DGIWG – 250

Defense Gridded Elevation Data
Product Implementation Profile

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i. Contributing organizations

Nation	Parent organization
France (Lead Nation)	Institut Géographique National (IGN)
Czech Republic	Military Geographic and Hydrometeorologic Office (MGHM)
Germany	Bundeswehr Geoinformation Office (BGIO)
Italy	
Sweden	Military Geographic Service
Turkey	
United States	National Geospatial-Intelligence Agency (NGA)

ii. Revision history

Key dates and milestones

Date	Release	Primary clauses modified	Description
2015-04-08	0.1.0	All	1st review draft
2015-05-22	0.1.2	6.3 Multi-Level Grid definition + 6.5 Horizontal Spatial resolution + Addition of new section 7	Adoption of latitudinal zones specified by WorldDEM / TRE-x products Addition of section 7 Elevation Values and Units
2015-08-22	0.2	All	2nd review draft
2016-02-21	0.6	All	Final draft; addition of level 4b. document submitted for ballot
2016-06-02	1.0		Resolution of comments per ballot (see DGED comments resolution)

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Introduction

The Implementation Profile for Defense Gridded Elevation Data (DGED) describes the data content, structure and metadata requirements required to create a suite of gridded elevation data products.

These products are defined in accordance with DGIWG's Elevation Surface Model (ESM) standard as a set of spatial resolution layers.

The spatial resolution layers covered by this profile include those resolutions covered by U.S. MIL-PRF-89020B (Digital Terrain Elevation Data), 23 May 2000 and U.S. Product Specification for High Resolution Elevation (HRE 1.1).

The intent of this profile is to increase the level of interoperability with and between organizations producing and using elevation data. The elevation data described in this implementation profile is typically used for mission planning, terrain modeling and other related applications.

Elevation data is often fused with other Geospatial products to provide enhanced visualization capabilities for analysts and mission planners.

1 Scope

This product implementation profile for gridded elevation data products has been developed to support defense requirements for a uniform, orthogonal grid-based geospatial elevation model for a wide range of geospatial resolutions, in order to ensure interoperability between implementations of elevation products (and their specifications).

This profile specifies the content, structure, multi-level grid system and tiling-scheme, as well as delivery and encoding format for gridded elevation products in support of elevation data storage, access, exploitation and exchange.

This product implementation profile is conformant to DGIWG's ESM standard (STD-116-1), with the following key features:

- Multi-level spatial resolution grid, including high resolution (metric and sub-metric) with two instances based on WGS84 horizontal CRS:
    - a Geographic / Angular grid
    - a Cartographic / Metric grid in UTM datum.
- Use of metadata as specified by ESM standard and the based on the DMF version 1.0.1 (November 2014).
- Constraints on horizontal and vertical accuracies specified for each level.
- Handling standardized encodings (GeoTIFF, GMLJP2, NSIF/STANAG 4545).

NOTE: TIN or Point cloud or contour lines elevation data are out of the scope of this specification.

2 Conformance

Any application or system or elevation data product specification or elevation dataset claiming conformance to this implementation profile shall meet the criteria for data conformance provided in the abstract test suite, as specified in Annex A.

3 Normative References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this profile.

International Standards

ISO 639-2:1998 Codes for the representation of names and languages

ISO 19111:2007 Geographic information – Spatial referencing by coordinates

ISO 19115-1:2014 Geographic information – Metadata

ISO 19123:2005 Geographic information - Schema for coverage geometry and functions

ISO 19131:2007 Geographic information - Data product specifications

NATO MC 0296/2**,** NATO Geospatial Policy, IMSTAM (GE0)-0001-2010 (SD3) dated 27 September 2010

STANAG 2215 IGEO (Edition 7, July 2010) Evaluation of Land maps, Aeronautical charts and Digital Topographic data

STANAG 3809 (Edition 4, Jan. 2004) Digital Terrain Elevation Data (DTED) Exchange Format (referencing U.S. MIL-PRF-89020B)

DGIWG - 114: DGIWG Metadata Foundation (STD-DP-12-010), version 1.0.1, November 2014

DGIWG 116-1 Elevation Surface Model Standardized Profile, Version 1.0.1, 10 June 2014

DGIWG 116-2 Elevation Surface Model – GML Application Schema, Version 1.0, 2 October 2014

DGIWG 116-3 Elevation Surface Model – Encoding rules, Version 1.0, 2 October 2014

DGIWG 108 GeoTIFF Profile for Georeferenced Imagery, Version 2.0.4, 17 March 2014

National Standards

NGA.STND.0036 1.0.0 WGS84, Department of Defense World Geodetic System 1984: Its Definition and Relationships with Local Geodetic Systems, 8 July 2014

NGA.STND.0037 2.0.0 GRIDS, Universal Grids and Grid Reference Systems, 28 February 2014

NGA.SIG.0012 2.0.0 UTMUPS, Implementation Practice – The Universal Grids and the Transverse Mercator and Polar Stereographic Map Projections, 25 March 2014

MIL-PRF-89020B 23 May 2000 Digital Terrain Elevation Data (DTED) (reference for STANAG 3809)

4 Terms and definitions, and abbreviated terms

4.1 Terms and definitions

Terms and definitions have been taken from the references cited in the Normative References (section 3) and the Bibliography.

Following terms and definitions are provided hereafter for ensuring proper understanding of the key terms used in this document.

4.1.1 data product specification

detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party [ISO 19131:2007]

NOTE: A data product specification provides a description of the universe of discourse and a specification for mapping the universe of discourse to a dataset. It may be used for production, sales, end-use or other purpose.

4.1.2 dataset

identifiable collection of data that can be represented in an exchange format or stored on a storage media [ISO 19115]

NOTE: A dataset may be a smaller grouping of data, which though limited by some constraint such as spatial extent or feature type, is located physically within a larger dataset. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart may be considered a dataset.

4.1.3 elevation

distance of a **point** from mean sea level measured along a line perpendicular to the mean sea level **surface**, positive if upwards or outside of the mean sea level **surface.** [ESM – DGIWG STD-116-1]

4.1.4 height

distance of a point from a chosen reference **surface** measured upward along a line perpendicular to that **surface** [ESM – DGIWG STD-116-1]

NOTE: A height below the reference surface will have a negative value.

4.1.4.1 ellipsoidal height (h)

distance of a point from the **ellipsoid** surface measured upward along a line perpendicular to the **ellipsoid,** positive if upwards or outside of the **ellipsoid**. Also known as geodetic height.

NOTE Only used as part of a three-dimensional coordinate system and never on its own.

4.1.4.2 gravity-related height (H)

Height dependent on the Earth's gravity field

NOTE: In particular, orthometric height or normal height, which are both approximations of the distance of a point above the mean sea level.

4.1.4.3 geoid height (N)

distance of a point on the geoid from the ellipsoid surface measured upward along the line perpendicular to the ellipsoid, positive if above the ellipsoid.

[ISO 19111]

NOTE: The reference **surface** is based on the **geoid** and may be approximated by an ellipsoid or hydrographic **surface**. Height is distinguished from elevation in that it is a directional measurement. A height below the reference **surface** will have a negative value. Negative height is also called depth. This definition also applies to altitude.

4.1.5 post

The locations of the intersections of rows and columns within an **elevation grid**. Post spacing for a **rectified grid** is a measure of its horizontal resolution

[ESM – DGIWG STD-116-1, derived from NATO STANAG 3809: DTED]

4.1.6 tile

A rectangular array of points on the reference grid, registered with and offset from the reference grid origin and defined by a width and height [ISO/IEC 15444-1]

4.2 Abbreviated terms

BIIF	Basic Imagery Interchange Format Standard (ISO/IEC 12087-5)
CE90	Circular Error measured at the 90% confidence interval
CRS	Coordinate Reference System
DEM	Digital Elevation Model
DMF	DGIWG Metadata Foundation
DSM	Digital Surface Model
DTED	Digital Terrain Elevation Data
DGED	Defense Gridded Elevation Data
DMED	Digital Mean Elevation Data (as defined in DTED)
EGM	Earth Gravitational Model
EO	Electro Optical
EPSG	European Petroleum Survey Group (Geodetic Parameter Registry)
ESM	Elevation Surface Model
GeoTIFF	Geographic Tagged Image File Format
GML	Geography Markup Language
GMLJP2	GML in JPEG2000
GSD	Ground Sample Distance
HRE	High Resolution Elevation (as of HRE1.1, NGA.IP.0002_1.1)
HREGP	HRE Geographic Product
ISO	International Organization for Standardization
LE90	Linear Error measured at the 90% confidence interval

JPEG	Joint Photographic Experts Group
MGRS	Military Grid Reference System
MSL	Mean Sea Level
NATO	North Atlantic Treaty Organization
NITF	National Imagery Transmission Format
NSIF	NATO Secondary Imagery Format (STANAG 4545)
TREx	TanDEM-X High Resolution Elevation Data Exchange
UoM	Unit of Measure
UPS	Universal Polar Stereographic
UTM	Universal Transverse Mercator (coordinate system)
WGS-84	World Geodetic System 1984
XML	eXtensible Markup Language

4.3 Symbols and notations

σ_H	Random Horizontal Error
σ_V	Random Vertical Error
$\sigma_{H,Val}$	validated Random Horizontal Error
$\sigma_{V,Val}$	validated Random Vertical Error

5 Applicability and use

This profile provides a framework for interoperable and consistent multi-level elevation gridded data product specifications, in support of elevation data storage, access, exploitation and exchange. It applies to elevation gridded data product specifications and to elevation gridded data.

This profile is designed primarily for a bare earth or reflective surface models. It does not address the design or implementation of a database to store data in its native format.

6 Data content and structure

The Defense Gridded Elevation Data Product Implementation Profile (DGED) data structure is a uniform, orthogonal grid-based geospatial elevation model, supporting a wide range of geospatial resolutions. This product profile specification supports 2 horizontal reference systems, World Geodetic System 1984 (WGS84) and UTM (Universal Transverse Mercator) or UPS projection on WGS84, multiple spatial resolutions, and multiple elevation data coverages where the various coverages allow for different surface classifications, such as reflective surface or bare earth.

6.1 Grid Structure

A grid structure is the most common geospatial data model used for modeling elevation data. The DGED grid structure is represented by a collection of regularly or uniformly spaced points as shown in Figure 1. This structure provides several advantages over other types of elevation geospatial data models in that a regular spacing of elevation points requires that only one elevation point be referenced to a horizontal coordinate. From this one point and its horizontal coordinate value and the ground sampling distance (GSD) between grid elevation points, the horizontal coordinate values of all other points can be determined. This eliminates the need to explicitly define the horizontal coordinate values of each elevation point and helps to minimize file size. The grid structure is also an efficient structure for data processing.

