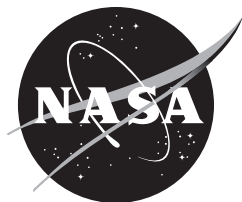
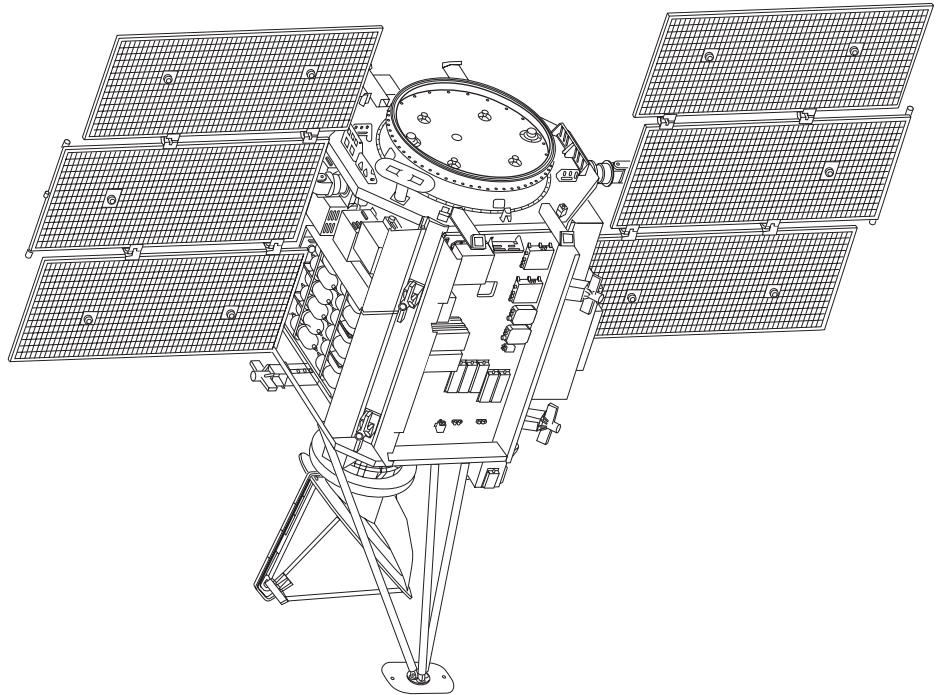


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Quick Scatterometer Launch

Press Kit
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RELEASE:

NASA'S NEW OCEAN-OBSERVING SATELLITE SET TO CHASE THE WIND

Built in record time in just 12 months, QuikScat, NASA's new ocean-observing satellite, will be launched on a Titan II rocket from California's Vandenberg Air Force Base at 7:15 p.m. Pacific Daylight Time on June 18. This satellite will be NASA's next "El Niño watcher" and will be used to better understand global weather abnormalities.

The Quick Scatterometer, or QuikScat, will provide climatologists, meteorologists and oceanographers with daily, detailed snapshots of ocean winds as they swirl above the world's oceans. The mission will greatly improve weather forecasting.

Winds play a major role in every aspect of weather on Earth. They directly affect the turbulent exchanges of heat, moisture and greenhouse gases between Earth's atmosphere and the ocean. To better understand their impact on oceans and improve weather forecasting, the satellite carries a state-of-the-art radar instrument called a scatterometer into orbit for a two-year science mission.

Knowledge about which way the wind blows and how hard it is blowing may seem simple, but this kind of information is actually a critical tool in improved weather forecasting, early storm detection and identifying subtle changes in global climate," said Dr. Ghassem Asrar, associate administrator of NASA's Office of Earth Science, Washington, DC.

The mission will help Earth scientists determine the location, structure and strength of severe marine storms—hurricanes in the Atlantic, typhoons near Asia and mid-latitude cyclones worldwide—which are among the most destructive of all natural phenomena. The National Oceanic and Atmospheric Administration (NOAA), a chief partner in the QuikScat mission, will use mission data for improved weather forecasting and storm warning, helping forecasters to more accurately determine the paths and intensities of tropical storms and hurricanes.

