



Product Description

SRTM/PD-03/11/03

SRTM
DTED Format

Version 1.1

December 03

Michaela Wagner

Table of Contents

1. SCOPE	3
2. DIGITAL ELEVATION MODEL	4
3. RECORD SEQUENCE AND FILE STRUCTURE	5
4. DTED FORMAT DEFINITIONS	6
4.1. USER HEADER LABEL (UHL)	6
4.2. DATA SET IDENTIFICATION (DSI) RECORD	7
4.3. ACCURACY DESCRIPTION (ACC) RECORD	9
4.4. DATA RECORD.....	9
5. EXPLANATION OF RECORDS AND FIELDS (DTED)	10
5.1. USER HEADER LABEL (UHL)	10
5.2. DATA SET IDENTIFICATION (DSI) RECORD	10
5.3. ACCURACY DESCRIPTION RECORD (ACC)	12
6. REFERENCES	13

1. Scope

Basis of this document is the “Performance Specification Digital Terrain Elevation Data (DTED)” (DMA, 1996) provided by the National Imaging and Mapping Agency (NIMA). The digital elevation models (DEM) derived from the SRTM/X-SAR data are provided in the DTED-format. This means that the height information file itself supports the structure and fields defined in the DTED-specification. Other definitions like accuracy and changes of the spacing in longitude for higher latitudes are not considered.

This document describes all single fields of the DTED format thus to assure uniformity of treatment among all mapping and charting element engaged in a coordinated production and maintenance program for this product.

Digital Terrain Elevation Data (DTED) are produced at two different levels of detail. The two classes of DTED are known as DTED, Level 1; and DTED, Level 2.

The DLR D-PAF supports the DTED Level 2 Format.

The Digital Elevation Model (DEM) and the corresponding height error map (HEM) are delivered on CD-ROM. The data files are located in the **dfd/SRTM.X-SAR.DEM** directory. The subdirectories describe 1° by 1° geographic areas. In each subdirectory up to 16 DEM and HEM files with a size of 15' x15' in longitude and latitude can be stored. The names of the directories are:

dfd/SRTM.X-SAR.DEM/Hxxx/Hyy

where

Hxxx is the hemisphere (E or W) and the longitude

Hyy is the hemisphere (N or S) and the latitude

2. Digital Elevation Model

The elevation information is derived from the signals reflected on the Earth's surface. Depending on the wavelength the radar signals penetrates the ground coverage and in some cases even the ground. The short wavelength of the X-band however causes normally a reflection on the surface producing a height surface model similar to the optical stereo case. The individual elevation values are generated from signals reflected by an area on ground of an approximate size of 25 x 25 m. The model is transformed into geographic coordinates and is provided in tiles of 15' (arc-minute) size in latitude and longitude. The product volume is about 3 Mbytes including the DEM and the corresponding height error map (HEM). This allows a fast provision and distribution over the internet. The distribution format is DTED (Digital Terrain Elevation Data). The product specification of the SRTM/X-SAR DEM is listed in Table 1.

Raster size	1"x1" Lon& Lat
Height levels	1m
Datum (horizontal)	WGS84
Datum (vertical)	WGS84
Data format	16-bit Signed Integer
Horizontal accuracy (absolute)	±20m 90% circular error
horizontal accuracy (relative)	±15m 90% circular error
vertical accuracy (absolute)	±16m 90% vertical error
vertical accuracy (relative)	±6m 90% vertical error

Table 1: DEM Product

The so called height error map (HEM) provides a local measure of the achieved accuracy. It is statistically determined from a neighborhood of image cells mainly considering the phase and baseline stability. Thus it describes the precision relative to the surrounding. The determination of the absolute accuracy requires the consideration of reference measures.

3. Record Sequence and File Structure

Both files - DEM (Digital Elevation Model) and HEM (Height Error Map) – are structured by the following records:

UHL	User Header Label
DSI	Data Set Identification Record
ACC	Accuracy Description Record
DATA	Data Record

A data file of DTED is a cell defined by latitudes and longitudes of a geographic reference system. The terrain elevation information is expressed in meters. The locations of elevation posts are defined by the intersections of rows and columns within a matrix.

The latitude and longitude grid spacing will be in whole second intervals.

The elevations with a data record have a constant longitude value. The first data value is the southernmost known elevation and the last data value is the northernmost. No two data records shall have the same longitude value.

