Problems

Undetected winter sea ice affects:
The Sea of Azov (northern Black Sea)
The Northern Caspian Sea

The shrinking Aral Sea is affected year round by land exposure.



Note that all of these areas are rain flagged.

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Graphic Image Maps

Each daily, weekly, or monthly scatterometer image in our browse data section shows the wind speed and direction for a specific geographical region.

The daily browse images display the ascending and descending satellite passes separately. The approximate UTC time of each pass is labeled near the bottom of the image. The date of the data displayed is the UTC date when the data was collected (See the Map dates and Times section of the FAQs). The observation times of ascending and descending pass segments are interleaved throughout the day. When browsing daily pass segments with the Previous and Next buttons, approximately half of the Earth will be browsed in temporal order; the other half will not be browsed in temporal order.

A scale of 10 meter ocean surface wind speeds is located on each image and extends between zero and 30 m/s. Land regions are colored gray. Areas where scatterometer data are not available are black. For the daily maps, the black color includes areas where the satellite did not pass over and no data was collected, areas where data was collected but it was determined to be bad, coastal areas, and regions containing sea ice.

The browse images are produced from the same gridded data files available on our FTP server.

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Gridded Binary Data Files

We produce daily and time averaged (3-day, weekly, monthly) gridded data files by mapping the scatterometer orbital data to a 0.25 deg longitude by 0.25 deg latitude Earth grid.

File Names and Locations

Gridded QuikScat and SeaWinds data are publicly available via FTP at:
ftp://ftp.ssmi.com/qscat/bmaps_v03a
ftp://ftp.ssmi.com/seawinds/bmaps_v03

Folders and file names follow these conventions:

Time	directory path	file name
Daily	[year]/[month]/	yyyymmdd.gz
3-Day	[year]/[month]/	yyyymmdd_3day.gz
Weekly	weeks/	yyyymmdd.gz
Monthly	[year]/[month]/	yyyymm.gz

Where [year], [month], "yyyy", "mm", and "dd" stand for:

[year]	year folder	y2002, y2003 etc.
[month]	month folder	m01 (Jan), m02 (Feb) etc.
yyyy	year	2002, 2003 etc.
mm	month	01 (Jan), 02 (Feb) etc.
dd	day	01, 02, ... 31

Note that 3-day and weekly files are named for the day they end on (including that 3rd or 7th day).

Data File Formats

Data are encoded in single byte values. Each data file contains a sequence of byte maps, or bmaps, each representing the Earth at quarter degree resolution: 1440 x 720 bytes.

Daily File Format

Daily files are byte arrays of size 1440 x 720 x 4 x 2 (longitude, latitude, parameter, orbit segment (ascending or descending passes)). The 4 parameters are: UTC Time of Observation, Ocean Surface Wind Speed, Ocean Surface Wind Direction, and a Rain Flag / Collocated Radiometer Rain combination value (see below). Two maps exist for each parameter: one of ascending orbit segments (local morning passes) and the other of descending orbit segments (local evening passes).

Dimension	Represents	Range
1440	longitude	0 to 360
720	latitude	-90 to 90
4	parameter	UTC time, wind speed, wind direction, rain info
2	orbit segment	ascending passes, descending passes

Thus, daily files contain 8 global maps:
[ascending time, ascending speed, ascending direction, ascending rain info, descending time, descending speed, descending direction, descending rain info]

Time Averaged File Format

Time averaged files (3-day, weekly, monthly) are byte arrays of size 1440 x 720 x 3 (longitude, latitude, parameter). The 3 parameters are: Ocean Surface Wind Speed, Ocean Surface Wind Direction, and a Rain Flag / Collocated Radiometer Rain Rate combination value (see below).

Dimension	Represents	Range
1440	longitude	0 to 360
720	latitude	-90 to 90
3	parameter	wind speed, wind direction, rain info

Time averaged files contain 3 global maps:
[wind speed, wind direction, rain info]

Overwriting

Data on daily maps are overwritten at both the high latitudes where successive orbits cross and at the "seam" or region where the last orbit of the day overlaps the first orbit of the day.

Cell Definition

The center of the first cell of the 1440 column and 720 row map is at 0.125 E longitude and -89.875 latitude. The center of the second cell is 0.375 E longitude, -89.875 latitude.