Within a DGED dataset, only one grid spatial resolution will be represented. The grid point locations for each elevation value are fixed within the coordinate system. The minimum grid sampling distance (see Grid sampling tables below) should be chosen to most efficiently represent the resolution of the source native dataset. Grids may not model all terrain features smaller or narrower than the grid spacing when the feature lies between grid points.

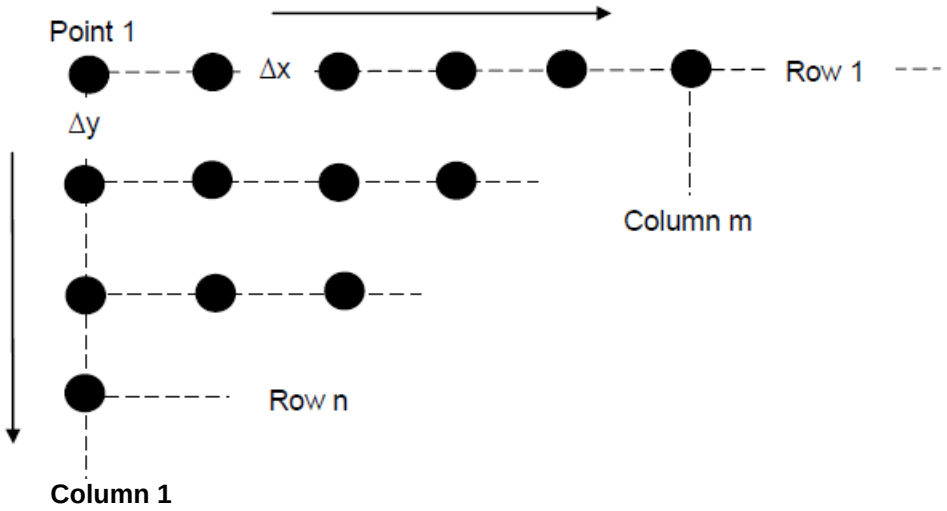

Figure 1 – DGED Grid structure

DGED grid records are structured in row major order such that the sequential order of the data within each record comprises a row of data for which the horizontal coordinates of each elevation point for that row has the same northing coordinate value. The records are sequenced north to south (1 to n) by a distance Δy, such that the first record in the dataset is the northern most row and subsequent records are the rows sequentially ordered to the south. The first elevation point value in a record is the western most elevation point for that row / record with subsequent elevation point values progressing west to east a distance Δx. The last elevation point value in the dataset is the elevation point in the south-eastern most location.

6.2 Multi-Level Grid definition, product naming and level consistency rules

DGED Product Levels and names are specified on the basis of the DGED multi-level grid defining spatial resolution, addressing low, medium and high resolution (up to metric and sub-metric resolution). In order to fulfil requirements the following two grid instances with eleven levels for Geographic grid and seven levels for UTM grid have been specified:

- **Geographic Grid** based on geographic / angular grid spatial resolution, in WGS84 horizontal datum, addressing the full set of 11 levels:
    - levels 0, 1 and 2, respectively with 30, 3 and 1 arc second latitudinal post spacing – as in DTED 0, 1 and 2;
    - level 3, with latitudinal post spacing of 0,4 arc sec. as in HREGP/TREx products;
    - level 4b, with latitudinal post spacing of 0,15 arc sec. (approx. 5m);
    - six higher resolution levels: levels 4 to 9, with latitudinal post spacing from 0,12 arc sec. (approx. 4m) to 0,00375 arc sec. (approx. 12,5 cm)
- **UTM Grid** based on cartographic / metric grid spatial resolution, in UTM horizontal datum, addressing 7 levels (level 4b to 9):
    - level 4b, with post spacing of 5m
    - six higher resolution levels: level 4 (post spacing = 4m) to level 9 (post spacing 12,5 cm)

The following table provides the specification of the 11 levels of DGED products and its two instances of the Geographic multi-level grid and UTM multi-level grid.

Table 1 – DGED Multi-level Geographic and UTM grids

DGED Levels	Geographic Grid		UTM Grid	Reference products
Level	Posts spacing in latitude		Posts spacing Ground Sample Distance (m)	
	Arc sec.	Approx. (m)		
0	30	1000		DTED0
1	3	100		DTED1
2	1	30		DTED2
3	0,4	12		HREGP, TREx
4b	0,15	5	5	
4	0,12	4	4	HRE40
5	0,06	2	2	HRE20
6	0,03	1	1	HRE10
7	0,015	0,5	0,5	HRE05
8	0,0075	0,25	0,25	HRE02
9	0,00375	0,125	0,125	HRE01

Products, producers and users will choose between the Geo or UTM option and level according to their specific requirements (and datum of the source of elevation data).

DGED product naming

A DGED data product specification shall be identified and named by its level and type (Geo or UTM), for example DGED L4G (0,12 arc sec.), or DGED L4bU (5m), or DGED L4U (4m), or DGED L6G (0,03 arc sec), or DGED L6U (1m).

This specification therefore specifies 18 DGED elevation product specifications as indicated by the following table.

Table 2 – DGED Data production specifications

DGED Level	Geo	UTM
0	L0	
1	L1	
2	L2	
3	L3	
4b	L4bG	L4bU
4	L4G	L4U
5	L5G	L5U
6	L6G	L6U
7	L7G	L7U
8	L8G	L8U
9	L9G	L9U

DGED consistency rules between successive levels (within Geographic or UTM grids)

The higher resolution levels (4 to 9) of the Geographic and UTM DGED grids are consistent in terms of aimed resolutions, but there is no coincidence between posts between Geographic and UTM DGED grids. Within each instance (Geo or UTM) of the multi-level grid for the higher resolution levels (4 to 9), the grid specifications ensure co-location of the grid posts between levels (or post alignment), as indicated hereafter.

For Geographic multi-level grid, the co-location rule for higher resolution levels (4 to 9) is:

- Between higher resolution levels (4 to 9): grid posts at level n correspond exactly to one grid post out of two at level n+1. For example, grid points at level 5 (0,06 arc sec.) correspond exactly to all even order grid points (from origin of the grid) at level 6 (0,03 arc sec.).
- Between level 4b and 6: grid posts at level 4b (0,15 arc sec.) correspond exactly to one grid post out of 5 at level 6 (0,03 arc sec.).

For UTM multi-level grid, the co-location rule for higher resolution levels (4 to 9) is:

- Between higher resolution levels (4 to 9): grid posts at level n correspond exactly to one grid post out of two at level n+1. For example, grid points at level 5 (2m) correspond exactly to all even grid points (from origin of the grid) at level 6 (following figure 2 illustrates this rule).
- Between level 4b and 6: grid posts at level 4b (5m) correspond exactly to one grid post out of 5 at level 6 (1m).

the following additional rule applies between level 3 (0,4 arc sec.) and level 4b (0,15 arc sec.) for the Geographic grid only: every third grid post (of rank 3i) at level 3 shall correspond to the eighth grid post (of rank 8i) at level 4b (from origin of the grid).

6.3 Grid Point coordinate locations

DGED grid points are 0-dimensional geometric primitives representing a coordinate location that is defined by the intersections of the curves that make up the grid.

DGED grid point coordinate locations shall adhere to a set of predefined elevation point locations within the horizontal coordinate reference system. This is to ensure points from different datasets with adjacent or overlapping horizontal spatial extents are horizontally coincident.

NOTE 1: This is only valid within each of the 2 grid systems that are specified in this product profile (in other words, valid within geographic grid products, or within UTM grid products).

NOTE 2: Attention is drawn on the fact that the GML convention (according to ISO 19136 or GML3.2.1 and ISO 19123) is: “When a grid point is used to represent a sample space (e.g. image pixel), the grid point represents the centre of the sample space.” Data providers shall ensure that the georeferencing information provided in the ESM GML description (if provided) is consistent with the georeferencing information provided in the encoding format (e.g. GeoTIFF).

6.3.1 UTM Point locations

For a DGED product based on UTM system, the reference origin for UTM products will be the origin of the UTM zone in which the DGED is located. UTM zone origins are specified by the intersection of the UTM zone central meridian with the equator. This intersection is assigned the UTM coordinates 500000,0 E, 0.0 N for zones in the northern hemisphere and coordinates 500000,0 E, 10000000,0 N for zones in the southern hemisphere. If the point spacing of a given DGED level is specified as {ΔE, ΔN}, then points for a DGED Level in the Northern hemisphere will be defined at {500000± i*ΔE, 0+ j*ΔN}. The values i and j are integer values of points in the Easting and Northing direction (respectively), +i*ΔE signifies an easterly direction from the central meridian, -i*ΔE

signifies a westerly direction from the central meridian, and +j*ΔN signifies a northerly direction from the equator. In a similar fashion, points in the Southern hemisphere are specified by {500000± i*ΔE, 10000000- j*ΔN}, where i and j are integer values of points in the Easting and Northing direction (respectively),+i*ΔE signifies an easterly direction from the central meridian, -i*ΔE signifies a westerly direction from of the central meridian, and -j*ΔN signifies a southerly direction from the equator.

Adhering to this system will assure that coincident points are maintained across the various UTM DGED levels within a zone. This will allow for direct comparison between datasets and direct decimation of high-resolution data to lower resolutions. See Figure 2 Example of UTM Point Locations in Northern Hemisphere.

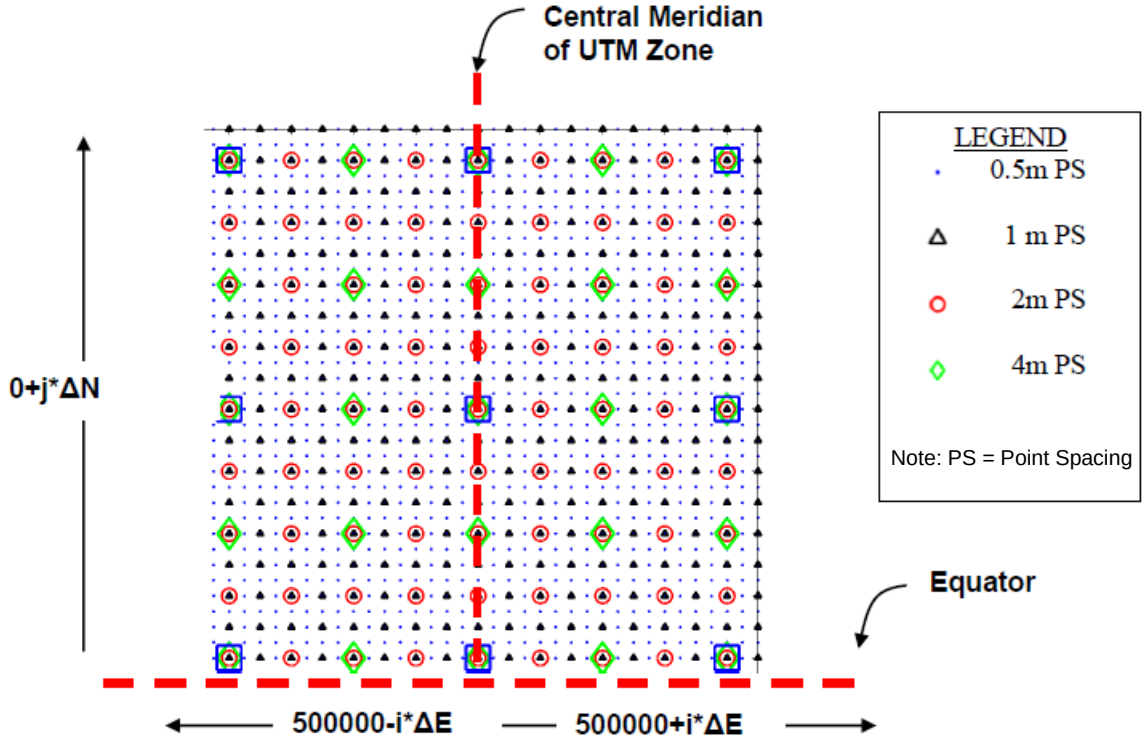

Figure 2 – Example of UTM Point Location in Northern Hemisphere

NOTE: The various symbols represent different DGED levels, but illustrate co-located points.

