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Product description:

Historic orthophotos

Innehållsförteckning

1 General description

Historic orthophotos are produced out of older (before 1995) scanned aerial photos, that are geometrically projected to an orthogonal (scale correct) map projection by using an elevation model.

In an orthophoto the scale or distance between points are not affected by variations in the terrain, which is the case in an aerial photo with central projection.

1.1 Contents

The product contains orthogonal projected aerial photos (orthophotos) in black and white (b/w), with a resolution of 0,5 m and 1 m. Local deviations may however occur depending on flight altitude. For overview information of the product, see Historiska ortofoton.

1.2 Geographic coverage

The objective is to create nationwide fully covering layers of Historic orthophotos for different reference years. A complete nationwide coverage with orthophotos from aerial photography carried out between mainly 1955 and 1965 is already available (Reference year 1960). Work is ongoing with a complete nationwide coverage of orthophotos from aerial photography carried out between mainly 1970 and 1980 (Reference year 1975).

For up-to-date and detailed presentation of coverage and available orthophotos, see www.geolex.lm.se, alternatively download as shape files here: Planer och utfall - Bildförsörjningsprogrammet, under the headline Historic orthophotos.

1.3 Geographic cut-out

Historic orthophotos are produced and stored in 5 x 5 km tiles, adjusted to the reference system RT 90 2,5 gon V. The reason for this is that the images exposure points, as well as the original ground support, are adjusted to RT 90 2,5 gon V. Delivery of Historic orthophotos are however made in SWEREF 99 TM and the associated local zones.

Historic orthophotos are delivered in files with corresponding 5x5 km index tiles, but can also be ordered in a preferred cut-out, with min-max coordinates. When ordered in cut-outs, polygons or tiles larger than the index tile, all affected index tiles will be delivered.

For more information regarding the index system and the new designation of the index tiles, see Infoblad 11.

Below are the file coverage and file sizes for the product presented.

Product	File coverage	Average file size for LZW-compressed GeoTIFF
Historic orthophoto b/w 1 m	5x5 km (5 000x5 000 pixlar)	21 MB
Historic orthophoto b/w 0,5 m	5x5 km (10 000x10 000 pixlar)	85 MB

1.4 Coordinate system

Horizontal: SWEREF 99 TM and associated local zones.

Vertical: RH 70.

2 Quality description

In Fel! Hittar inte referenskälla. quality, including quality themes and quality parameters as described in the standard SS-EN ISO 19157:2013 Geografisk information – Datakvalitet, is presented. More detailed description of lineage and quality can be found in the text below.

Table 1: Quality themes and quality parameters for Historic orthophotos

Quality theme	Quality parameter	Quality
Positional accuracy	-Absolute positional accuracy -Positional accuracy of raster data	With the methods used in the production of Historic orthophotos the horizontal standard error normally amounts to approximately 2 m. This can however not be guaranteed. There may be local deviations caused by the varying quality of the aerial photos and uncertainties in the support used, due to lack of GPS. Also see chapter 2.4.1 Positional accuracy.

2.1 Purpose and utility

Historic orthophotos are for example used for follow-up on changes in vegetation and built-up areas, identification of old real property boundaries, re-creation of wetlands, locating old landfill sites around industries containing environmentally hazardous waste and other potential and nowadays invisible environmental risks.

Factors such as fog, sun angle and conditions on the ground, such as drought, at the time of photography can give some amount of variation in the photos. Also factors such as the result of the photo processing (i.e. the quality of the physical aerial photo) and the result of the scan can give some amount of variation in the photos.

The orthophotos normally have invisible seams between the included aerial photos.

2.2 Data capture

2.2.1 Lineage

The aerial photography has mainly been carried out from a flight altitude of 4 600 m, with monochromatic film, adjusted to the reference system of that time, RT 90 2,5 gon V. Those aerial photos have more recently been scanned and used for the production of Historic orthophotos.

The aerial photos have been scanned with 15 micrometres. The following georeferencing of the digital photos are partly done with other methods than for new aerial photos, due to the lack of GPS data.

The centre coordinate for the aerial photos are taken from old analogue flight line overviews. Inner orientation is mainly done by searching for the photos collimating marks and measuring these. Old camera calibration protocols are used to achieve coordinates for collimating marks to be able to correct the cameras distortion error. In the case of the protocols only containing the lengths between the collimating marks, the coordinates of the collimating marks must be calculated. Many natural ground control points used in the ordinary block triangulation can also be used for the historic photos.