Byte Values

The data values fall between 0 and 255. Specific values have been reserved:

0 to 250	=	valid geophysical data
251	=	not used for scatterometers
252	=	not used for scatterometers
253	=	scatterometer observations exist, but are bad
254	=	no scatterometer observations
255	=	land mass

The data values between 0 and 250 need to be scaled to obtain meaningful geophysical data. To scale the data:

Time:	either multiply by	**6.0**	to get	**0 to 1440** minute of day UTC
	or multiply by	**0.1**	to get	**0.0 to 24.0** hour of day UTC
Wind Speed:	multiply by	**0.2**	to get	**0 to 50.0** meters/sec
Wind Direction:	multiply by	**1.5**	to get	**0 to 360.0** degrees
Rain Flag:	extract first bit		to get	**0 = no rain; 1 = rain**
Radiometer Rain:	extract bits 3 to 8	**(x/2) - 0.5**	to get	**0 to 31** km*mm/hr

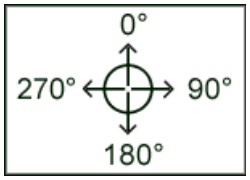
Rain Flag / Colocated Radiometer Rain

The Rain byte contains 3 pieces of information.
Use bit extraction to obtain the following:

scatterometer rain flag (bit 1)	0 = no rain 1 = rain
collocated radiometer flag (bit 2)	0 = no radiometer data within 60 minutes 1 = radiometer data within 60 minutes
radiometer columnar rain rate (bits 3 - 8)	0 = no rain 1 = rain in adjacent cells 2 thru 63 = value/2 -0.5 rain rate in km*mm/hr)

Wind directions follow Oceanographic Convention:

Winds blowing **towards the North**: **0°** (or **360°**)
Winds blowing **towards the East**: **90°**
Winds blowing **towards the South**: **180°**
Winds blowing **towards the West** : **270°**



Zip Compression

The files are stored in zipped form. If your programming environment does not read compressed files directly, use any GZIP compatible tool to unzip files before reading.

Gridded Data File Read Routines

We provide Fortran, IDL, and Matlab reading routines via FTP at:
ftp://ftp.ssmi.com/qscat/scatterometer_bmap_support

The QuikScat and SeaWinds data file formats are identical. The read routines work for both QuikScat and SeaWinds datasets.

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Swath Data Files

File Names and Locations

Orbital scatterometer data are publicly available via FTP at:
ftp://ftp.ssmi.com/qscat/qscat_wind_vectors/
ftp://ftp.ssmi.com/seawinds/seawinds_wind_vectors/

The files are stored in directories based on orbit number (00000to09999, 01000to01999, 02000to02999, etc.). The file names have the form:

QSCAT:	winvec_RRRRR_v03.gz
SeaWinds:	winvec_RRRRR_v03.dat

where RRRRR is the five digit orbit number.

Swath Data File Format

The orbital data file format is described at:
ftp://ftp.ssmi.com/qscat/readme_scatterometer.txt

Date and time information for each QuikScat and SeaWinds orbit is at:

ftp://ftp.ssmi.com/qscat/qscat_info.txt

ftp://ftp.ssmi.com/seawinds/seawinds_info.txt

where columns represent:

Orbit Number	Number of good WVC rows	Equatorial Crossing Date (UTC)	Equatorial Crossing Time (UTC)	Equatorial Crossing Longitude	Orbit Period

Read Routines for Swath (Orbit) Files

We provide Fortran, IDL, and Matlab reading routines at:
ftp://ftp.ssmi.com/qscat/scatterometer_orbit_support/

The QuikScat and SeaWinds swath file formats are identical. The read routines work for both QuikScat and SeaWinds datasets.

Verification data to help ensure you are reading the data file correctly is at:
ftp://ftp.ssmi.com/qscat/scatterometer_orbit_support/readme.txt

If you have any questions about the data, contact:

Deborah Smith
(707) 545-2904 ext. 11 (Pacific Standard Time)
support@remss.com

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Scatterometer Storm Watch

Scatterometer images of active tropical storms are located in our Active Storms section. QuikScat and SeaWinds images of past tropical cyclones are located in the Storm Data Archive.

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Acknowledgement

QuikScat data are produced by Remote Sensing Systems and sponsored by the NASA Ocean Vector Winds Science Team. Data are available at www.remss.com.

SeaWinds data are produced by Remote Sensing Systems and sponsored by the NASA Ocean Vector Winds Science Team. Data are available at

Have You Used These Data?

www.remss.com.

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Last updated: November 24, 2009 support@remss.com

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