NASAfacts

ISS-RapidScat

NASA's International Space Station Rapid Scatterometer, or ISS-RapidScat, scheduled for launch in 2014, is the first near-global scientific Earth-observing climate instrument specifically designed and developed to operate from the exterior of the space station. The experimental mission will measure near-surface ocean wind speed and direction in Earth's low and mid-latitudes in any kind of weather except heavy rain. The data will be used to support weather and marine forecasting, including tracking storms and hurricanes, and to study Earth's climate.

ISS-RapidScat's berth on the space station will put it in an orbit that is unique from any other wind measuring instrument currently in orbit. This vantage point will give scientists the first near-global direct observations of how ocean winds vary over the course of the day, while adding extra eyes in the tropics and mid-latitudes to track the formation and movement of tropical cyclones.

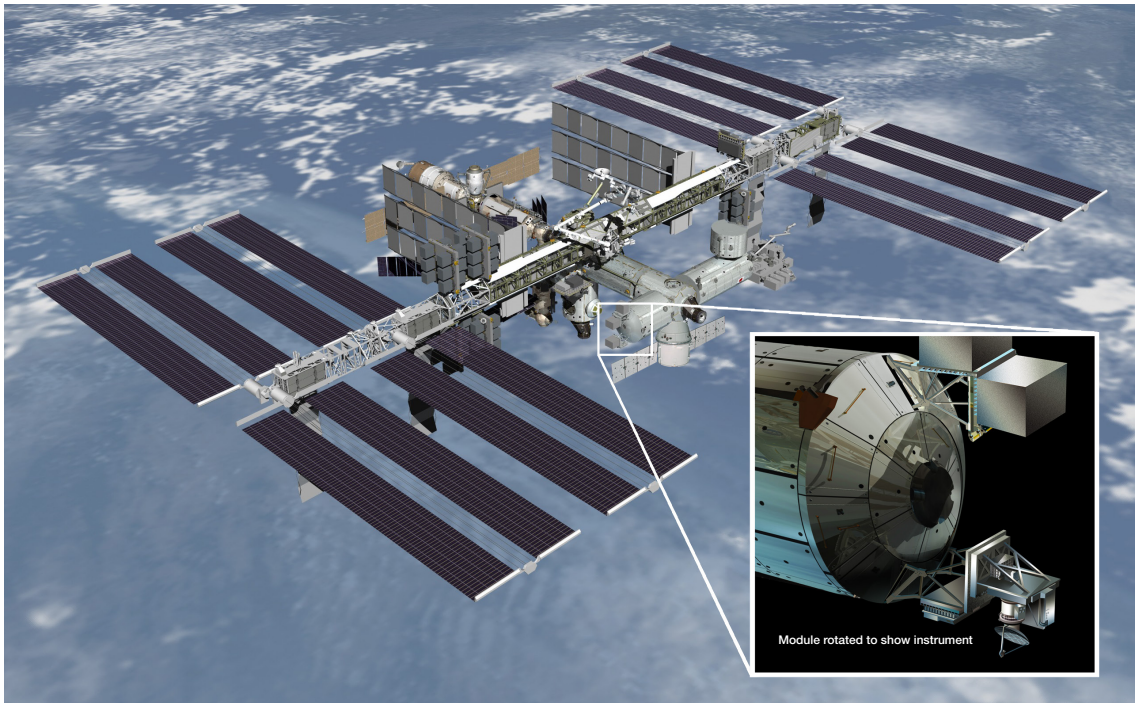
Mission Overview

Oceans cover more than 70 percent of Earth's surface. Scatterometers are the best remote-sensing system for providing accurate, frequent, high-resolution measurements of ocean-surface wind speed and direction in most weather and cloud conditions. These instruments play an increasingly important role in oceanographic, meteorological and climate studies.

Winds over the ocean are a critical factor in determining regional weather patterns and climate. In severe storms they can inflict major damage on shore populations and shipping. Ocean winds also enable ocean upwelling where nutrient-rich deep waters rise to the surface, nourishing marine life and benefiting coastal fisheries. Changes in ocean winds also help us monitor large-scale patterns in Earth's atmosphere and oceans, such El Niño.

Ocean winds have been measured from space since 1973. The most recent NASA scatterometer instrument was the SeaWinds instrument on the QuikScat satellite, launched in 1999. After that instrument exceeded all expectations by collecting data for more than a decade, its antenna stopped spinning in 2009, although the satellite continues to collect limited data that are being used to calibrate other scatterometer instruments in orbit.