6.3.2 Geographic Point locations

For a geographic DGED, the predefined reference origin is the elevation point at the southwest corner elevation point of the one degree cell in which the southwest corner of the geographic data is located. The origin must be evenly divisible by the GSD to ensure alignment between datasets. If the point spacing is specified as {Δφ, Δλ} and the southwest corner of dataset with which it is associated is {φ, λ} then point location coordinates will be defined at {φ+ j*Δφ, λ+ i*Δλ}.

The values i and j are integer values of points in the Longitude and Latitude direction (respectively), +i*Δλ signifies an easterly direction from the origin and +j*Δφ signifies a northerly direction from the origin. See Figure 3 – Example of geographic projected point locations.

NOTE: The same co-location / coincidence mechanism applies across the various Geographic DGED levels for higher resolution levels 4-9 only.

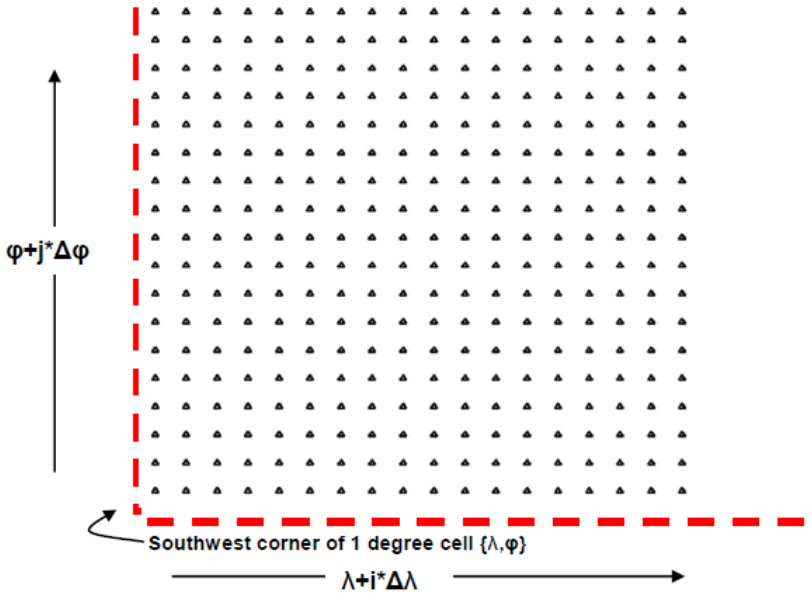

Figure 3 – Example of Origin and Point Locations for Geographic Data

6.4 Horizontal Spatial Extent and Projection

The horizontal spatial extent of DGED varies based on a number of factors. These factors can include but are not limited to spatial resolution, geographic location, customer requirements and file size limitations. Typically as the horizontal spatial resolution of the data set increases (points are closer together geographically) the horizontal spatial extent decreases in size.

- DGED Geographic products are cast on a geographic projection and primarily cover large geospatial areas (nominally region sized). DGED Geographic products are typically tiled (not to be confused with internal encoding format sub-block which are sometimes referred to as tiles) to allow them to be joined into these large area configurations. DGED Geographic dataset horizontal and vertical values will be horizontally and vertically coincident at the dataset edges. That is, the adjacent DGED Geographic product coincident points horizontal coordinates and vertical elevation values will be the same.
- DGED UTM products are cast on the Universal Transverse Mercator projection and primarily cover localized area dataset extents (in other words are not produced with global coverage). These DGED UTM datasets are designed to be spatially contained within a single UTM zone. Adjacent datasets within one UTM zone will be horizontally coincident at the dataset edge but adjacent dataset in adjacent UTM zones will not be horizontally coincident at the dataset edge. Vertical elevation values may (not required) match across DGED UTM products (at any level) for the same geographic area or elevation point.

6.5 Horizontal Spatial Resolution

6.5.1 DGED Geographic Point spacing

DGED Geographic products have 11 levels of spatial resolutions (levels 0 to 3, 4b and 4 to 9 for higher resolutions) with a fixed horizontal spatial latitudinal resolution and a varying longitudinal resolution based upon latitude both depending on the product level, as specified by Table 4 DGED Multi-level Geographic Point spacing.

With convergence of meridians in higher latitudes, the longitudinal arc-second point spacing of the DGED Geographic products varies as a function of latitude and is defined in six zones of latitude as shown below in Table 2 DGED Geographic Point Spacing per Zones, as specified in Tandem X / TREx DEM specification (cf. Annex E).

Table 3 – DGED Geographic Point spacing per Zones

Zone	Zone latitudes (North - South)	Latitude spacing	Longitude spacing
1	0° - 50°	r	r
2	50° - 60°	r	1.5 * r
3	60° - 70°	r	2 * r
4	70°- 80°	r	3 * r
5	80° - 85°	r	5 * r
6	85° - 90°	r	10 * r

Where r is the nominal grid spacing for a given resolution level.

Table 4 – DGED Multi-level Geographic Grid and Point spacings

Level	Posts spacing in latitude (arc sec.)	Approx. Ground Sample Distance (m)	Posts spacing in longitude (arc sec.)					
Latitudinal Zone			**1**	**2**	**3**	**4**	**5**	**6**
0	30	1000	30	45	60	90	150	300
1	3	100	3	4,5	6	9	15	30
2	1	30	1	1,5	2	3	5	10
3	0,4	12	0,4	0,6	0,8	1,2	2	4
4b	0,15	5	0,15	0,225	0,3	0,45	0,75	1,5
4	0,12	4	0,12	0,18	0,24	0,36	0,6	1,2
5	0,06	2	0,06	0,09	0,12	0,18	0,3	0,6
6	0,03	1	0,03	0,045	0,06	0,09	0,15	0,3
7	0,015	0,5	0,015	0,0225	0,03	0,045	0,075	0,15
8	0,0075	0,25	0,0075	0,01125	0,015	0,0225	0,0375	0,075
9	0,00375	0,125	0,00375	0,00563	0,0075	0,01125	0,01875	0,0375
Factor			1	1,5	2	3	5	10

6.5.2 DGED UTM Point spacing

DGED UTM products have 7 levels of spatial resolutions (4b with 5m spacing, and levels 4 to 9 between 4m and 0,125m), as indicated by Table 1.

This enables horizontal coordinates for elevation to be consistent across DGED UTM Levels.

This post spacing applies to both directions (easting and northing) and is constant for a given level.

6.6 DGED Product structure

A DGED product may contain a single dataset or a collection of datasets corresponding to tiles, according to the tiling scheme (specified in 13.2).

A DGED collection of datasets includes:

- an ESM collection GML instance (optional)
- an ESM Collection metadata set in accordance with DMF for collection resource, with RSTYPE set to ‘series’.
- The set/collection of datasets.

In case the ESM collection GML instance is present, it shall reference the ESM Collection metadata set in its metaDataProperty.

Each DGED dataset includes:

- an ESM dataset GML instance (optional), based on the GMLCOV for ESM Grid Coverage,

- its associated ESM dataset metadata set in accordance with DMF for dataset resource, with RSTYPE set to ‘dataset’,
- the DGED elevation data file, in a standardized encoding format, as specified in 12.2.

In case the ESM dataset GML instance is present, it shall reference the ESM dataset metadata set in its metaDataProperty.

NOTE: The metadata resource and the elevation data file are usually both constrained by specific requirements in terms of metadata or information on the data. Consequently, some information items are redundant in these two components of an “ESM dataset”. In order to avoid additional redundancy of information, the ESM GML instance information (if present) is specified with the minimum level of information required by the GMLCOV model. However, the constraints of ESM GML schema requires the provision of some information (e.g. CRS, UoM). Subsequently, such information may occur three times (in ESM GML document, ESM metadata and data file encoding), as explained further in this document.

7 Elevation Values and vertical Units

DGED will contain valid elevation values and may contain null (no-data) values. Elevation values may be encoded in:

- signed 16 bits integers (allowing values between +/- 32767): for integer metric elevation values : mandatory for levels 0 to 2, and valid for level 3 (12m resolution). Not valid for levels 4 and above. Associated unit is meter, referenced as EPSG code 9001.
- signed 32 bits integers : for submetric elevation values, expressed in submetric unit (dm, cm or mm) : valid for level 3 (12m resolution) and above. The default associated units are either meter, referenced as EPSG code 9001, or centimeter for higher resolution / accuracy, referenced as EPSG code 1033. In case a submetric unit is used, integer encoded values must be multiplied by adequate decimation factor before exploitation; for example, when using centimeter unit, the decimation factor is 0,01, and elevation value = 0,01 x integer value.
- 32 bit floating point (single precision): for floating point metric elevation values: valid for level 3 (12m resolution) and above.

The advantages to using integer data (when appropriate) are:

- reduced data volume (16 bits per sample vs. 32 for floating-point data for lower resolution levels when vertical accuracy is in integer meter)
- number of significant digits adapted to information content (in terms of information theory) and accuracy of elevation data (in floating-point values, superfluous digits in decimal part of the values cause numerical noise) – for example a value of 15,48732m as elevation when accuracy is about 1m
- compression (if any) is simpler (faster to process, with a greater compression ratio)
- accelerated access (read/write) to values and processing times.

Consequently, though the use of floating-point encoding is not prohibited by this specification, it is recommended to use integer encoding for standardized products from DGED level 0 to 3 (for optimization of elevation values encoding and for performance of systems).

The vertical unit for DGED shall be meters by default, or for levels higher or equal to 3, submetric unit (cm or mm) is allowed in order to allow for elevation integer values (32 bits integer). Vertical unit will be specified according to the encoding standard used for data delivery, on the basis of EPSG unit of measure codes.
The data type for elevation values and vertical elevation unit shall be specified according to the encoding standard used for data delivery and to the rules specified in section 12 (Data product delivery). In all cases, the vertical unit documented in the ESM metadata shall be meter.

