Latvijas Ģeotelpiskās
informācijas aģentūra

Raster data in LGIA

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Raster data described in following slides

Orthophoto created from aerial photography

Digital terrain and surface models created from LiDAR data

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Orthophoto

Orthophoto in the LGIA is created by using aerial photo or satellite imagery data

Orthophoto is the most demanded product of the LGIA that is also used as the base for the map creation for Latvian territory

The production of the maps is a long term process but an orthophoto can provide new geospatial data as soon as a couple of months after the aerial photography

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Cycles of aerial photography	1994-1999	2003-2005	2007-2008	2010-2011	2013-2015	2016-2018
Camera	analogue	digital	digital	digital	digital	digital
Scenes	black-and-white	RGB, PAN	RGB, PAN	RGB, PAN CIR	RGB CIR, PAN	RGBI, PAN, RGB, CIR
Orthophoto	black-and-white	RGB	RGB	RGB, CIR	RGB, CIR	RGB, CIR
Resolution	1m	1m	0,50m	0,50m	0,40/0,25	0,25m
Companies that carried out the aerial photography	Swed Survey, Sweden	Swed survey/ FMKartta, Sweden	Finn-Map, Finland	SIA Metrum, Latvia	Mggp Aero, Poland	Georeal, Czech Republic

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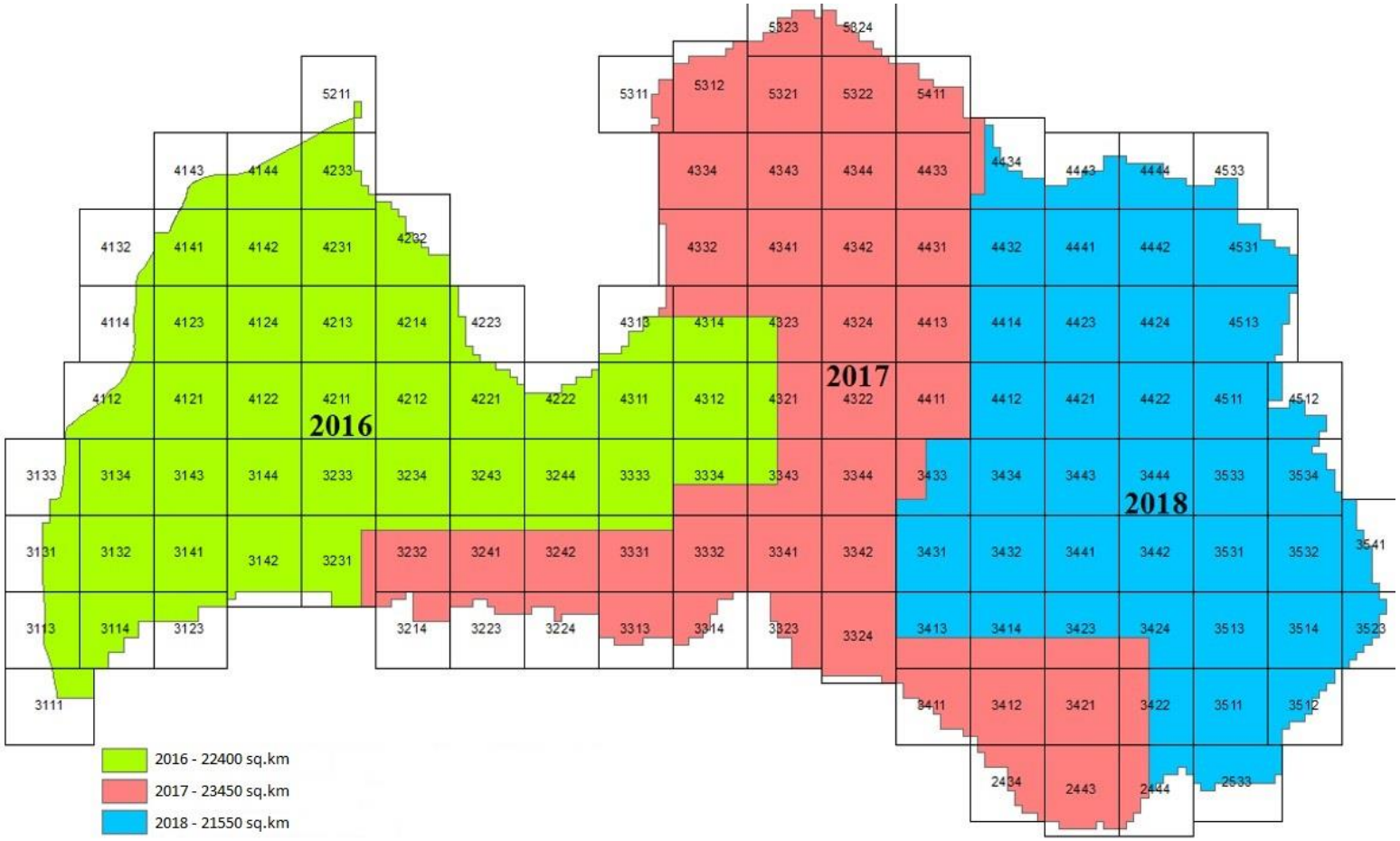
Areas for the aerial photography in Latvia for 2016-2018



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Orthophoto production in the 6th cycle (scene size of a map sheet on a scale 1:5000)

