GeoBase Orthoimage 2005-2010

Data Product Specifications

Edition 1.0

2007-10-31

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RELEASES HISTORY

Date	Version	Description
2007-10-31	1.0	Initial version

These specifications are produced in accordance with *International Standard ISO/TC 211, 19131: 2007 Geographic Information / Geomatics – Data Product Specification*, which refers in particular to standard *ISO 19115: 2003 Geographic information – Metadata.*

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1 OVERVIEW

1.1 Title

GeoBase Orthoimage 2005-2010

1.2 Reference date

Data product specifications creation date:

2007-10-31

1.3 Responsible party

GeoBase
Natural Resources Canada
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1.4 Language

Languages in which the data product specifications are available according to ISO 639-2 standard:

eng – English

fra – French

1.5 Terms and definitions

Orthoimage

An image derived from a conventional perspective image by simple or differential rectification to remove image displacements caused by sensor tilt and relief of terrain.

SPOT

Spot (Système probatoire d'observation de la Terre) satellites, which, in this context, invariably refers to the Spot 4 or Spot 5 satellites.

1.6 Abbreviations and acronyms

NTDB: National Topographic Data Base

GDAL: GeoBase Data Alignment Layer

CCRS: Canada Centre for Remote Sensing

CTI-S: Centre for Topographic Information – Sherbrooke

CDED: Canadian Digital Elevation Data

FGCD: (*US*) Federal Geographical Data Committee

GCMD: (*NASA*) Global Change Master Directory

GeoTIFF: Georeference Tagged Image File Format

GPS: Global Positioning System

GRS80: Geodetic Reference System 1980

LCC: Lambert Conformal Conic (projection)

NAD83SCRS: North American Datum 1983 Canadian Spatial Reference System

CPLIC1: Control Points for Landsat 7 Imagery, Canada, Level 1

NRN: National Road Network

UTM: Universal Transverse Mercator (projection)

1.7 Informal description of the data product

The *GeoBase Orthoimages 2005-2010* are Spot 4 and Spot 5 raster data and comprise five spectral bands: one panchromatic band with a pixel size of 10 m, and four multispectral bands with a pixel size of 20 m. The orthoimages are produced in accordance with the 1983 North American Reference System (NAD83SCRS) using the Univeral Transverse Mercator (UTM) and Lambert Conformal Conic (LCC) projections.

All orthoimages are created with the most accurate control data available at the time. Various sources of planimetric data are used to rectify the images, and priority is given to the most accurate sources. The priority of sources used is established according to the following order: The *Control Points for Landsat 7 Imagery, Canada, Level 1* (PCILC1), the *National Road Network* (NRN) and lastly, the *Landsat 7 Orthorectified Imagery over Canada*.

The CDED (Canadian Digital Elevation Data) was also used to orthorectify the images. The most precise CDED are given priority. The majority of the data is extracted from the GeoBase portal, except for those areas of Quebec that are south of the 49th parallel, for which provincial data was used.

The accuracy is evaluated for each data set of orthoimages. The control data, which is extracted from the aforementioned sources, is comprised of road intersection vector data and lake/island centroids. In some cases, the intersection of the centre line of a surficial river is used. The control points are evenly distributed within the image in specific sectors.

The main objective of the project is to produce a complete set of orthoimages covering Canada's landmass. The process of acquiring raw and orthorectified Earth observation images covering Canada's entire landmass will be spread out over a five-year period, from May 2005 to October 2010. The goal is also to promote the use of geomatics and education through a Web site, and to make this data available through the GeoBase portal.

The data or choices of spectral bands are available for downloading, free of charge, in GeoTIFF format using the LCC and UTM cartographic projections.

The *GeoBase Orthoimages 2005-2010* are made available to the public as soon as they are produced. The production of orthoimages depends on the availability of control information at the origin and the ability of the producing organization to generate them.

2 SPECIFICATION SCOPE

2.1 Scope identification

Global

2.2 Level

This scope makes reference to the following level according to the ISO 19115 standard:

006 – series

2.3 Level name

GeoBase Orthoimage 2005-2010

2.4 Extent

This section describes spatial and temporal extents of the scope.