Valid elevation point values exist in geographic areas where the elevation point value can be accurately determined.

Null (No-Data) values are used for geographic areas when the elevation point values cannot be accurately determined due to various factors, often related to source anomalies, metrological or topography related conditions. Reasons for Null Values may be because of image cloud cover, shadows or obscuration due to topographic conditions. The Null value, when used, will be specified according to the encoding standard used for data delivery and should be documented in the ESM metadata (SpecialCell mechanism).

Null values for DGED shall be -32767 encoded as:

- hexadecimal 0x8001 for signed 16 bit integer value,

- hexadecimal 0xFFFF8001 for signed 32 bit integer value,
- -32767,0 encoded in IEEE-754.

8 Reference systems

8.1 Horizontal Reference system

The Horizontal reference datum for DGED shall be the World Geodetic System - WGS-84.

DGED data shall conform to the unit of measure specified for the Horizontal CRS, that is decimal degrees for geographic and meter for UTM.

The horizontal CRS and epoch (Time Reference system) shall be encoded in the ESM GMLCOV document (if any) associated to the elevation data file, in the data file (according to the encoding standard used) and in the associated ESM metadata. This information shall be consistent.

8.2 Vertical Reference system

This profile permits the use of any of the following vertical datums:

(1) The WGS84 ellipsoid [NGA.STND.0036 1.0.0 WGS84]

(2) The geoid defined by the WGS84 Earth Gravity Field Model (EGM). The specific model (e.g. EGM2008) shall be specified in the metadata.

The vertical CRS shall be encoded in the ESM GMLCOV document (if any) associated to the elevation data file, in the data file (according to the encoding standard used) and in the associated ESM metadata. This information shall be consistent.

9 Data quality

DGED quality characteristics are defined by five factors:

(1) point spacing,

(2) random horizontal error per point,

(3) relative horizontal accuracy between points,

(4) random vertical error per point

(5) the relative vertical accuracy between points.

Additionally, goal levels for absolute horizontal and vertical accuracy have been established. The specifics of these accuracy requirements are provided in the following sections. Optional accuracy information for per point and regional error estimates are also provided in Annex C.

9.1 Horizontal accuracy

DGED elevation datasets shall conform to the predefined thresholds for horizontal accuracy. Randomly selected datasets may be tested to assure that the random horizontal error per point and relative horizontal accuracy between points meet or exceed the thresholds detailed in Table 5 (Geographic DGED Horizontal Accuracy Requirements) and Table 6 (UTM DGED Horizontal Accuracy Requirements).

Additionally, there is a goal that the absolute horizontal accuracy meets the values established in Tables 5 and 6 (or is better).

Although it is not required to meet a threshold requirement, an absolute horizontal accuracy estimate will be reported for each data set.

Table 5 – DGED Horizontal Accuracy Requirements

Product name	Spatial resolution		Random Horizontal Error Per Point (σH – meters)	Relative Horizontal Accuracy between Points (RH – meters)	Goal: Absolute Horizontal Accuracy CE90 (meters)
	Angular (arc sec.)	Linear (m)			
L0	30	1000			<= 50m
L1	3	100			<= 50m
L2	1	30			<= 23m
L3	0,4	12	4,4	12,4	<= 15,0m
L4b	0,15	5	1,75	5,00	<= 6,00m
L4	0,12	4	1,41	4,00	<= 5,00m
L5	0,06	2	0,71	2,00	<= 3,00m
L6	0,03	1	0,35	1,00	<= 2,00m
L7	0,015	0,5	0,18	0,50	<= 1,00m
L8	0,0075	0,25	0,09	0,25	<= 0,50m
L9	0,00375	0,125	0,04	0,125	<= 0,25m

Horizontal Accuracy notes:

1. The random horizontal error is the random circular error at point (reported at 90% confidence).

2. The Relative Horizontal Accuracy (point-to-point) between points is calculated at the 90% confidence interval.

3. The relative (point-to-point) horizontal accuracy is based on a distance (“D”) which is determined by the size of a standard DGED dataset at a given DGED Level. “D” is defined as the maximum radial distance between any two points in the said tile. The relative error is expected to vary as a function of distance between points, and its value ranges from R0 for points within one pointspacing to the table value for points at distance “D”.

4. The absolute horizontal accuracy is a goal value, but not a requirement. Although not required to meet a threshold, the Absolute Horizontal Accuracy should be reported in the metadata and is measured at the 90% confidence interval as a CE90.

5. Relative Horizontal Accuracy and random horizontal error may be difficult to assess in the coarse datasets. In these datasets, very large targets (which may not be available) would be required for such assessment. Therefore, the relative horizontal accuracy may not be evaluated for Levels 0 to 5.

NOTE: These absolute horizontal accuracy values may be beyond current capabilities.

9.2 Vertical accuracy

DGED products at a given Level shall conform to the predefined thresholds for vertical accuracy. Randomly selected datasets will be tested to assure that the random vertical error per point and relative vertical accuracy between points meet or exceed the thresholds detailed in the tables below. Additionally, there is a goal that the absolute vertical accuracy meets the values established in Table 7 DGED Vertical Accuracy Requirements (or is better).

Table 6 – Geographic and UTM DGED Vertical Accuracy Requirements

Product name	Spatial resolution		Random Vertical Error Per Point (σv – meters)	Relative Vertical Accuracy between Points (RV – meters)	Goal: Absolute Vertical Accuracy LE90 (meters
	Angular (arc sec.)	Angular (arc sec.)			
L0	30	1000		<= 20m	<= 30m
L1	3	100		<= 20m	<= 30m
L2	1	30		<= 12m	<= 18m
L3	0,4	12	2,2	6,2	12,4
L4b	0,15	5	0,87	2,5	5,00
L4	0,12	4	0,71	2,0	4,00
L5	0,06	2	0,35	1,00	2,00
L6	0,03	1	0,18	0,50	1,00
L7	0,015	0,5	0,09	0,25	0,50
L8	0,0075	0,25	0,04	0,12	0,25
L9	0,00375	0,125	0,02	0,06	0,12

Vertical Accuracy notes:

1. The random vertical error per point is the random linear error per point (reported at 90% confidence)

2. The Relative Vertical Accuracy (point-to-point) between points is defined at the 90% confidence

3. The relative (point-to-point) vertical accuracy is based on a distance (“D”) which is determined by the size of a standard DGED tile at a given Level. “D” is defined as the maximum radial distance between any two points in the said tile. The relative error is expected to vary as a function of distance between points, and its value ranges from R0 for points within one point spacing to the table value for points at distance “D”.

4. The vertical accuracies described above are based on low to medium relief areas (predominant slope from 0 to 20 percent) within the data cell. In areas where the predominant slope exceeds 20 percent, the vertical accuracies listed in the table above can be scaled by 1.4 to account for increased inaccuracies.

5. The Absolute Vertical Accuracy is a goal value, but not a value that is required to meet a threshold in a DGED product. Although not required to meet a threshold, the Absolute Vertical Accuracy is measured at the 90% confidence interval as a LE90 and should be reported in the metadata

10 Data capture

Gridded elevation data are derived from source data from sensors (EO imagery (optical, radar, Lidar, …). DGED datasets may be generated/derived from a variety of sources and production processes. Resolution and accuracy are critical criteria when deriving datasets. Where deemed necessary or appropriate, finer resolution elevation datasets may be used to derive coarser resolution elevation datasets, however coarser resolution datasets must not be used to derive finer resolution datasets. Equally only elevation datasets of higher accuracy should be used to derive elevation datasets of lower accuracy. Specific DGED capture requirements will be defined in product specific guidance documentation that will accompany production assignments. Typical guidance would include specific instruction for surface type depiction, water body portrayal, optional accuracy derivation (per point or regional) or other data portrayal requirements.

11 Data maintenance

DGED datasets will be maintained and updated as requirements dictate. Data maintenance criteria will vary by data level. Higher resolution elevation data is more likely to need updates or replacement due to the temporal nature of high resolution details.

12 Data product delivery

In order to facilitate ingestion and processing of DGED products, the file structure and file naming conventions for geospatial datasets, their associated metadata files and annexed resources (such as quality information) must be defined and documented. File names should also be meaningful to humans.

Data delivery media and specific instructions for file structure and naming conventions may vary according to each product specification, whether in NATO, other multi-national or national context. The ESM Encoding Rules (DGIWG STD-116-3) shall apply.

Data delivery media and specific instruction will vary for the DGED types. Specific instructions shall be documented in the Product Specific Guidance for DGED products.

12.1 File structure and naming conventions

Specific instructions should be documented in the Product Specific Guidance for DGED products. In addition to this document, products shall be delivered with a “table of content” mechanism, describing the structure of products and content (addressing files and folders). This table of content shall be provided in a XML file, in order to document the file structure to humans and systems.

Additional detailed information shall be provided within an XML metadata file and therefore the file name should not duplicate this content. Information indicated in the file name must align with the information provided by metadata. In case of any inconsistency, metadata information prevails. Therefore, applications accessing datasets should utilize the metadata.

These conventions should follow the following rules:

- Product structure and file organisation should be provided by a “table of content” XML file, conformant with the Product specific Guidance.
- Filenames should indicate the Data Product Specification and any sub-type specified by that specification: for DGED products, this means DGEDLnt, where n= level and t = G or U.
- Filenames should be unique. This may be achieved using in conjunction 2 information:
    - a producing agency or nation identifier as part of the name
    - a producer allocated unique identifier (this may be a *uuid* or an agency naming construct as indicated below).

- Filenames could also indicate the security classification: c = security classification (T, S, C, R, U), when required by national or NATO rules.

Agency naming construct may contain the following information:

- Coordinates of SW corner of DEM (geographic – including hemisphere – *DDMMSShDDDMMSSe,* where h = hemisphere (N for North, S for South), e = hemisphere (E for East, W for West). This convention applies to Geographic products and may apply to UTM grid products.
- MGRS grid square identification, with location of SW corner of tile, depending on DGED level and the choice of tile size (according to 13.2); the grid zone designator and 100km Grid square Identification (4 digits), and easting and northing of South West corner of tile, coded on 1 digit (tile size provided as a multiple of 10km), 2 digits (tile size provided as a multiple of 1km), 3 digits (tile size provided as a multiple of 100m), or 4 digits (tile size provided as a multiple of 10m),
- Source data type[1] coded by 1 alphanumeric character

  A = optical source, unedited reflective surface

  B = optical source, edited reflective surface

  C = optical source, edited bare earth surface

  F = IFSAR source, unedited reflective surface

  G = IFSAR source, edited reflective surface

  H = IFSAR source, edited bare earth surface

  K = LIDAR source, unedited first return

  L = LIDAR source, unedited last return

  M= LIDAR source, unedited bare earth

  N = LIDAR source, edited first return

  O = LIDAR source, edited last return

  P = LIDAR source, edited bare earth

  T = SAR source, unedited reflective surface

  U = SAR source, edited reflective surface

  V = SAR source, edited bare earth

  X = unidentified source, reflective surface

  Y = unidentified source, bare earth surface

  D, E, I, J, Q, R, S, W and Z are reserved for future use

Version of product, under 2 digits 00 to 99

[1] The source data information is provided in a simple way by this code; detailed information on source must be provided by metadata.

