

Topographic Processing Service

TPS Manual

GEOSUR



Manual for the GeoSUR program's on-line Topographic Processing Service (TPS). This document describes the tools available through its Regional Map Viewer for creating and acquiring high-resolution digital elevation model derivative products.

**CAF - Development Bank of
Latin America
GeoSUR Program
www.geosur.info**

TPS Overview



To provide better access to the Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM) dataset, the [U.S. Geological Survey \(USGS\)](#) and [CAF - Development Bank of Latin America GeoSUR program](#) integrated topographic processing tools into its [Regional Map Viewer](#). This tool called the Topographic Processing Service (TPS) expands access to the SRTM DEM for Latin America. The SRTM level-2 source data is not freely available due to restricted distribution set by the [U.S. National Geospatial-Intelligence Agency \(NGA\)](#). The TPS allows users to derive 1 arc-second (~30m) resolution derivative products from this restricted data without access to the original dataset.

Users request selected products derived from the data through a web-enabled geo-processing service. This service allows them to create 1 arc-second (~30) resolution products that can provide more detailed information to better assist them with natural disaster prevention, mitigation, natural resource management, and local and international infrastructure development.

Designed and implemented at the [USGS Earth Resources Observation and Science \(EROS\) Center](#), the TPS offers data extraction, aspect, shaded relief, color shaded relief, slope, slope classification, raindrop trace, watershed delineation, and watershed analysis as downloadable products (figure 1). For a detailed description of these products and how they are developed, visit the [USGS Land Cover Applications \(LCA\) SRTM](#) product page. The web TPS application allows the user to define their area of interest (AOI) and select the desired derivative product then submit the request (Figure 2A,B) for processing.

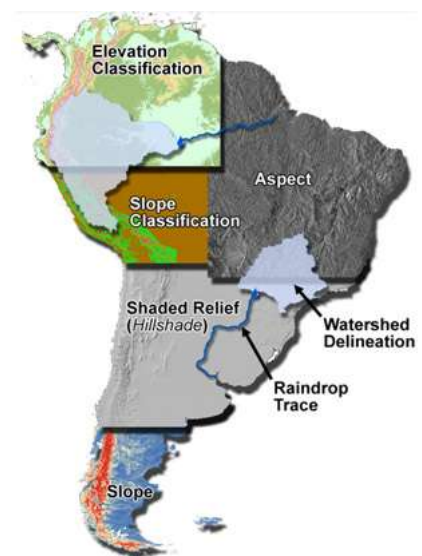


Figure 1: TPS DEM derivative product collage



Figure 2A: GeoSUR's Region Map Viewer with the TPS toolbox interface open



Figure 2B: TPS web user interface

TPS Source Elevation Datasets (Input Dataset)

In addition to providing the SRTM Level-2 1 arc-second (~30m) DEM (Rodriguez, 2005) as an elevation input source the TPS offers four other sources; HydroSHEDS 3 arc-second (~90m), GMTED2010 7.5, 15, and 30 arc-second median DEMs.

The HydroSHEDS is a conditioned DEM for the purpose of hydrologic modeling. It provides hydrographic information at a regional and global-scale. It can be used to generate data layers to support watershed analyses, hydrologic modeling, and freshwater conservation planning (WWF, 2012). The dataset was developed by the [World Wildlife Federation](#) (WWF) in partnership with [USGS](#), [Centro Internacional de Agricultura Tropical](#) (CIAT), [The Nature Conservancy](#), and [Centre for Environmental Systems Research](#) (CESR).

The GMTED2010 (Global Multi-resolution Terrain Elevation Data 2010), is a suite of products at three different resolutions (approximately 1,000, 500, and 250 meters) designed to support many applications directly by providing users with generic products (for example, maximum, minimum, and median elevations) that have been derived directly from the raw input data that would not be available to the general user or would be very costly and time-consuming to produce for individual applications. Currently the TPS provides the median product at these three resolutions (Danielson, 2011). For detailed information on this dataset and the entry suite of GMTED products visit the USGS GMTED publication page at pubs.usgs.gov/of/2011/1073/.



Topographic Modeling Tools

Available Tools (figure 3A)

- 1) Data Extraction
- 2) Aspect Derivative
- 3) Shaded Relief Derivative
- 4) Color Shaded Relief
- 5) Slope Derivative
- 6) Slope Classification Derivative
- 7) Raindrop Trace
- 8) Watersheds
- 9) Viewshed Analysis



Figure 3A: TPS Tool selection interface

1. **Data Extraction:** Allows for the extraction of raw data for a defined AOI for the selected data source (figure 3B). Available dataset for extraction are:

- a. SRTM 30m aspect derivative
- b. SRTM 30m shaded relief
- c. HydroSHEDS DEM
- d. GMTED 7.5 arc-second median DEM
- e. GMTED 15 arc-second median DEM
- f. GMTED 30 arc-second median DEM



Figure 3B: TPS Data Extraction web interface

2. **Aspect Derivative:** Allows for the extraction of the aspect model of the selected DEM data source for the defined AOI.