2.4.1 Description

The main objective of the project is to produce, over a five-year period, a complete set of orthoimages covering Canada's landmass south of the 81st parallel.

2.4.2 Vertical extent

The *GeoBase Orthoimages 2005-2010* are two-dimensional. There is no elevation (z) associated with the data.

2.4.3 Horizontal extent

The geographic box, or minimum bounding rectangle, for covering all of the existing or future *GeoBase Orthoimages 2005-2010* in Canada is:

2.4.3.1 West bound longitude

-142 (or 142 degrees west)

2.4.3.2 East bound longitude

-52 (or 52 degrees west)

2.4.3.3 South bound latitude

+41 (or 41 degrees north)

2.4.3.4 North bound latitude

+81 (or 81 degrees north)

2.4.4 Temporal extent

There is no temporal attribute for the *GeoBase Orthoimages 2005-2010* other than the date of capture of the imagery identified in the metadata.

However, the following periods for image acquisition are approximate in order to coincide with periods of active vegetation whenever possible.

Annual acquisition period:

- South of the 60th parallel: May to October.
- Between the 60th and the 68th parallels : June to September.
- North of the 68th parallel : mid-July to mid-September.

For an image to be acceptable, it must be 95% free of snow and ice in its land coverage, with the exception of permanent snow or ice. Shorelines must all be free of ice and snow (although there may be ice or snow at the centres of bodies of water).

2.4.4.1 Beginning date

2005-05-01

2.4.4.2 Ending date

2010-10-31

3 DATA PRODUCT IDENTIFICATION

3.1 Title

GeoBase Orthoimage 2005-2010

3.2 Abstract

To acquire raw and orthorectified Earth observation images covering Canada's landmass south of the 81st parallel during the period 2005-2010. Each *GeoBase Orthoimage 2005-2010* covers an area of approximately 3 600 km^2, or 60 km x 60 km of the Earth's surface.

3.3 Purpose

The main objective of the project is to produce a complete set of orthoimages of Canada's landmass south of the 81st parallel. The process of acquiring raw and orthorectified Earth observation images covering Canada's entire landmass will be spread out over a five-year period, from May 2005 to October

2010. The goal is also to promote the use of geomatics and education through a Web site, and to make this data available through the GeoBase portal.

Geomatics Canada of Natural Resources Canada has the mandate to provide Canadians with geomatic knowledge of the land.

Geomatics Canada and its provincial, territorial and federal collaborators, as well as the GeoConnections program, acquired a series of Landsat 7 orthoimages covering the entire territory over five years (1999-2003). This series of images was used for a variety of purposes, both by the project collaborators and the community at large through the GeoBase portal (http://www.geobase.ca).

In order to renew this series of images with up-to-date data and sharper spatial resolution, Geomatics Canada and its collaborators wish to acquire a series of orthoimages of corresponding recent raw images (2005-2010).

3.4 Topic category

Key themes of the product, as defined according to the ISO 19115 standard:

001 - farming

002 - biota

005 - economy

007 - environment

010 - imageryBaseMapsEarthCover

011 - intelligenceMilitary

012 - inlandWaters

017 - structure

018 - transportation

019 - utilitiesCommunication

3.5 Spatial representation type

The form of the spatial representation (see: ISO 19115: *MD_SpatialRepresentationTypeCode* «CodeList»).

002 - grid

3.6 Spatial resolution

Spatial resolution denominators of the data:

10 000 - 100 000

Local or regional scale.

The highest-resolution orthoimages used in national imagery are resampled at 10 m for the panchromatic image and at 20 m for the multispectral image. For example, if the image is located in a region for which a 5 m panchromatic resolution is required, the 10 m panchromatic national image is derived from the

highest-resolution orthoimage. The 5- and 10-metre grids are aligned. The radiometric values of the 10/20 metre pixels of the national image are obtained through 5/10 metre pixels from the highest-resolution image.

3.7 Geographic description

3.7.1 Authority

International Organization for Standardization (ISO)

3.7.1.1 Title

Standard of the code of geographical regions:

ISO 3166-1:1997 Codes for the representation of names of countries and their subdivisions – Part 1: Country codes.