The character '_' should be used as separator between each information field in the file name construct.

Filename extension shall follow the file extension rules specified by the encoding standard for the DGED product. For associated metadata file, extension shall be .xml.

12.2 Encoding Options

As stated in section 7, elevation values may be encoded in:

- signed 16 bits integers (allowing values between +/- 32767): for integer metric elevation values ;
- signed 32 bits integers : for submetric elevation values, which must be used with the decimation factor that shall be deduced from vertical unit (submetric unit, such as cm or mm) or a Z scaling factor, depending on encoding standard capabilities ;
- 32 bit floating point (single precision): for floating point metric elevation values.

Encoding standards that are specified for DGED products are:

- GeoTIFF (according to DGIWG GeoTIFF profile).
- GMLJP2 with lossless JPEG2000 compression (according to DGIWG GMLJP2 profile, to be made available in the second version of ESM Encoding Rules).
- NSIF (to be made available in the second version of ESM Encoding Rules).

The encoding rules shall be based on the rules provided by ESM Encoding Rules (DGIW STD-116-3). The restriction to this DGIWG standard that is recommended by this specification is to avoid the GMLJP2 floating-point mode, and prefer the use of submetric unit and upscaled integer elevation values.

12.3 ESM GML document

An associated ESM GML document (based on GMLCOV schema, as specified, in DGIWG STD116-2), may be provided optionally in DGED products. Such a document provides a harmonised Coverage description of each DGED product; it is perfectly suited in web services environments, for Web Coverage Service.

In case such a document is provided, it shall conform to DGIWG STD116-2 and follow the mapping rules provided in DGIWG STD116-3, for the sake of consistency.

In case of any inconsistency, the information provided in the data file shall prevail.

13 DGED Product files

The DGED Product files shall consist of a number of standardized components, as follows:

- ESM GML document (optional, cf.12.3), providing an harmonised coverage description of the product, with full Coverage description of spatio-temporal extent and georeference for RectifiedGridCoverage

- ESM Data file, in one of the standardized encoding specified in 12.2 (mandatory)

- ESM Metadata description (XML document): this document may be embedded or external (mandatory).

Optional ESM GML document component presence depends on mission and infrastructure requirements.

13.1 Data Compression

DGED elevation data will be provided uncompressed or in lossless compression, according to the capabilities of the standardized format: LZW in GeoTIFF, and lossless compression mode in GMLJP2.

13.2 Tiling

For high resolutions (levels 4-9), several tiling schemes that fit together are designed to be able to better adjust the file to the area effectively produced.

In all cases, the number of grid posts per tile is equal to the number of intervals per tile plus one. Subsequently, overlapping posts (in both directions) of adjacent tiles shall have identical elevations.

Tile sizes are designed so that the file size is below 1 GB, and so that there is always an integer number of posts in the file.

Tiling scheme recommendations are provided here in the case of Geographic DGED products.

The number of intervals in longitude varies according to the longitudinal factor specified in Section 6.5. The maximum number of posts longitudinally is equal to the number of posts latitudinally in Zone 1.

The following table provides recommended tiling size options for DGED Geographic products.

Table 7 –DGED Geographic Tiling Scheme and size options

Level	Approx. Ground Sample Distance (m)	File Coverage / Extent	Number of files in a square degree	Number of intervals in latitude for a square degree	Number of posts in latitude per tile
0	1000	1 dc	1	120	121
1	100	1 dc	1	1200	1201
2	30	1 dc	1	3600	3601
3	12	1 dc	1	9000	9001
4b	5	1 dc	1	24000	24001
		30 min x 30 min	4		12001
		15 min x 15 min	16		6001
4	4	30 min x 30 min	4	30000	15001
		15 min x 15 min	16		7501
5	2	30 min x 30 min	4	60000	30001
		15 min x 15 min	16		15001
		6 min x 6 min	100		6001
6	1	15 min x 15 min	16	120000	30001
		6 min x 6 min	100		12001
		3 min x 3 min	400		6001
7	0,5	6 min x 6 min	100	240000	24001
		3 min x 3 min	400		12001
		1,5 min x 1,5 min (90 sec x 90 sec)	1600		6001
8	0,25	3 min x 3 min	400	480000	24001
		1,5 min x 1,5 min (90 sec x 90 sec)	1600		12001
		1 min x 1 min	3600		8001
9	0,125	1,5 min x 1,5 min (90 sec x 90 sec)	1600	960000	24001
		1 min x 1 min	3600		16001

The following table provides recommended tiling size options for DGED UTM products.

Table 8 –DGED UTM Tiling Scheme and size options

Level	Ground Sample Distance (m)	File Coverage / Extent	Number of files in a 100km x 100km zone	Number of posts per tile (in both directions)
4b	5	100km x 100km	1	20001
		50km x 50km	4	10001
		25km x 25km	16	5001
4	4	50km x 50km	4	12501
		25km x 25km	16	6251
5	2	50km x 50km	4	25001
		25km x 25km	16	12501
		10km x 10km	100	5001
6	1	25km x 25km	16	25001
		10km x 10km	100	10001
		5km x 5km	400	5001
7	0,5	10km x 10km	100	20001
		5km x 5km	400	10001
		2,5km x 2,5km	1600	5001
8	0,25	5km x 5km	400	20001
		2,5km x 2.,5km	1600	10001
		1,25km x 1,25km	6400	5001
9	0,125	2,5km x 2,5km	1600	20001
		1,25km x 1,25km	6400	10001

13.3 File size estimates

The following table provides maximum file size estimates for DGED Geographic products (in Zone 1) when uncompressed mode.

Table 9 –DGED Tiling Scheme and file size estimates

Level	File Coverage / Extent	Number of files/tiles in a square degree	Number of posts in latitude per tile	File Size estimate	Comment
0	1 dc	1	121	28 KB	16 bits encoding
1	1 dc	1	1201	2,75 MB	16 bits encoding
2	1 dc	1	3601	24,7 MB	16 bits encoding
3	1 dc	1	9001	154 MB	16 bits encoding
			9001	308 MB	32 bits encoding
4b	1 dc	1	24001	2197 MB	
	30 min x 30 min	4	12001	549 MB	
	15 min x 15 min	16	6001	137 MB	
4	30 min x 30 min	4	15001	858 MB	
	15 min x 15 min	16	7501	215 MB	
5	30 min x 30 min	4	30001	3433 MB	
	15 min x 15 min	16	15001	549 MB	
	6 min x 6 min	100	6001	137 MB	
6	15 min x 15 min	16	30001	3433 MB	
	6 min x 6 min	100	12001	549 MB	
	3 min x 3 min	400	6001	137 MB	
7	6 min x 6 min	100	24001	2197 MB	
	3 min x 3 min	400	12001	549 MB	
	1,5 min x 1,5 min (90 sec x 90 sec)	1600	6001	137 MB	
8	3 min x 3 min	400	24001	2197 MB	
	1,5 min x 1,5 min (90 sec x 90 sec)	1600	12001	549 MB	
	1 min x 1 min	3600	8001	244 MB	
9	1,5 min x 1,5 min (90 sec x 90 sec)	1600	24001	2197 MB	
	1 min x 1 min	3600	16001	976 MB	

13.4 Security

Security marking and security metadata are required to follow DGIWG or NATO rules for security and security marking, or national rules otherwise.

Individual DGED data and supporting files may have different security classifications and markings but when provided as one dataset or combined, the results shall be marked with the highest security level of the individual datasets.

14 Product metadata

DGED product metadata specification is based on ESM metadata for Gridded elevation data model and associated to the DGED Elevation data file, for discovery, catalogs and Elevation data delivery purposes.

DGED product metadata may be encoded:

- Either in external XML metadata file associated to DGED elevation data (at collection or dataset level)
- or in XML metadata document embedded in DGED elevation data file (at dataset level).

It is reminded that in case the ESM CoverageCollection or ESM Grid coverage is encoded in a GML document, the metaDataProperty of this feature will reference the metadata file or resource.

ESM metadata elements (mandatory and recommended optional) for describing any elevation dataset provide the basis for the elements specified in Annex B.

The tables in this annex specify the minimum metadata requirements for compliance with this specification and the ESM profile.

DGED product quality should be reported as a result of a pre-defined registered data quality measure (Regulated Quality Element) for commonly-used data quality measures or as a result of an unregistered quality measure (Unregulated Quality Element) when the measure is too specific to proceed to its registration. For both the ‘regulated’ and ‘unregulated’ measures, the result of the evaluation is either a conformance, quantitative, descriptive, or coverage result (see DMF). If two results are reported, one of them must be a conformance result.

The coverage result is an instance of CoverageResult of a Regulated Quality Report (DMF) and is used to report the results of some error propagation estimate measures (see Annex C). These estimates are recommended for high-resolution DGED datasets.

Quality reporting metadata for any DGED dataset should include, at a minimum, a completeness percentage and absolute horizontal and vertical accuracy of the dataset. Both require quantitative results. The completeness percentage shall be reported via the CompletenessCommission quality measure and the absolute horizontal and vertical accuracy of the dataset shall be reported via the AbsoluteExternalPositionalAccuracy of the Regulated Quality Report quality measure (DMF), based on the corresponding ISO DQ_CompletenessCommission and DQ_AbsoluteExternalPositionalAccuracy.

Additional metadata elements not described in DMF can nevertheless be included in an elevation dataset’s metadata in accordance with extension rules specified in DMF section B.3. Such extensions should be applied to a dedicated DMF requirement class. The additional elements may represent a profile of the DMF, and may be described either within each metadata instance document, or within an online resource (i.e. a registered profile).

Reference to an online registry of metadata elements is a more efficient method, particularly when an entire class of extended elements are required (e.g. a country or organization-specific extension to the ISO MD_SecurityConstraints class) to accommodate additional security requirements within a classification system.

Annex A
Abstract Test Suites
(normative)

Any application or system or elevation data product specification or elevation dataset claiming conformance to this implementation profile shall meet the following criteria for data conformance. For application or system, this applies to the data that is produced. For a product specification, this applies to the requirements and conformance tests.

NOTE: the requirements in each section indicated below may be identified by the use of “shall”.

A.1 Alignment of CRS with DGED geographic or cartographic datum

As specified in Section 8.