After the photos have been georeferenced the methods used are the same as for the modern production of orthophotos. The aerial photos are recalculated from central projection to orthogonal projection and corrected for scale variations caused by height differences in the terrain.

The scale-correct photos are thereafter put together in large mosaics, where the seams between the photos are covered as much as possible. The result is orthophotos fitted in a pre-determined coordinate system. Seams can also be placed in a manner that occurring clouds are removed. Therefore a Historic orthophoto can contain photos from different flight years.

The elevation model used for the production of Historic orthophotos is GSD-Höjddata grid 50 +. This model is better suited in terms of time than the new elevation model with a resolution of 2 m. The assessment is that many bigger recent changes, for example new roads and traffic junctions shown in the new elevation model, would create large geometrical errors when used on older photos where these objects don't exist.

Every orthophoto is normally produced from aerial photos from the same flight year. For reference year 1960 however, approximately 20 % of the orthophotos to a certain extent consist of aerial photos from different flight years. This is due to the limited and irregular access to aerial photos. For what is so far produced for reference year 1975 the corresponding percentage is somewhat lower (16 %).

2.2.2 Geometric resolution

The photography has mainly been done from an altitude of 4 600 m, with a negative scale of approx. 1:30 000 and the scan is performed with 15 micrometers. This results in a resolution for the aerial photos of 0,45 m/pixel and a resolution for the orthophotos of 0,5 m/pixel. Some deviations may however occur in the northern mountain regions, where the flight altitude sometimes has been 9 200 m.

An orthophoto can always be recalculated into a lower resolution. An orthophoto with a resolution of 0,5 m can for instance be recalculated and delivered with a resolution of 1 m.

2.2.3 Radiometric resolution

Historic orthophotos have the radiometric resolution of 8 bits, grayscale 0-255. The orthophotos normally have invisible seams between the included aerial photos.

2.3 Maintenance

2.3.1 Maintenance frequency

Older photo material (before 1995) is only available as aerial photos with central projection, mainly stored in an analogue photo storage but also in smaller amount as scanned copies. To facilitate the usage of those old aerial photos, ”new” orthophotos are produced from this old historical photo material. The new-produced scale-corrected aerial pictures are called Historic orthophotos and are “snapshots” from the past.

The objective is to create nationwide fully covering layers of Historic orthophotos for different reference years, for example 1960 (that is already available) and 1975. The concept ”reference year” refers to a year +- approximately 5 years. The reference year 1960 is considered to be the oldest vintage where a complete national coverage can be achieved with the existing photo material. Complete national coverage can not be achieved for older vintages.

For up-to-date and detailed presentation of the production of Historic orthophotos, see www.geolex.lm.se.

2.4 Data quality

2.4.1 Positional accuracy

Since the production methods used are a combination of new and old technique, the positional accuracy for Historic orthophotos is relatively good. Unlike the oldest existing digital orthophotos, where only one photo was used to create the orthophoto, are nowadays approximately three aerial photos (and only the most central parts of each photo) used to produce an orthophoto.

With the methods used in the production of Historic orthophotos the horizontal standard error normally amounts to approximately 2 m. This can however not be guaranteed. There may be local deviations caused by the varying quality of the aerial photos and uncertainties in the support used, due to lack of GPS.

