Making the 3-D Image of Wisconsin

Shuttle Radar Topography Mission: February 2000

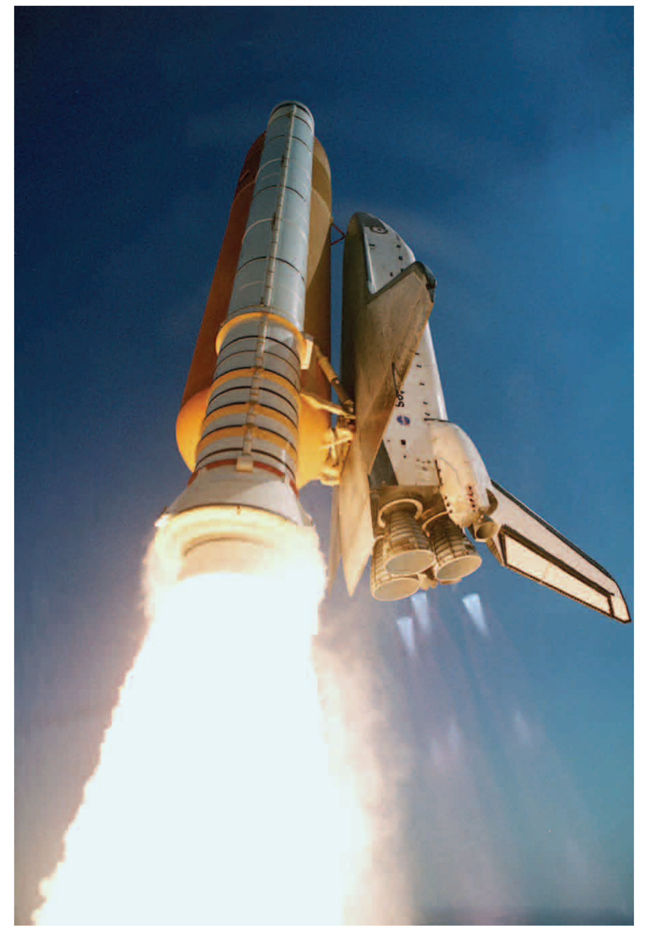
Mission

The Shuttle Radar Topography Mission (SRTM) obtained elevation data on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. The 3-D anaglyph images of Wisconsin displayed here are derived from SRTM data.