A.2 Alignment with DGED grid and resolution (cartographic or cartographic UTM)

As specified in Section 6.2, 6.3, 6.4 and 6.5.

A.3 Alignment with DGED tiling scheme

As specified in Section 13.2.

A.4 DGED product structure

As specified in Section 6.6.

A.5 Horizontal Accuracy

Datasets shall conform to the predefined thresholds for horizontal accuracy, as specified in 9.1. An absolute horizontal accuracy estimate shall be reported for each dataset.

A.6 Vertical Accuracy

Datasets shall conform to the predefined thresholds for vertical accuracy, as specified in 9.2. An absolute vertical accuracy estimate shall be reported for each dataset.

A.7 Units of measure

Horizontal and vertical units of measure shall conform to the specifications in 7 and 8.1.

A.8 DGED encoding

Implementation shall follow the rules provided for DGED encoding in sections 7 and on the basis of one of the specified encoding standard, GeoTIFF, GMLJP2 or NSIF. This includes the encoding of null values.

A.9 DGED product delivery

Implementation shall follow the rules provided for DGED product delivery in sections 12 and 13.

Depending on implementation option, this may apply to the associated ESM GML document describing the RectifiedGridCoverage which provides an harmonised description of the elevation coverage.

A.10 DGED Security

Implementation shall follow the rules provided for security marking and security metadata in section 13.4.

A.11 DGED / ESM metadata

Implementation shall follow the rules provided for DGED metadata in section 14 and elements specified in Annex B.

Annex B
DGED Metadata Specification
(normative)

This DGED metadata specification is specified by the following table from ESM metadata and based on DMF (on the basis of ISO TC211 metadata standards), serves to define the model for ESM minimum required metadata.

The last two elements in the table provide the DGED occurrence and values as specified by DGED/ESM. The Obligation, Maximum Occurrence, and Value Domain requirement for each element is derived from DMF (and based on ISO), with any additional constraints on the corresponding ESM element indicated in the table.

In the Obligation column

- a 'M' indicates that the metadata element is ESM mandatory
- an "O" indicates that the element is ESM optional
- a "C" indicates that the element is ESM mandatory under the condition provided.

The obligation letter code is in bold text when the ESM obligation exceeds the DMF obligation (i.e. when the DMF obligation has been changed from optional to conditional or mandatory for ESM).

The Max Occur column is simply an indication of whether DMF allows multiple instances of the element to be included in the metadata file. The contents of the Value Domain column indicate the allowed values for the element. For most elements, these are presented as DMF-defined basic types, complex types and codelists, but ESM-specific constraints on the domain may be specified.

Table 10 –DGED / ESM Core Metadata

	Name DMF ID (Requirement Class)	**Definition**	**Obligation**	**Max Occur**	**Value Domain**
1	**Metadata file identifier** MDSID (Core)	unique identifier for this metadata file	**M**	1	String NOTE: DMF strongly recommends a unique identifier (e.g. UUID or URI) or a locator (e.g. URL). Otherwise: dataset filename.XML or relative reference to XML metadata in dataset filename.
2	**Parent metadata file identifier** MDPTSID (Common)	file identifier of the metadata to which this metadata is a subset (child)	**C / if parent metadata file exists**	1	String
3	**Metadata language** MDDLOC (Core) + language	language used for documenting metadata	M	1	Locale language = 'eng'
4	**Metadata character set** MDDLOC (Core) + encoding	full name of the character coding standard used for the metadata	M	1	Locale encoding = 'utf8'
5	**Metadata Translation** MDTLOC (Common)	locale in which some metadata elements may be translated	O	1..*	Locale

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
6	**Metadata date stamp** MDDATE (Core)	date that the metadata was created	M	1	Date
7	**Metadata point of contact** MDRPTY (Core)	identification of, and means of communication with, person(s) and organizations associated with the dataset	M	1..*	Responsible Party
8	**Metadata standard name** MDSTD (Core) + title	name of the metadata standard (including profile name) used	M	1	'urn:dgiwg:metadata:dmf'
9	**Metadata standard version** MDSTD (Core) + version	version (profile) of the metadata standard used	M	1	'1.0'
10	**Metadata security constraint level** MDSCST (Common) + level	name of the handling restrictions on the metadata	**C / based on requirement of security constraint system**	1	Security Constraint Level
11	**Metadata security constraint system** MDSCST (Common) + system	national or international system used to classify the metadata	**C / based on presence of security constraint level**	1	Security Constraint System
12	**Metadata releasability** MDREL (NATO)	establishes a body to which the metadata can be released	O	1..*	Releasability Codelist, NATO Body Codelist, or String (a 3-character country code from STANAG 1059 when available).
13	**Metadata legal constraint** MDLCST (Common)	provides a means to express a set of legal constraints applicable to the metadata	**C / legal constraints exist**	1..*	Legal Constraint
14	**Metadata maintenance frequency** MDMFRQ (Common)	information on the frequency with which changes and additions are made to the metadata after the initial metadata is completed	O	1	Frequency Codelist
15	**Dataset title** RSTITLE (Core)	name by which the cited resource is known	M	1	Filename
16	**Dataset alternate title** RSALT (Common)	short name, informal name, or name in another language by which the dataset is known	O	1	Free Text
17	**Abstract describing the dataset** RSABSTR (Core)	brief narrative summary of the content of the resource(s)	M	1	Free Text

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
18	**Collection Tiling Scheme** GPHICS (Common)	reference to a graphic that provides a description of the collection's tiling scheme	**C / if RSTYPE= series and tiling scheme is defined**	1	GPHICS.name (file name) and GPHICS.description (= 'TilingScheme')
19	**Dataset purpose** RSPURP (Core)	A summary of the intentions with which the resource was developed	O	1	Free Text
20	**Metadata type code** RSTYPE (Core)	scope to which the metadata applies	M	1	Resource Type Codelist Value = 'dataset', or 'series' for a collection
21	**Metadata type name** RSTYPN (Core)	name of the hierarchy level for which the metadata is provided	**C / RSTYPE = series**	1	Free Text
22	**Dataset edition** RSED (Core)	version identifier of the resource	O	1	String
23	**Dataset edition date** RSEDDAT (Core)	reference date of this edition of the resource	O	1	Date
24	**Dataset identifier** RSID (Core)	value uniquely identifying an object within a namespace	**M**	1..*	Identifier
25	**Collection Name** RSSERI (Core)	Identifier of the collection, when the dataset is a member of a collection	**C / when dataset is a member of a collection**	1	String
26	**Tile Identifier** RSSHNA (Core)	Identifier of the Tile, when the dataset is a member of a tiled collection	**C / when dataset is a member of a tiled collection**	1	String
27	**Keywords** RSKWDS (Core) + keyword	commonly used word(s) or formalized word(s) or phrase(s) used to describe the subject.	**M**	1..*	Controlled Vocabulary Enumerations
28	**Spatial resolution of the dataset** RSGSD (Core)	factor which provides a general understanding of the density of spatial data in the dataset	**M**	1	Distance NOTE: This distance may be approximate, as it is aimed at providing a general understanding only on the ESM dataset.
29	**Dataset language** RSLOC (Core) + language	languages(s) used within the dataset	M	1..*	Locale language
30	**Dataset character set** RSLOC (Core) + encoding	full name of the character coding standard used for the dataset	M	1..*	Locale encoding
31	**Spatial representation type** RSRPTP (Core)	method used to spatially represent geographic information	**M**	1	Spatial Representation type Codelist Grid

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
32	**Dataset type** DGITYP (Core)	information about the type of geospatial information provided by the dataset	O	1	Geospatial Information Type Codelist elevationModel
33	**Dataset georeferencing level** RSGFLV (Core)	level of georeferencing of the dataset	O	1	Georeferencing Level Codelist georeferenced
34	**Dataset level** RSDTLVL (Core)	method of categorizing resolution bands of digital geographic data by equivalence to paper map scales	O	1	Data Level Codelist L0-L9
35	**Dataset topic category** RSTOPIC (Core)	main theme(s) of the dataset	M	**1**	Topic Category Enumeration 'elevation'
36	**Dataset theme** RSTHEME (Core)	provides more precise thematic information enabling discovery of the dataset	O	1..*	Thematic Codelist Geomorphology (for DTM)
37	**Dataset environment description** RSENVD (Data)	information on producer's processing environment, including items such as the software, the computer operating system, file name, and the dataset size.	O	1	Free text
38	**Value type** GRCINF (Data) + contentType	type of information represented by the cell value	**M**	1	Coverage Content Type CodeList
39	**Surface type** GRCINF (Data) + range	description of the attribute described by the measurement value	**M**	1	Range
40	**Special Cell** GRCINF (Data) +specialCell	cell playing a specific role (e.g. no data) in the coverage. When the content type of the coverage is a thematic classification, each thematic class is represented by a special cell.	O	1..*	'physicalMeasurement' Special Cell Values -32767 (no data)
41	**Geographic location of the dataset (by coordinates)** RSEXT/boundingBox (Core)	geographic position of the dataset	**C / for unprojected data**	1..*	Bounding Box NOTE: RSEXT may be repeated
42	**Dataset positional extent** RSEXT/boundingPolygon (Core)	the boundary enclosing the dataset, given as a set of (x,y) WGS84 coordinates of a polygon, with the last point replicating the first	**C / for UTM projected data**	1	Polygon NOTE: RSEXT may be repeated

	Name DMF ID (Requirement Class)	**Definition**	**Obligation**	**Max Occur**	**Value Domain**
43	**Dataset temporal extent** RSEXT/temporalExtent (Core)	date and time for the content of the dataset (collection date and time)	O	1	Temporal Extent
44	**Dataset vertical extent** RSEXT/verticalExtent/ minz and maxz (Core)	vertical domain of the dataset expressed using WGS84 ellipsoid	**M**	1	Integer
45	**Coordinate reference system – horizontal** RSRSYS (Core)	identifier used for reference systems	**M**	1	String, Anchor or Identifier URI of CRS (WGS84 or UTMZone)
46	**Coordinate reference system – temporal** RSRSYS (Core)	identifier used for reference systems	**C / for high-resolution datasets**	1	String, Anchor or Identifier URI of Temporal CRS
47	**Dataset status** RSSTAT (Common)	Information about the status of the dataset	O	1	Status Codelist
48	**Dataset reference date** RSDATE (Core)	reference date for the cited resource	M	1..*	Reference Date
49	**Dataset originator** RSRPTY:originator (Core)	party that created the dataset	**M**	1	ResponsibleParty (role = originator)
50	**Dataset point of contact** RSRPTY:pointOfContact (Core)	party that can be contacted for inquiries regarding or acquisition of the dataset	**M**	1..*	ResponsibleParty (role = pointOfContact)
51	**Maintenance frequency** RSMTNC (Common) + maintenanceFrequency	frequency with which changes and additions are made to the resource after the initial resource is completed	**M**	1	Maintenance Information
52	**Dataset classification** RSSCST (Core) + level	name of the handling restrictions on the resource	**C / based on requirement of classification system**	1	Security Constraint level
53	**Dataset classification system** RSSCST (Core) + system	national or international system used to classify the dataset	**M**	1	Security Constraint system
54	**Dataset releasability** RSREL (NATO)	provides a means to express a set of releasability information applicable to the dataset	O	1..*	Releasability
55	**Dataset use constraints** RSUSE (Core)	provides a means to express general use limitations (limitations not implied by security or legal constraints) of the dataset	O	1..*	Free Text

