LANTMÄTERIET

2023-03-28

PRODUCT DESCRIPTION

Historical orthophotos (Historiska orto-foton)

DOCUMENT VERSION: 2.5

Figure 1. Example of an historical orthophoto.

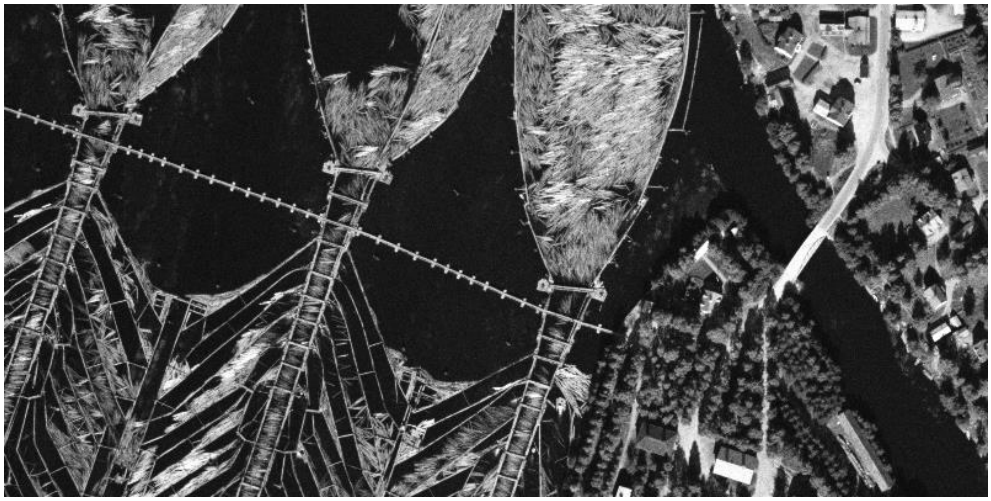


Table of contents

1 General description

Historical orthophotos are produced out of older 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, also orthophotos in colour and IR with a resolution of 0,5 m. Local deviations may however occur depending on flight altitude. For overview information of the product, see Historiska ortofoton at Lantmäteriet's website.

1.2 Geographic coverage

Since there are not enough aerial photographs from one and the same year to cover entire Sweden, we use the term reference year. Reference year 1960 contains a layer of orthophotos from years as close to 1960 as possible in order to obtain national coverage, hence it consists of orthophotos from 1949 to 1970. Reference year 1975 covers large parts of Sweden and consists of orthophotos mainly from the 1970's and 1980's. A few orthophotos might however be available from more years than two. Both reference year layers consist of black and white orthophotos with a resolution of 0,5 m.

There are also a large amount of orthophotos from the years 1993-2005 available; black and white with a resolution of 1 m, colour (2002-2005) and IR(2003-2005) with a resolution of 0,5 m.

For up-to-date and detailed presentation of coverage and available orthophotos, see GeoLex beneath Planer och utfall - Bildförsörjningsprogrammet, alternatively download as shape files there beneath the headline Historical orthophotos.

1.3 Geographic cut-out

Historical 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 adapted to RT 90 2,5 gon V. Delivery of Historical orthophotos are however made in SWEREF 99 TM and the associated local zones.

Historical orthophotos are delivered in files containing the chosen 5x5 km index tiles. For a chosen entire municipality all affected index tiles are delivered.

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

In table 1 below are the file coverage and file sizes for the product presented.

Table 1. File coverage and file size.

Product	File coverage	Average file size for LZW-compressed GeoTIFF
Historical orthophoto b/w 0,5 m/pixel.	5x5 km (10 000 x 10 000 pixels)	85 MB
Historical orthophoto colour/ IR, 0,5 m/pixel.	5x5 km (10 000 x 10 000 pixels)	202 MB
Historical orthophoto b/w, 1 m/pixel.	5x5 km (5 000 x 5 000 pixels)	21 MB

1.4 Coordinate system

Horizontal: SWEREF 99 TM and associated local zones.

Vertical: RH 2000.

2 Quality description

In table 2. 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 2. Quality themes and quality parameters for Historical orthophotos.

Quality theme	Quality parameter	Quality
Positional accuracy	• Absolute positional accuracy • Positional accuracy of raster data	With the methods used in the production of Historical 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

Historical 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.

Pixels without any picture information (that lie outside the orthophotos cut polygon or coverage) have the value 0, in order to be distinguished from for example dark surfaces like water. This is mainly used when the photos do not cover an entire 5 x 5 km tile. If the format is GeoTIFF this is included as embedded information in the shape of No Data Value. There might however occur pixels with the value 0 within the coverage of the orthophoto.

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 Historical orthophotos.

The aerial photos have been scanned with 14-16 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 make corrections for the camera’s distortion error.

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 Historical orthophoto can contain photos from different flight years.

The elevation model used for the production of Historical 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 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 14-16 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.

2.2.3 RADIOMETRIC RESOLUTION

Historical black and white 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 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 Historical orthophotos and are "snapshots" from the past.