Within a data file, the data records are arranged by ascending (west to east) longitude.

All elevation values are signed magnitude binary integers, right justified, 16 bits (2 bytes). The sign bit is in the high order position. Negative values are not complemented.

The numeric value will allow a theoretical range of elevations between $\pm 32,767$ meters; however in practice, the terrain elevation values shall not exceed + 9,000 meters or - 12,000 meters.

Unknown elevations along a scan line which are bounded by known elevations values will contain the null value. The null value is represented by data values with all bits set to 1 > bits within the structure of a data record. This null elevation value of - 32,767 meters is used as a place holder in the data record. Null elevation values are allowed in 1° cells (i.e., partial cells) which have not been fully compiled. Null elevation values shall not be contained in 1° cells (i.e., full cells).

Missing Elevations.

- Elevation posts which are missing prior to the first known elevation are not represented. The location of the first known point is given by the latitude count field in the Data Record.
- Elevation posts which are missing past the last known elevation are not represented. The last known elevation is immediately followed by a checksum.
- Missing elevations are allowed in 1° cells (partial cells) which have not been fully compiled.

4. DTED Format Definitions

4.1. User Header Label (UHL)

Field	Bytes	Contents	Description
1	1-3	UHL	Recognition sentinel
2	4	1	Fixed by standard
3	5-12	DDMMSSH	Longitude of origin (lower left corner of data set; full degree value; leading zero(s) for all subfields: degrees, minutes and seconds) H is the Hemisphere of the data
4	13-20	DDMMSSH	Latitude of origin (lower left corner of data set; full degree value; leading zero(s) for all sub fields: (degrees, minutes and seconds) H is the Hemisphere of the data
5	21-24	SSSS	Longitude data interval in seconds (decimal point is implied after third integer)
6	25-28	SSSS	Latitude data interval in seconds (decimal point is implied after third integer)
7	29-32	0000-9999 or Not Available (NA\$\$)	Absolute Vertical Accuracy in Meters (With 90% assurance that the linear errors will not exceed this value relative to mean sea level (Right justified))
8	33-35	U	Unclassified Security Code
9	36-47	Unique Reference	*Unique reference number (Provides Number pointer to file containing detailed file description)
10	48-51	Number of longitude lines	Count of the number of longitude (profiles) lines
11	52-55	Number of latitude points	*Count of the number of latitude points per longitude line
12	56	Multiple accuracy	0 - Single 1 - Multiple
13	57-80	Reserved	Unused portion for future use

Note: *These fields, to be defined by producer, may be left blank.

4.2. Data Set Identification (DSI) Record

Fixed Length = 648 ASCII Characters

Field	Bytes	Contents	Description
1	1-3	DSI	Recognition Sentinel
2	4	U	Unclassified Security Code
3	5-6	Spares	Security Control and Release Markings
4	7-33	Spares	Security Handling Description
5	34-59	Spares	Reserved for future use
6	60-64	DTED1 or DTED2	DMA Series Designator for product level
7	65-79	0000000000000000	Unique reference number
8	80-87	Spares	Reserved for future use
9	88-89	01-99	Data Edition Number
10	90	A-Z	Match / Merge Version
11	91-94	0000	Maintenance Date (Zero filled until used)
12	95-98	0000	Match/Merge Date (Zero filled until used)
13	99-102	0000	Maintenance Description Code (Zero filled until used)
14	103-110	DEDLRDFD	Producer Code
15	111-126	Spares	Reserved for future use
16	127-135	Spares	Product Specification (Alphanumeric field)
17	136-137	00	Product Specification (Amendment Number 00-99)
18	138-141	0000	Date of Product Specification (YYMM)
19	142-144	W84	Vertical Datum
20	145-149	WGS84	Horizontal Datum Code
21	150-159	GeMoS2.0.0	Digitizing/Collection System
22	160-163	YYMM	Compilation Date
23	164-185	Spares	Reserved for future use
24	186-194	DDMMSS.SH	Latitude of origin of data leading zero for values less than 10 H is the hemisphere of the data
25	195-204	DDDMMSS.SH	Longitude of origin of data leading zero for values less than 100 H is the hemisphere of the data
26	205-211	DDMMSSH	Latitude of SW corner of data bounding rectangle leading zero for values less than 10 H is the hemisphere of the data
27	212-219	DDDMMSSH	Longitude of SW corner of data bounding rectangle leading zero for values less than 100 H is the hemisphere of the data
28	220-226	DDMMSSH	Latitude of NW corner of data bounding rectangle leading zero for values less than 10 H is the hemisphere of the data