3.7.1.2 Date

Reference date of the ISO 3166-1 standard:

1997-10-01

3.7.1.3 Date type code

Type of date according to ISO 19115 standard:

002 – publication

3.7.2 Code

Code of the geographical region covered by the product according to the ISO 3166-1 standard:

CA – Canada

3.7.3 Extent type code

Type of code of the delimitation polygon of the extent according to the ISO 19115 standard:

1 – inclusion

3.8 Reference to specification scope

Global

4 DATA CONTENT AND STRUCTURE

4.1 Description

The *GeoBase Orthoimages 2005-2010* are composed of thousands of pixels. Each pixel of information covers a portion of the Earth's surface according to its spatial resolution (spectral bands). The pixels are located in a column (north/south) and row (east/west) axis reference system.

4.2 Coverage information (CD)

4.2.1 Description

Orthoimages have a resolution of 10 metres for the panchromatic band and 20 metres for the multispectral bands. The panchromatic and multispectral bands are aligned. If the resolution of the source image is better than the requested 10 metres or 20 metres and the images are resampled at 10 and 20 metres, the original source images are provided for quality control purposes. The radiometric information from the resulting image matches the information from the original higher-resolution image as closely as possible. Each band has a radiometry of 8 bits (values between 0 and 255).

The multispectral image provides four bandsThe minimum cloud-free (2% maximum) coverage required for an image (selected zone) is 40 km x 40 km, panchromatic and multispectral taken simultaneously.

4.2.2 Coverage type

Continuous quadrilateral grid coverage.

4.2.3 Specification

4.2.3.1 Domain extent

Canada's landmass according to the orthoimage coverage acquired.

4.2.3.2 Range type

Name: Radiometry

Value: Integer (0-255)

Spot 4 Imagery – Spectral and spatial resolution

Spot4 Band No.	Spectral Location	Wavelength (in µm)	Resolution (pixel size in m)
	Panchromatic	0.61 – 0.68	10
B1	Green	0.50 – 0.59	20
B2	Red	0.61 – 0.68	20
B3	Near infrared	0.78 – 0.89	20
4	Short wavelength infrared	1.58 – 1.75	20

Spot 5 Imagery – Spectral and spatial resolution

Spot5 Band No.	Spectral Location	Wavelength (in µm)	Resolution (pixel size in m)
	Panchromatic	0.48 – 0.71	10
B1	Green	0.50 – 0.59	20
B2	Red	0.61 – 0.68	20
B3	Near infrared	0.78 – 0.89	20
4	Short wavelength infrared	1.58 – 1.75	20

4.2.3.3 Common point rule

High

NOTE: The value of the pointing may vary due to the application used.

4.3 Reference to specification scope

Global

5 REFERENCE SYSTEMS

5.1 CANLAMB (LCC for Canada) Spatial reference system

Spatial data is expressed according to the Canada Lambert Conformal Conic (CANLAMB) projection, in reference to the North American Datum 1983 Canadian Spatial Reference System (NAD83CSRS).

CANLAMB Projection Data:

Coordinate reference system type code:	1 (in accordance with the ISO 19111 Standard)
Coordinate reference system identifier:	CANLAMB-CSRS
Datum identifier:	NAD83 CSRS
Ellipsoid identifier:	Geodetic Reference System 1980
Ellipsoid semi-major axis:	6378137.0 m
Ellipsoid shape:	true
Ellipsoid inverse flattening:	298.257222101
Coordinate system identifier:	Lambert Conformal Conic
Coordinate system type:	projected
Coordinate system dimension:	2
Coordinate system axis name:	N
Coordinate system axis direction:	north
Coordinate system axis unit identifier:	metre
Coordinate system axis name:	E
Coordinate system axis direction:	east
Coordinate system axis unit identifier:	metre
Coordinate operation identifier:	Lambert Conformal Conic
Coordinate operation method formula:	EPSG
Coordinate operation method parameter number:	6140
Coordinate operation parameter name:	latitude of origin
Coordinate operation parameter value:	49 degrees
Coordinate operation parameter name:	longitude of origin
Coordinate operation parameter value:	-95 degrees
Coordinate operation parameter name:	standard parallel 1
Coordinate operation parameter value:	77 degrees
Coordinate operation parameter name:	standard parallel 2
Coordinate operation parameter value:	49 degrees
Coordinate operation parameter name:	false easting
Coordinate operation parameter value:	0 metre
Coordinate operation parameter name:	false northing
Coordinate operation parameter value:	0 metre

