High Resolution Digital Elevation Model Mosaic (HRDEM Mosaic)

– CanElevation Series – Product Specifications

Edition 1.1

2022-11-15

Government of Canada
Natural Resources Canada

Telephone: +01-819-564-4857 / 1-800-661-2638 (Canada and USA)
Fax: +01-819-564-5698
E-mail: geoinfo@nrcan-rncan.gc.ca
URL: https://open.canada.ca/en/open-maps

Copyright Notice

RELEASES HISTORY

Date	Version	Description
2020-12-01	1.0	Original version
2022-11-15	1.1	Standardization of various sections with the other specifications from the CanElevation Series.
2024-08-20	1.2	Addition of the STAC collections.

ACRONYMS

ANPD	Aggregate Nominal Pulse Density
CGVD28	Canadian Geodetic Vertical Datum of 1928
CGVD2013	Canadian Geodetic Vertical Datum of 2013
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model
HRDEM	High Resolution Digital Elevation Model
ISO	International Organization for Standardization
LiDAR	Light Detection and Ranging
MSL	Mean Sea Level
NAD83 (CSRS)	North American Datum of 1983 (Canadian Spatial Reference System)
NRCan	Natural Resources Canada
TIN	Triangular Irregular Network
WCS	Web Coverage Service
WGS84	World Geodetic System 1984
WMS	Web Map Service

TERMS AND DEFINITIONS

Aggregate Nominal Pulse Density (ANPD)

A variant of nominal pulse density that expresses the total expected or actual density of pulses occurring in a specified unit area resulting from multiple passes of the light detection and ranging (LiDAR) instrument, or a single pass of a platform with multiple LiDAR instruments, over the same target area. In all other respects, ANPD is identical to nominal pulse density (NPD). In single coverage collection, ANPD and NPD will be equal.

ArcticDEM

ArcticDEM is a National Geospatial-Intelligence Agency and National Science Foundation public-private initiative to automatically produce a high-resolution, high-quality DSM of the Arctic using optical stereographic imagery, high-performance computing, and open source photogrammetry software. The product is a collection of time-dependent DEM strips and a seamless terrain mosaic that can be distributed without restriction. DEM(s) were created from DigitalGlobe, Inc., imagery and funded under National Science Foundation awards 1043681, 1559691, and 1542736.

Canadian Geodetic Vertical Datum of 2013 (CGVD2013)

The Canadian Geodetic Vertical Datum of 2013 (CGVD2013) is the reference standard for heights across Canada. This system has replaced the Canadian Geodetic Vertical Datum of 1928 (CGVD28). For more information on CGVD2013, visit the following resource: https://www.nrcan.gc.ca/maps-tools-and-publications/tools/geodetic-reference-systems/canadian-spatial-reference-system-csrs/9052

CanElevation

Series of elevation products created in support of the National Elevation Data Strategy implemented by NRCan.

Digital Elevation Model (DEM)

A digital representation of relief composed of an array of elevation values referenced to a common vertical datum and corresponding to a regular grid of points on the earth's surface. These elevations can be either ground or reflective surface elevations.

Digital Surface Model (DSM)

A representation of the earth’s surface including vegetation and man-made structures. The Digital Surface Model (DSM) provides the height of the vegetation, canopies and structures relative to the vertical datum.

Digital Terrain Model (DTM)

A representation of the bare ground surface without any objects such as vegetation and man-made structures. The Digital Terrain Model (DTM) provides the height of the ground relative to the vertical datum.

LiDAR

Stands for Light Detection and Ranging. It is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.

Metadata

Metadata summarizes basic information about data, which can make finding and working with particular instances of data easier.

National Hydro Network

The National Hydro Network (NHN) focuses on providing a quality geometric description and a set of basic attributes describing Canada's inland surface waters. It provides geospatial digital data compliant with the NHN Standard such as lakes, reservoirs, watercourses (rivers and streams), canals, islands, drainage linear network, toponyms or geographical names, constructions and obstacles related to surface waters, etc. The best available federal and provincial data are used for its production, which is done jointly by the federal and interested provincial and territorial partners. The NHN is created from existing data at the 1:50 000 scale or better.

