This page contains FGDC GEO Profile compliant metadata for Collection Level Metadata

Landsat-7 Orthoimage

Metadata:

Identification_Information:
Citation:
Citation_Information:
Originator: Geomatic Canada Centre for Topographic Information
Geospatial_Data_Presentation_Form: remote-sensing image
Series_Information:
Series_Name: Landsat_ETM
Issue_Identification:
The Landsat-7 satellite's payload includes the ETM+ sensor. The ETM+ sensor is an enhanced version of the TM sensor flown aboard the Landsat-4 and -5 satellites. Sensor enhancements include the addition of the panchromatic band and two gain ranges, improved spatial resolution for the thermal band, and the addition of two solar calibrators.
Description:
Abstract:
The orthoimage data set is created with the most accurate control data available at the time of creation. The imagery has been corrected with either provincial and aerial triangulation data or, if not available, the most accurate NTDB data. The objective is to obtain accuracy of 30 metres or better in the South and 50 metres or better in the North for a 90% level of confidence. The accuracy is evaluated for each orthoimage data set. The control data, which has been extracted from sources as mentioned above, can consist of road intersection vector data or lake/island centroids. In some cases the intersection of the centre line of surficial river may have been used. The control points are distributed homogeneously within the image in specific sectors. Sectors are located in the surround of the image, in the lowest and highest elevation area of the image, and in all other areas in which overlapping image base sectors are located.
Purpose:
The national orthoimage objective is the production of a complete set of cloud-free orthoimages covering the Canadian landmass, using the Thematic Mapper data from the Landsat-7 satellite.

Supplemental_Information:

Landsat-7 data are collected from a nominal altitude of 705 kilometres in a near-polar, near-circular, Sun-synchronous orbit at an inclination of 98.2 degrees, imaging the same 183-km swath of the Earth's surface every 16 days. Each frame is denoted by a sequential Path and Row determined by the 16-day repeat cycle. Landsat sensors require 233 orbits. The Rows, indexed east/west, are generated by partitioning each Path into 23.92 seconds of spacecraft time in both directions at the equator, resulting in 248 Rows per complete orbit. The Landsat sensors continuously collect data which are segmented post-collection on the ground, using telemetry ephemeris data, into individual framed scenes. The orbital tracks can drift over time due to a variety of factors and are adjusted when necessary. The framing is unique for each orbit. Accordingly, the frame locations are not exact, but are within a tolerance of movement off the original satellite orbit. The satellite orbit results in a coverage side overlap of a minimum of 7.3% at the equator increasing to approximately 85% at 80 degree of latitude.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

Six (6) multispectral bands are available with a resolution of 30 metres (also available with a resolution of 25 metres to Province of Quebec). A panchromatic band 8 was added, with a resolution of 15 metres (also available with a resolution of 12.5 metres to Province of Quebec). Band 6 now has high-gain and low-gain bands with a resolution of 60 metres (also available with a resolution of 50 metres to Province of Quebec).

Logical_Consistency_Report:

Control points are chosen in predefined areas on the image to ensure good and equitable distribution. The image area planned for control-point selection has been reduced by 4.5 km in the east and west boundaries of the image. This reduction ensures reuse of the same control points in the next image update. Tests were done on 3 images to determine the best location of control points within an image in order to achieve greater accuracy. These images contained various types of terrain and were very representative of the canadian landmass. Various control-data types and accuracy were used for these images. The tests concluded that control points in 6 base sectors in the image surround and in the minimum and maximum elevation sectors deliver the best accuracy. Overlapping images are considered and corresponding base sectors are added. These additional sectors (between 4 to 10) do not improve the accuracy but ensure the use of the same control points in the image overlaps. When accurate control (sub-pixel) is used, the correction model is a good indicator of the derivation of the orthoimage's accuracy.

Completeness_Report:

The data set is derived from Landsat-7 raw image level L1G. It has been processed using control points based on the most accurate control available data in the country. The methodology ensures homogeneous distribution of control points within the image. The parametric model was developed by Dr. Thierry Toutin at the Canada Centre for Remote Sensing (CCRS), Natural Resources Canada. This model is based on principles related to orbitography, photogrammetry, geodesy, and cartography. It reflects the physical reality of the complete viewing geometry and corrects distortions that occur due to platform, sensor, Earth, and cartography projection. The Digital Elevation Model (DEM) is the most accurate source available as of the date of ortho rectification. It can be a combination of provincial data, 50K Canadian Digital Elevation Data (CDED), or 250K CDED.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

The horizontal accuracy is based on the control data, DEM, and methodology used to extract and position control points on the image. Tests were done on images located in Kamloops (British Columbia), Winnipeg (Manitoba), and Montreal (Quebec). These areas were selected for their differences in terrain and the availability of control data. Various sources of control data were used, such as provincial vector data, roads controlled by GPS, 50K National Topographic Data Base (NTDB) and 250K NTDB data. Various types of distribution of control points and the impact of DEM has been tested and assessed. The accuracy given in the metadata is derived from an analysis of the parametric model and DEM accuracy. The analysis includes the elimination of blunders (3 sigmas). For DEMs, the altimetric and planimetric accuracies of the original map must be considered to calculate the combined altimetric accuracy that affects the orthoimage. In order to evaluate the impact on the orthoimage of the 250K DEM planimetric accuracy, a slope evaluation of the entire country has been done (excluding British Columbia because provincial DEM is provided). The results of this evaluation indicated that for 95% of the area covered by an image, the slope is lower than 25%. The DEM used to ortho-rectify images is built by merging DEM coming from different sources (federal or provincial). For each DEM, the vertical accuracy is calculated. These calculations include the DEM error in the 3 axis (x,y,z) and the highest slope of the region covered by the DEM. Finally this accuracy impact has been combined

to the RMS given by the parametric model to obtain the resulting orthoimage planimetric accuracy at a 90% level of confidence. Well-defined features located in areas of higher than 25% slope may not meet this level of accuracy. Tests revealed that very few well-defined features are located in areas in which the slope is greater than 25%.