A layer with nationwide coverage from reference year 1960, with orthophotos from 1949 to 1970, is already completed. A layer from reference year 1975 covers large parts of Sweden and contains orthophotos from mainly the 1970's and 1980's. Apart from that, a large amount of orthophotos from the years 1993-2005 are available.

For up-to-date and detailed presentation of the production of Historical orthophotos, see GeoLex beneath Planer och utfall - Bildförsörjningsprogrammet.

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 Historical 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 Historical 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

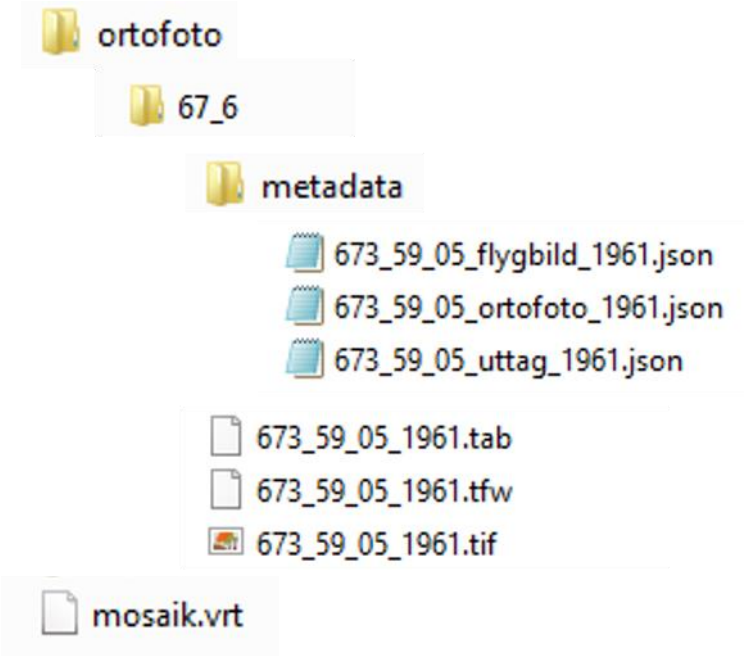
Historical orthophotos with a resolution of 0,5 m/pixel are delivered in files covering 5x5 km, adjusted to the chosen coordinate system. The associated metadata files, also adjusted to the chosen coordinate system, show for example which orthophotos they are comprised of and their spread. Information 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. Observe that for the orthophotos from the years 1993-2005 no metadata at all are available.

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 Historical orthophotos in SWEREF 99 TM.

Figure 2. Folder structure at delivery.



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.

3.2 Delivery format

Historical orthophotos are delivered in LZW-compressed GeoTIFF- or JPEG-format and we also always supply separate WORLD-files. Orthophotos can be delivered in SWEREF 99 TM and associated local zones.

For the GeoTIFF-format Historical 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.

3.3 File sets

The file name for a 5x5 km tile consists of the designation of the tile according to the index system, followed by the year of the orthophoto with four digits.

The year in the file name is set according to the flight year, if an orthophoto consists of aerial photos from different flight years it is the flight year of the main part of the surface that is presented here.

However, if the orthophoto consists of parts from orthophotos from different years, it is the year from the main part of the surface that is indicated in the file name. If surfaces from different years should be of exactly the same size, the most recent year of those surfaces is presented in the file name.

Files delivered in SWEREF 99 TM local zones are named with a zone prefix first in the file name, for example 1200_.

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

Table 3. File contents in image file and coordinate files.

File name (example)	File contents
673_59_05_1961.tif	The image in LZW-compressed GeoTIFF-format. In case of delivery of JPEG-format the file has the extension .jpg.
673_59_05_1961.tfw	WORLD-file (coordinate information) for TIFF-format. In case of delivery of JPEG-format the file has the extension .jgw.
673_59_05_1961.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 4. File contents in metadata files.

<table>
<tr><th>File name (example)</th><th>File contents</th></tr>
<tr><td>673_59_05_ortofoto_1961.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>Letter</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.
</td></tr>
</table>

File name (example)	File contents
	• 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. • produktionstidpunkt (Production date and time according to ISO 8601 Swedish local time, where also the time difference in hours compared to UTC (GMT) is stated; +01 (Swedish standard time) or +02 (Swedish summer time). • The geometries for the orthophotos in RT 90 2,5 gon V are shown in the shape of polygons.

673_59_05_flygbild_1961.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.

673_59_05_uttag_1961.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). • flygar (Flight year). If the delivered orthophoto consists of parts from orthophotos from different years, it is always the year from the main part of the surface that is indicated in the file name. If surfaces from different years should be of exactly the same size, the most recent year of those surfaces are indicated in the file name. • format (Format of the delivered orthophotos).

File name (example)	File contents

	• bandstatistik (Band statistics for the different colour bands) Pixels with No Data Value (0) are not included in the statistics.
	  ○ Standardavvikelse (Standard deviation)
	  ○ Medel (mean)
	  ○ minimum
	  ○ maximum
	• The geometry for the whole orthophoto extraction is shown in the shape of a polygon.