North American Datum 1983 CSRS (NAD83(CSRS))

The North American Datum of 1983 CSRS (NAD83(CSRS)) is the official geometric reference system in Canada. NAD83(CSRS) is a dynamic 3D representation of NAD83(Original) adapted for Canada. NRCan maintains NAD83(CSRS) aligned to the North American plate using plate motion estimation. For more information on NAD83(CSRS), visit the following resource: https://www.nrcan.gc.ca/maps-tools-and-publications/tools/geodetic-reference-systems/canadian-spatial-reference-system-csrs/9052

Orthometric Height (elevation)

It is the elevation of a point above the geoid. It is measured along the plumb line, which is perpendicular to the equipotential surfaces.

LiDAR Point Cloud

This is the primary data product of a LiDAR instrument. In its crudest form, a LiDAR point cloud is a collection of range measurements and sensor orientation parameters. After initial processing, the range and orientation associated with each laser pulse is converted to a position in a three-dimensional frame of reference. In its final form, the points in the LiDAR point cloud are classified according to various classes such as ground, noise, buildings and bridge structures. This spatially coherent cloud of classified points is the base for further processing and analysis. The raw point cloud typically includes first, last, and intermediate returns for each emitted laser pulse.

Web Coverage Service (WCS)

Standardized service interface allowing access to coverage data. This service allows interaction with the data by providing detailed information about the data.

Web Map Service (WMS)

Standardized service interface allowing the visualization of data in the form of a static map. This service only allows the visualization of data. The detailed information of the data is not available.

World Geodetic System 1984 (WGS84)

WGS84 is an Earth-centered, Earth-fixed terrestrial reference system and geodetic datum. WGS84 is based on a consistent set of constants and model parameters that describe the Earth's size, shape, and gravity and geomagnetic fields.

TABLE OF CONTENTS

1. Overview

1.1 Title

High Resolution Digital Elevation Model Mosaic : Product Specifications

1.2 Reference Date

2022-11-15

1.3 Product Responsible

Natural Resources Canada
Strategic Policy and Innovation Sector
Canada Centre for Mapping and Earth Observation
Client service

Telephone : +01-819-564-4857 / charge free : 1-800-661-2638 (Canada and United-States)
Fax : +01-819-564-5698
Email : geoinfo@nrcan-nrcan.gc.ca
URL : https://open.canada.ca/en/open-maps

1.4 Language

Languages in which the product specifications are available according to the ISO 639-2 standard :
fra – French
eng – English

1.5 Informal Product Description

Elevation data is a core theme that has been provided by Natural Resources Canada (NRCan) to Canadians as essential geographic information. New technologies, including LiDAR data, provide opportunities for enhancing elevation information, products and services. The need for elevation data continues to grow and become more specialized, and the acquisition technologies for this type of data are becoming more accessible and efficient.

These product specifications are for the High Resolution Digital Elevation Model Mosaic which provides a unique and continuous representation of the high resolution elevation data available across the country. The mosaic is available for both the Digital Terrain Model (DTM) and the Digital Surface Model (DSM) from web mapping services. It is part of the CanElevation Series created to support the National Elevation Data Strategy implemented by NRCan. This strategy aims to increase Canada's coverage of high-resolution elevation data and increase the accessibility of the products.

The acquisition strategy has two main components: north, and south of the productive forest line (see Figure 1). The productive forest line is used to separate the northern and the southern parts of the country. This line is approximate and may change based on requirements.

Because of the high similarity between DSM and DTM datasets in the north, due to the low density of vegetation and infrastructure, only DSM datasets are generated north of the productive forest line. This should satisfy many needs regarding geology, climate change adaptation, geo-hazards and polar continental shelf logistics support. Most of these datasets are derived from autocorrelation of high resolution optical satellite images but other remote sensing methods, such as radar interferometry, may be used to complete the coverage. Occasionally, airborne LiDAR data may be acquired based on project planning needs. The data from the ArcticDEM project are used by NRCan to increase the coverage of high resolution elevation data in the northern part of Canada.

In the southern part of the country (south of the productive forest line), more accurate elevation data such as airborne LiDAR data is needed for forest inventory, coastal monitoring, flood plain mapping, precision agriculture, infrastructure, etc. The federal government is currently working with the provinces and territories to free-up existing airborne LiDAR data and to participate in new acquisitions. Both DSM and DTM datasets in this region are generated from airborne LiDAR data.