As NASA's next "El Niño watcher," QuikScat will be used to better understand global El Niño and La Niña weather abnormalities. Changes in the winds over the equatorial Pacific Ocean are a key component of the El Niño/La Niña phenomenon. QuikScat will be able to track changes in the trade winds along the equator.

Scatterometers operate by transmitting high-frequency microwave pulses to the ocean surface and measuring the "backscattered" or echoed radar pulses bounced back to the satellite. The instrument senses ripples caused by winds near the ocean's surface, from which scientists can compute the winds' speed and direction. The instruments can acquire hundreds of times more observations of surface wind velocity each day than can ships and buoys, and are the only remote-sensing systems able to provide continuous, accurate and high-resolution measurements of both wind speeds and direction regardless of weather conditions.

The satellite is the first obtained under NASA's Indefinite Delivery/Indefinite Quantity program for rapid delivery of satellite core systems. The procurement method provides NASA with a faster, better and cheaper method for the purchase of satellite systems through a "catalog," allowing for shorter turnaround time from mission conception to launch. Total mission cost for QuikScat is \$93 million.

Fifteen times a day, the satellite will beam down collected science data to NASA ground stations, which will relay them to scientists and weather forecasters. SeaWinds will provide ocean wind coverage to an international team of climate specialists, oceanographers and meteorologists interested in discovering the secrets of climate patterns and improving the speed with which emergency preparedness agencies can respond to fast-moving weather fronts, floods, hurricanes, tsunamis and other natural disasters.

By combining QuikScat's wind data with information on ocean height from another ocean-observing satellite, the joint NASA-French TOPEX/Poseidon mission, scientists will be able to obtain a more complete, near-real-time look at wind patterns and their effects on ocean waves and currents, said Dr. Timothy Liu, QuikScat project scientist at NASA's Jet Propulsion Laboratory, Pasadena, CA. He added that QuikScat will complement data being collected by other Earth-monitoring satellites such as NASA's currently orbiting Tropical Rain Measurement Mission (TRMM) and Terra, which will be launched later this year.

The 1,910-pound (870-kilogram) QuikScat satellite, provided by Ball Aerospace & Technologies Corp., Boulder, CO, with its 450-pound (200-kilogram) radar instrument, called SeaWinds, will be placed in a circular, near-polar orbit with a ground speed of 14,750 miles per hour (6.6 kilometers per second). The satellite will circle Earth every 101 minutes at an altitude of 500 miles (800 kilometers).

QuikScat is managed for NASA's Office of Earth Science, Washington, DC, by the Jet Propulsion Laboratory, which also built the Seawinds radar instrument and will provide ground science processing systems. NASA's Goddard Space Flight Center, Greenbelt, MD, managed development of the satellite, designed and built by Ball Aerospace & Technologies Corp., Boulder, CO.

NASA's Earth Sciences Enterprise is a long-term research and technology program designed to examine Earth's land, oceans, atmosphere, ice and life as a total integrated system. JPL is a division of the California Institute of Technology, Pasadena, CA.

[End of General Release]

Media Services Information

NASA Television Transmission

NASA Television is broadcast on the satellite GE-2, transponder 9C, C band, 85 degrees west longitude, frequency 3880.0 MHz, vertical polarization, audio monaural at 6.8 MHz. The schedule for television transmissions for the QuikScat launch will be available from the Jet Propulsion Laboratory, Pasadena, CA; Johnson Space Center, Houston, TX; Kennedy Space Center, FL, and NASA Headquarters, Washington, DC; and also on the Internet at <http://www.nasa.gov/ntv> .

Status Reports

Status reports on mission activities for QuikScat will be issued by the Jet Propulsion Laboratory's Media Relations Office. They may be accessed online as noted below. Audio status reports are available by calling (800) 391-6654 or (818) 354-4210.

Launch Media Credentialing

Requests to cover the QuikScat launch must be sent in advance to the Public Affairs Office, 30th Space Wing, Vandenberg Air Force Base, by fax to (805) 606-8303 or by email to cherryj@vafb3.vafb.af.mil or knowlest@vafb3.vafb.af.mil. Fax requests must be on the letter-head of the news organization and must specify the editor making the assignment to cover the launch.