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
56	**Dataset legal constraints** RSLCST (Core)	restrictions and legal prerequisites for accessing and using the resource	**C / legal access/use constraints exist?**	1..*	Legal Constraint
57	**Dataset lineage** RSLING (Core)	information about the source, the method of data capture, and any information on the transformation, conversion, or resampling that has been applied to the data, if available	M	1	Free Text
58	**Dataset quality report** RSRQR or RSUQR (Data)	Information related to the result of a quality evaluation of the dataset **NOTE**: any DGED Elevation data accuracy measures, global, as specified in Annex C, or other detailed quality information on specific quality areas, or per post, such as height error map / per post error estimate.	**M**	1..*	Regulated Quality Element or Unregulated Quality Element (see ESM (STD-116-1) Annex E.5 for definition and minimum requirement) and Annex C for definition of Regulated quality Elements.
59	**Dataset source** RSSRC (Data)	information about the source data used in creating the dataset	O	1..*	Source
60	**Method used to estimate values** RSPRST (Data)	information about the method used to estimate elevation values	**C / dataset includes estimated values**	1	Process Step
61	**Dataset intended usage** RSSPUS (Common)	brief description of ways in which the resource(s) is/are currently or has been used	O	1..*	Usage
62	**Dataset distribution format** RSDFMT (Core)	name of the data distribution format(s) and version of the format (date, number, etc.)	M	**1**	Format
63	**Online resource** RSONLLC (Core)	information about on-line sources from which the dataset, specification or community profile name and extended metadata elements can be obtained	**M**	1..*	Online Location
64	**Dataset distribution unit** RSUD (Data)	a description of the unit (tiles, layers, geographic areas, etc.) in which the data is available	O	1	Free Text
65	**Dataset transfer size** RSTS (Data)	estimated size of a unit in the specified transfer format, expressed in megabytes. The transfer size is > 0.0	O	1	Float
66	**Dataset offline distribution** RSOFDM (Data)	information about offline media through which the dataset can be obtained	O	1	Medium

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
67	**Instrument identification** (DMF ID is to be determined)	unique identification of the instrument	**M**	**1**	MD_Identifier <<DataType>>
68	**Instrument type** (DMF ID is to be determined)	name of the type of instrument	**M**	**1**	Free Text

Annex C
DGED Elevation data accuracy measures (informative)

This annex describes the minimum accuracy related metadata elements to be reported for every DGED Standard dataset.

The DGED data will contain ESM XML metadata in a DQ_DataQuality module for the following values and the data vendor is required to provide the following values and store them in the DGED Standard product metadata for all DGED standard products:

- Predicted / vendor measured Absolute Horizontal Accuracy (CE90ABS,Pre)
- Predicted / vendor measured Absolute Vertical Accuracy (LE90ABS,Pre)
- Predicted / vendor measured Relative Vertical Accuracy (LE90REL,Pre)
- Predicted / vendor measured Random Vertical Error (σV,Pre)

NOTE: These required reported values are to be representative of the entire dataset and not relate to a specific sub-cell, sub-section, or region. However, ESM metadata allows storing these values on a per region basis when this information is available.

For levels 5 to 9, the following values (in addition to the above values) are also required to be provided by the data vendor in the ESM Standard product metadata and stored in a DQ_DataQuality module:

- Predicted / vendor measured Random Horizontal Error (σH,Pre)
- Predicted / vendor measured Relative Horizontal Accuracy (CE90REL,Pre)

Although random horizontal and relative horizontal values are not required for levels 3 and 4, they can (and should) be reported if they were measured or if representative predictive values are available.

The ESM XML metadata will contain additional record sets of DQ_DataQuality modules that apply to the entire DEM if the dataset has been tested for validation by an authoritative organisation. When tested, the following fields will be populated for all DGED standard products (levels 3 to 9):

- measured / validated Absolute Horizontal Accuracy (CE90ABS,Val)
- measured / validated Absolute Vertical Accuracy (LE90ABS,Val)
- measured / validated Relative Vertical Accuracy (LE90REL,Val)
- measured / validated Random Vertical Error (σV,Val)

Note: If similar values have been created on a per region level, these can be reported and stored in the metadata. However, these values are not required by the Implementation Profile for High Resolution Elevation DGED products.

The goal of this section is to provide the team testing the data (control authority or others) a place to report summary results of their evaluation of the dataset. These fields will provide the user with the information required to determine if a dataset (or region in some cases) accuracy can support certain critical applications. The absence of these fields would indicate to the user that the dataset was not tested against ground truth.

When DGED Level 5 to 9 data are evaluated, the following values (in addition to the above values) will also be recorded in the metadata:

- measured / validated Random Horizontal Error (σH,Val)
- measured / validated Relative Horizontal Accuracy (CE90REL,Val)

If possible, these values should be provided when assessing DGED data Level 3 to 4. However, this will not always be possible.

Table 11: DGED Accuracy Metadata Reporting Requirements (from vendor)

Accuracy Value	Required for all DGED products	Required for Levels 5 (# 2m) to 9 and reported for all DGED levels if measured or predicted by vendor
Predicted / vendor measured Absolute Horizontal Accuracy ($CE90_{ABS,Pre}$)	X	X
Predicted / vendor measured Absolute Vertical Accuracy ($LE90_{ABS,Pre}$)	X	X
Predicted / vendor measured Relative Vertical Accuracy ($LE90_{REL,Pre}$)	X	X
Predicted / vendor measured Random Vertical Error ($\sigma_{V,Pre}$)	X	X
Predicted / vendor measured Relative Horizontal Accuracy ($CE90_{REL,Pre}$)		X
Predicted / vendor measured Random Horizontal Error Per Point ($\sigma_{H,Pre}$)		X

Table 12: DGED Accuracy Metadata Reporting Requirements (from authoritative organisation after test)

Accuracy Value	Required for all DGED products	Required for Levels 5 (# 2m) to 9 and reported for all DGED levels if measured
measured / validated Absolute Horizontal Accuracy ($CE90_{ABS,Val}$)	X	X
measured / validated Absolute Vertical Accuracy ($LE90_{ABS,Val}$)	X	X
measured / validated Relative Vertical Accuracy ($LE90_{REL,Val}$)	X	X
measured / validated Random Vertical Error ($\sigma_{V,Val}$)	X	X
measured / validated Relative Horizontal Accuracy ($CE90_{REL,Val}$)		X
measured / validated Random Horizontal Error Per Point ($\sigma_{H,Val}$)		X

Per Point Error Estimate

The use of high resolution elevation data for tasks that require a specified level of geolocation accuracy necessitates the inclusion of data to estimate geolocation errors anywhere within the elevation data coverage area. To support this need, this document proposes a new error metadata storage scheme within the DGED file on the basis of ESM metadata using a series of DQ_DataQuality modules in conjunction with a series of associated image segments. This error storage scheme provides the uncertainty data needed to compute estimated horizontal and vertical errors (both absolute and relative) for each point in the associated high resolution elevation image segment. This is accomplished by defining the fields needed to specify the

covariance data for an accompanying data set. Standard error propagation techniques (i.e., linear combinations of Gaussian random variables) may then be used to compute a unique 3 by 3 covariance matrix for each point in the data set.

The metadata required to generate the per point error estimates consists of several sections. First, it consists of the definition of regions within which, uniform systematic errors are expected. Second, the information required to develop a 3x3 covariance matrix for the systematic errors within a region is stored along with the information necessary to develop the cross correlation between regions. Finally, the metadata required to build the 3x3 covariance matrix of random errors per point is stored. These individual pieces are then combined and exploited to determine the predicted errors at a single point or between a series of points.

This predicted error metadata is not required for DGED datasets. However, as mentioned above, as the exploitation capabilities on DGED datasets continue to expand, the necessity for such error prediction capabilities increases.

Annex D
Conversion and mapping of DTED Level 0/1/2 to DGED Level 0/1/2 (informative)

Latitude Zone Table Changes between DTED and DGED

This annex contains the DTED Latitude Zone Tables and provides the new DGED Latitude Zone Table. DGED has re-aligned and updated the number of latitude zones to 6, which is compliant with the TanDEM X data source products.

Table 13: DTED zones definition

Zone	Zone Latitude (North – South)	Matrix Interval	
		Latitude spacing (r = 30, 3, 1 at level 0, 1, 2)	**Longitude Level 0, 1, 2**
I	0° – 50°	r	r
II	50° – 70°	r	2r
III	70° –75°	r	3r
IV	75° – 80°	r	4r
V	80° – 90°	r	6r

Table 14: DGED zones definition

Zone	Zone latitudes (North - South)	Latitude spacing	Longitude spacing
1	0° - 50°	r	r
2	50° - 60°	r	1,5 * r
3	60° - 70°	r	2 * r
4	70°- 80°	r	3 * r
5	80° - 85°	r	5 * r
6	85° - 90°	r	10 * r

DTED data have to be re-sampled accordingly:

- no re-sampling is required between [0°-50°], [60°-70°], [70°-75°],

- longitudinal re-sampling is required between [50°-60°], [75°-90°], according the tables above.

Metadata mapping between DTED and DGED

This document maps current DTED metadata (located in the DTED headers) to the current ESM XML metadata requirements. There is no attempt to replicate all of the DTED header information in the current XML, but only the critical DTED information.

This annex provides detailed location of each DTED information that may be mapped to DGED. However, this annex should be used by users that are familiar with DTED, otherwise the use of DTED specification is highly recommended.

Only ESM XML fields that have corresponding DTED metadata are shown in this Annex (metadata element numbers remain consistent with Annex B).

NOTE: DGED will not replicate the current DTED DMED metadata.