5.2 UTM Spatial reference system (Universal Transverse Mercator)

Spatial data is expressed according to the Universal Transverse Mercator projection, in reference to the North American Datum 1983 Canadian Spatial Reference System (NAD83CSRS). Longitude is expressed using a negative number to represent a position west of the central meridian (0°). The unit of measure for the coordinates is the degree expressed in true value to seven decimal points.

5.2.1 Authority

5.2.1.1 Title

Registry containing reference system parameters:

EPSG Geodetic Parameter Dataset

5.2.1.2 Date

Reference date:

2007-02-08

5.2.1.3 Date type code

Type of date according to ISO 19115 standard:

002 – publication

5.2.1.4 Responsible party

OGP (International Organisation of Oil and Gas Producers

URL : http://www.epsg.org

5.2.2 Code

Reference system identifier or CRSID (Coordinate Reference System Identifier):

2955 to 2962 and 3154 to 3161

Note: Each code represents one of Canada's 16 UTM (7 to 22) zones.

5.2.3 Code space

EPSG - European Petroleum Survey Group

5.3 Reference to specification scope

Global

6 DATA QUALITY

6.1 Completeness

Not applicable

6.1.1 Commission

Not applicable

6.1.2 Omission

Not applicable

6.2 Logical consistency

The highest-resolution orthoimages used in national imagery are resampled at 10 m for the panchromatic image and at 20 m for the multispectral image. For example, if the image is in a region for which a 5 m panchromatic resolution is required, the 10 m panchromatic national image is derived from the highest-resolution orthoimage. The 5- and 10-metre grids are aligned. The radiometric values of the 10/20 metre pixels of the national image are obtained through 5/10 metre pixels from the highest-resolution image.

To ensure that the panchromatic and multispectral orthoimages are aligned, the coordinates of the upper left-hand corner and lower right-hand corner of each image are exactly identical. Thus, the panchromatic image will contain twice as many pixels as the multispectral image on each axis.

6.2.1 Conceptual consistency

Not applicable

6.2.2 Domain consistency

Not applicable

6.2.3 Format consistency

Not applicable

6.2.4 Topological consistency

Not applicable

6.3 Positional accuracy

Planimetric accuracy of orthoimages depends on the control data, the digital elevation model (DEM) and the method used to extract the positions of the control points on the image. The best sources of control data available in Canada are used to generate the orthoimages. A certain number of control sources are used to rectify the images, including the *National Road Network* (NRN), the CPLIC1 (Control Points for Landsat 7 Imagery, Canada, Level 1) and Landsat 7 orthoimages. Various digital elevation models (DEMs) were also used to generate the orthoimages: DEMs from Quebec and Canadian Digital Elevation Data (CDED) at scales of 1:50 000 and 1:250 000. The accuracy is determined using a level of confidence of 90% (Circular Map Accuracy Standard (CMAS) (CCSM, 1984)).

The planimetric accuracy for the orthoimages in Southern Canada is about 20 metres, compared to about 30 metres in the northern part of the country. It should be noted that only control data within Canada was used. The planimetric accuracy of the part of the image located outside of Canada may therefore be inferior. Each orthoimage has a different planimetric accuracy.

The accuracy of the orthoimages is greater than or equal to that of the GeoBase of Landsat 7 orthoimages (GDAL). The goal is for the orthoimage to be at least aligned with the existing infrastructure.