Model Inputs: User defined AOI (*spatial extent*)

Input Dataset (elevation data source)

3. **Shaded Relief Derivative:** Allows for the extraction of the shaded relief or hillshade model (figure 4) of the selected DEM data source for the defined AOI. This derivative product is typically used as a base-layer in cartographic products.

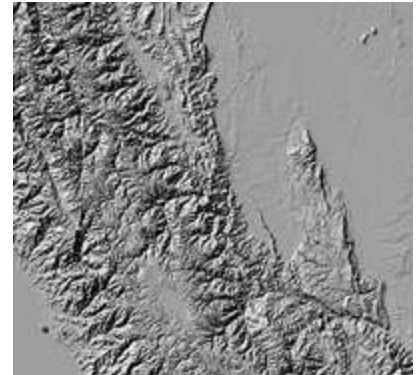


Figure 4: Shaded Relief

Model Inputs: User defined AOI (*spatial extent*)
Input Dataset (*elevation data source*)
Altitude Angle (*default 45°*)
Azimuth (*sun angle, default 315°*)
Z Factor¹

4. **Color Shaded Relief Derivative:** Similar to the shaded relief derivative, but with an applied semi-opaque color gradient over the shaded relief. This product is also typically used for a base-layer in cartographic products (figure 5).



Figure 5: Color Shaded Relief

5. **Slope Derivative:** Allows for the extraction of the slope model of the selected input DEM data source. The model provides for the user to define the slope's unit of measure and scale factor or "Z-Factor".

Model Inputs: User defined AOI (*spatial extent*)
Input Dataset (*elevation data source*)
Unit of Measure (*default is degree, percent is the other option*)
Z Factor¹

¹ 0.00003 is the default scale factor for TPS data sources because they are in a geographic coordinate system.

6. **Slope Classification:** Allows for the extraction of a classified slope dataset. The user can define the slope classification. In the “Slope Class List” input field they can specify any number of slope class ranges. For example if they list 5, 10, 30 and 50 in the field the resulting product will be a raster dataset with 4 classes with values of 1, 2, 3 and 4. The classes 1 through 4 relate directly with the defined ranges. Class 1 represents all percent slope values ranging from 0 to 5, class 2 are values greater than 5 and equal to 10 and so no.

Model Inputs: User defined AOI (*spatial extent*)

Input Dataset (*elevation data source*)

Slope Class List (*comma delimited list for slope ranges in respective unit of measure*)

Z Factor²

Unit of Measure (*degrees or percent*)

7. **Raindrop Trace:** This model traces the path of a theoretical rain drop from the point of impact over bare ground, into the drainage network and out to the sea or to the lowest point in a closed basin. Currently this model is using only SRTM 30 arc-second DEM as the data source.

Model Inputs: User defined source points (*multiple source points are allowed*)

8. **Watersheds:** This model delineates the contributing drainage area upstream from a given location or pour-point on a stream or drainage network. Currently this model is using only SRTM 30 arc-second DEM as the data source.

Model Inputs: User defined pour-point along a stream (*multiple source points are allowed*)

Pour Point Snap Distance (*tolerance distance, when a pour-point is placed on the map it will snap to the location with the high stream volume with the Snap Distance indicated*)

² 0.00003 is the default scale factor for TPS data sources because they are in a geographic coordinate system.

9. **Viewshed Analysis:** This model identifies the areas in an input elevation source that can be seen from one or more observations points (OP). These OPs have several parameters that describe their characteristics. An example of an OP is a cellular tower (ESRI 2012). The characteristics are:

- a. The height of the tower (OFFSETA), height of receiving location (OFFSETB) (can be a person or other object, figure 6).
- b. The horizontal angles or azimuths of the signal (AZIMUTH1, AZIMUTH2), these viewing angles range from 0 to 360 (figure 7).
- c. The vertical angles of measurements (VERT1, VERT2) are in degrees (figure 8). The first angle range is 0 to 90 degrees, the second is 0 to -90 degrees.
- d. The search radii (RADIUS1, RADIUS2). The first radius is the distance out from the OP before a search begins called the inner ring, the second is the distance from the OP out, measuring the maximum distance to search called the outer ring (figure 9). The second radius must be greater than the first.

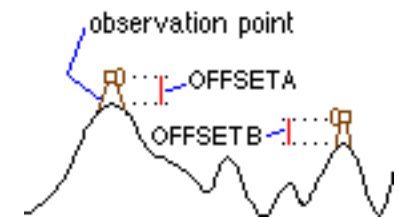


Figure 6 Observation point offsets (ESRI, 2012)

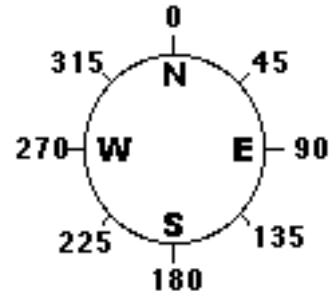


Figure 7 Horizontal angle or azimuth search angles (ESRI, 2012)

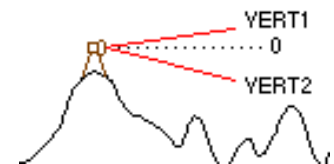


Figure 8 Vertical angles (ESRI, 2012)

With the option for this analysis to be done on multiple OPs the output is provided with values ranging from 0 to a maximum equal to the number of OPs. A value of 0 indicates that from that area, with the provided parameters, there are no visible OPs. A value of 1 indicates that one OP can be seen, 2 indicates that two OPs can be seen and so on (figure 10 A and B).