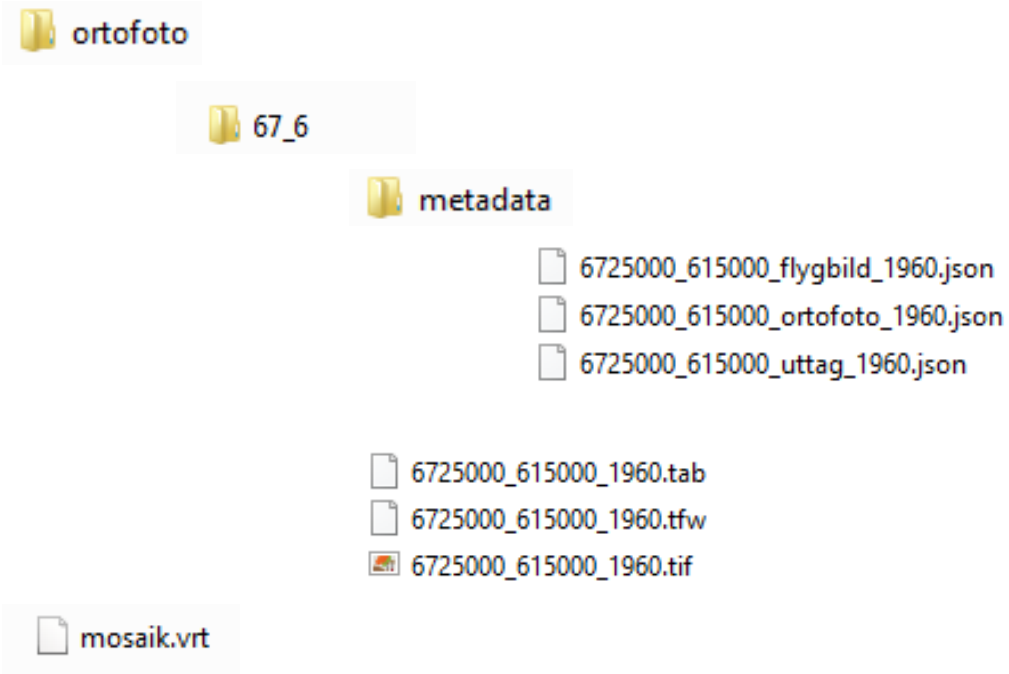
2.5 Metadata

Historic orthophotos with a resolution of 0,5 m are delivered in files covering 5x5 km, adjusted to the chosen coordinate system. The associated metadata files, also adjusted to the chosen coordinate system, show for example which orthophotos they are comprised of and their spread. Information regarding the included aerial photos are also presented, for example time of flight for each included aerial photo, and seamlines are shown in the shape of polygons.

3 Contents of the delivery

3.1 Folder structure at delivery

At delivery the files are sorted under different folders, see example below of a delivery of Historic orthophoto in SWEREF 99 TM.



3.1.1 The folder ”ortofoto”

This folder contains the file mosaik.vrt; a file that creates a virtual mosaic of all the orthophotos in the delivery.

3.1.2 The folder ”67_6”

The naming of this folder is based on the coordinates of the orthophoto, hence it is dynamic. The name of the folder consists of the first two digits in the north-south direction (northern) and the first digit in the east-west direction (eastern) of the lower left corner, for example 67_6.

Beneath this folder lie the image files in LZW-compressed GeoTIFF-format, they can also be delivered in JPEG-format. Together with the image files the associated WORLD-files for the above mentioned formats lie (with the file extensions .tfw and .jgw respectively) and also specifically for MapInfo (with the file extension .tab).

3.1.3 The folder ”metadata”

This folder contains metadata in three different GeoJSON-files for the aerial photos the orthophoto consists of (including their spread), the orthophoto itself and the orthophotos it consists of (including their spread) and the whole orthophoto extraction. The files are adjusted to the chosen coordinate system. For more information regarding file contents, see chapter 3.3.

Schemes for the GeoJSON-files can be downloaded from a scheme server here:
http://namespace.lantmateriet.se/distribution/produkter/ortofoto/v1/

3.2 Delivery format

Historic orthophotos are delivered in LZW-compressed GeoTIFF- or JPEG-format. Both formats have built-in georeferencing in the file, but we also always supply separate WORLD-files. Orthophotos can be delivered in SWEREF 99 TM and associated local zones.

For the GeoTIFF-format Historic orthophotos are delivered with insertion point ”area” (Pixel Is Area), i.e. the value of a pixel covers the whole area of the pixel. For more information we refer to the GeoTIFF-specification:
http://web.archive.org/web/20160326194152/http://remotesensing.org/geotiff/spec/geotiff2.5.html#2.5.2.

3.3 File sets

The file name for a 5x5 km tile can consist of the designation of the tile according to the index system, or the coordinates for the lower left corner of the tile, or the corners of the circumscribing rectangle (minN_minE_maxN_maxE), followed by the year of the orthophoto with four digits. The file name for an arbitrary cut-out can consist of the coordinates for the lower left corner of the cut-out, or the corners of the circumscribing rectangle (minN_minE_maxN_maxE), followed by the year of the orthophoto with four digits.

Files delivered in SWEREF 99 TM local zones are named with a zone prefix first in the file name, for example 1200_. If an orthophoto consists of parts from orthophotos from more than one flight year it is always the most recent flight year that is indicated in the file name.

For more information about the index system and the designation of the index tiles, see Infoblad 11.

