SeaWinds on QuikSCAT

Special Product: SeaWinds on QuikSCAT Radiometric L2A Product

Product Description

Version 2.1

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Summary

Following up on the successful NSCAT mission, the SeaWinds on QuikSCAT scatterometer (Qscat) will provide σ^o measurements of the Earth's surface at unprecedented coverage and resolution. In making measurements of σ^o, Qscat also measures the system noise power. These noise measurements can be converted into measurements of the apparent brightness temperature of the Earth. These Ku-band radiometer observations can be useful in evaluating the location of rain over the ocean and may have application for land and ice studies. Designed as a radar, Qscat is not an optimum radiometer, and its individual brightness measurements are noisier than desired. This can be ameliorated by using spatial averaging. To this end, a special Qscat radiometric product has been developed which consists of spatial and temporal averages of the brightness temperature-converted noise observations.

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1 Product Overview

Though cut short by the loss of the host spacecraft, NSCAT was an unqualified success. As a follow-up/replacement for the NSCAT mission, the SeaWinds on QuikSCAT scatterometer (Qscat) will continue to provide high quality σ^o measurements of the Earth's surface at unprecedented coverage and resolution.

In making σ^o measurements Qscat transmits Ku-band RF pulses and measures the return echo power. Since the return echo is contaminated by radiometric and thermal noise, a separate measurement of the noise power is also made and subtracted from the measured echo power to estimate the return signal power. Unlike NSCAT, this noise measurement is made simultaneously with the echo power measurement but over a wider (1 MHz versus 180 kHz) bandwidth. The noise measurement bandwidth includes the signal bandwidth, requiring a somewhat more complicated noise subtraction scheme than used for NSCAT. Nevertheless, the receiver gain is very stable and with careful calibration the noise power measurements can be converted into apparent brightness temperature measurements. The observed apparent brightness temperatures are a function of the instrument noise, the surface emissivity and temperature, and the attenuation/emission of the intervening atmosphere. Over the ocean, rain results in higher brightness temperatures than the ocean alone. Thus, the brightness temperature measurements can be useful in locating rain and possibly estimating rain rate.

2 Product Generation

This product is generated using information from both L1A and L2B files. In generating this product the individual noise measurements contained in the L1A product files are converted to noise-only measurements by subtracting out the signal power contained in the slice measurements. The resulting noise-only power estimate is converted to effective brightness temperatures (Tb's) using calibration coefficients determined by L. Jones [2].

In order to Earth-locate the Tb measurements, the lat/lon location of the corresponding pulse in the L1B file is extracted. The wind vector cell (wvc) in which the measurement center falls into is then determined by using M. Frelich and B. Vanhoff's KEY grid indexing which gives the the along-track/cross-track grid index that each measurement falls in. This insures that the radiometric product grid is identical to the L2B product. Note that only Tb measurements corresponding to 'usable' (according the L1B SIS [1]) σ^o values are retained; the others are discarded. Frame quality and other flags are also examined, with measurements discarded which do not pass very conservative flag checking.

The mean, standard deviation, and count of the Tb measurements (for a given beam) falling into each wvc are then determined. This results in two Tb measurements, one for each polarization or beam, for each wvc along with the counts and standard deviations. Note that Tb measurements for both forward-looking and aft-looking azimuth directions are averaged into the final product.

3 Product Format

This product is stored in HDF form similar to the L2B standard product. The Tb, count, and standard deviation arrays are stored as scientific data sets. Global attributes are copied from selected L1B global attributes and are stored in the same manner. In addition, two new global attributes are included. These give the full file names of the L1A and L1B data files used to create the brightness temperature product.

The 6 scientific data sets in each file are 1624 by 76 arrays containing the mean Tb values, the counts, and standard deviations for each wvc. The SDS names are Tb_h, Tb_v, Tb_hcnt, Tb_vcnt, Tb_hstd, and Tb_vstd. Two additional scientific data sets named wvc_lat and wvc_lon are also stored as 1624 by 76 arrays. The cnt's are stored as 4 byte integers while the other variables are stored as floats.

