QuikSCAT Near−Realtime (NRT) Data Product Release Notes
31 January 2000

QuikSCAT launched flawlessly from Vandenberg AFB on June 19, 1999. Since QuikSCAT was first activated on July 7, it has been extremely stable and has operated within expected limits. Throughout the Calibration/Validation period, the data from QuikSCAT have been provided to the Science Working Team to assess the quality of the data. Simultaneously the data have been provided to NOAA/NESDIS to test the near−realtime processing and dissemination system, and to perform in−house quality control evaluations of the data.

NRT Data Processing and Product Overview

Processing QuikSCAT data to wind vectors in near−realtime was a challenging task, given the relatively large data volume of the SeaWinds instrument. The overarching requirement on the NRT processing is the latency requirement: The wind vector products are required to be available within less than 3 hours of the time of the oldest observations in a data pass. Given the orbit period of 101 minutes, and the time to downlink and transfer the telemetry to the processing system, this leaves about 40 minutes in which to process an incoming (usually longer than one orbit) data pass. By contrast, it takes over an hour of CPU time for the science L2B product to be produced for one rev of data.

In addition to data latency, the output products were required to include both collocated sigma0 and wind vector data over the oceans, and the sigma0 data over land and ice; in effect, a merged L2A/L2B product. At the same time, the products had to be kept to a manageable volume in order to be able to be transferred via the network to the operational centers using the data.

To address these requirements, the QuikSCAT NRT system was designed as follows:

1) All processing is pass−based, regardless of gaps or overlaps between successively received passes.

2) The data processing from telemetry up to the Earth−located sigma0 data is identical to the science processing up through Level 1B. The NRT data products are generated directly from the L1B pass files with no intermediate products.

3) The NRT wind processing uses the technique of slice−compositing of L1B sigma0 slices, then re−compositing the composites to generate two (fore and aft) sigma0 measurements for each beam (maximum of 4 sigma0/25km cell). The wind vectors are generated from these "composite−composite" sigma0s using the standard science L2B wind retrieval algorithm. Reducing the number of sigma0s in this way significantly speeds up the processing and provides a uniform number of sigma0

measurements in each wind vector cell, simplifying and reducing the volume of the output product.

4) Due to the timeliness requirement, the initialization of the ambiguity removal algorithm is done using NCEP global aviation forecast wind fields, rather than analysis fields.

5) The output of the NRT wind processor is converted to BUFR format to facilitate the use of the data by the operational centers.

Data Quality Assessment

The primary conclusions of the Calibration/Validation phase with regard to the QuikSCAT NRT data quality are listed below.

1) Based on open−ocean analyses, the v−pol (outer) and h−pol (inner) backscatter measurements are relatively calibrated to within 0.1 dB. Prior to rev 2252 (24 Nov 99, UT1518), h−pol σ_o measurements were underestimated by 0.2 dB.

2) The occurrences of negative σ_o measurements over the ocean are within expectations and are correlated with low wind speeds. The fraction of negative σ_o measurements in the science L2A varies between 0.2% and 1.0% for individual revs, averaging around 0.5% globally. The NRT composite negative σ_o fraction averages around 0.25% globally; it is lower due to the compositing process, as expected.

3) Analyses comparing collocated science L2A (egg) sigma0s and NRT composite sigma0s shows no significant bias between the two backscatter types. The mean bias between mean L2A sigma0s of the same "look" as the NRT value within the same wind vector cell is less than 0.05 dB for cells where the winds were between 3 to 30 m/s.

4) QuikSCAT σ_o and vector wind measurements are accurate within approximately one cell (~ 25 km) of the coastline. The pre−launch land−flagging algorithm, which used a global land mask extending 50 km seaward from all coasts was deemed to be overly conservative. New land masks with seaward margins ranging from 12.5 km to 30 km were tested, and little evidence of land contamination of the wind retrievals was found for a margin of 30 km. The same land mask is used for both the science and NRT processing.

5) Wind retrieval performance appears to be good at moderate to high wind speeds over the entire dual−beam portion of the swath. Winds retrieved in the outer (V−pol only) swath in the NRT data are based on only two (fore+aft) sigma0 measurements, and exhibit rapid degradation in performance as the azimuth difference between the two measurements diminishes. *The outer swath winds in the NRT products should be used with caution.*

6) A combination of NSCAT−2 model errors and residual beam balance errors seems to result in larger wind errors at speeds under 5 m/s. For NCEP and ECMWF wind speeds in the range of 5 to 30 m/s, the QuikSCAT RMS speed and direction errors relative to the model analyses are about 2 m/s and 17−20 degrees, respectively, based on our preliminary analysis. Directional accuracies vary as a function of wind speed (as expected from an error model incoporating random component errors), with overall rms differences of 18 degrees for speeds from 5−20 m/s and 21 degrees for winds from 3−20 m/s.The beam balance was tuned to NCEP 1−degree analyses; hence the speed bias relative to NCEP is nearly zero across the swath (~0.1 m/s). Model function refinements to be implemented for the April science reprocessing will correct minor observed distortions of the directional histograms and a 0.5−1.0 m/s apparent wind speed bias (SeaWinds/QuikSCAT low).

7) Ambiguity removal using only the QuikSCAT data and the NWP nudging algorithm (initialized using the 1.0 degree resolution aviation forecast nearest in time to the data) averages in excess of 95% skill on the dual−beam swath, when compared against spatially *and* temporally interpolated ECMWF analyses for speeds from 3−30 m/s. Some variations in overall wind retrieval performance as a function of cross−track location are observed, resulting from the conical scan geometry of the instrument. The incorporation of the Direction Interval Retrieval technique, developed by B. Stiles, in the NRT ambiguity removal minimizes the cross−track performance variations. The DIR winds are the "selected" ambiguities in the NRT product.

8) Observations of apparent rain contamination were presented and discussed at the November, 1999 cal/val workshop, and led to an intensive effort to develop autonomous rain indicators. Indices and flags from two such algorithms are included in the NRT data. At present, rain indices and flags cover the swath where both H and V polarization data are available. The NRT variable *wvc_quality_flag* contains bits indicating both the detection of rain and an indication of the validity of the given algorithms result for that wind vector cell. One objective for this Interim data release is to obtain further evaluation of these rain indicators. When presenting and comparing results based on the Interim data, users should clearly state which flagging algorithms(s) were used. The Multi−Parameter technique uses the MLE objective function values, direction of the retrieved wind relative to the swath, the retrieved wind speed, and the normalized beam difference (NBD) parameter [based on observed versus expected V and H polarization differences] to assign a rain probability. The Normalized Objective Function (NOF) algorithm estimates a rain−free wind speed and uses a table of mean rain−free sigma0 residuals to compare to the actual values derived for a given wind vector cell, thus deriving a rain index. The algorithm tables and thresholds for these algorithms have been tuned to SSM/I rain detections. The results from each algorithm show substantial agreement. The rain flags in the *wvc_quality_flag* are spatially filtered to reject isolated points.

9) The work by L. Jones, J. Zec, and Y. Liu to derive brightness temperatures from the QuikSCAT noise−only data has progressed significantly during the Calibration Validation phase. As of the January 31 science data release, the brightness

temperatures are included in the Level 1B product. Work to refine the algorithms for rain detection and attenuation estimation is on−going and not yet stabilized. Additional space in the NRT product has been assigned to hold mean H and V brightness temperatures and their standard deviations, and to hold values for Tb−derived rain rates and attenuation. It is planned that these will be filled with computed values once the algorithms have been fully established and tested.