Briefings

An overview of the mission will be presented in a news briefing broadcast on NASA Television originating from NASA Headquarters in Washington, DC, at 2 p.m. EDT June 3, 1999. A pre-launch briefing at Vandenberg Air Force Base will be scheduled the day before launch.

Internet Information

Information on QuikScat, including an electronic copy of this press kit, press releases, fact sheets, status reports and images, is available from the Jet Propulsion Laboratory's World Wide Web home page at <http://www.jpl.nasa.gov/quikscat> . The QuikScat mission also maintains a home page at <http://winds.jpl.nasa.gov/missions/quikscat/quikindex.html> . The home page for NASA's Office of Earth Science is at <http://www.earth.nasa.gov> .

Quick Facts

QuikScat Satellite

Dimensions: Main bus 6.3 feet (2.2 meters) by 4.9 feet (1.7 meter) by 4 feet (1.4 meter); radar extends 3.7 feet (1.3 meter) from main bus; total wingspan from tip to tip of solar arrays 11 feet (3.8 meters)

Weight: 2,140 pounds (970 kilograms) total, consisting of 1,914-pound (870-kilogram) satellite (including radar instrument) and 167 pounds (76 kilograms) of thruster propellant

Power: Solar panels providing 642 watts

SeaWinds Instrument

Radar: 110-watt pulse at frequency of 13.4 gigahertz, transmitted and received by 39-inch-diameter (1-meter) rotating dish antenna

Weight: 440 pounds (200 kilograms)

Power consumption: 220 watts

Science data rate: 40 kilobits per second average

Coverage: 1,120-mile (1,800-kilometer) swath during each orbit, covering about 90 percent of Earth's oceans every day

Measurements: Wind speeds between 7 and 45 miles per hour (3 to 20 meters per second), with an accuracy of about 4.5 miles per hour (2 meters per second); also wind direction, with an accuracy of 20 degrees

Launch Vehicle

Type: Titan II two-stage liquid-fuel rocket

Mission

Launch: June 18, 1999 from Vandenberg Air Force Base, CA

Daily launch opportunity: 10-minute window opens at 7:15 p.m. Pacific Daylight Time

Primary mission: Two years

Orbit path: Circular 500-mile-altitude (800-kilometer) crossing close to Earth's north and south poles at an inclination of 98.6 degrees; completes one orbit every 101 minutes

Program

Cost: \$71 million total (not including launch vehicle), consisting of \$39 million for satellite; \$13 for radar instrument; \$19 million for mission/science operations and other costs

Why Study Ocean Winds?

The Quick Scatterometer, or QuikScat, satellite is a near-term solution to learning about ocean circulation, wind speed and wind directional patterns.

Current knowledge of ocean surface winds is sketchy, coming mostly from localized, infrequent and often inaccurate reports from ships. Earth-orbiting radar instruments called scatterometers are the only remote-sensing instruments capable of measuring wind speed and direction across the globe under all weather conditions. These instruments emit radar pulses which are reflected, or backscattered, by rippling wave patterns on ocean surfaces. Automatic analysis of the reflected signal can reveal the speed and direction of the winds that created the ocean rippling.

QuikScat's radar instrument, called SeaWinds, will map wind speed and direction across 90 percent of the Earth's ice-free oceans, assembling a picture of the entire globe once every two days. By combining wind data from QuikScat with ocean height data from another satellite, the joint NASA-French TOPEX/Poseidon, Earth scientists will be able to obtain a more complete, near real-time look at wind patterns and their effects on ocean waves and currents.

How Scatterometers Work

Scatterometry has its roots in early radar equipment used in World War II. In the 1950s and 1960s, radar operators on naval and merchant ships experienced a troublesome phenomenon called "sea clutter." Appearing on radar screens as noise that obscured small boats or low-flying aircraft, this clutter was in fact radar pulses returned from the ocean surface. Radar reflection or backscattering was caused by the interaction of the radar signal with wind-blown, rippling waves, also called "cat's paws," on the ocean's surface, each about 1/2 to 1-1/2 inch (1 to 3 centimeters) in height. While electronics were developed to reduce this interference in conventional radar, researchers realized that radar instruments could be customized to take advantage of this backscattering.