Model Inputs: User defined observation point(s)
 Offset A (*OFFSETA*)
 Offset B (*OFFSETB*)
 Azimuth 1 (*AZIMUTH1*)
 Azimuth 2 (*AZIMUTH2*)
 Vertical Angle 1 (*VERT1*)
 Vertical Angle 2 (*VERT2*)
 Search Radius 1 (*RADIUS1*)
 Search Radius 2 (*RADIUS2*)
 Input Dataset (*elevation data source*)



Figure 9 Radius search distances (ESRI, 2012)

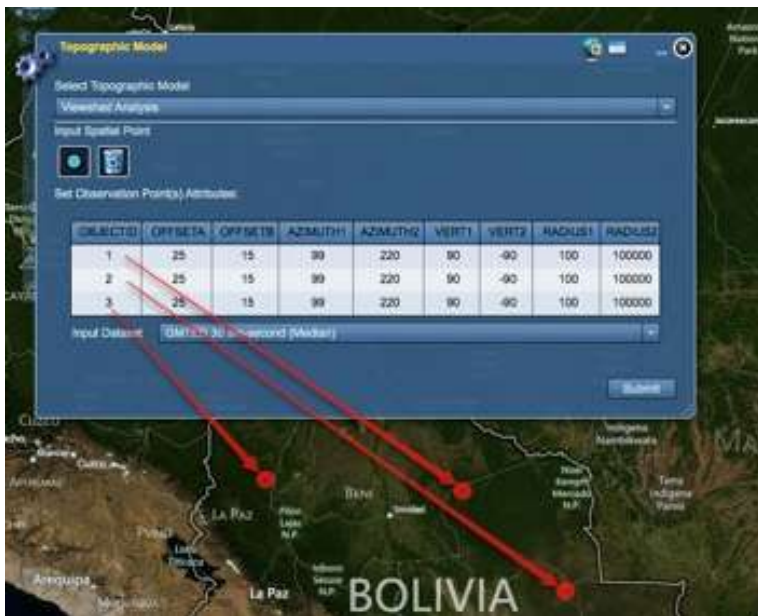


Figure 10A Viewshed web tool interface

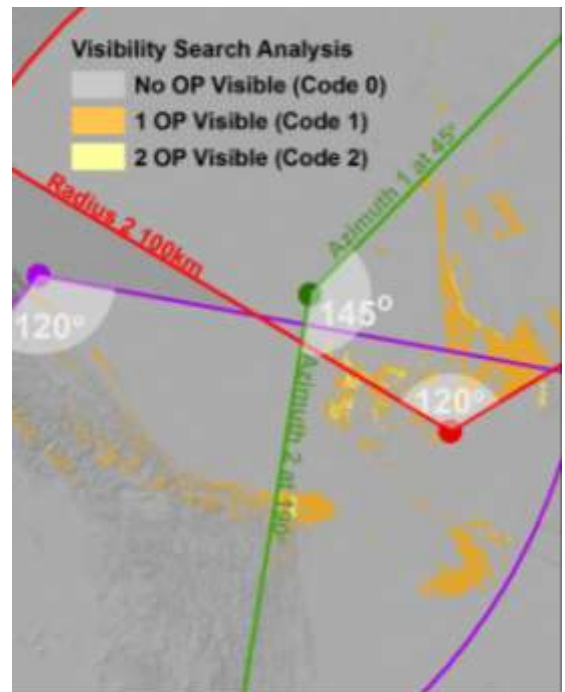


Figure 10B Example of a Viewshed Analysis

Reference:

Danielson, J.J., and Gesch, D.B., 2011, [Global multi-resolution terrain elevation data 2010 \(GMTED2010\)](#): U.S. Geological Survey Open-File Report 2011–1073, 26 p.

ESRI, 2012 [Using Viewshed and Observer points for visibility analysis: http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Performing_visibility_analysis_with_Viewshed_and_Observer_Points/009z000000v8000000/](#) (version 25 May 2012)

Rodriguez, E., C.S. Morris, J.E. Belz, E.C. Chapin, J.M. Martin, W. Daffer, S. Hensley, 2005, [An assessment of the SRTM topographic products](#), Technical Report JPL D-31639, Jet Propulsion Laboratory, Pasadena, California

World Wildlife Federation (WWF), 2012, [Freshwater Science HYDROSHEDS: http://www.worldwildlife.org/science/projects/freshwater/item1991.html](#) (version 25 May 2012)