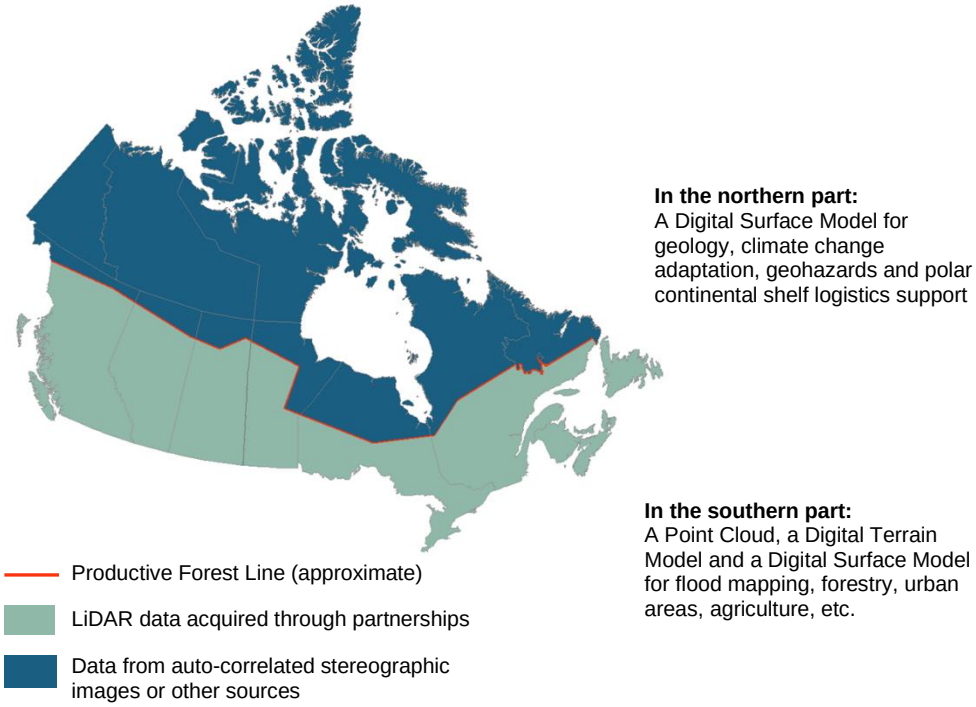

Figure 1: General acquisition plan for the elevation strategy

Unlike the HRDEM product in the same series, which is distributed by acquisition project without integration between projects, the mosaic is created to provide a single, continuous representation of strategy data. The most recent data sets for a given territory are used to generate the mosaic.

This HRDEM mosaic is disseminated through the Data Cube Platform, implemented by NRCan using geospatial big data management technologies. These technologies enable the rapid and efficient visualization of high-resolution geospatial data and allow for the rapid generation of dynamically derived products. The mosaic is available from Web Map Services (WMS) and Web Coverage Services (WCS). Accessible data includes the Digital Terrain Model (DTM), the Digital Surface Model (DSM) and derived products such as shaded relief, slope and aspect. The mosaic is referenced to the Canadian Height Reference System 2013 (CGVD2013) which is the reference standard for orthometric heights across Canada.

For more information on the MNEHR product, see the Product Specification.

2. Data Identification

2.1 Spatial Resolution

The spatial resolution of the product data varies depending on the extent of the region requested by the user and the source of the data. The HRDEM Mosaic product data is available at a basic resolution of 1 m or 2 m depending on the source used. This base resolution is the best available resolution. However, due to dataset size constraints, the extraction resolution may be lower than the base resolution, depending on the extent of the region to be extracted. See Section 3.4 for more details.

2.2 Language

NOT APPLICABLE

2.3 Character Set

NOT APPLICABLE

2.4 Topic Category

According to the Government of Canada Core Subject Thesaurus, the HRDEM Mosaic product is classified according to the following keyword :

- Digital elevation data

Free text keywords:

- Aspect map
- Color relief map
- Digital elevation model
- Digital surface model
- Digital terrain model
- High-resolution Digital Elevation Model Mosaic
- LiDAR
- Shaded relief map
- Slope map

2.5 Geographic Box

The HRDEM production will occur over several years and will cover the following geographic box or minimum-bounding rectangle:

- West-bounding coordinate: 142° West (or -142°)
- East-bounding coordinate: 52° West (or -52°)
- North-bounding coordinate: 84° North (or 84°)
- South-bounding coordinate: 41° North (or 41°)

2.6 Geographic Description

The geographic area is comprised of land and water that fall within the Canadian jurisdiction. In some cases, the project coverage may extend to other jurisdictions.

2.7 Extent

The vertical domain of the dataset identifies the lowest and highest vertical extent contained within the data. The vertical extent is expressed in meters and the maximum elevation is 5,959 meters (Mount Logan) in Canada.

2.8 Supplemental Information

2.8.1 Elevation

The elevation values in the DTM datasets represent the bare ground surface without any objects such as vegetation and man-made structures.

