

QuikSCAT



QuikSCAT URL
winds.jpl.nasa.gov/

Summary

QuikSCAT acquires accurate, high-resolution, continuous, all-weather measurements of global (land, ice, and ocean) radar cross-sections and near-surface vector winds over the ice-free global oceans. The wind measurements are used for research investigations as well as in operational weather prediction. Radar cross-sections from land and ice-covered regions are used for vegetation classification/monitoring, cryospheric investigations, and operational ice-edge and iceberg detection and monitoring.

Instrument

- SeaWinds

Points of Contact

- *SeaWinds Principal Investigator:* Michael Freilich, Oregon State University
- *QuikSCAT Project Scientist:* W. Timothy Liu, NASA Jet Propulsion Laboratory/California Institute of Technology

Other Key Personnel

- *QuikSCAT Program Scientist:* Eric Lindstrom, NASA Headquarters
- *QuikSCAT Program Executive:* Lou Schuster, NASA Headquarters
- *QuikSCAT Project Manager:* Rob Gaston, NASA Jet Propulsion Laboratory/California Institute of Technology

Mission Type

Earth Observing System (EOS) Systematic Measurements

Key QuikSCAT Facts

Spacecraft: Ball Aerospace BCP 2000 QuikBird Bus (variant)

Orbit

Type: Sun-synchronous
Equatorial Crossing: 6:00 p.m.
Altitude: 803 km
Inclination: 98.6°
Period: 101 minutes

Dimensions: Main spacecraft bus is 2.2 m × 1.7 m × 1.4 m; radar extends 1.3 m from main spacecraft

Mass: 970 kg

Power: 874 W

Downlink: S-band, 262 kbps. Ground stations at Wallops Flight Facility Ground Station (WGS), Alaska Ground Station (in Poker Flats) (AGS), Svalbard Ground Station (SGS), and McMurdo Ground Station (MGS) designed to allow fully processed data products within three hours of measurement acquisition by the spacecraft, to enable operational applications such as weather and ice/marine hazard prediction.

Design Life: 3 years (exceeded)

Contributors

Ball Aerospace & Technologies Corp. (BATC): Integration and testing of total space segment—includes bus and instruments

Laboratory for Atmospheric and Space Physics (LASP), University of Colorado: Mission operations

Honeywell: Antenna subsystem

Raytheon: Radio-frequency subsystem

NASA JPL: Command and data subsystem

Launch

- *Date and Location:* June 19, 1999, from Vandenberg Air Force Base, California

Relevant Science Focus Area

(see NASA's *Earth Science Program* section)

- Climate Variability and Change
- Weather

Related Applications

(see *Applied Sciences Program* section)

- Air Quality
- Coastal Management
- Disaster Management

QuikSCAT Mission Background

The QuikSCAT mission was developed rapidly following the premature demise of Japan's National Space Development Agency (NASDA) Advanced Earth Observation Satellite (ADEOS). QuikSCAT operated throughout the lifetime of the ADEOS-II mission (December 2002–October 2003), which carried an identical SeaWinds instrument, and beyond, still operating in early 2006.

SeaWinds

SeaWinds Background

SeaWinds is a Ku-band scatterometer with rotating antenna to measure global radar scattering cross-section and ocean near-surface wind velocity.

The SeaWinds instruments are designed to acquire accurate, high-resolution, continuous, all-weather measurements of global (land, ice, and ocean) radar cross-sections and near-surface vector winds over the ice-free global oceans. SeaWinds on QuikSCAT is crucial because it is the only instrument currently on orbit capable of measuring wind velocity—both speed and direction—under nearly all-weather conditions. SeaWinds data enable studies of tropospheric dynamics, upper-ocean circulation, and air-sea interaction. SeaWinds data are provided in near real time to NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) and then are distributed nationally and internationally for routine use in global and regional operational weather and ice prediction.

SeaWinds transmits pulses of microwave radiation at 13.4 GHz and measures the backscattered signal from Earth over a continuous, 1800-km-wide swath centered on the subsatellite track. The surface normalized radar cross-section is calculated from the backscatter measurements and knowledge of the viewing geometry and instrument characteristics. Over the ocean, the received power results primarily from scattering from centimetric ocean roughness elements whose amplitudes and directional distributions are in equilibrium with the local wind; thus backscattered power varies as a function of wind speed and direction relative to the radar beam. Multiple, near-simultaneous measurements of normalized radar cross-sections obtained from the same location, but from different viewing directions and incidence angles, are combined with an empirical model function relating backscatter cross-section to wind conditions to allow calculation of near-surface wind speed and direction over the ice-free oceans.