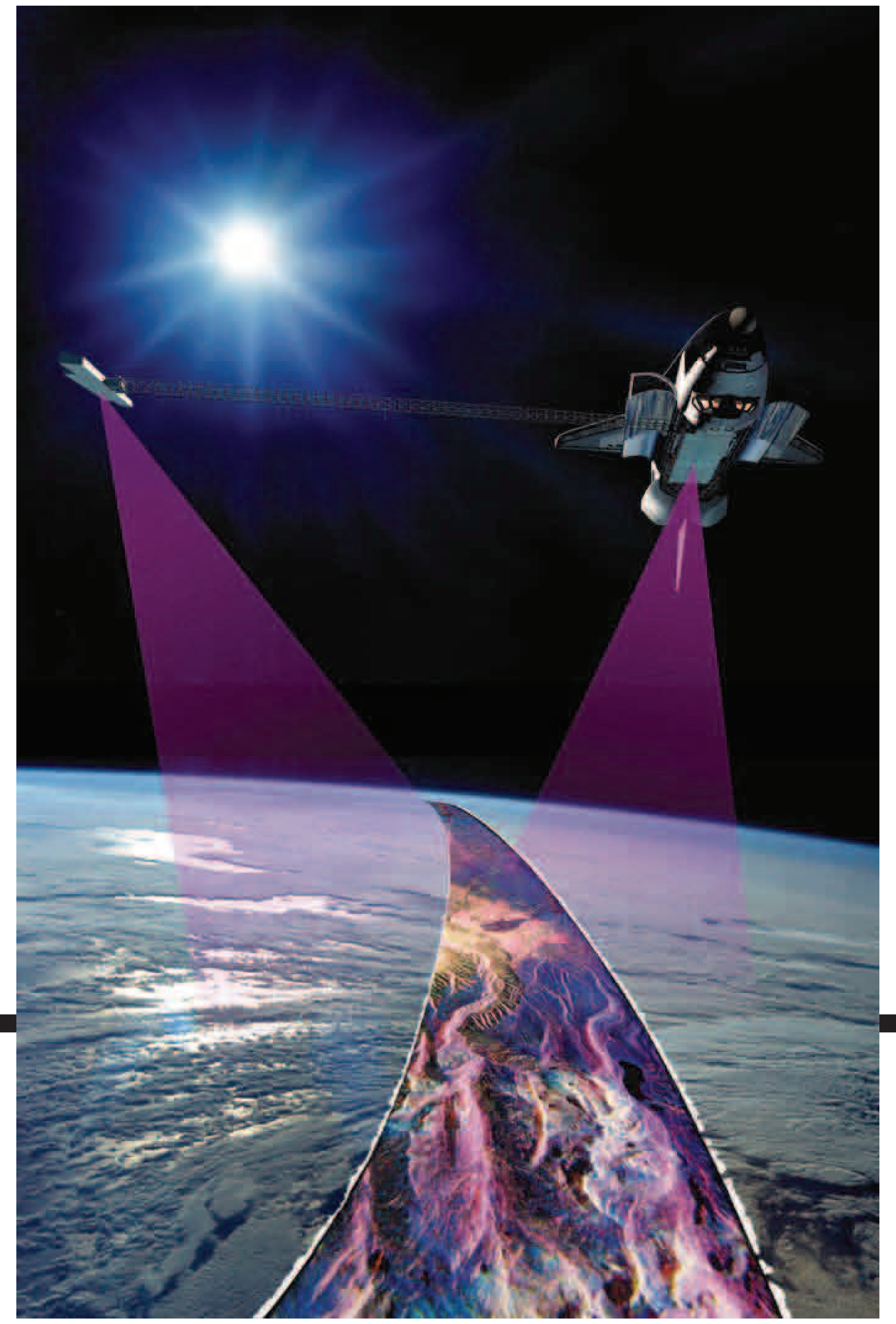
SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour during an 11-day mission in February of 2000.

The Shuttle Radar Topography Mission was an international project spearheaded by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration (NASA). International cooperators included the National Space Development Agency (NASDA) of Japan, and the European Space Agency (ESA).

Astronauts head for launch pad: (foreground) Pilot Dominic Gorie (left) and Commander Kevin Kregel. Behind them (left to right) are Mission Specialists Janice Voss, Mamoru Mohri (Japan), Gerhard Thiele (Germany) and Janet Lynn Kavandi. Credit: NASA

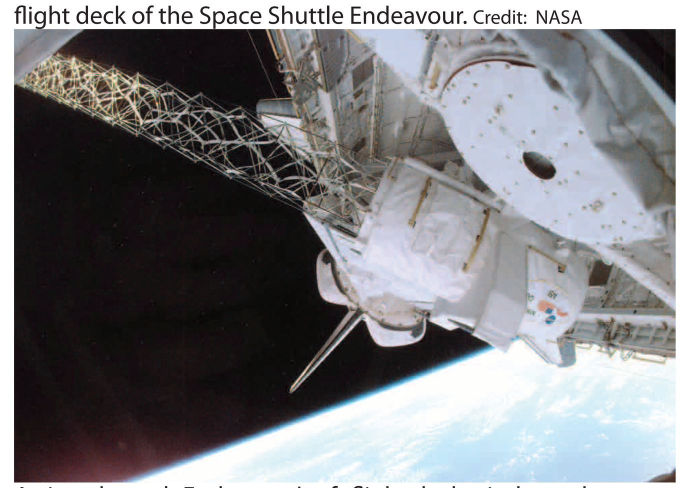


Launch of Space Shuttle Endeavour from the Kennedy Spaceflight Center February 11, 2000.
Credit: NASA