The elevation values in the DSM datasets represent the surface above the vegetation (canopies) and man-made structures.

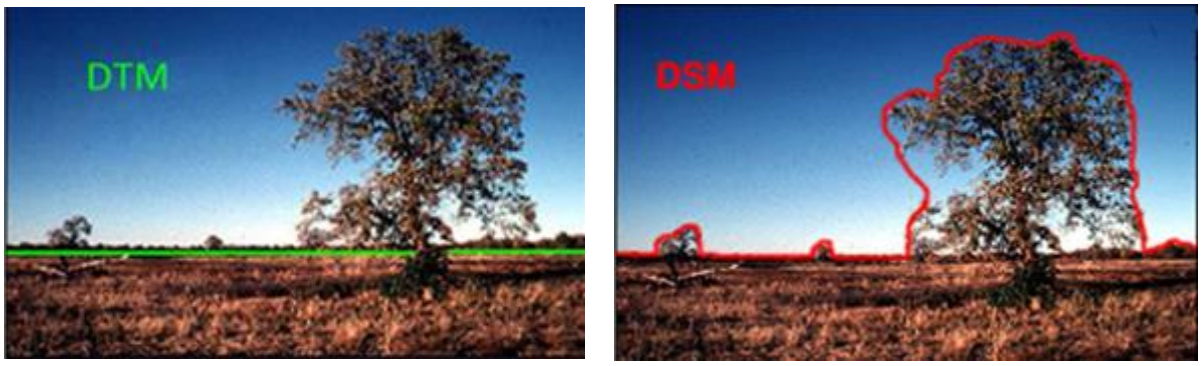

Figure 2: DTM and DSM representations (source: Wikipedia)

2.8.2 Waterbodies

Airborne LiDAR source data:

Due to the properties of the LiDAR used, the pulses are absorbed by water, reducing the point densities in water areas. The DEMs derived from LiDAR points, generated without breaklines, depict water surfaces with artifacts and void data resulting from the interpolation and void filling processing affecting accuracy.

Optical imagery source data:

Due to the surface conditions at the acquisition time, several waterbodies contain artifacts, areas of high roughness or void areas on the raw ArcticDEM products.

When integrating these products into the HRDEM product, where possible, lake flattening was performed using vector layers from the National Hydrographic Network. To do this, the minimum elevation found at the edge of a lake was attributed to all the pixels located within the lake boundaries. The small remaining void areas along lakes were then filled by interpolating from valid pixels around these areas. For rivers, areas of high roughness identified within them have been converted to void areas.

2.8.3 Void Areas

For source data accessible via the WCS service, empty areas (for which there is no data) are represented by elevation values of -32 767.

For products generated from airborne LiDAR data, data may contain void pixels where there is a lack of LiDAR points. The lack of points in the point cloud is caused by surface absorbance of the LiDAR pulse, an obstruction of the LiDAR pulse, an instrument failure, or a flight planning issue.

Where the source data is optical imagery, atmospheric obstructions and environmental conditions such as clouds, fog, shadows, strong reliefs and dust can prevent high quality elevation data from being obtained. Open water, vegetation, and homogeneous terrain can also cause voids or artifacts.

2.8.4 Quality Control

Quality control of the source data is to be conducted by the partner responsible for its acquisition which can render non-homogeneous data among the projects.

The quality control of the HRDEM data used for the creation of the mosaic as well as the quality control of the HRDEM mosaic are performed visually by NRCan.

3. Geospatial Characteristics

3.1 Spatial Representation Type

A grid format is used to represent the elevation data.

3.2 Spatial Representation

The HRDEM mosaic is represented by raster data that contains a variable number of pixels corresponding to elevations depending on the extent of the selected region and the source of the data.

3.3 Coverage and Continuity

The complete coverage of the Canadian territory is gradually being put in place. The mosaic is processed and made available as LiDAR data is acquired and as the HRDEM are created. Unlike the HRDEM product of the same series which is distributed by acquisition project without integration between projects, the mosaic is created to provide a single, continuous representation of the strategy data. When newly acquired data overlay older datasets, the recent data replace the older data.

3.4 Resolution

The HRDEM Mosaic product data is available at a basic resolution of 1 m or 2 m depending on the source used. This base resolution is the best available resolution.

