ASTER Global Elevation Data

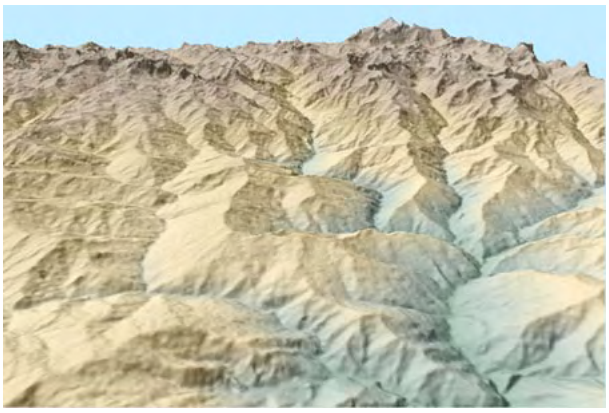
A Global, 1 arc-second (approximately 30-m) Digital Elevation Model (GDEM) derived from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) imagery is now available. This DEM was jointly released by the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA). It consists of 22,600 1°-by-1° tiles covering land surfaces between 83°N and 83°S latitude. The tiles are in GeoTIFF format with latitude-longitude coordinates referenced to the WGS84 datum and elevations in integer meters referenced to the EGM96 geoid. The GDEM tiles may be downloaded individually or in small groups at no charge from the Earth Remote Sensing Data Analysis Center (ERSDAC) of Japan and NASA's Land Processes Distributed Active Archive Center (LP DAAC):

http://www.gdem.aster.ersdac.or.jp **https://wist.echo.nasa.gov/api/**

GDEM Production

ASTER can acquire stereo images using its near-infrared band, which has nadir-pointing and backward-pointing telescopes and thus can image the same area along the satellite track from different angles. The ASTER GDEM was produced by automated processing of the entire 1.5-million-scene ASTER archive in the following steps:

- stereo-correlation to produce 1,264,118 individual scene-based DEMs, providing repeat coverage for nearly all land areas
- cloud-masking to remove cloud-obscured pixels
- stacking all cloud-screened scene DEMs
- removal of residual bad values and outliers
- averaging of the stacked pixel values to produce final pixel values
- replacing selected residual bad values with elevations from reference DEMs
- partitioning into 1°-by-1° tiles



3D perspective view of 1 arc-second ASTER GDEM tile N27E086, Himalaya Mountains, Nepal. A color relief-shaded rendering of the DEM is draped over the DEM terrain layer. View is toward the north-northeast, with Mt. Everest on the horizon in the upper right.

Comparison with SRTM DEM

The ASTER GDEM, like the DEMs produced from the Shuttle Radar Topography Mission (SRTM), is the product of direct remote-sensing of the Earth's surface from orbit. The ASTER GDEM extends farther north and south into the Arctic and Antarctic regions than SRTM data, providing unique data for arctic Eurasia, Greenland, Canada, and for Antartica. The original SRTM DEMs also contain numerous voids in steep mountainous areas due to radar shadowing and foreshortening effects. The elevation coverage of steep terrain is more complete in the ASTER GDEM, though its accuracy degrades in such areas.

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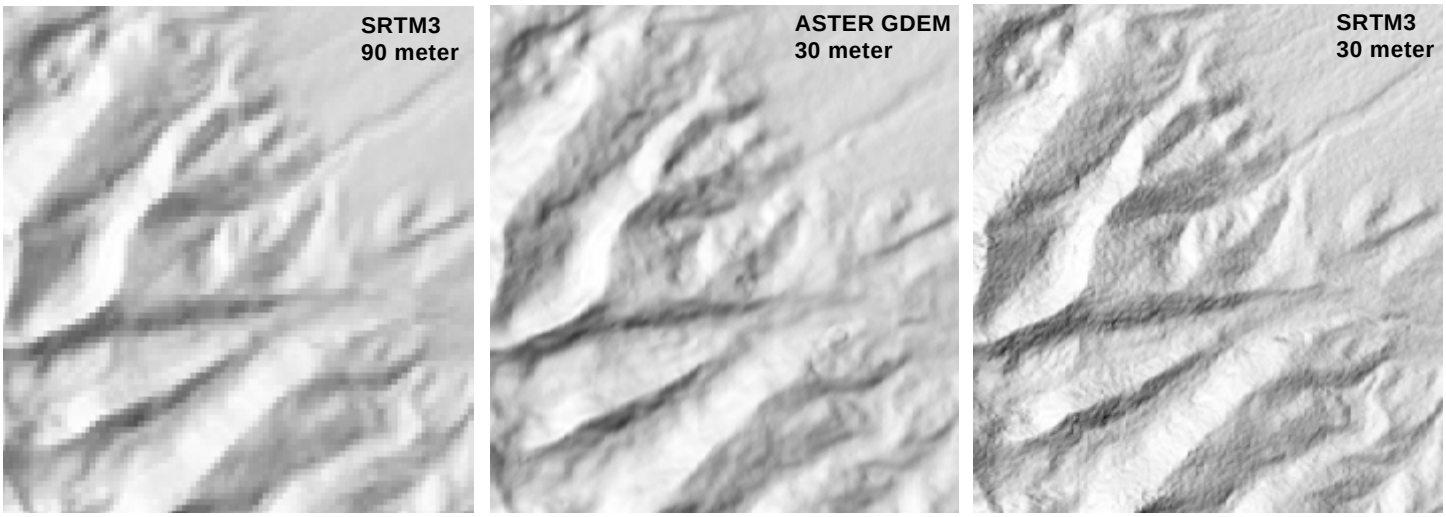


Shaded relief images computed for a mountainous area in central Colorado. Images compare the ASTER GDEM (1 arc-second or nominal 30 meter cell size) in the center with two version of the Shuttle Radar Topography Mission version 3 DEM: the 3 arc-second / 90 meter data that is available for most of the globe (left) and the 1 arc-second / 30 meter data that is available for the United States (right). While the cell size of the ASTER GDEM is approximately 30 m, topographic features smaller than 100 to 120 m, such as the smaller channels on the alluvial fan surface in the upper right, are not resolved in the ASTER GDEM. Its effective spatial resolution is thus comparable to the global 90-meter SRTM3 DEM.