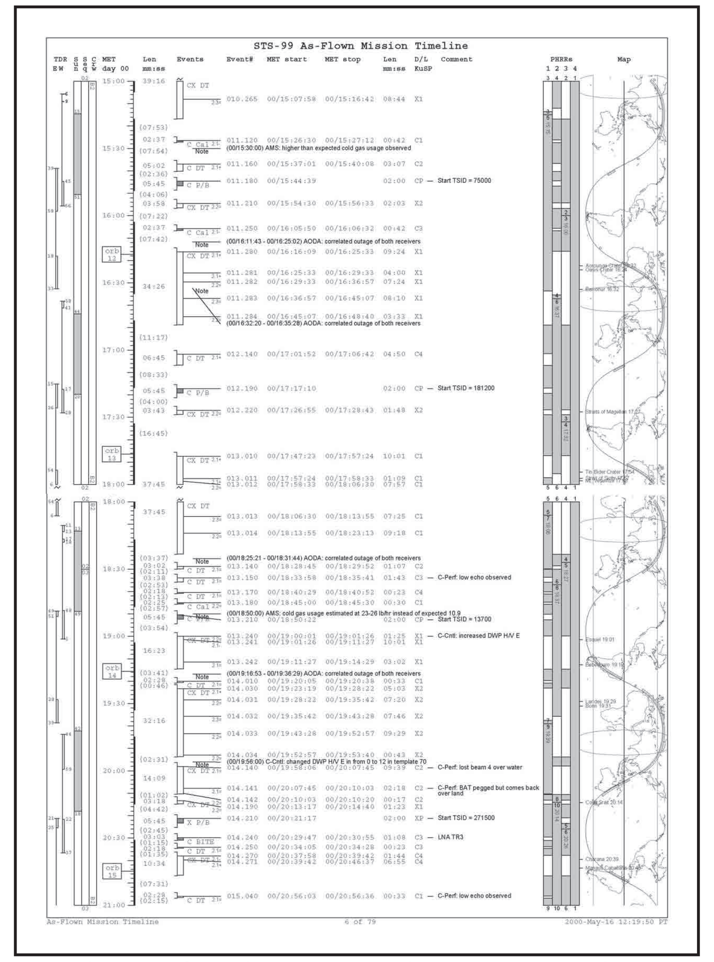


Artist's rendering of Space Shuttle Endeavour mapping the topography of Earth, from some 145 miles (233 kilometers) above with SRTM radar instruments. Unlike most optical sensors, radar is capable of "seeing" through clouds and at night.
Credit: NASA

Astronauts Thiele and Kavandi check SRTM "data takes" on the flight deck of the Space Shuttle Endeavour. Credit: NASA



A view through Endeavour's aft flight deck windows about halfway through the scheduled 11-day SRTM flight.
Credit: NASA



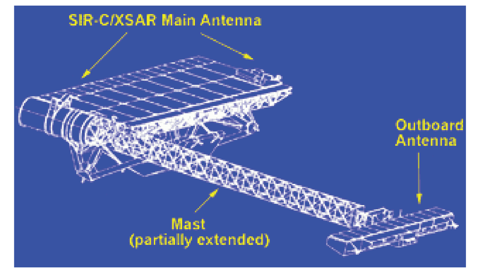
Example pages from the STS-99 "As-Flown Mission Timeline."
Credit: NASA

Data

The SRTM radar contained two types of antenna panels, C-band and X-band. The near-global topographic maps of Earth called Digital Elevation Models (DEMs) are made from the C-band radar data. These data were processed at the Jet Propulsion Laboratory and are distributed through the United States Geological Survey's EROS Data Center. Virtually all of the land surface between +/- 60 degrees latitude was mapped by SRTM.