Source data sets generated from airborne LiDAR data are available at a base resolution of 1 m or 2 m depending on the density of the source data. When the ANPD of the LiDAR data is greater than or equal to 2 pulses per m^2 the product data is at a base resolution of 1 m. When the ANPD of the LiDAR data is less than 2 pulses per m^2, the product data is at a basic resolution of 2 m. However, for processing purposes, the 2 m data grid has been redefined to 1 m resolution using nearest neighbor resampling.

When the source data are optical images, the data are offered at a basic resolution of 2 m.

The data in the HRDEM mosaic product are available at the resolutions shown in Table 1. The resolutions are generated by successively applying a bilinear resampling from the basic resolution. Due to data set size constraints, the extraction resolution varies according to the extent of the region requested by the user and may differ from the available resolutions. Where appropriate, bilinear resampling is also applied.

Level	Resolution (m)	Approximate Scale
0	32 768	1:150 million
1	16 384	1:70 million
2	8 192	1:35 million
3	4 096	1:15 million
4	2 048	1:10 million
5	1 024	1:4 million
6	512	1:2 million
7	256	1:1 million
8	128	1:500 000
9	64	1:250 000
10	32	1:150 000
11	16	1:70 000
12	8	1:35 000
13	4	1:15 000
14	2	1:8 000
15	1	1:4 000

Table 1: Mosaic product data availability by resolution

3.5 Data Segmentation

NOT APPLICABLE

4. Data Model

NOT APPLICABLE

5. Data Dictionary/Feature Catalogue

The Metadata Model used for the HRDEM Mosaic is the same as the HRDEM Metadata Model. It provides information on the attributes of the metadata polygons that describe the resource.

6. Reference System

6.1 Horizontal Reference System

6.1.1 Horizontal Coordinate System

The planimetric coordinate system used is the Canadian Spatial Reference System (NAD83 (CSRS) / Canada Atlas Lambert) (EPSG : 3979). The mosaic is also available under the following projections for WMS and WCS services:

- WGS 84 / World Geodetic System 1984 (EPSG : 4326)
- WGS 84 / Pseudo-Mercator (EPSG : 3857)

Several other projections are available for the WMS service. The information is available with the following GetCapabilities query from the web mapping service.

https://datacube.services.geo.ca/ows/elevation?service=wms&request=GetCapabilities

6.1.2 Horizontal Unit of Measure (coordinate system axis units)

Metric is used and represented in meters.

6.2 Vertical Reference System

Elevations are orthometric and expressed in reference to the Canadian Geodetic Vertical Datum of 2013 (CGVD2013) (EPSG : 6647).

Source: https://www.NRCan.gc.ca/earth-sciences/geomatics/geodetic-reference-systems/9054.

6.2.1 Vertical Unit of Measure (coordinate system axis units)

The unit of measure for storing vertical data is meters. Elevations are expressed as floating points.

7. Data Quality

7.1 Scope

NOT APPLICABLE

7.2 Lineage

Airborne LiDAR source data:

The DTM datasets are generated from the LiDAR data using only the classified points Ground and Water. The used algorithm triangulates the LiDAR point cloud in a temporary TIN, then rasterizes the TIN to create a DTM. The small areas without data (usually no data areas) are filled by interpolating pixels from valid pixels around the edges of the areas.

The DSM datasets are generated from the LiDAR data with only the highest points. The algorithm used triangulates the LiDAR point cloud in a temporary TIN, then converts the TIN to create a DSM. The small areas without data (usually no data areas) are filled by the pixel values of the DTM.

Optical imagery source data:

The DSM datasets, used to create the 2 m resolution DSM mosaic to the North, are created by the Polar Geospatial Center (University of Minnesota) from the best stereo pair DSMs (2 m resolution) that have been aligned and merged to reduce void areas and artifacts due to horizontal integration. ICESat altimeter data were applied to the raster file to improve absolute accuracy. Stereographic pair DSMs were previously generated by applying high-resolution optical satellite image autocorrelation techniques (see the article by Noh and Howat (2017)* for more information on the algorithm). During the integration with the HRDEM product, the 2 m resolution DSMs were transformed in the hydrographic areas as explained in section 2.8.2 and the elevations were converted to the CGVD2013 datum.

* Noh, M. J., & Howat, I. M. (2017). The Surface Extraction from TIN based Search-space Minimization (SETSM) algorithm. *ISPRS Journal of Photogrammetry and Remote Sensing*, *129*, 55-76.

7.3 Completeness

NOT APPLICABLE

7.4 Logical Consistency

Marked differences in elevation can be observed in the mosaic at the junction of some projects when they were acquired at different dates. These differences will be more pronounced on streams and above the canopy.