ESM XML Metadata

Red text = Current DTED Header

Blue text = Proposed DGED value

	Name DMF ID (Requirement Class)	**Definition**	**Obligation**	**Max Occur**	**Value Domain**
1	**Metadata file identifier** MDSID (Core)	unique identifier for this metadata file	**M**	1	String DTED = UHL/DSI/ACC record DGED = Unique identifier (e.g. UUID or URL) or a locator (e.g. URL) or dataset filename.XML or relative reference to XML metadata in dataset filename
15	**Dataset title** RSTITLE (Core)	name by which the cited resource is known	M	1	Free Text (located in DSI header record character start[2] at 60, 5 characters) DTED = level, SW Corner geographics of one degree cell (origin): character start at 65 (15 characters) DGED = filename for levels 0, 1, 2

[2] Character start is the DTED term, should be understood as byte number (starting at one – character start = 1 indicates 1st byte). **This applies throughout this table.**

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
16	**Dataset alternate title** RSALT (Common)	short name, informal name, or name in another language by which the dataset is known	O	1	Free Text DTED = DTED partial or full cell indicator XX, if partial XX indicates percent full (located in DSI header record character start at 290, 2 characters) DGED = DGED level 0/ 1/2 product, Coverage Indicator XX XX indicates percentage of data coverage; 00 indicates full.
17	**Abstract describing the dataset** RSABSTR (Core)	brief narrative summary of the content of the resource(s)	M	1	Free Text DTED = Mil-PRF 89020B (located in DSI header record character start at 127, 9 characters) DGED = Product Specific Guidance (PSG) and DGED Implementation
18	**Collection Tiling Scheme** GPHICS (Common)	reference to a graphic that provides a description of the collection's tiling scheme	**C / if RSTYPE= series and tiling scheme is defined**	1	GPHICS.name (file name) and GPHICS.description (= 'TilingScheme') DTED = one degree cell (defined in DTED MIL PRF 89020B section 3.5.1) DTED = one degree cell DGED = one degree cell
22	**Dataset edition** RSED (Core)	version identifier of the resource	O	1	String DTED = Data Edition Number (located in DSI header record character start at 88, 2 characters) DGED = data version (as in file name)

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
23	**Dataset edition date** RSEDDAT (Core)	reference date of this edition of the resource	O	1	Date DTED = compilation date DTED = compilation date (located in DSI header record character start at 160, 4 characters) DGED = production date
28	**Spatial resolution of the dataset** RSGSD (Core)	factor which provides a general understanding of the density of spatial data in the dataset	**M**	1	Distance DTED = latitude interval in tenths/second followed by longitude interval in tenths /second (located in DSI header record, 2 fields of 4 characters, character start at 274, 8 characters) DGED = long spacing
31	**Spatial representation type** RSRPTP (Core)	method used to spatially represent geographic information	**M**	1	Spatial Representation type Codelist DTED = Geographic (defined in DTED MIL PRF 89020B section 3.9.2) DGED = Geographic
33	**Dataset georeferencing level** RSGFLV (Core)	level of georeferencing of the dataset	O	1	Georeferencing Level Codelist DTED = .dt0, .dt1 or .dt2 (defined in DTED MIL PRF 89020B section 3.9.2) DGED = level x
34	**Dataset level** RSDTLVL (Core)	method of categorizing resolution bands of digital geographic data by equivalence to paper map scales	O	1	Data Level Codelist DTED = .dt0, .dt1 or .dt2 (defined in DTED MIL PRF 89020B section 3.9.2) DGED = level x

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
40	**Special Cell** GRCINF (Data) +specialCell	cell playing a specific role (e.g. no data) in the coverage. When the content type of the coverage is a thematic classification, each thematic class is represented by a special cell.	O	1..*	Special Cell Values DTED = -32767 = no data (defined in DTED MIL PRF 89020B section 3.10.9.1 and 3.11.3.1) DGED = -32767 = no data
41	**Geographic location of the dataset (by coordinates)** RSEXT/boundingBox(Core)	geographic position of the dataset	**C / for unprojected data**	1..*	Bounding Box NOTE: RSEXT may be repeated DTED = cell origin (SW corner – latitude DDMMSS.SH and longitude DDDMMSS.SH, H being the hemisphere) (located in DSI header record 2 fields with character start at 186, 19 characters) DGED = cell origin (SW corner)
42	**Dataset positional extent** RSEXT/boundingPolygon (Core)	the boundary enclosing the dataset, given as a set of (x,y) WGS84 coordinates of a polygon, with the last point replicating the first	**C / for UTM projected data**	1	Polygon NOTE: RSEXT may be repeated DTED = bounding rectangle SW, NW, NE and SE corners (latitude DDMMSSH and longitude DDDMMSSH) (located in DSI header record, 4 fields of 15 characters with a Character start at 205). Character start at 205, 15 characters for SW corner (LatLong), character start at 235, 15 characters for NE corner) (LatLong). DGED = bounding rectangle SW and NE corners

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
43	**Dataset temporal extent** RSEXT/temporalExtent (Core)	date and time for the content of the dataset (collection date and time)	O	1	Temporal Extent DTED = compilation date (Most descriptive year/month) (located in the DSI header record character start at 160, 4 characters) DGED = production date
45	**Coordinate reference system – horizontal** RSRSYS (Core)	identifier used for reference systems	**M**	1	String, Anchor or Identifier DTED = WGS 84 (located in the DSI header record character start at 145, 5 characters) DGED = WGS 84
46	**Coordinate reference system – temporal** RSRSYS (Core)	identifier used for reference systems	**C / for high-resolution datasets**	1	String, Anchor or Identifier DTED = vertical geoid model (EGM 96) (located in the DSI header record character start at 142, 3 characters) DGED = geoid model for geoid referenced data
49	**Dataset originator** RSRPTY:originator (Core)	party that created the dataset	**M**	1	ResponsibleParty (role = originator) DTED = Producer code (located in the DSI header record character start at 103, 8 characters) DGED = Producer

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
52	**Dataset classification** RSSCST (Core) + level	name of the handling restrictions on the resource	**C / based on requirement of classification system**	1	Security Constraint level DTED = security classification code (located in the DSI header record character start at 4, 1 character, also in UHL header record character start at 33, 3 characters) DGED = classification
54	**Dataset releasability** RSREL (NATO)	provides a means to express a set of releasability information applicable to the dataset	O	1..*	Releasability DTED = Security Handling (located in the DSI header record character start at 7, 27 characters) DGED = releasability
55	**Dataset use constraints** RSUSE (Core)	provides a means to express general use limitations (limitations not implied by security or legal constraints) of the dataset	O	1..*	Free Text DTED = Not to be used for Targeting Purposes (this information is provided on the DTED home page at the NGA Gateway, Gateway is referenced in DTED MIL PRF 89020B section 3.8) DGED = Not to be used for Targeting Purposes

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
58	**Dataset quality report** RSRQR or RSUQR (Data)	Information related to the result of a quality evaluation of the dataset	**M**	1..*	Regulated Quality Element or Unregulated Quality Element (see E.5 for definition and minimum requirement) DTED = AH, AV, RV and RH accuracies at 90% confidence in meters (located in the ACC header record, 4 fields character start at 4, 16 total characters) DGED = AH,AV, RV and RH accuracies at 90% confidence in meters
59	**Dataset source** RSSRC (Data)	information about the source data used in creating the dataset	O	1..*	Source DTED = Source Type Code (located in the ACC header record starting at character 24, 1 character) DGED = Source code from filename
64	**Dataset distribution unit** RSUD (Data)	a description of the unit (tiles, layers, geographic areas, etc.) in which the data is available	O	1	Free Text DTED = one degree cell (defined in DTED MIL PRF 89020B section 3.5.1) DGED = one degree cell

	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
65	**Dataset transfer size** RSTS (Data)	estimated size of a unit in the specified transfer format, expressed in megabytes. The transfer size is > 0.0	O	1	Float DTED 0 = 0,3 MB, DTED1 = 2,8 MB, DTED 2 = 25,9 MB (this information is not contained in the DTED MIL PRF, calculated from Gateway distribution format information) DGED = levels are the same, size varies by format.
66	**Dataset offline distribution** RSOFDM (Data)	information about offline media through which the dataset can be obtained	O	1	Medium DTED = CD and DVD (defined in DTED MIL PRF 89020B section 3.9)
67	**Instrument identification** (DMF ID is to be determined)	unique identification of the instrument	**M**	**1**	MD_Identifier <<DataType>> DTED = Digitizing/Collection System (located in the DSI header record starting at character 150, 10 characters) DGED = Production System

Annex E
Rationale for the specification of 6 latitudinal zones for DGED

(source: TanDEM-X DEM latitude zone alignment (provided by DLR email 12/06/ 2015 to NGA)

The TanDEM-X DEM decision for 6 zones (instead of 5 in DTED) is a compromise between keeping the longitudinal posting within an acceptable range (see below diagram) and the number of zones.

With this result, the ground sampling distance variations within one zone is reduced, i.e. a posting between 12m (for TREx aimed resolution) and 8m for the major land masses is achieved.

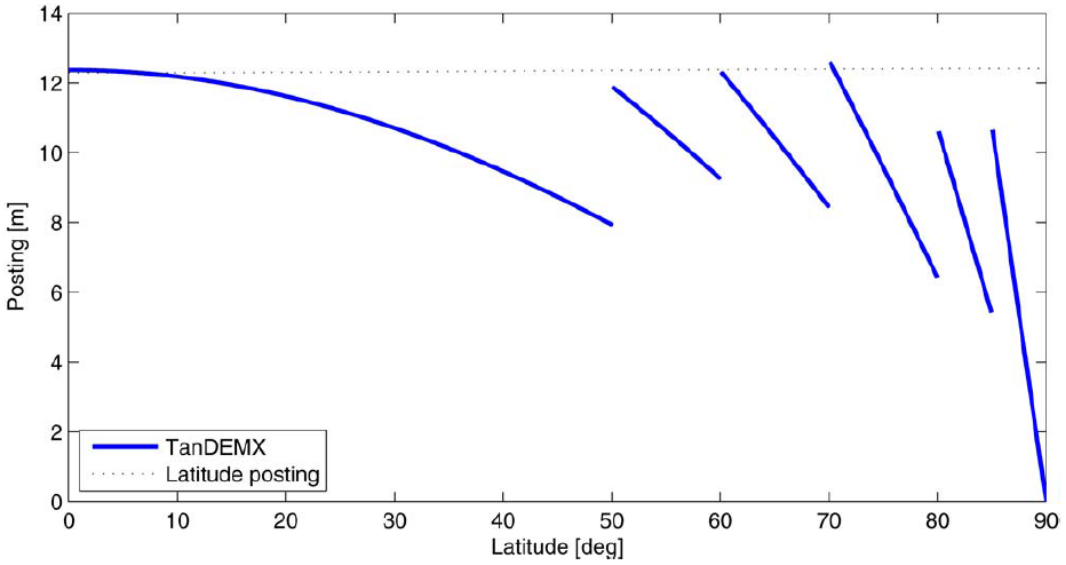

Figure 4 – Longitudinal posting as a function of latitude

This decision has been adopted by DGIWG in DGED specifications, instead of the 5 zones specified by DTED, which result in bigger variations.

Annex F
Bibliography

DGIWG profile of ISO 19131 - Geographic information - Data product specification Ed. 0.6 June 2016

High Resolution Elevation (HRE 1.1) Implementation profile - NGA.IP.0002_1.1 – 12 June 2014