In the 1960s, scientists established a link between such ocean waves and the speed of wind just above the ocean's surface. By sending radar pulses from an airborne or spaceborne instrument and then measuring the backscattered signal, they could indirectly gauge ocean wind speed. In addition to measuring radar backscatter, they also learned that backscattered signals were influenced by the direction of the wind. By taking into account the angle at which the radar was beaming its pulses down toward the ocean, they could calculate wind direction.

Satellites promised to be far more effective than the prevailing practice of collecting wind readings from ships. Most ocean ship reports are limited in their geographical coverage, and ships necessarily must stay away from active storm regions. Ship reports of wind velocity are also notoriously inaccurate owing to untrained observers, poor quality instruments, questionable measurements caused by the motion of the vessels and a variety of other conditions. Moored buoys gathering wind data are highly accurate, but such buoys are few in number and

concentrated in coastal regions in the northern hemisphere.

Only satellite-borne instruments can acquire wind data with global coverage, high spatial resolution and frequent sampling. Certain satellite instruments called altimeters and radiometers can be used to estimate wind speeds. But these instruments do not measure wind direction, thus making them far less useful to scientists who are trying to understand atmospheric dynamics.

Orbiting scatterometers can acquire hundreds of times more observations of surface wind velocity each day than can ships and buoys. These orbiting instruments are also the only remote-sensing systems able to provide accurate, frequent, high-resolution measurements of ocean surface wind speed and direction in both clear sky and cloudy conditions.

Scatterometers must take several readings simultaneously from different angles in order to get a clear picture of how the ocean's surface is reflecting radar signals. They must also cover a wide swath of the sea surface at any given time in order to build up a complete global map on a frequent basis. Both of these factors call for special antennas on the satellite-borne instruments.

History of Scatterometers

Scatterometers have been flown on space missions since the early 1970s. In addition to such experiments on satellites and crewed flights, they have also been tested in flights on airplanes.

Skylab. The first scatterometer in space flew as part of the crewed Skylab missions in 1973 and 1974, and demonstrated that spaceborne scatterometers were feasible. The Skylab missions carried a relatively simple radar instrument, however, which could make only single measurements of wind speeds at one location on the sea surface at any given time. In order to calculate wind speed, wind direction had to be obtained from some other source.

Seasat. In 1978, a scatterometer was flown on NASA's Seasat satellite, which tested a number of different spaceborne oceanographic instruments. This instrument used a total of four fan-beamed antennas to allow it to take readings from a pair of swaths instead of a single point. It was capable of spatial resolution of approximately 30 miles (50 kilometers) in two swaths about 370 miles (600 kilometers) wide. Measurements from the various antennas were combined to provide estimates of wind speed and up to four possible directions. Because of a spacecraft malfunction, the Seasat mission lasted only four months, from June to October 1978. Despite the brevity of the mission, the scatterometer on Seasat achieved a number of major technical milestones and returned a wealth of scientific information.

European Remote Sensing Satellite. This satellite launched in July 1991 carries a radar instrument with a split personality, functioning both as an imaging radar to take pictures of land masses and as a scatterometer to study ocean winds. In its scatterometer mode, the instrument takes readings across a 310-mile-wide (500-kilometer) swath on the starboard side

of the spacecraft, sending and receiving radar pulses in the microwave C-band at a frequency near 5 gigahertz. Its coverage is limited by its single-swath design and the narrow width of its swath. On the other hand, the satellite has operated nearly continuously for nearly eight years, providing the longest record of global scatterometer data yet obtained.

NASA Scatterometer. The NASA Scatterometer, or NSCAT, was launched in August 1996 by Japan's National Space Development Agency (NASDA) onboard its Midori satellite. Named with the Japanese word for greenery, the satellite was also known as the Advanced Earth Observing Satellite (ADEOS).