7.5 Positional Accuracy

For the LiDAR-derived HRDEM mosaic, the accuracies listed in the Project Metadata File (see section 8) are those of the project LiDAR data used to create the HRDEM mosaic product data. Typically, HRDEM product data generated from airborne LiDAR data have an accuracy better than 1 m.

For the North of the mosaic generated from the ArcticDEM project, the accuracy value is the vertical accuracy of the DSM at 90% confidence level (LE90 = Standard Deviation X 1.6449), i.e. 1.6m. In this formula, the standard deviation comes from Candela et al (ArcticDEM Validation and Accuracy Assessment, AGU Conference, December 2017) and corresponds to the standard deviation of the difference between ArcticDEM DSMs and LiDAR points (ICESat satellite and NASA G-LiHT LiDAR points). Vertical accuracy is poorer at the edge of water bodies due to flattening using the National Hydrographic Network.

7.6 Temporal Accuracy

NOT APPLICABLE

7.7 Thematic (attributes) Accuracy

NOT APPLICABLE

8. Metadata

The HRDEM mosaic product has a metadata record that complies with the *North American Profile of ISO 19115:2003 – Geographic information – Metadata*.

Metadata for HRDEM mosaic product consists of polygons and attributes. It is distributed in ESRI File Geodatabase format (.gdb). The attributes provided with the polygon are divided in three categories. Among others, each category covers:

- Metadata
  - Temporal extent
  - Description
  - Abstract
  - Title
  - Planimetric and altimetric accuracy
- Legal Constraints
  - Use limitation
  - Legal constraints type
  - Restriction type
- Source
  - Description
  - Title
  - Series
  - Organisation name

See section 5 for the complete metadata model.

9. Data Portrayal/Data Transfer Format/Physical Model

NOT APPLICABLE

10. Data Capture and Maintenance

NOT APPLICABLE

11. HRDEM Product Data Delivery

11.1 Format Information

The mosaic is available as a web mapping service (Web Map Service (WMS) and Web Coverage Service (WCS)) compliant with Open Geospatial Consortium (OGC) standards (https://www.ogc.org/standards). The services are hosted in NRCan's Data Cube Platform, which uses geospatial big data management technologies (https://datacube.services.geo.ca/ows/elevation).

11.2 Medium Information

NOT APPLICABLE

11.3 Data Use and Restrictions

Information regarding the use of the data is defined in the Open Government Licence - Canada (http://open.canada.ca/en/open-government-licence-canada).

11.4 Data Extraction

The source data of the mosaic can be extracted for a desired area via the WCS service.

11.4.1 Directory tree

As the mosaic is available as web services, the directory only contains documents and data related to the metadata and product specifications. These can be found in the following download directory:

https://ftp.maps.canada.ca/pub/elevation/dem_mne/HRDEMmosaic_mosaiqueMNEHR

The directory contains the elements below:

- Metadata_HRDEMmosaic_mosaiqueMNEHR_DSM_MNS.gdb
- Metadata_HRDEMmosaic_mosaiqueMNEHR_DTM_MNT.gdb
- HRDEM_Mosaic_Product_Specification.pdf
- Mosaique_MNEHR_Specification_Produit.pdf

11.4.2 Tile identifier

NOT APPLICABLE

11.5 Derived Data

Products derived from the DTM and DSM mosaics are also available. This section describes derivative products that are accessible via WMS and WCS web mapping services. Information about these products is available with the following GetCapabilities queries from the web mapping service:

WMS: https://datacube.services.geo.ca/ows/elevation?service=wms&request=GetCapabilities

WCS: https://datacube.services.geo.ca/ows/elevation?service=wcs&request=GetCapabilities

11.5.1 Hillshade Map

A relief representation which enhances the illumination and shadow variations, according to elevation and slope, is created by a light source located at a specified height and in a specified direction. The resulting 8-bit greyscale raster image provides realistic terrain visualization. This derivative product is available for both DTM and DSM mosaics. This layer is only available for the WMS web mapping service.

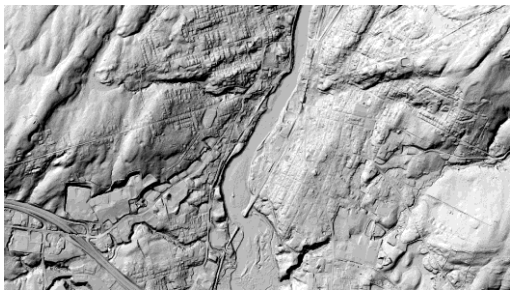

Figure 3: Relief Representation of a DTM

Parameters

Azimuth: Direction of light source, between 0 and 360, measured in degrees, clockwise from the north.