ASTER GDEM Accuracy Assessment

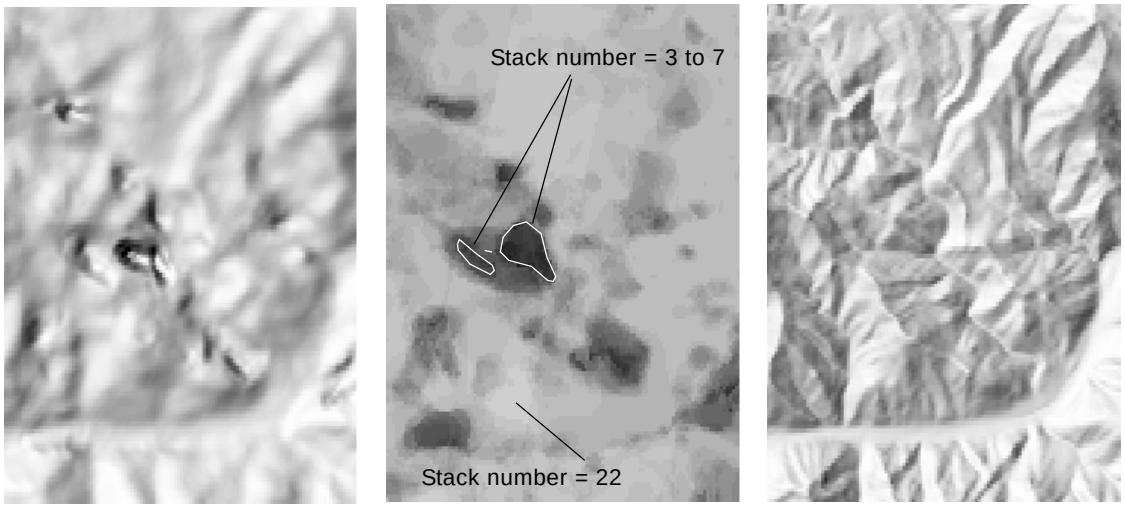
The accuracies estimated for the ASTER GDEM prior to its production were 20 meters for the elevation values and 30 meters for horizontal positioning (both at 95% confidence level). A preliminary quality assessment of the ASTER GDEM by the producing agencies compared GDEM tiles for the conterminous United States with USGS NED data and more than 13,000 ground control points. GDEM tiles for other continents were compared to local DEM data and to SRTM data. This assessment concluded that the actual elevation accuracy of GDEM tiles is within or close to the stated accuracy of 20 meters at 95% confidence. However, this research concluded that while the ASTER GDEM elevation values are posted on a 1 arc-second (approximately 30 meter) grid, it does not actually resolve topographic features of that size. The ASTER GDEM appears blurry in comparison to other 30-meter DEMs (NED30 and the 30-meter SRTM data for the United States). The spatial detail that is resolvable by the ASTER GDEM is estimated to be between 100 and 120 meters.

Color shaded-relief from ASTER DEM tile S01W079, northern Ecuador, showing several volcanoes rising above populated and cultivated valleys. Width of view is approximately 40 km.

Anomalies and Artifacts

The ASTER GDEM also contains residual artifacts and anomalies that affect the overall accuracy and use of the data. Some of the artifacts are evident in a display of the raw elevation data, while others become visible when the DEM is relief-shaded.

The most common artifacts relate to local variations in the number of individual scene DEMs that were stacked to create the final averaged DEM elevation value. Each ASTER GDEM tile is provided with a companion GeoTIFF file that records the stack numbers for that tile. The most accurate elevations were derived from stacks of 20 or more scene DEMs. Elevation accuracy decreases with decreasing stack number, and is especially poor for stack number of 4 or less. Small, irregular areas with much lower stack number than their surroundings are common and give rise to small pits and bumps in the ASTER GDEM with elevation anomalies from a few meters to 100 meters or more. The illustration above shows an example of these anomalies as expressed in a shaded relief view and the corresponding stack number image.



At left is a small area of an ASTER GDEM tile, shown with relief shading, that includes a number of "pit" anomalies. The middle image is the stack number raster for the corresponding area, and the image on the right is the relief-shaded NED30 data for comparison. The pits correspond to local areas of low stack number (darker gray tones) in the stack number raster.

Some ASTER GDEM tiles include pixels for which no cloud-free ASTER data are available. These areas are dominantly in the tropics and in extreme northern and southern latitudes. These voids were patched using SRTM, NED, and other DEM data where available; the patched values were adjusted to correct for offsets between the ASTER and reference DEM. In the arctic and antarctic regions, where no reference DEMs were available, residual cloud cells have been assigned a value of -9999 in the ASTER GDEM. In addition, inland water bodies have not been specially processed to produce horizontal water surfaces.

Research Grade

METI and NASA state that Version 1 of the ASTER GDEM should be viewed as "experimental" or "research grade". However, they have decided to release it because they feel its benefits outweigh its flaws and because they hope the work of the user community will help to produce an improved version in the future.