With the failure of the ADEOS-II spacecraft on October 24, 2003, the SeaWinds instrument on QuikSCAT once again became the only space-based scatterometer in operation. The SeaWinds instrument builds on the heritage of the NASA scatterometer (NSCAT), which flew on ADEOS from August 1996 until the failure of the spacecraft in June 1997. The dual-scanning pencil-beam design of the SeaWinds instruments replaces the six, 3-m-long antenna array used for NSCAT with a single 1-m diameter rotating-dish antenna. This compact design allowed SeaWinds to

Key SeaWinds Facts

Heritage: SEASAT, NASA Scatterometer (NSCAT) Advanced Earth Observing Satellite (ADEOS)

Dimensions:

Computer and Data Subsystem:
32 cm × 46 cm × 34 cm

Scatterometer Electronics Subsystem:
81 cm × 91 cm × 43 cm

100-cm-diameter antenna dish on
60-cm diameter × 60-cm pedestal

Scatterometer Antenna Subsystem
Total Height: ~150 cm

Mass: 220 kg

Power: 220 W

Duty Cycle: 100%

Data Rate: 40 kbps

Thermal Control: Radiators

Thermal Operating Range: 5–40° C

Field of View (FOV): Rotating (at 18 rpm) pencil-beam antenna with dual feeds pointing 40° and 46° from nadir

IFOV: ±51° from nadir (actual IFOV is 25 km × 35 km (ellipse) ±51° is total swath width.)

Swath: 1800 km (±51°) from 803-km altitude

Pointing Requirements (3σ):

Control: < 0.3° (~1000 arcsec)

Knowledge: < 0.05° (~167 arcsec)

Stability: < 0.008°/s (30 arcsec/s)

Contributor: NASA JPL

be accommodated on both the QuikSCAT and ADEOS-II spacecraft and also provides a contiguous measurement swath (eliminating the 329-km nadir gap in the NSCAT data).

SeaWinds acquires high-accuracy measurements of wind speed and direction over nearly 90% of the ice-free global oceans each day (exceeding the temporal-resolution requirements in the data product table found at the end of this section). SeaWinds measurements are provided in near real time to the Centers for Environmental Prediction (CEP), the European Centre for Medium-Range Weather Forecasts (ECMWF), and other meteorological agencies for use in marine forecasting, operational global numerical weather prediction, and climate forecasting. SeaWinds data play a crucial role in interdisciplinary scientific investigations of global weather patterns, marine meteorology, wind-driven ocean circulation, air-sea interaction, and climate dynamics. Raw backscatter measurements from land and ice are also used to classify vegetation type, monitor large-scale land use and productivity changes, and identify and monitor ice type and extent. Post-launch validation of the SeaWinds measurements showed that they exceeded the pre-launch science-accuracy requirements. Research studies and operational analyses using these data confirm the utility and impact of the scatterometer vector winds and demonstrate the scientific potential of the scatterometer measurements over land and ice. SeaWinds data products consist of global, multi-azimuth normalized radar-cross-section measurements with ~6-km × 25-km spatial resolution, and 25-km resolution ocean vector winds (~12% speed and 20° direction accuracies for wind speeds of 3–30 m/s under non-raining conditions) in the measurement swath.

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QuikSCAT/SeaWinds References

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Note: For additional references, see the ADEOS-II section.

QuikSCAT Data Products

Product Name or Grouping	Processing Level	Coverage	Spatial/Temporal Characteristics
SeaWinds <i>Data Set Start Date: July 19, 1999</i>			
Normalized Radar Cross Section and Ancillary Data	1B	Global	6 km × 25 km horizontal resolution (hres)/ 70% daily and 90% every 2 days
Grouped and Surface-Flagged Backscatter and Attenuations	2A	Global	25 km × 25 km hres/70% daily and 90% every 2 days
Ocean Wind Vectors in 25-km Grid	2B	Oceans	25 km hres/90% every 2 days
Ocean Wind Vectors on regular, global latitude-longitude grid	3	Oceans	25 km hres/90% every 2 days

QuikSCAT Data Products