Default: 315.

Altitude: Vertical direction of light source, from 0 (horizon) to 90 degrees (zenith).

Default: 45.

zFactor: Vertical exaggeration factor.

Default: 5.

Figure 4: Relief Representation of a DSM

11.5.1 Color Relief Map

A relief representation in which the elevations are assigned different colours according to their value. The resulting product is a raster image where the colours are blended gradually to depict elevations, according to a pre-defined correspondence table. This layer is provided for both DTM and DSM datasets. This layer is only available for the WMS.

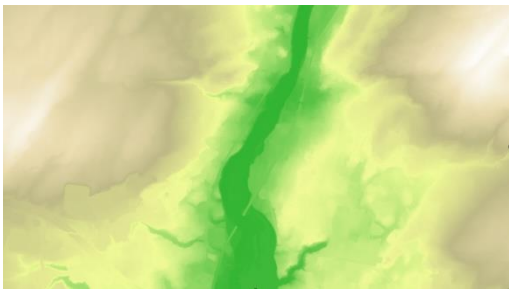

Figure 5: Color Relief Map representation of a DTM

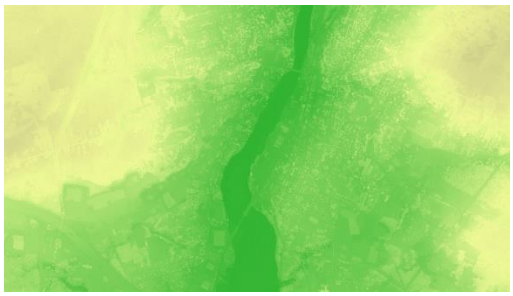

Figure 6: Color Relief Map representation of a DSM

11.5.2 Slope map

A relief-derived representation in which every pixel is attributed the value of the greatest slope (the measure of change in elevation over distance, in degrees from the horizontal) at the corresponding point of the represented surface. This layer is provided for both DTM and DSM datasets and available through both the WMS and WCS.

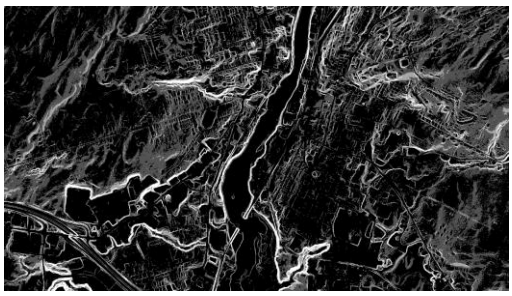

Figure 7: Slope Map Representation

11.6 Mosaic in Cloud Optimized GeoTIFF (COG) format

The HRDEM mosaic is available as a file-based mosaic in Cloud Optimized GeoTIFF (COG) format. The COG format enables efficient data distribution, as compatible tools and software can now remotely access only the portions of the data they need, simplifying data management and improving access times. As the

COG format is directly based on the GeoTIFF format, it enables existing software to read these files without any further modification.

Due to the large volume of data, the mosaic's COG files are organized in tiles of 500 kilometers by 500 kilometers.