29	227-234	DDMMSSH	Longitude of NW corner of data bounding rectangle leading zero for values less than 100 H is the hemisphere of the data
30	235-241	DDMMSSH	Latitude of NE corner of data bounding rectangle leading zero for values less than 10 H is the hemisphere of the data
31	242-249	DDMMSSH	Longitude of NE corner of data bounding rectangle leading zero for values less than 100 H is the hemisphere of the data
32	250-256	DDMMSSH	Latitude of SE corner of data bounding rectangle leading zero for values less than 10 H is the hemisphere of the data
33	257-264	DDMMSSH	Longitude of SE corner of data bounding rectangle leading zero for values less than 100 H is the hemisphere of the data
34	265-273	0000000.0	Clockwise orientation angle of data with respect to true North (Will usually be all zeros for DTED)
35	274-277	SSSS	Latitude interval in tenths of seconds between rows of elevation values (Decimal point is implied after third integer)
36	278-281	SSSS	Longitude interval in tenths of seconds between columns of elevation values (Decimal point is implied after third integer)
37	282-285	0000-9999	Number of Latitude lines
38	286-289	0000-9999	Number of Longitude lines
39	290-291	00-99	Partial Cell Indicator 00 = Complete 1° cell 01-99 = % of coverage completed
40	292-392	00-999999999999	Coverage in percent (00 = 100%)
41	393-492	Geoid Undulation xxxx meters	Reserved for producing nation use only
42	493-648	Spares	Reserved for future use

4.3. Accuracy Description (ACC) Record

Fixed Length = 2700 ASCII Characters

Field	Bytes	Contents	Description
1	1-3	ACC	Recognition Sentinel
2	4-7	NA\$\$	Absolute Horizontal Accuracy Not Available (NA)
3	8-11	NA\$\$	Absolute Vertical Accuracy Not Available (NA)
4	12-15	NA\$\$	Relative (Point-to-Point) Horizontal Accuracy Not Available (NA)
5	16-19	NA\$\$	Relative (Point-to-Point) Vertical Accuracy Not Available (NA)
6	20-23	Spares	Reserved for future use
7	24	Spares	Reserved for DMA use only
8	25-55	Spares	Reserved for future use
9	56-57	00	Multiple Accuracy Outline Flag 00 = No accuracy sub regions provided
10	58-2613	Spares	Accuracy of Sub regions
11	2614-2631	Spares	Reserved for DMA use only
12	2632-2700	Spares	Reserved for future use

4.4. Data Record

Each elevation is a true value referenced to mean sea level datum recorded to the nearest meter. The horizontal position is referenced to precise longitude-latitude locations in terms of the current World Geodetic System (WGS), determined for each file by reference to the origin at the southwest corner. The elevations are evenly spaced in latitude and longitude at the interval designated in the user header label in South to North profile sequence.

Every data record begins with an 8-byte preamble with contains general information describing the data file.

Field	Length in Bytes	Contents	Description
1	1	170	Recognition Sentinel
2	3	Data block count	Sequential count of the block within the file, starting with zero for the first block (Fixed Binary)
3	2	Longitude count	Count of the meridian. True longitude = longitude count x data interval + origin (Offset from the SW corner longitude) (Fixed Binary)
4	2	Latitude count	Count of the parallel. True latitude = latitude count x data interval + origin (Offset from the SW corner latitude) (Fixed Binary)
5	2	Elevation 1 - n	True elevation value of point 1-N of meridian in meters (Fixed Binary)
6	4	Checksum	Algebraic addition of contents of block. Sum is computed as an integer summation of 8-bit values (Fixed Binary)

5. Explanation of records and fields (DTED)

5.1. User Header Label (UHL)

This record is maintained for minimum impact to users not desiring to use the DSI record, but all information in it is in the DSI record as well.

Fields (UHL):

- Longitude of Origin - Origin is always a full degree value even though the format allows values to be expressed to the second.
- Latitude of Origin - Origin is always a full degree value even though the format allows values to be expressed to the second.
- Seconds Longitude Interval - A cell of DTED is North-South oriented with columns of elevation posts running from south to north. The longitude interval is the East-West distance between the columns expressed as tenths of seconds.
- Seconds Latitude Interval - The spacing between the elevation posts within a column (i.e., the distance between the rows) is the latitude interval expressed in tenths of a second.