Data Acquisition:
222.4 hours total duration of mapping phase
99.2 hours C-band operation
90.6 hours X-band operation
8.6 Terabytes C-band data (=14,317 CDs)
3.7 Terabytes X-band data (=6101 CDs)
12.3 Terabytes total data (=20,418 CDs)

Processing of the C-band data took two years.



The SRTM instrument was made up of three sections: the main radar antenna, the mast, and the outboard radar antenna.
Credit: NASA

Joining the SRTM outboard antenna and mast canister (foreground) with the main antenna (background) at the Kennedy Space Center Multi-Payload Processing Facility.
Credit: NASA

Instrument

To acquire topographic (elevation) data, the SRTM payload was outfitted with two radar antennas. One antenna was located in the shuttle's payload bay, the other on the end of a 60-meter (200-foot) mast that extended from the payload bay once the Shuttle was in space.

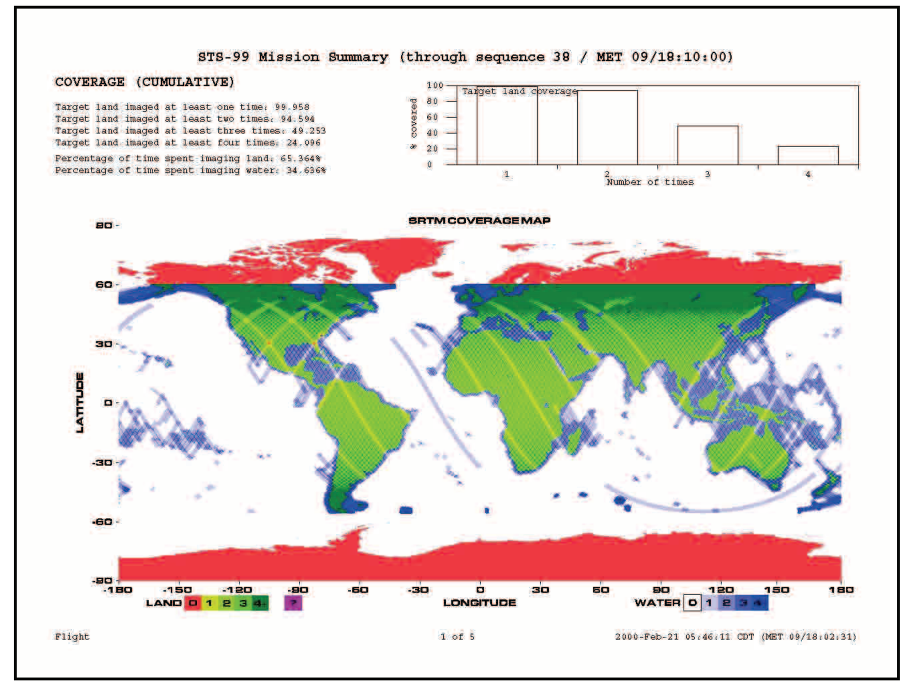
The main radar antenna transmitted the radar pulse. It contained special panels that allowed it to receive the returned radar pulse after it bounced off the Earth. It was attached to a structure that was bolted into the payload bay of the space shuttle.

The mast was folded up accordian-style inside a canister that was attached to the side of the main antenna. After the shuttle was in space and the payload bay doors opened, the mast emerged from the canister and extended out to 60 meters (200 feet). Until completion of the International Space Station, the SRTM mast was the longest rigid structure ever flown in space.

The outboard antenna contained special panels that allowed it to receive the same returned pulse as the main antenna, a technique called "interferometry."

