## Data Recording, Processing, and Products

Payload Bay

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**Overview**

### Data Recording

Once SRTM payload managers receive the radar echoes from both antennas, they will route the data through the Digital Data Handling System (DDHS). That system puts the different channels together and then sends the data to the Recorder Interface Controller (RIC), a laptop in the flight deck of the Shuttle. The laptop decides which of three Payload High-Rate Recorders (PHRR) will get the data. The crew will monitor this and will change tapes as they become full. SRTM will record to about 300 tapes during the mission, which adds up to about 10 terabytes of data. Mission managers also will send a small amount of data to the ground during the flight in order to monitor the instrument.

### Data Processing and Products

When the high-speed digital tapes on board the Shuttle record the echoes collected by the SRTM interferometer, it is only the beginning of the mission. The worlds of microwave optics, orbital mechanics, signal processing, and computer processing and networking merge in a sophisticated and intensive effort to map the Earth's topography with record accuracy in record time.

A synthetic aperture radar is much like a camera without a lens, transcribing enough information from the signal echoes to allow the raw data to be focused into an image. The SRTM interferometer has two sets of these radar "cameras," one antenna in the Shuttle bay, the other at the end of the mast. The radars alternately look at four different subswaths in order to build up the wide swath necessary to map the world. The task of generating digital topography from the recorded data requires powerful computers to focus the eight data sets into images, two for each of four subswaths. The echoes in each subswath are not continuous because the radar can collect only two subswaths at a time, so mini-images are formed individually for each small segment of data. Then for each subswath, the two small image pieces are combined to form the "interferogram" which encodes the information about topography. These miniature topographic images then must be carefully pieced together for each subswath to form a larger interferogram.

Topographic information in the interferogram needs further deciphering to be useful, however. The interferometer produces what are in essence topographic contours of equal height, but at this point the elevation value for any contour is unknown, as is the height difference between any two contours. This is where the measurements made by the Attitude and Orbit Determination Avionics (AODA) becomes useful. Accurate knowledge of the mast length and orientation is used to solve for the height of each contour. In addition, data collected over the ocean are used to reference all elevations to sea level.

These operations must be repeated for each subswath for the length of each data-take. An SRTM data-take extends from the time just before landfall until just after the swath leaves land for every continent and every island.

These data are still not a map, as they are still in distorted radar coordinates, so each subswath must be "ortho-rectified" to map coordinates. With hundreds of data takes processed to ortho-rectified intermediate products, the effort shifts from interferometry to mosaicking. Specifically, the subswaths and data takes must be "sewn" together to form a continent, with all the seams well-formed and continuous across boundaries. If all goes according to plan, the subswaths will lay down perfectly on top of each other. If there are some small uncertainties in the geometry of the interferometer, a little assistance to the mosaicking may be needed. This is accomplished by measuring how well the subswaths match each other where they overlap and by comparing them to known points on the ground. Once these measurements are made, they are used to adjust all subswaths in three dimensions to the best, smoothest mosaic.

After the mosaic is produced, the product must be checked. At least six stages of quality checks are performed on the subswaths as they proceed through the processing, so the mosaicked data are expected to be of high quality. Nonetheless, a last test of the accuracy of the product is made and the results recorded in map form.

This entire process is carried out for all the continents covered by SRTM. A powerful computerized production system has been developed to transform the basic radar and ancillary measurements acquired by SRTM to these digital topographic maps and other derived products. The system brings together all data elements in a processing environment that will deliver the world's topography in less than two years. To accomplish this feat, the production system comprises numerous computer subsystems linked together on a high-speed network at JPL. The system pushes several terabytes of raw data through in two years, with intermediate storage of upwards of 100 terabytes.

First, special-purpose hardware decodes the raw data. A workstation then conditions the data to a usable form. A suite of parallel processing computers performs the radar interferometry processing and mosaicking. A robotic tape storage device automatically retrieves the data tape needed for processing at each step. The final verified product is delivered to the customer electronically, continent by continent.

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