With the loss of SeaWinds' full swath, the international constellation of satellites that measure ocean surface winds suffered a significant reduction in observational



capabilities. NASA developed ISS-RapidScat to mitigate the lost capacity — an objective that became even more urgent after the loss of the Indian Space Research Organization's OSCAT instrument — and to improve our understanding of how interactions between the ocean and atmosphere influence weather and climate.

In the summer of 2012, NASA's space station program manager offered scientists at NASA's Jet Propulsion Laboratory (JPL), Pasadena, California, a mounting location on the space station for a replacement instrument and a free ride on a space station resupply mission in 2014. The entire ISS-RapidScat mission has been built in the two years since then — an extraordinarily short timeline compared to most spaceborne missions.

Rather than designing and building a new instrument from scratch, the ISS-RapidScat team has adapted hardware for use on the space station from test parts of the QuikScat mission and has added a new, smaller reflector antenna. Although some QuikScat components had been warehoused since the 1990s, they offer all the needed capability for the ISS-RapidScat mission. The development approach leverages space station capabilities, inherited hardware and some new technology that was needed to marry the old hardware with space station interfaces. Combining old and new, space-grade and industrial-grade hardware allows great savings in cost and development schedule, but comes with a greater mission risk.

ISS-RapidScat will provide cross-calibration of the international constellation of ocean wind satellites, extending the continuity and usefulness of the scatterometer data record. Currently, the satellites in the constellation observe at different local times and do not see the same patch of ocean at the same time. In the space station orbit, RapidScat will be able to periodically observe winds at the same time as each of the other scatterometers in the constellation. This capacity will allow scientists to correct any previously unknown errors and to extend the ten-year record from the SeaWinds instrument on QuikScat with RapidScat measurements, creating a continuous data set.

Mission data are processed by an adaptation of the QuikScat science data processing system funded by the ISS program. Science products and cross-calibration are funded by NASA's Science Mission Directorate.

Instrument Overview

The ISS-RapidScat scatterometer is a radar instrument that operates at the microwave wavelength of 13.4 gigahertz. It bounces microwaves off the ocean surface and measures the echo strength with a precision comparable to that of QuikScat. Several views of the same sea surface during the overflight of the instrument provide radar return signals that can be turned into estimates of wind speed and direction. This bit of magic is possible because the roughness of the surface varies in a predictable way in relation to wind speed and direction. ISS-RapidScat's observation swath of approximately 560 miles (900 kilometers) covers the majority of the ocean between 51.6 degrees north and south latitude (approximately from north of Vancouver, Canada, to the southern tip of Patagonia) in 48 hours.

As the first near-global Earth-observing climate instrument on the outside of the space station, RapidScat had some unique engineering challenges. The docking point faces outward toward space, not down toward Earth, and the space station's flying angle changes as new pieces are added to it. JPL engineers designed a new, downward-pointing mounting device called a nadir adapter, which also accounts for the space station's average flying angle.

Another concern was that one of the space station's docking ports is within the scatterometer's field of view. To avoid either bombarding astronauts with microwaves or having to turn off the instrument when the docking port is in use, the engineers devised a unique scanning pattern that avoids the docking port while still scanning across the vast majority of the instrument's viewing range.

Launch, Orbit and Docking

ISS-RapidScat is scheduled for launch from Florida's Cape Canaveral Air Force Station in 2014 on SpaceX's fourth contracted mission of the Falcon-9/Dragon commercial cargo resupply spacecraft. The altitude of the space station's orbit is at 233 to 270 miles (375 to 435 kilometers), and its inclination is 51.6 degrees. This orbit samples the tropics better than sun-synchronous orbits, providing an excellent platform for key observations at these latitudes.

Upon docking at the space station, the instrument will be installed on the External Payload Facility SDX site of the Columbus module by the station's robotic arm, which is controlled from the ground. ISS-RapidScat is an autonomous payload, requiring no interaction from station astronauts.

Partners

RapidScat is a partnership between JPL; the International Space Station Program (Johnson Space Center, Houston; Kennedy Space Center, Florida; and Marshall Space Flight Center, Huntsville, Alabama); NASA's Science Mission Directorate; the European Space Agency; and SpaceX, Hawthorne, California.

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

For more information about RapidScat, visit —

www.jpl.nasa.gov/missions/iss-rapidscat