Topography, Slope, and Texture Mosaics

The main objective of this data set was to delineate the extent of flooding that occurred between the two acquisitions (one at approximate high flood stage of the Amazon River main stem, and one at the approximate low flood stage). When viewing the imagery, the rivers will appear relatively dark, while the flooded forest areas will appear bright. The flooded forests appear bright due to the radar L-band microwaves reflecting off both the underlying water and the tree trunks (double bounce reflections). The rivers are dark because SAR is a side-looking instrument - when imaging water most of the radiation is reflected away from the radar. The forest is of middle brightness mostly due to the volume scattering of the microwave radiation by the forest canopy.

The bright signal associated with the flooded forest is not due to an increase in moisture, but to the double bounce scattering mechanism. It requires that the forest be currently flooded.

Urban areas and areas of low vegetation also may be discerned in the imagery. Urban areas tend to be bright (also due to double bounce reflections), while areas of low vegetation tend to be between the brightness levels of undisturbed mature tropical forests and water. More subtle differences in vegetation in certain areas may also be observed.

In the presence of topography, the radar backscatter will vary according to the slope. Areas on the side facing toward the East (the approximate direction to the sensor) will appear brighter, and toward the West, darker. Care should be taken to not confuse this effect with ecological differences.

In the savanna areas, more subtle interpretation of the imagery may be required.

Description of GIF version of GTOPO30 Topography Image

Topography images are provided for each of the 34 tiles. The pixel spacing of the topography data is 1-km per pixel.

The height above sea level (from the GTOPO30 topography data) may be retrieved from the GIF imagery by the following equation:

$$h_{meters} = 20(D_n - 50)$$

where h_{meters} is the height above sea level in meters, and D_n is the value of the pixel (between 0 and 255).

Each unit change in D_n value corresponds to a change in height of 20 meters. Since the D_n values range to a maximum of 255, the maximum height in these gif images corresponds to 4,100 meters. Any height above 4,100 meters will be saturated at 4,100 meters. (The original imagery is stored at 16 bit imagery, and does not have this restriction). A D_n of 32 indicates either missing data, or an elevation below sea level.

For South America, most of the topographic information was derived from the Digital Chart of the World (DCW), based on the 1:1,000,000 scale Operational Navigation Chart (ONC) series. The primary contour interval on the ONC charts is 305 meters, with supplemental contours at 76 meter intervals below 305 meters. In some high elevation areas, supplemental contours at 152 meter intervals are also present.

In Peru, a 1:1,000,000 scale map from the Peruvian government was used for filling in gaps. The contour interval in these maps was 1000 meters.

The vertical accuracy of GTOPO30 varies by location. For topography derived from the DCW, the specified accuracy is + or - 650 meters linear error at the 90% confidence level. In many areas, the accuracy is much better than this. Another analysis indicated that the root mean square error (RMSE) was 97 meters, or + or - 160 meters linear error at the 90% confidence level.

In Peru, the RMSE was found to be 304 meters, or 500 meters linear error at the 90% confidence level.

For a more in depth analysis of the topography data that this imagery is based upon, please read the GTOPO30 documentation at the USGS Eros Data Center.

Description of GIF Slope Images Derived from GTOPO30 Topography Data

A GIF image of the slope is provided for each of the 34 tiles. The pixel spacing of the topography data is 1-km per pixel.

The slope was derived as follows:

Using the GTOPO30 data set, the derivative of the height was measured in both the North and East direction. These slope vectors were then rotated by 11 degrees, the nominal track angle of the JERS-1 satellite at the equator. To convert to an 8 bit value, the slope in the swath "cross track" direction was divided by 4, with a 0 slope assigned a value of 128.

To convert to height change in meters per 1 km pixel, please use the following formula :

$$slope = 4(D_n - 128)$$

where D_n is the pixel value (between 0 and 255). Positive slopes indicate that the height, from the direction looking from the JERS-1 satellite, increased toward the satellite. The maximum positive slope, corresponding to a D_n of 255, is 508 meters/km, while the maximum negative slope (corresponding to a D_n of 0) is -512 meters/km.

For a more in depth analysis of the topography data that this imagery is derived from, please read the **GTOPO30** documentation at the USGS Eros Data Center.

Texture Images

There are 66 texture images (15 arcseconds per pixel in latitude and longitude, or about 500 meters) which correspond in geometry to the 66 GeoTIFF mosaics. Radar texture can be represented by many different measures. The texture measure used here is simply the normalized square of the ratio of the standard deviation and the mean of the pixel intensities (Swain, P.H., Remote Sensing, the Quantitative approach. USA, McGraw-Hill, Inc, 1978).

The radar texture indicates the degree of roughness of the target at a scale smaller than the (500-m*500-m) pixel resolution, so that a rough area (e.g. an area with high topographic variability) will result in a high texture DN value, while a smooth area (e.g. homogeneous floodplain forest) consequently will be represented by a low texture DN value.