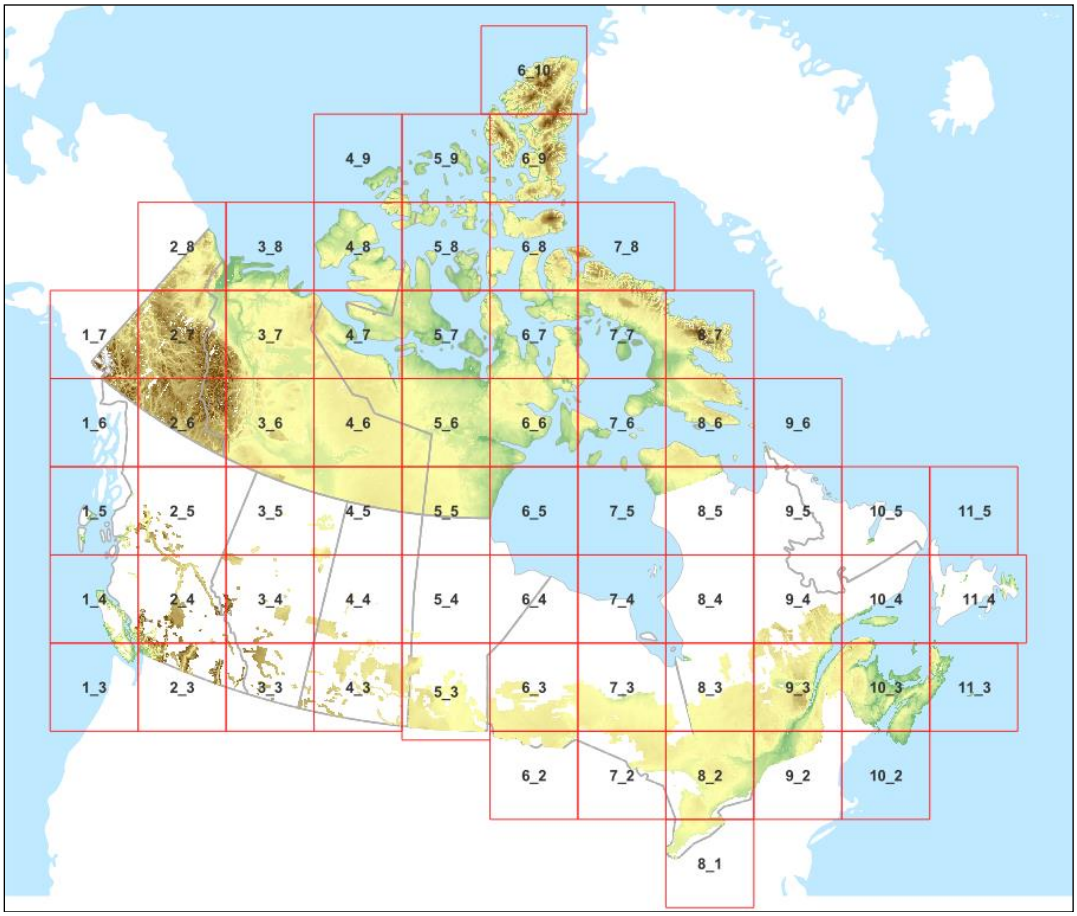

Figure 8: HRDEM Mosaic COG collection, tile pattern overview

To enable efficient streaming, and to facilitate integration of data from other sources available on a national scale, the conformal Lambert conic projection (EPSG:3979) is the reference system used for these files.

11.6.1 Data discovery

The mosaic can be discovered and consulted using a catalog service compatible with the SpatioTemporal Asset Catalog (STAC) specification. This type of catalog allows geospatial information to be described in a common language, and spatiotemporal searches to be carried out using a standardized application programming interface (API).

Two collections are currently available:

- hrdem-mosaic-1m

Link to STAC collection : https://datacube.services.geo.ca/api/collections/hrdem-mosaic-1m

Contains a record per mosaic tile at 1-meter resolution. Only the HRDEM projects available at that resolution are part of this version. Each item contains links to access the data files.

- hrdem-mosaic-2m

  Link to STAC collection : https://datacube.services.geo.ca/api/collections/hrdem-mosaic-2m

  Contains a record per mosaic tile at 2-meter resolution. This version includes all HRDEM projects at 1 meter (resampled to 2-meter resolution) as well as projects at 2-meter resolution. Each item contains links to access the data files.

11.6.2 Available Resources

The items in the STAC collections provide resources for accessing the data. The main resources are links to the COG files and to Virtual Raster Layer (VRT) files. The latter format is offered to enable COG to be used on platforms that do not directly support the COG format. Here are resources details by collection.

11.6.2.1 hrdem-mosaic-1m collection

Nom	Titre	Description
dsm	Digital Surface Model (COG)	Digital Surface Model.
dtm	Digital Terrain Model (COG)	Digital Terrain Model.
dsm-vrt	Digital Surface Model (VRT)	Digital Surface Model.
dtm-vrt	Digital Terrain Model (VRT)	Digital Terrain Model.
dsm-hillshade	Hillshade of the Digital Surface Model (COG)	Hillshade of the Digital Surface Model.
dtm-hillshade	Hillshade of the Digital Terrain Model (COG)	Hillshade of the Digital Terrain Model
thumbnail	Thumbnail	Thumbnail of the DEM
coverage	Data Coverage (GeoPackage)	Detailed vector extent of the DEM coverage
extent	Boundary of the mosaic tile (GEOJSON)	Boundary of the available data

11.6.2.2 hrdem-mosaic-2m collection

This collection offers the same resources as the hrdem-mosaic-1m collection.