NSCAT was designed to take 190,000 wind measurements per day, mapping more than 90 percent of the world's ice-free oceans every two days. During its lifetime the instrument provided scientists with more than 100 times the amount of ocean wind information available from ship observations and buoys.

Benefits

QuikScat data will provide benefits in areas ranging from weather forecasting to help for various industries that rely on the sea.

Weather forecasting. Nearly two-thirds of Earth is covered by oceans, where there are no weather stations and only a scattered array of buoys. This lack of information hampers scientists' knowledge of today's weather and impedes their ability to forecast the future. Most of the weather that hits the West Coast of the United States begins over the Pacific Ocean. QuikScat's frequent, extensive and all-weather coverage will alleviate this problem.

The National Oceanic and Atmospheric Administration (NOAA) will process QuikScat data in near real time and distribute it to NOAA's National Weather Service and other users who will incorporate the measurements into their forecast models. The data will be important in short-term weather warnings and forecasts, and will play a key role in scientists' ability to understand and predict complex global weather patterns and climate systems.

QuikScat will also play an important role in NASA's continuing work to monitor global El Niño and La Niña weather abnormalities. Changes in the winds over the Pacific are a key component of the El Niño/La Niña phenomenon. The satellite will be able to track the changes in the trade winds along the equator as a new El Niño develops and will help predict a La Niña condition that might arise in the wake of the El Niño.

Storm detection. QuikScat's radar will be able to determine the location, structure and strength of storms at sea. Severe marine storms—hurricanes in the Atlantic, typhoons near Asia and mid-latitude cyclones worldwide—are among the most destructive of all natural phenomena. In the United States alone, hurricanes have been responsible for at least 17,000 deaths since 1900, and have caused hundreds of millions of dollars in damage annually. If worldwide statistics are considered, the numbers are substantially higher. And while mid-latitude cyclones are not usually as violent as hurricanes and typhoons, these storms also exact a heavy toll in casual-

ties and material damage.

In recent years, scientists' ability to detect and track severe storms has been dramatically enhanced by the advent of weather satellites. Cloud images from space are now routine on TV weather reports. QuikScat will augment these familiar images by providing a direct measurement of surface winds to compare to observed cloud patterns. These wind measurements can help to identify more accurately the extent of gale force winds associated with a storm, and will provide inputs to computer models that provide advance warnings of high waves and flooding.

Global climate. Another important application of QuikScat data for study of world climate and global warming. Most of the heat absorbed by Earth is stored in the tropics near the equator. The main factor responsible for world climate is heat transport from the tropics to higher latitudes. This heat transport takes place through the process of ocean circulation and the winds that drive the ocean. Precise knowledge of the winds over the global ocean will enable scientists to better understand this complicated process.

Monsoon monitoring. Monsoons are heavy winds and rain in the tropics that result from seasonal changes in winds caused by differences in temperatures over land and water. Monsoons affect large areas of the world, but are most common in the Indian Ocean and Southeast Asia. Their annual onset, intensity and retreat vary greatly, and the variation of a monsoon has strong economic impact and the potential for widespread human suffering. Besides bringing rain to land, a monsoon also changes ocean currents, and stirs nutrients in the depths of the ocean that sustain great populations of fish and other sea life. QuikScat, with its repeated global observations and unprecedented spatial resolution, will help scientists monitor and understand the development, movement and potential strength of these seasonal weather systems.

Ship routing. Wind observations from QuikScat could be of particular commercial significance to the shipping industry. By identifying storms that might harm vessels and crews, captains of ocean-going cargo ships will be able to chart their courses more efficiently. Prior knowledge of winds will enable ships to choose routes that steer clear of active or potentially active storm centers, especially turbulent seas or high headwinds that could slow a ship's progress and require additional fuel supplies.

Oil production and cleanup. Oil and gas production takes place at numerous offshore sites around the world—the Gulf of Mexico, the North Sea, the Persian Gulf and other areas. Thorough knowledge of the historical wind and wave conditions at any specific location is crucial to the design of drilling platforms. In the event of an oil spill, information on surface winds will be key to determining how the oil will spread. QuikScat data could help cleanup efforts and aid containment crews in minimizing the environmental effects of such a disaster.