Engineers at the Kennedy Space Center maneuver the main antenna onto a workstand.
Credit: NASA

NASA engineer, Howard Eisen, explains to the astronauts how the radar antenna mast will be deployed from its cylindrical canister.
Credit: NASA



SRTM coverage map showing parts of the Earth mapped during the 11-day mission.
Credit: NASA

Just after sundown February 22, 2000, Space Shuttle Endeavour touches down to complete the 11-day STS-99 mission.
Credit: NASA

Astronauts Kevin R. Kregel (right center), mission commander, shakes hands with astronaut Dominic L. Gorie during February 23 crew return ceremonies.
Credit: NASA

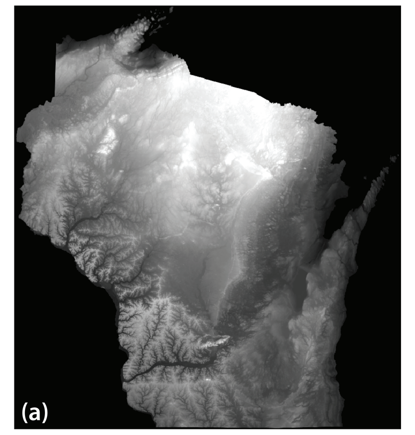
Visualization

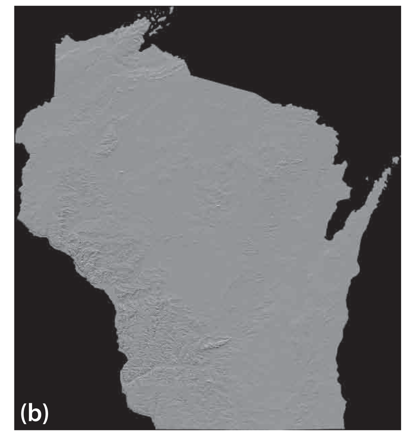
Digital Elevation Models (DEMs) can be visualized in a number of ways. Coding levels of gray to each "z" or height value renders an image like example **(a)**. A "hillshade" effect can be added by computer software to simulate a 3-D surface as seen in example **(b)**. Additional computer processing can generate an anaglyph image that consists of a pair of slightly off-set red and blue images that trick your brain into perceiving depth when viewed with red/blue glasses as in the images above. But DEM data are more than fun. Here are examples of the utility.

Scientific applications: geology, geophysics, earthquake research, volcano monitoring, hydrologic modeling, co-registration of remotely acquired image data.

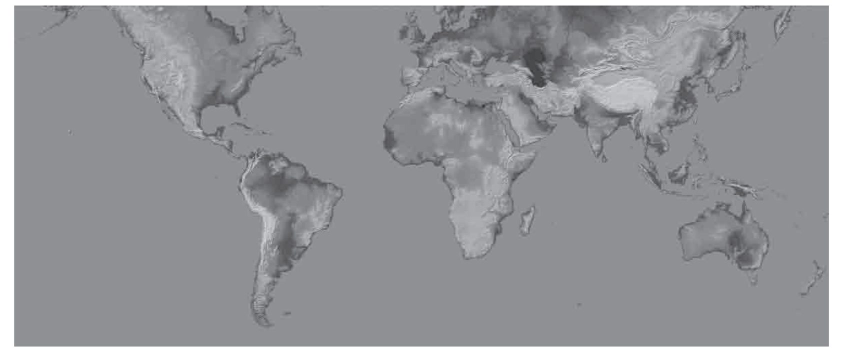
Civilian applications: Enhanced Ground Proximity Warning Systems for aircraft, civil engineering, land use planning, line of sight determination for communications (e.g. cell phones).

Military applications: flight simulators, logistical planning, missile and weapons guidance systems, battlefield management, tactics.





(a) The Digital Elevation Model (DEM) can be visualized with a gray scale to differentiate elevation. Lighter shades are higher values, and dark shades are lower values. This "shaded relief" or "hillshade" map **(b)** represents the same data processed to approximate a texture as if shaded by the sun.
Credit: WisconsinView, Space Science and Engineering Center, UW-Madison.



This shaded relief map represents the full area of coverage from which the Wisconsin DEM data above were extracted.
Credit: NASA

Compiled by Sam Batzli
WisconsinView, SSEC, UW-Madison
Sources of information and imagery:
http://www2.jpl.nasa.gov/srtm/index.html
http://spaceflight1.nasa.gov/home/index.html

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