6.3.1 Absolute spatial accuracy

When the control points are evenly distributed along the road network, the following formula is used to calculate the horizontal accuracy:

1.5174 * {[Velx * tangent (viewing angle)]^2 + RMSx^2 + RMSy^2}^1/2, where:

Velx is the weighted vertical accuracy of the DEM affecting the direction of X. RMSx and RMSy are the control point accuracies given by the residual RMS of the satellite model, and the viewing angle is the viewing angle of the sensor when the image is captured.

In the other cases, the resulting accuracy is equal to the weighted average of the accuracy of the Landsat 7 orthoimages used during the orthorectification process.

6.3.2 Relative spatial accuracy

Unknown

6.4 Temporal accuracy

Not applicable

There is no temporal attribute for the *GeoBase Orthoimages 2005-2010* other than the date of capture of the imagery identified in the metadata.

6.4.1 Accuracy of a time measurement

Not applicable

6.4.2 Temporal consistency

Not applicable

6.4.3 Temporal validity

Not applicable

6.5 Thematic accuracy

Four (4) multispectral bands with a resolution of 20 metres and one panchromatic band with a resolution of 10 metres are available.

6.5.1 Thematic classification correctness

Not applicable

6.5.2 Non quantitative attribute accuracy

Not applicable

6.5.3 Quantitative attribute accuracy

Not applicable

6.6 Reference to specification scope

Global

7 DATA CAPTURE

7.1 Description

The *GeoBase Orthoimages 2005-2010* are produced from control points located in sectors in the image corner and in the middle of the east and west boundaries (9 base sectors). The accuracy of the digital elevation model (DEM) affects the accuracy of the orthoimage (tangent of the viewing angle in degrees). The Canadian Digital Elevation Data (CDED) used in the orthorectification process is that found in the GeoBase portal. When available, CDED at a scale of 1:50 000 is used. If it is not available, CDED at a scale of 1:250 000 is used instead. The Quebec digital elevation data (*Ministère des Ressouces naturelles et de la Faune*) is favoured for Quebec's landmass south of the 49th parallel.

The DEM may be a combination of provincial data and Canadian Digital Elevation Data (CDED) at scales of 1:50 000 or 1:250 000. The geometric correction model developed by Dr. Thierry Toutin (CCT) and implemented by PCI Geomatics is used with the raw, level 1A SPOT image and a DEM to produce the orthoimage. The resampling method used during orthorectification is cubic convolution Sin 8pt (8 point sine).

The following basic data is used to produce the *GeoBase Orthoimages 2005-2010*: the National Road Network (NRN), the Control Points for Landsat 7 Imagery, Canada, Level 1 (CPLIC1) and Landsat 7 orthoimages found in the GeoBase portal.

A minimal pre-treatment is applied to the source data corresponding to level 1A of the SPOT satellites.

The *GeoBase Orthoimages 2005-2010* are provided to the public as soon as they are produced. The production of *GeoBase Orthoimages 2005-2010* depends on the availability of control information at the origin and the ability of the producing organization to generate them.

Radiometric corrections:

The radiometric corrections requested are the corrections related to the sensor and the satellite platform. The basic level of correction does not include geometrically correcting the image. For example, in the case of SPOT satellites, the requested corrections correspond to level 1A. The methodology includes the basic corrections performed on the raw image that is delivered.

A maximum viewing angle of 15 degrees is allowed.. A viewing angle of more than 15 degrees may be used but only in exceptional circumstances and upon approval from the Centre for Topographic Information in Sherbrooke (CTI-S).

All portions of scenes composed in the cloud-free zone selected (40 km x 40 km) are free from haze, smog, fog and mist and have a transparency factor of 95%.

Resampling by cubic convolution is used in the creation of the orthoimage.

To ensure that the panchromatic and multispectral orthoimages are aligned, the coordinates of the upper left-hand corner and lower right-hand corner of each image are identical. Thus, the panchromatic image contains twice as many pixels as the multispectral image on each axis.

The accuracy of the orthoimages is greater than or equal to that of the GeoBase of Landsat 7 orthoimages (GDAL). The goal is for the orthoimage to be at least aligned with the existing infrastructure.

