National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

The World in Three Dimensions:
Shuttle Radar Topography Mission

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The Shuttle Radar Topography Mission (SRTM) has achieved its goal of producing the most complete high-resolution map of Earth's landforms. Radar measurements over 80 percent of Earth's landmass, home to nearly 95 percent of the world's population, were collected during a single 11-day Space Shuttle mission in February 2000. These data were then processed to create the SRTM digital elevation model. Nearly every natural process at Earth's surface and most human activities are affected by the altitude, slope, and shape of that surface, making the SRTM elevation model an important input to scientific research and for planning many human endeavors.

The international crew members of Space Shuttle mission STS-99 formed a crucial link in the ultimate success of SRTM. In the group photograph at the upper right, the astronauts are (top row, left to right): Gerhard P. J. Thiele, Mission Specialist, European Space Agency; Kevin R. Kregel, Mission Commander; Janet Kavandi, Mission Specialist; and (bottom row, left to right) Mamoru Mohri, Mission Specialist, National Space Development Agency of Japan; Janice Voss, Mission Specialist; Dominic L. Gorie, Pilot.

In the upper left photo, Payload Commander Janice Voss checks the crew activity timeline. At lower left, Mission Commander Kregel and Mission Specialist Thiele demonstrate the orbiter's position using an inflatable globe, and at the lower right, Mission Specialist Kavandi assists Thiele in operating one of the payload's data recorders.

THE MISSION: HERITAGE AND DESIGN

SRTM is the latest in a series of radar imaging missions that started with the Space Shuttle fleet's first science mission in 1981. Because radar can "see" through clouds and can "see" at night, SRTM had an unobstructed view of Earth within the large north–south range of the Shuttle orbit.

Unlike the earlier missions, SRTM included an outboard antenna, mounted 60 meters (about 200 feet) away from the onboard antenna in the Shuttle cargo bay. This design required the use of an expanding mast that could be extended from the Shuttle after achieving orbit.

The outboard antenna acted as a second vantage point. Radar viewing from two vantage points is somewhat akin to humans viewing with two eyes (although certainly different in technical details). In both cases, differences in the two views can reveal the shape of the objects being viewed. In the case of SRTM, the shape of Earth's surface, namely its topography, was being viewed, and processing of the data produced a precise digital elevation model.

TOPOGRAPHIC DATA: ITS MANY USES

The shape of Earth's surface controls virtually all the natural processes that occur there. Topographic shading controls the distribution of sunlight that provides energy to plants, melts snow, and dries soil. Topography also directs water runoff, and so defines the pattern of flood hazards during rainstorms and the sources of water supply year-round.

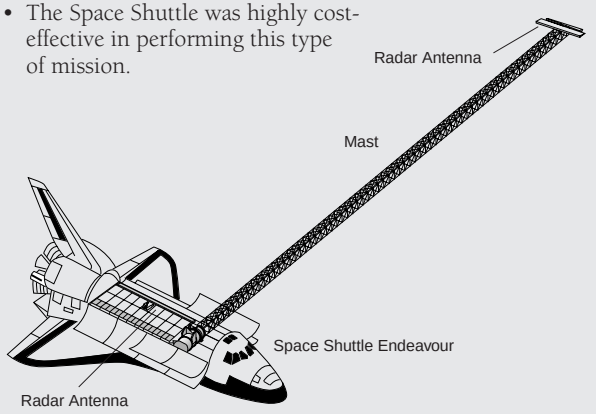
Similarly, the shape of Earth's surface substantially controls processes within the overlying atmosphere (like local wind direction and regional rain distribution) and provides evidence of processes within the bedrock below (like volcanic and earthquake activity). Indeed, topographic information is important across the full spectrum of Earth sciences.

Likewise, the shape of Earth's surface is a controlling factor of human activity. We generally build homes away from unstable slopes, build roads through mountain passes, and place radio transmitters on mountain peaks. Topographic data, as provided by the SRTM mission, have innumerable uses in urban planning, aviation safety, military operations, and resource management.

SRTM is a cooperative project of the National Aeronautics and Space Administration (NASA), the Department of Defense's National Imagery and Mapping Agency (NIMA), and the German and Italian space agencies. The Jet Propulsion Laboratory, California Institute of Technology, manages the SRTM project for NASA's Earth Science Enterprise and NIMA. SRTM data are distributed by the U.S. Geological Survey (USGS) Earth Resources Observation Systems (EROS) Data Center, Sioux Falls, South Dakota.

The Space Shuttle's Unique Role

- Use of the Space Shuttle and its crew permitted hands-on operation, including on-orbit checkout and troubleshooting.
- SRTM used radar mapping hardware from a previous Shuttle flight, which was efficient and provided an added measure of reliability.
- The Space Shuttle is well suited to perform a worldwide mapping mission, as it is able to observe most of Earth's landmass from orbit.
- The Space Shuttle was highly cost-effective in performing this type of mission.



SRTM simultaneously used antennas in the payload bay and at the end of a mast to record radar signals reflected off Earth's landforms from two differing viewpoints.

For more information, visit these Web sites:

SRTM — http://www.jpl.nasa.gov/srtm/

USGS — http://edc.usgs.gov/srtm/data/obtainingdata.html

NASA Planetary Photojournal — http://photojournal.jpl.nasa.gov

National Imagery and Mapping Agency — http://www.nima.mil/