5.2. Data Set Identification (DSI) Record

This record provides identification and security information relating to the DTED. The record is fixed length consisting of 648 ASCII characters. Certain fields in the DSI record are duplicated in the UHL/UTL. These fields are required to match. Users may process the data using only the information in the DSI record if desired.

Note: Numeric values shall be right justified with leading zeros. Alpha and alphanumeric characters shall be left justified unless 'free text' is indicated in description.

Fields (DSI):

- Security control and release markings - This field may contain the two character codes from DIAM 65-19 or may be blank filled
- DMA series designator - Five character code to uniquely identify a product. DTED1 for Level 1, or DTED2 for Level 2.
- Unique reference number - Free text or zero filled.
- Data edition number - The number assigned to the data indicating either original compilation (Edition 1) or subsequent replacements of the data (Editions 2, 3, etc.) in the Data Base (DB) to achieve accuracy requirements (recompilation) or currency/specification requirements (revision). The data edition number does not reflect the number of replacements made to the data to effect boundary matches.
- Match/merge version - The number of times an edition of the data was changed to effect boundary continuity with adjacent data in the DB. Alphabetic Code A denotes original release of the edition, B - Z designates data change for boundary continuity.

- Maintenance date - YYMM (year and month); the date existing DB data was either revised (updated) to meet the currency requirements (or to effect specification changes), or recompiled to meet accuracy requirements. When the existing data is only revised (horizontal position or vertical values are not significantly changed) the maintenance date will reflect the date of the revision, but the compilation date will not be changed. It will continue to reflect the date of the original compilation. However, when the data is subjected to a major recompilation, the Compilation Date and the Maintenance Date will both be changed to reflect the date of the recompilation.
- Match/merge date - YYMM (year and month); the latest date the data in the database (DB) was changed to effect continuity with adjacent data. This data corresponds to the Match/Merge Version Code.
- Maintenance description code - Zero filled until used.
- Producer codes - The first two characters (left justified) indicate the producing. The last six characters are to be used at the discretion of the producer. Blanks are acceptable. Example codes:

Belgium	BE	Netherlands	NL
France	FR	Norway	NO
United Germany	GE	United Kingdom	UK
Italy	IT	United States	US

- Product specification - Identifies the product specification containing the compilation and accuracy requirements used to produce the data.
- Product specification amendment and change number - Indicates the highest numbered amendment or change used to produce the data. The first character identifies the Amendment number and the second character identifies the Change Notice number. (Amendment 0, Change 1-01; Amendment 2, Change 2-22; etc.)
- Date of product specification - Identifies the published date of the product specification used to produce the data.
- Vertical datum code - Currently W84.
- Horizontal datum code - Currently WGS84.
- Digitizing collection system - Identifies the equipment used to collect the elevation values from the source material used.
- Compilation date - YYMM (year and month); the date the data was either originally compiled (Edition 1) or the date existing data was subjected to a major recompilation which involved significant changes to the horizontal positions and vertical values. (Edition 2, 3, 4, etc.)
- Latitude of origin - Expressed in degrees, minutes, seconds and tenths of seconds with N or S to indicate hemisphere (always a full degree value even though the format allows value to be expressed to tenths of seconds).

- Longitude of origin - Expressed in degrees, minutes, seconds and tenths of seconds with E or W to indicate hemisphere (always a full degree value even though the format allows value to be expressed to tenths of seconds).

5.3. Accuracy description record (ACC)

The accuracy record provides accuracy information relating to the DTED. The record is fixed length consisting of 2700 ASCII characters. The record allows for up to nine accuracy sub regions within the product should the accuracies of various portions of this product differ. Each sub region may consist of up to fourteen coordinate pairs to accurately portray the outline. Coordinates are input clockwise. Unused coordinate pairs are blank filled.

Note: Numeric values shall be right justified with leading zeros. Alpha and alphanumeric characters shall be left justified.

Accuracy sub region description record (not supported!)

6. References

DMA, 1996: Performance Specification Digital Terrain Elevation Data (DTED), MIL-PRF-89020A, 19. April 1996, Superseding MIL-D-89020