The following formula is used:

(((Model_RMSX**2 + (tan (7) * DEM accuracy)**2)+
Model_RMSY**2)**1/2)*1.5174
Where,

Model_RMSX:	RMS given by the parametric model,
tan (7):	Impact in X of the elevation at the maximum view angle
DEM accuracy:	Accuracy of the worst DEM used in rectification (slope < 40%)
Model_RMSY:	RMS given by the parametric model and
1.5174:	Circular error factor for a 90% probability

Lineage:

Source_Information:

Many different sources may have been used to control the image. The best control data available at the production time has been used. The possible types of control data are: provincial data (lakes, islands, rivers and road intersection), NTDB accurate vector data (less than 30 metres), roads acquired by GPS, and vectors extracted from federal aerial triangulation photograph. Source information on each control point used to control the image can be provided by CTIS with the Orthoimage Landsat-7-PathRow_EditionVersion_YYMMDD_L7 identifier.

Source_Citation:

Citation_Information:

Originator: U.S. Geological Survey (raw image), CTIS Centre for Topographic Information – Sherbrooke (NTDB), CTIO (aerial triangulation), and/or Provincial data

British Columbia: Provincial vector data
Alberta: Provincial vector data
Saskatchewan: NTDB data
Manitoba: Federal aerial triangulation and GPS road network
Ontario: Provincial vector data
Quebec: Provincial vector data
New Brunswick: Provincial vector data
Nova-Scotia: Provincial vector data and NTDB data
Prince Edward Island: Provincial vector data and NTDB data

Geospatial_Data_Presentation_Form: remote-sensing image and vector digital data

Source_Citation_Abbreviation: Province name, Federal or MultiSource

Source_Contribution: When the Source Citation Abbreviation is Province, digital vector data and DEM (in some cases) have been used as control data. If the Source Citation Abbreviation is Federal or MultiSource, federal (road network, NTDB, aerial triangulation) and/or provincial data have been used. The orthoimage accuracy has been computed in reference to the control data used. The control points have been derived from road and river intersections and lake/island centroids.

Process_Step:
Process_Description: Orthoimages are produced from control points located in sectors in the image corner and in the middle of the east and the west boundaries (6 base sectors). Additional sectors are used in minimum and maximum elevation areas within the image. The theoretical limit of overlapping images has been used to create additional sectors (where projected base sectors of overlapping images are located). A minimum of 3 control points by sector has been selected. An average of 14 sectors containing control points allows the creation of the correction model. The worst case scenario gives a minimum of 42 well-distributed control points for the correction model. The Digital Elevation Model (DEM) accuracy has a small impact on orthoimage accuracy (tan 7 * DEM accuracy). Elevations attached to entities used as control points are derived from provincial DEMs, federal DEMs, or from aerial-triangulation models. Various DEMs can be used for rectification depending on availability. The horizontal accuracy given for the orthoimage uses the worst DEM accuracy in the calculation. DEM used can be provincial, NTDB 50K, or NTDB 250K data, depending on availability. The process uses provincial DEM if available, completes the gaps with DEM derived from 50K NTDB contours, and, finally, completes the remaining gaps with DEMs derived from 250K contours. Since DEM accuracy has little impact on image accuracy, the worst DEM accuracy (including slope impact) serves in assessing orthoimage accuracy. At the end of the process, all valid control data and image entities are kept in a database. The database is linked to the Canadian Alignment Layer (CDAL). The correction model can be recreated at any time using the control data and image information. The correction model is not provided.

Algorithm_Information: PCI Satellite Ortho and DEM package
Algorithm_Identifiers: Parametric Model
Algorithm_Reference:
Toutin, Thierry. 1993. Multisource data fusion with an integrated and unified geometric modelling. Internal Report, Canada Centre for Remote Sensing, 588 Booth Street, Ottawa, Ontario, Canada.
Toutin, Thierry and Yves Carboneau. 1992. La Création d'ortho-images avec MNE: Description d'un nouveau Système, Canadian Journal of Remote Sensing. Vol. 18, No. 3. July 1992. Pgs 136-141.

Processing_Information:
Processing_Identifiers:
Citation:
Citation_Information:
Originator: Centre for Topographic Information- Sherbrooke
Geospatial_Data_Presentation_Form: remote-sensing image
Series_Information:
Series_Name: Landsat_ETM
Issue_Identification:
The Landsat-7 satellite's payload includes the ETM+ sensor. The ETM+ sensor is an enhanced version of the TM sensor flown aboard the Landsat-4 and -5 satellites. Sensor enhancements include the addition of the panchromatic band and two gain ranges, improved spatial resolution

for the thermal band, and the addition of two solar calibrators. The processing of Landsat-7 images is an ortho rectification based on the best accurate control data available from federal and provincial governments. Control points are well distributed and reused in overlapping images to allow better mosaicking.

Processing_Software:

Processing_Software_Reference:

Citation:

Citation_Information:

Originator: PCI Geomatics

Title: Satellite Ortho and DEM package

Metadata_Contact:

Contact_Information:

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Address_Type: mailing and physical address

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Metadata_Standard_Name: Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998

Metadata_Time_Convention: local time

Metadata_Access_Constraints: None

Metadata_Security_Information:

Metadata_Security_Classification: Unclassified