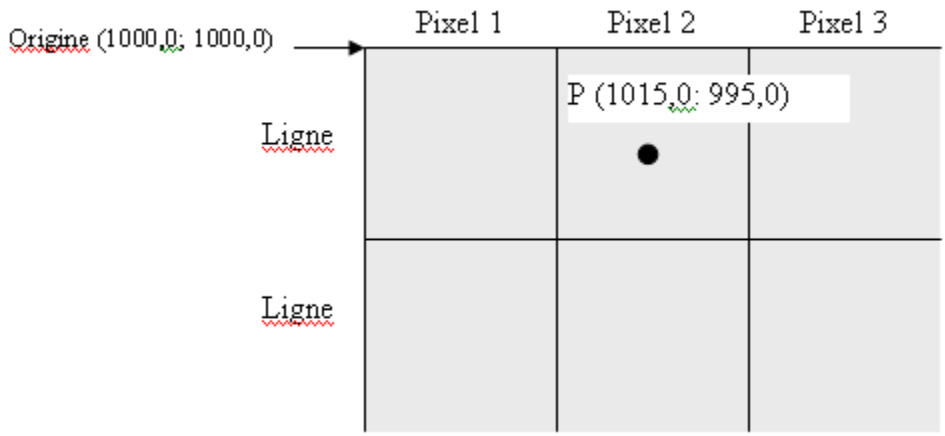
Cloud-free coverage:

One of the objectives of the national imagery coverage is to obtain cloud-free coverage. Cloud cover over a maximum of 4% of the orthoimage (excluding shadows) is considered acceptable.

To achieve this objective, a zone measuring at least 40 km x 40 km of the delivered image, that meets the maximum 4% cloud coverage, can be selected. The portions of the delivered image that are outside of the zone selected may contain a cloud cover over 4%.

Coordinates reference system:

The geographic coordinates are referenced with respect to the northwest corner of the orthoimage grid. The following image shows an example of the reference for a random point on the orthoimage. For example, if the northwest corner of the image (upper left) has the coordinates (X, Y): (1000.0; 1000.0), the point P found at the centre of the second pixel of the first line for a resolution of 10 metres would have the coordinates: X = 1015.0 and Y = 995.0



7.2 Reference to the specification scope

Global

8 DATA MAINTENANCE

8.1 Description

Initial production of orthoimages for Canadian coverage. At present, there is no maintenance (image renewal) planned.

8.2 Reference to specification scope

Global

9 DATA PRODUCT DELIVERY

9.1 Delivery format information GeoTIFF

SPOT satellite image.

9.1.1 Format name

GeoTIFF

9.1.2 Version

Version 1.8.2

9.1.3 Specification

GeoTIFF Format Specifications – Revision 1.0

(http://www.remotesensing.org/geotiff/spec/geotiffhome.html)

9.1.4 Language

Languages used in the dataset according to ISO 639-2 standard:

eng–English

fra–French

9.2 Delivery medium information

9.2.1 Units of delivery

SPOT satellite image.

9.2.2 Transfer size

The average size of a full GeoBase Orthoimage is approximately 130 MB, including the five bands.

9.2.3 Medium name

FTP

9.2.4 Other delivery information

The *GeoBase Orthoimages 2005-2010* are available directly on-line through an FTP site. The client is informed via email when the process has been completed and the file is available for transfer.

Information regarding restrictions in terms of access to the data and its use is explained in the GeoBase Unrestricted Use Licence Agreement (www.geobase.ca - in the Data section).

When the orthoimage covers two UTM zones, the orthoimage is produced in both zones.

In Canada, for the LLC projection, the standard parallels are 49 degrees North and 77 degrees North; the latitude of the projection origin is also 49 degrees North, and the longitude of the central meridian is 95 degrees West. The false easting and the false northing are both equal to 0 (zero) metres.

For UTM projection in Canada, the scale factor of the central meridian is 0.9996; the UTM zone number is determined using the following formula: (180°-λ/ 6° + 1); the latitude of the projection origin is zero degrees. The false easting is 500 000 metres and the false northing is equal to 0 metres.

9.3 Reference to specification scope

Global

10 METADATA

Not applicable

10.1 Reference to specification scope

Global