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Product description:
Historic Orthophotos

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1 General description

Historic orthophotos are digitally stored and 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.

This document describes the product Historic Orthophotos and what is included in a delivery.

1.1 Contents

Historic orthogonally projected aerial photos (orthophotos) are only available in black and white with the resolution 0,5 m (local deviations may occur depending on flight height), but can also be delivered with the resolution of 1 m.
For overview information, see http://www.lantmateriet.se/Kartor-och-geografisk-information/Flyg--och-satellitbilder/Flygbilder/Historiska-ortofoton/

1.2 Geographic coverage

The objective is to create a nationwide fully covering layer of historic orthophotos for different reference years, for example 1960. The concept ”reference year” in this document refers to a year +- approximately 5 years.

For historic orthophotos the objective is to have the same spread as for new orthophotos, as far as there are available photos. The reference year 1960 is considered to be the oldest vintage where a complete national coverage can be achieved with the existing photo material. Older vintages will not be fully covering.

For current presentation of coverage and available orthophotos, see www.geolex.lm.se/ and choose Bild och höjd/Historiska ortofoton, alternatively download as shape files (below the headline Historiska ortofoton) on Planer och utfall - Bildförsörjningsprogrammet - Lantmäteriet.

1.3 Geographic cut-out

Historic orthophotos are produced and stored in 5 x 5 km tiles, adapted to the reference system RT 90. The reason for this is that the photos exposure point, as well as the original ground support, is adapted to RT 90.

Historic orthophotos are delivered in files according to the 5x5 km tiles they are stored in, but can also be ordered in an optional cut-out, with min-max coordinates.

1.4 Coordinate system

For Historic Orthophotos: RT 90 2,5 gon V. Delivery can however be made in an optional coordinate system.

1.5 Amount of data

A file containing a historic orthophoto in black and white of a 5 x 5 km tile with the resolution 0,5 m contains 10 000 x 10 000 pixels in a 8-bit photo. Such an uncompressed file amounts to 100 Mb. A corresponding file with the resolution 1 m contains 5 000 x 5 000 pixels, which amounts to 25 Mb.

1.6 Collection method

1.6.1 Aerial photography

The aerial photography has mostly been carried out from a flight height of 4 600 m, with monochromatic film, adapted to the reference system of that time; RT 90. Those aerial photos have more recently been scanned and used for the production of Historic orthophotos.

1.6.2 Production of Historic Orthophotos

The aerial photos are scanned with 15 micron. The following georeferencing of the digital photos are partly done in other ways 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 distorsion error. In the case of the protocols only containing the lengths between the collimating marks, the coordinates of the collimating marks can 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. 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 eventual clouds are removed. Therefore a historic orthofoto can contain photos from different flight years.

The elevation model used for production of historic orthophotos is GSD-Höjddata grid 50 +. This model is better suited in terms of time than the new elevation model with resolution 2 m. The assessment is that many bigger recent changes, for example

newer 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.

1.7 Currency

Lantmäteriet produces fully nationwide covering digital orthophotos since the mid 1990s. 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 photos, "new" orthophotos are produced from this old histocial photo material. The newly produced scale-corrected aerial pictures are called Historic orthophotos and are snapshots from the past.

1.8 Quality

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

Some factors can affect and give some amount of variation in the photos. Examples of such factors are fog, sun angle, conditions on the ground at the photography occasion (such as drought), the result of the developing the photo (i.e. the quality of the fysical aerial photo) and also on the result of the scan.

1.9 Positional accuracy (Geometric quality)

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

1.10 Radiometric quality

The orthophoto normally has invisible seams for every included aerial photo. That can however not always be achieved.

