

# US GeoData Digital Elevation Models

## Digital Elevation Models

Digital elevation model (DEM) data are arrays of regularly spaced elevation values referenced horizontally either to a Universal Transverse Mercator (UTM) projection or to a geographic coordinate system. The grid cells are spaced at regular intervals along south to north profiles that are ordered from west to east. The U.S. Geological Survey (USGS) produces five primary types of elevation data: 7.5-minute DEM, 30-minute DEM, 1-degree DEM, 7.5-minute Alaska DEM, and 15-minute Alaska DEM.

*Similar digital elevation data, arranged not by quadrangles but as a huge, single, seamless file, are known as National Elevation Data, or NED, and are treated in a separate fact sheet available at [mapping.usgs.gov/mac/isb/pubs/factsheets/fs14899.html](http://mapping.usgs.gov/mac/isb/pubs/factsheets/fs14899.html).*

## Data Collection

The USGS has used four methods to collect DEM data. Of these methods, only one, interpolation from vectors or digital line graph (DLG) hypsographic and hydrographic data, is currently used for 7.5-minute DEM's and other series DEM's. The following three methods (now discontinued or deactivated) were used primarily for the production of 7.5-minute DEM data: (1) the Gestalt Photo Mapper II, (2) manual profiling from photogrammetric stereomodels, and (3) interpolation of the elevations from stereomodel digitized contours.

DEM data for 15-minute and 2-arc-second (30-minute) units are derived from DLG hypsographic and hydro-



Part of a 7.5-minute DEM plot of Tumwater, Wash.

graphic data. DEM data for 1-degree units are collected from topographic map sources, ranging from the 7.5-minute map series to the 1- by 2-degree map series, or from photographic sources by using image correlation systems.

## Unit Size and File Extent

DEM data for 7.5-minute units correspond to the USGS 7.5-minute topographic quadrangle map series for all of the United States.

Data for 2-arc-second (30-minute) DEM's provide coverage for the conterminous United States. This series is distributed as four units of 15-minute DEM data covering full 30- by 30-minute areas that correspond to the east or west half of the USGS 30- by 60-minute topographic quadrangle map series (1:100,000-scale).

DEM data for 15-minute units correspond to the USGS 15-minute topographic quadrangle map series

in Alaska. The unit sizes in Alaska vary depending on the latitude. Units south of 59° N. cover 15- by 20-minute areas, those between 59° and 62° N. cover 15- by 22.5-minute areas, those between 62° and 68° N. cover 15- by 30-minute areas, and those north of 68° N. cover 15- by 36-minute areas. (All values are latitude-longitude, respectively.)

DEM data are produced by the National Imagery and Mapping Agency (NIMA) in 1- by 1-degree units that correspond to the east or west half of the USGS 1- by 2-degree topographic quadrangle map series (1:250,000-scale) for all of the United States and its territories. In Alaska these are west, central, and east files.

All nonstandard quadrangles with neat-lines that extend beyond the standard unit size to accommodate overedge boundaries are collected and sold as multiples of the standard unit sizes.

## Data Characteristics

Vertical elevations are in decimal and whole units of meters and feet except for the 1-degree DEM, which is distributed in whole meters only. Elevation values for the continental United States and Alaska are in reference to the National Geodetic Vertical Datum of 1929 (NGVD 29), with values for the islands of Hawaii, Puerto Rico, and Guam referenced to local mean sea level. Additional characteristics by data type are as follows:

The 7.5-minute DEM's cast on the UTM projection system are referenced to either the North American Datum of 1927 (NAD 27)

or NAD 83. These data are stored as profiles with a 10- or 30-meter square grid spacing along and between each profile. Approximate file sizes are 9.9 megabytes for a 10-meter resolution and 1.1 megabytes for a 30-meter horizontal resolution. Data profiles for this product do not always have the same number of elevations because of the variable angle between true north and grid north in the UTM coordinate system.

The 7.5-minute Alaska DEM data are referenced horizontally to the geographic (latitude/longitude) coordinate system of horizontal datums NAD 27 or NAD 83. The spacing between elevations along profiles is 1 arc-second of latitude by 2 arc-seconds of longitude.

The 30-minute DEM data consist of four 15-minute units of coverage that are referenced horizontally to either NAD 27 or NAD 83. The spacing of elevations along and between each profile is 2 arc-seconds.

The 15-minute Alaska DEM data are referenced horizontally to NAD 27 or NAD 83. The spacing between elevations along profiles is 2 arc-seconds of latitude by 3 arc-seconds of longitude. Each profile has 451 elevations.

The 1-degree DEM data are referenced geographically with the horizontal datum of the World Geodetic Survey (WGS) system of 1972. A few units are also available using the WGS 1984 Datum. Spacing of the elevations along and between each profile is 3 arc-seconds with 1,201 elevations per profile. The only exception is DEM data in Alaska, where the spacing and number of elevations per profile vary depending on the latitude. Latitudes between 50° and 70° N. have spacings at 6 arc-seconds with 601 elevations per profile, and latitudes greater than 70° N. have spacings at 9 arc-seconds with 401 elevations per profile.

## Data Records

A DEM file is organized into three logical record types: A, B, and C. The type A record contains information defining the general characteristics of the DEM, including its name, boundaries, units of measurement, minimum and maximum elevations, number of type B records, and projection parameters. There is only one type A record per DEM file. The type B record contains profiles of elevation data and associated header information. There is a type B record for each profile. The type C record contains statistics on the accuracy of the data.

## Data Accuracy

The accuracy of DEM data depends on the source and resolution of the data samples. DEM data accuracy is derived by comparing linear interpolation elevations in the DEM with corresponding map location elevations and computing the statistical standard deviation or root-mean-square error (RMSE). The RMSE is used to describe the DEM accuracy. For 7.5-minute DEM's derived from a photo-grammetric source, 90 percent have a vertical accuracy of 7-meter RMSE or better and 10 percent are in the 8- to 15-meter range. For 7.5- and 15-minute DEM's derived from vector or DLG hypsographic and hydrographic source data, an RMSE of one-half of a contour interval or better is required. The 1-degree DEM data have an absolute accuracy of 130 meters horizontally and 30 meters vertically.

## Ordering Instructions

All DEM's are available on the following media: CD-Recordable, Internet "at cost" File Transfer Protocol (FTP) delivery,\* 8- mm tape, and 3,480-cartridge tape. DEM data are written as ANSI-standard ASCII characters in fixed-block format. To order DEM data, specify the unit size, maximum block size, and tape label,

and identify the sales unit by topographic quadrangle name or by the southeast latitude and longitude corner coordinates.

The Earth Science Information Center can furnish indexes, price lists, and order forms. Data users guides are included with each order.

\*Except the 1- by 1-degree DEM's that are available at no charge using FTP from [edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html](http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html).

## For More Information

EROS Data Center  
Customer Services  
Sioux Falls, SD 57198  
Telephone: 605-594-6151  
Fax: 605-594-6589  
E-mail: [custserv@usgs.gov](mailto:custserv@usgs.gov)

For information on these and other USGS products and services, call 1-888-ASK-USGS, use the ASK.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at [mapping.usgs.gov/mac/isb/pubs/pubslists/index.html](http://mapping.usgs.gov/mac/isb/pubs/pubslists/index.html).

Please visit the USGS home page at [www.usgs.gov](http://www.usgs.gov).

The address for the WebGLIS is [edcwww.cr.usgs.gov/webglis](http://edcwww.cr.usgs.gov/webglis).