The global attributes (with typical values) are:

Source_L1A_file*	QS_S1A00678.19992301242
Source_L1B_file*	QS_S1B00678.19992301325
LongName	QuikSCAT L2B Radiometer Measurements in 25km Swath Grid
ShortName	QSCAT_RadMode_L2
producer_agency	NASA
producer_institution	Brigham Young University
PlatformType	spacecraft
InstrumentShortName	SeaWinds
PlatformLongName	NASA Quick Scatterometer
PlatformShortName	QuikSCAT
project_id	QuikSCAT
data_format_type	NCSA HDF
QAPercentOutofBoundsData	0
QAPercentMissingData	0
build_id	QS_revrad Version 3
ProjectionDateTime	19992450910
RangeBeginningDate	1999-217
RangeEndingDate	1999-218
RangeBeginningTime	23:17:50.690
RangeEndingTime	00:58:54.107
rev_number	678

The global attributes marked with '*' (Source_L1A_file and Source_L1A_file) are new. They are the file names for the L1A and L1B data files used in creating this product. All other attributes are identical to those documented in the L1B SIS [1].

4 User Notes

The Qscat design is optimized for operation as a radar rather than as a radiometer. As a radiometer, it design is sub-optimum though good quality radiometric measurements are obtained. The following paragraphs consider some of the known limitations of the data.

Because the radiometric and radar measurements are made simultaneously, some contamination of the radiometric measurement by the radar signal can be expected, particularly for large attitude excursions which might shift some of the return echo signal outside of the signal measurement spectrum. However, very little signal 'spill over' has been observed in the data studied thus far.

The absolute calibration of the measurements is somewhat uncertain since no provisions for absolute radiometric calibration of the Qscat receiver are incorporated into the design or operation since they are not needed for radar operation. The short-term (hours to days) relative calibration is considered to be accurate to a few tens of Kelvin. Long-term calibration will be established by comparison to other satellite radiometer systems (e.g., SSM/I and TRMM-TMI). The radiometric precision (ΔT) for a single pulse observation is approximately 25 K. This is reduced by averaging multiple pulses with an improvement being 1/sqrt(number of pulses averaged).

In producing this temporal/spatial average product note that, unlike the L2B wind product which reports wvc lat/lon values as the average of the lat/lon's of the individual σ^o measurements used in the particular wvc, the reported lat/lon values are the nominal wvc (ideal wvc center location) lat/lon values.

5 Product file name format

The standardized data file naming scheme is:

$$QS\_XTbap2A\mathbf{RRRRR.YYYYDDDHHMM}$$

where **RRRRR** is the 5 digit rev number, and the 11 character extension contains the production date where **YYYY** is a four digit year code, **DDD** is a three digit Julian day code, **HH** is a two digit hour, and **MM** is a two digit minute. One file is produced for each orbit rev. Files are typically just under 3 MB in size.

References

[1] B. Weiss, "Level 1B data Software Interface Specification," JPL Internal Document D-16077, May 1999.

[2] W.L. Jones and D.G. Long, "QuickSCAT Ratiometer Processing", QuikSCAT Cal/Val meeting minutes, Nov. 1999

6 Points of Contact

Questions concerning data distribution should be be directed to the PO.DAAC. Issues related to data quality or processing should be directed to David Long or Linwood Jones. Please note that e-mail is the preferred means of communication.

6.1 PO.DAAC: Data Distribution Issues - Contact information

JPL PO.DAAC User Services Office
Jet Propulsion Laboratory
Mail Stop Raytheon-299
4800 Oak Grove Dr.
Pasadena, CA 91109 USA

e-mail: `qscat@podaac.jpl.nasa.gov` Telephone: (626) 744-5508
FAX: (626) 744-5506
Homepage: `http://podaac.jpl.nasa.gov/quikscat`
FTP: `ftp://podaac.jpl.nasa.gov`

6.2 Technical/Algorithm Issues - Contact information

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