File name (exampel)	File contents
6725000_615000_1960.tif	The image in LZW-compressed GeoTIFF-format. In case of delivery of JPEG-format the file has the extension .jpg.
6725000_615000_1960.tfw	WORLD-file (coordinate information) for TIFF-format. In case of delivery of JPEG-format the file has the extension .jgw.
6725000_615000_1960.tab	Coordinate information specifically for MapInfo. Attached regardless of the chosen file format.
mosaik.vrt	Creates a virtual mosaic of all orthophotos in the delivery.

<table>
<tr><th>File name (exampel)</th><th>File contents</th></tr>
<tr><td>6725000_615000_ortofoto_1960.json</td><td>
File in json format (GeoJSON), containing metadata for the delivered orthophoto, including the orthophotos it consists of.

The file contains:

• produkttyp: (Product type): Ortofoto från flygbild (Orthophoto from aerial photo).
• ortoidentitet (Ortho identity), an internal production-id in the format: sey_yg_orrrrr_kåå.

<table>
<tr><th>Letter comb.</th><th>Meaning</th></tr>
<tr><td>se</td><td>Sweden</td></tr>
<tr><td>y_y</td><td>Resolution in metres (0_5 = 0,5 meter)</td></tr>
<tr><td>g</td><td>Grayscale image</td></tr>
<tr><td>o</td><td>Orthophoto</td></tr>
<tr><td>rrrrr</td><td>The 5x5 km index tile in RT 90 2,5 gon V</td></tr>
<tr><td>k</td><td>Källa (Source). Can be one of the following:
<table>
<tr><th>Letterv</th><th>Flight altitude</th><th>Camera constant</th></tr>
<tr><td>a</td><td>9200 m</td><td>150 mm</td></tr>
<tr><td>b</td><td>7600 m</td><td>150 mm</td></tr>
<tr><td>c</td><td>4600 m</td><td>150 mm</td></tr>
<tr><td>d</td><td>3200 m</td><td>150 mm</td></tr>
<tr><td>e</td><td>8300 m</td><td>150 mm</td></tr>
<tr><td>f</td><td>2300 m</td><td>150 mm</td></tr>
<tr><td>g</td><td>3000 m</td><td>300 mm</td></tr>
<tr><td>h</td><td>1800 m</td><td>150 mm</td></tr>
</table>
</td></tr>
<tr><td>åå</td><td>The two last digits of the flight year.</td></tr>
</table>

• ortonamn (Ortho name) in the format: orrrrr_kåå, see above.
• gridreferens (Grid reference) in the format: orrrrr, see above.
• flygar (Flight year). An orthophoto may however consist of aerial photos from different flight years. In that case it is the flight year of the main part of the surface that is presented here.
• flyghojd (Flight altitude, in metres).
• hojdmodell (Elevation model used in the production).
• medelfel ((Standard error (RMSE): For a large number of random selected points take the quadratic sum of the difference between measured and approximated value for each point, divide this with the number of points and thereafter take the square root of the result.

The geometries for the orthophotos in RT 90 2,5 gon V are shown in the shape of polygons.
</td></tr>
</table>

File name (exampel)	File contents

6725000_615000_flygbild_1960.json	File containing metadata in json format (GeoJSON) for the included aerial photos.
	
	The file contains:
	• bildidentitet (Image identity) for all included aerial photos, consisting of:
	  ○ stråkbeteckning (Flight line designation, consists of 1 or 2 digits).
	  ○ flygår (Flight year, consists of 2 digits).
	  ○ bildnummer (Image number, can consist of up to 4 digits).
	• For some vintages some additional metadata may also be presented.
	
	The structure of bildidentitet (Image identity) may also vary somewhat between different vintages: For aerial photos from 1960 onwards the flight year comes first and for aerial photos until 1959 the flight year comes after the flight line designation.
	
	Seamlines between the included aerial photos are shown in the shape of polygons.

6725000_615000_uttag_1960.json	File containing metadata in json format (GeoJSON) for the whole orthophoto extraction.
	
	The file contains
	• ursprung (Origin): Lantmäteriet.
	• land (Country): Sverige.
	• produktionsdatum (Production date and time for the orthophoto extraction).
	• orderidentitet (Order identity).
	• projektion (Projection, EPSG-code).
	• markupplosning (Resolution on the ground, in metres).
	• format (Format of the delivered orthophotos).
	• bandstatistik (Band statistics for the different colour bands).
	  ○ standardavvikelse (Standard deviation)
	  ○ medel (Mean)
	  ○ minimum
	  ○ maximum
	
	The geometry for the whole orthophoto extraction is shown in the shape of a polygon.