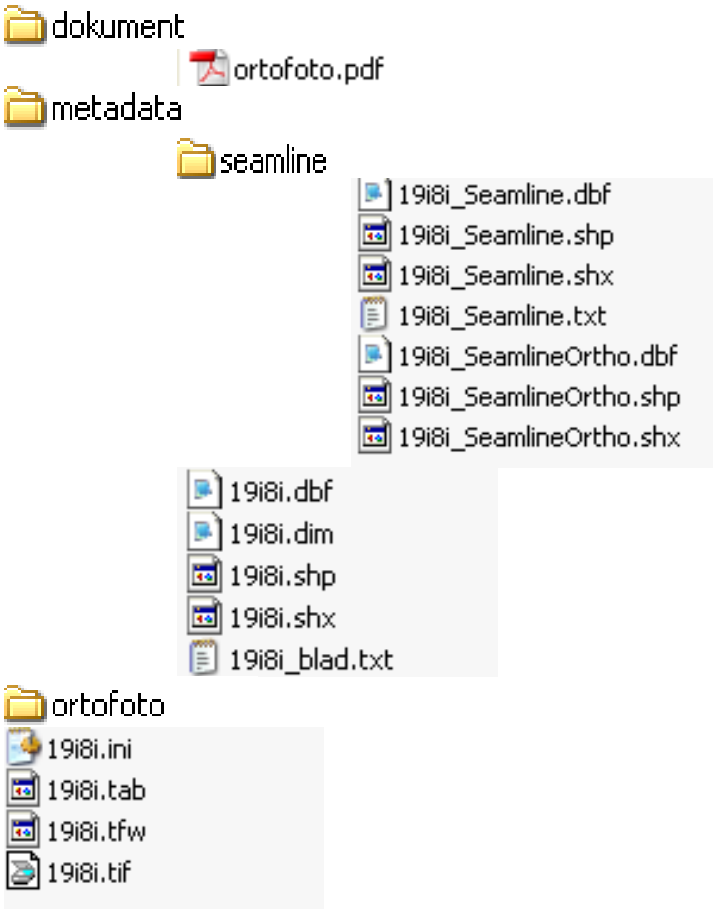
1.11 Geometric resolution

The flight height for the aerial photos, that are the origin of the orthophoto, is crucial for the original geometric resolution. The photography has mainly been done from 4 600 m, with a negative scale of approx. 1:30 000 and the scan is performed with 15 micron, which together gives a resolution of 0,5 m/pixel. Some deviations may however occur in the mountains, where the flight height sometimes has been 9 200 m.

2 Delivery contents

2.1 Folder structure in deliveries

At delivery the files are sorted under three different folders, see example below.



2.1.1 The folder *dokument*

This folder contains the product description for Historic Orthophotos in pdf-format (ortofoto.pdf).

2.1.2 The folder *metadata*

This folder contains metadata in shape format for the spread of each of the produced orthophotos in RT 90 that the delivered orthophoto contains. Partly the same information is presented in a dimap-file (.dim) and in a text file (.txt).

This folder also contains the sub folder seamline, containing:

- BildId (PhotoId, consisting of flight year etc.) for the included aerial photos, including the seamlines between the aerial photos (Seamline), in shape format and corresponding text file.

- Information about the elevation model and software etc. used in the production of the orthophotos in RT 90, including their spread, that the delivered orthophoto contains (SeamlineOrtho), in shape format.

2.1.3 The folder *orthophoto*

This folder contains the orthophoto in TIFF- or JPEG-format together with the corresponding coordinate information for ArcMap (.tfw), MapInfo (.tab) and AutoKa PC (.ini).

2.2 Delivery format

Historic orthophotos are as standard delivered in uncompressed TIFF- or JPEG-format, together with coordinate information. Historic orthophotos are produced in RT 90, but can also be delivered in SWEREF 99 TM.

2.3 Sets of files and contents

The file name for a 5 x 5 km tile consists of the designation of the tile according to the index system. For an optional cut-out with min/max coordinates another identifying designation is assigned.

Below are descriptions of the contents in the files described in chapter 2.1 *Folder structure in deliveries*:

File name (example)	File content
19i8i.tif	The photo in TIFF-format.
19i8i.tfw	Coordinate information for ArcMap.
19i8i.tab	Coordinate information for MapInfo.
19i8i.ini	Coordinate information for AutoKa PC.
Ortofoto.pdf	Product description in pdf-format.

Shape-format is delivered in 3 files.

File name suffix	Type of file
*.shp	Geometry file
*.dbf	Attribute file in Dbase-format.
*.shx	Index file.

<table>
<tr><th>File name (example)</th><th>File content</th></tr>
<tr><td>19i8i.dbf
19i8i.shp
19i8i.shx</td><td>Files containing metadata for the orthophoto in shape format:

• ImageId in the format: sey_yg_orrrrr_kåå.

Letter comb. — Meaning
se — Sweden
y_y — Resolution (for example 0_5 = 0,5 meter)
g — Greyscale
o — Orthophoto
rrrrr — The 5 km index tile in RT 90
k — Source. Can be one of below:
<table><tr><th>Letter</th><th>Flight height</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>åå — The two last digits of the flight year

• ImageName in the format: orrrrr_kåå, see above.
• GridRef (Index tile in RT 90), see above.
• Time (Flight year)
• Altitude (Flight height)
• There is also information about metadata in shape format for the spread of each produced orthophoto in RT 90 that the delivered orthophoto consists of.</td></tr>
</table>

File name (example)	File content
19i8i_blad.txt	Corresponding metadata as above, except for the spread, are also presented in the text file.
19i8i.dim	Metadata can also be found in the dimap file. For documentation and information, see link www.spotimage.fr/dimap/spec/dimap.htm
19i8i_Seamline.dbf 19i8i_Seamline.shp 19i8i_Seamline.shx	Files containing metadata in shapeformat: • BildId (PhotoId) for the included aerial photos, consisting of flight year, flight line and image number. • Information can also be found regarding which aerial photos are included in the orthophoto and where the seamlines between the aerial photas are. Seamlines are shown in the shape of polygones.
19i8i_Seamline.txt	Corresponding metadata as above, except the seamlines, are also presented in the text file.
19i8i_SeamlineOrtho.dbf 19i8i_SeamlineOrtho.shp 19i8i_SeamlineOrtho.shx	Files containing metadata in shapeformat: • BildId (PhotoId) for the orthophoto (see ImageName above) • Time (Flight year). • Elevation model (used in the production). • Software (used in the production of orthophotos). • Standard error (RMSE, calculation method: for a large number of random selected points take the quadratical sum of the differences between measured and approximated value for each point, divide this with the number of points and thereafter take the square root of that result. • Information is also presented regarding the orthophotos that are included in the delivered orthophoto and their spread.