Mission Overview

QuikScat is a rapidly developed mission intended to replace the capability of the NASA Scatterometer (NSCAT) instrument on Japan's Midori satellite (previously known as the Advanced Earth Observation Satellite (ADEOS)), which lost power in June 1997 nine months after launch in September 1996.

QuikScat will be launched on a Titan II vehicle from Vandenberg Air Force Base, CA, entering a north-south orbit that will take it over nearly the entire surface of Earth. Its primary mission is scheduled to continue for two years.

Launch Site

Vandenberg Air Force Base stands on 98,400 acres (39,800 hectares) of what was once open grazing land for wild game and cattle on California's central coast some 140 miles (225 kilometers) northwest of Los Angeles. In 1941, the U.S. Army established a training center for armored and infantry troops called Camp Cooke that operated during World War II and the Korean War. In 1957, the facility was transferred to the U.S. Air Force and acquired its present name. In the decades since, it has served as a staging ground for ballistic missile tests as well as the launch of space-bound rockets. Today the base is operated by the Air Force Space Command's 30th Space Wing.

Vandenberg's location, with a stretch of clear ocean for thousands of miles to the south,

Launch Events

<i>Time</i>	<i>Event</i>
-3.2 sec	Titan II's first stage ignites
0	Liftoff, Titan II begins vertical flight
9 sec	Begins roll to direction of flight
19 sec	Ends roll
2 min 31 sec	First-stage engine shuts down
2 min 32 sec	Second stage ignites
2 min 33 sec	Second stage separates from first stage
3 min 37 sec	Fairing (nose cone) jettisoned
5 min 36 sec	Second-stage engine shuts down
5 min 52 sec	Turn to shield QuikScat satellite from sunlight
53 min 38 sec	Turn to orient QuikScat satellite for thruster firing
55 min 48 sec	Farthest point in orbit from Earth; thrusters on Titan II's second stage fire for 15 seconds to adjust orbit
58 min 43 sec	QuikScat satellite separates from Titan II's second stage
60 min	QuikScat deploys solar arrays
76 min	QuikScat's first signal picked up by station at Svalbard, Norway

makes it ideal for the launch of satellites that are designed to orbit Earth in so-called polar orbits from north to south. The base has eight active launch pads for Atlas, Delta, Titan, Taurus and other rockets. Titan II vehicles are launched from Vandenberg's Space Launch Complex 4-West.

Launch Vehicle

The Titan II is a decommissioned intercontinental ballistic missile (ICBM) that has been refurbished as a space launch vehicle. It is a medium-lift launch vehicle, capable of lofting about 4,200 pounds (1,900 kilograms) to low-Earth orbit.

It was the first launch vehicle to use hypergolic propellants, meaning chemicals that spontaneously burn when they are combined. The propellant is Aerozine 50, a mixture of hydrazine and unsymmetrical dimethyl hydrazine (UDMH), and nitrogen tetroxide as the oxidizer.

The Titan II's first stage is 70 feet (21 meters) long and 10 feet (3 meters) in diameter, with an engine thrust of 474,000 pounds (2.1 million newtons). The second stage is 40 feet (12 meters) long and 10 feet (3 meters) in diameter, with an engine thrust of 100,000 pounds (445,000 newtons). For the QuikScat launch, the nose cone, or fairing, is 20 feet (6.1 meters) long and 10 feet (3 meters) in diameter. Fully fueled on the launch pad, the rocket stands 130 feet (39.6 meters) tall, is 10 feet (3 meters) in diameter and weighs 408,000 pounds (185,000 kilograms).

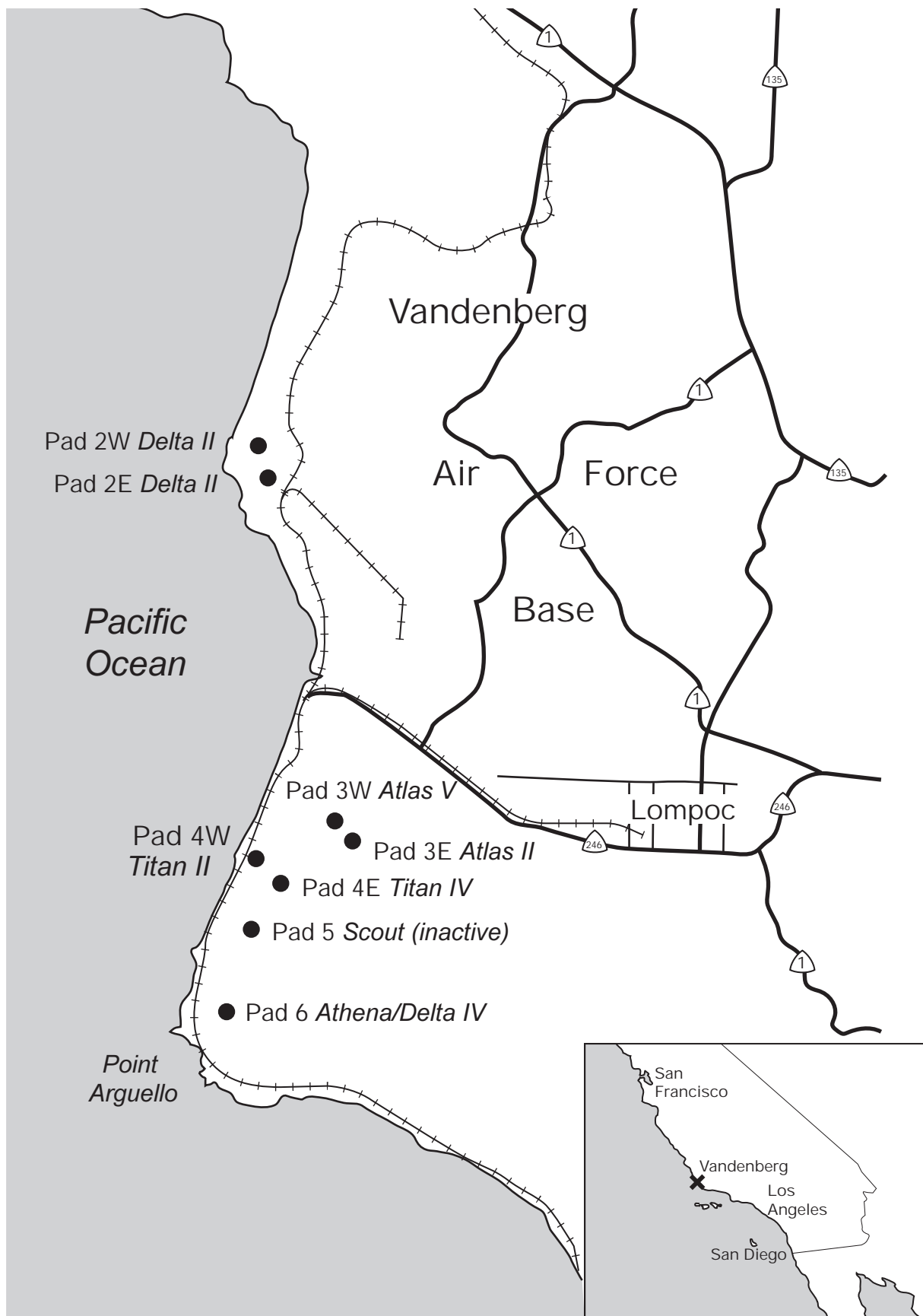
Launch Timing

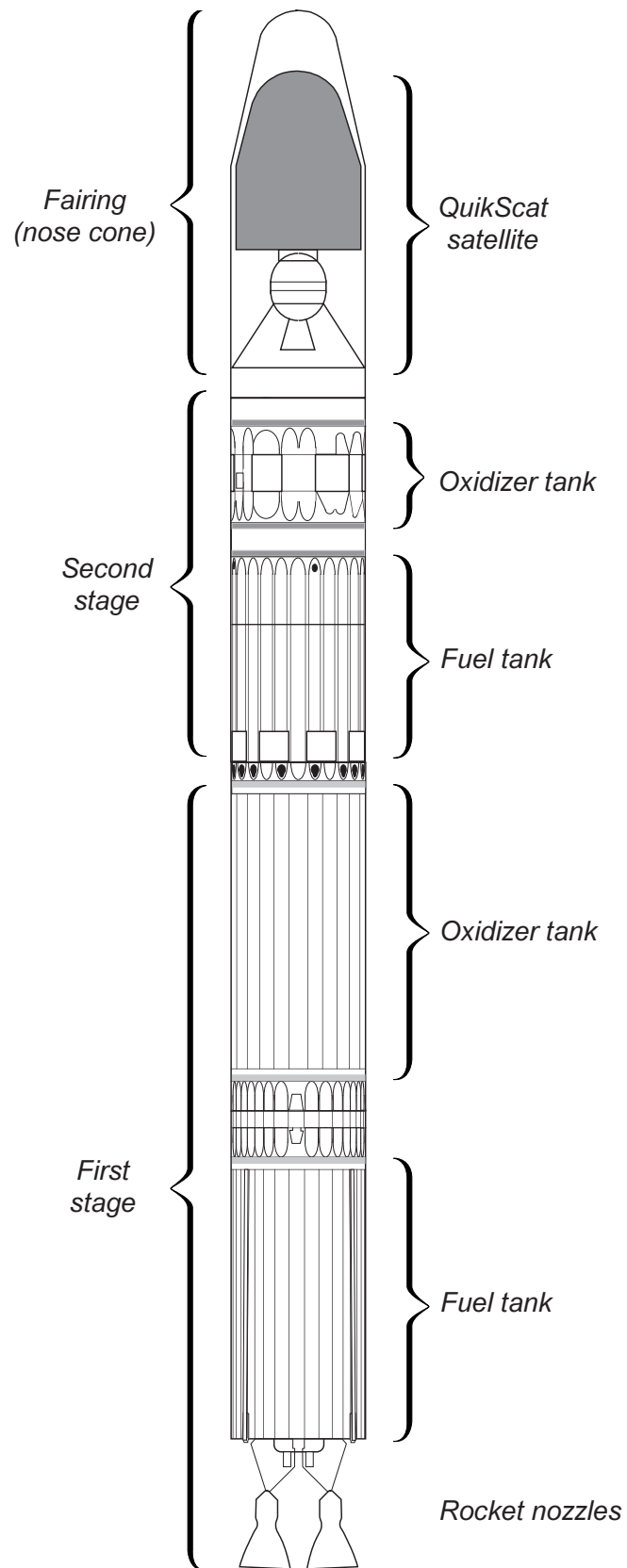
Unlike spacecraft sent to other planets, comets or asteroids, the launches of Earth-orbiting satellites such as QuikScat do not need to be timed based on the alignment of the planets. The launch date is based only on the readiness of the QuikScat satellite, the Titan II launch vehicle and the launch range at Vandenberg Air Force Base.

Earth-orbiting satellites do, however, need to be launched during particular windows within any given 24-hour day in order to get into the proper orbit around Earth. QuikScat will assume what is called a Sun-synchronous orbit flying close to Earth's north and south poles. In order to achieve this orbit, the satellite must be launched during a daily 10-minute launch window that opens at 7:15 p.m. Pacific Daylight Time. The window remains the same for any launch date. Launch is currently scheduled for June 18, 1999.

Launch Events

Liftoff takes place when the Titan II's first stage engine ignites and the rocket rises vertically from the launch pad. Nine seconds later, the Titan II rolls so that its flight path takes it in a south-southwesterly direction, crossing the California coastline and climbing into space as thousands of miles of unbroken Pacific Ocean pass underneath.





Titan II launch vehicle

Nose cone jettisoned

Time = 217 seconds

Altitude = 141,642 meters (464,706 feet)

Velocity = 12,013 km/hr
(10,938 f)