- **2016**
  RGB, RGBI (colored), CIR (infrared) – each type 3584 scenes covering 22 400 km2

- **2017**
  RGB, RGBI (colored), CIR (infrared) – each type 3752 scenes covering 23 455 km2

- **2018**
  RGB, RGBI (colored), CIR (infrared) – each type 3752 cenes covering 23 455 km2

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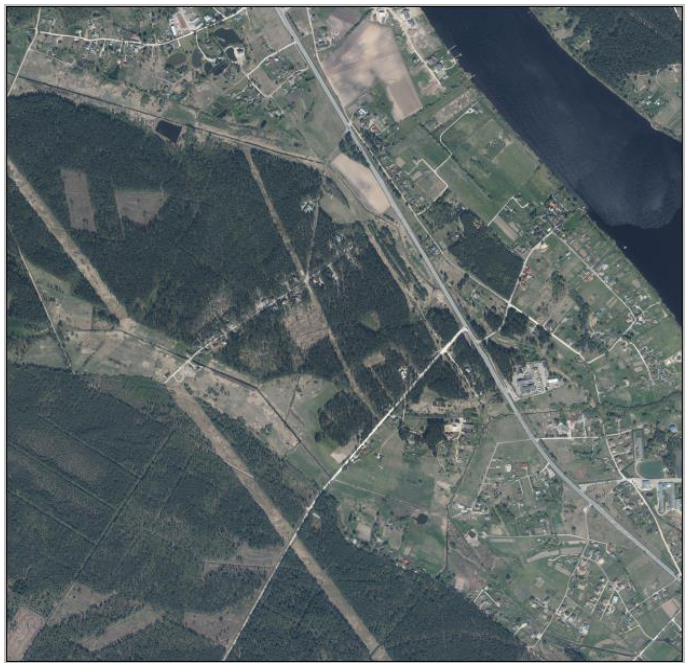
Orthophoto examples from 2016

RGB (colored) 0.25 m



CIR (infrared) 0.25 m

Colored RGB orthophoto scenes are the main products that interest mostly municipalities and planners but also other clients

Infrared orthophoto scenes can be used for the detection of the state of vegetation, therefore they are in demand by the forestry industry

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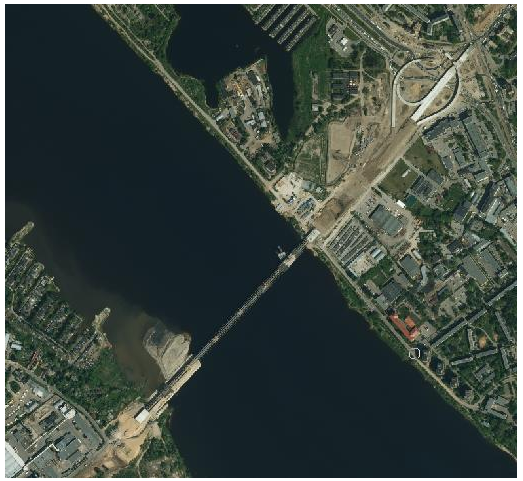
Comparison of the orthophoto

Area of the Southern (Dienvidu) bridge

1st Cycle orthophoto 1994

2nd Cycle orthophoto 2003-2005

3rd Cycle orthophoto 2007-2008



4th Cycle orthophoto 2010-2011

5th Cycle orthophoto 2013-2015

6th Cycle orthophoto 2016-2018

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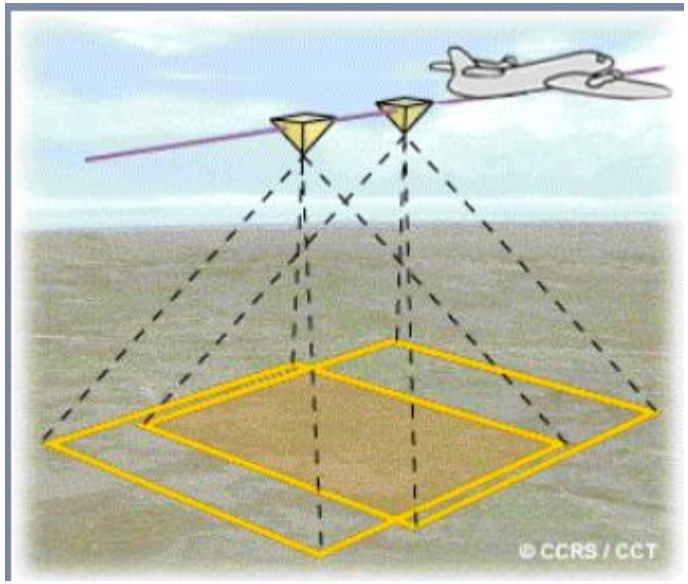
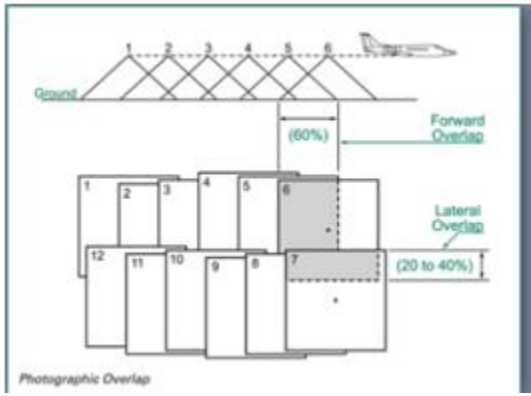
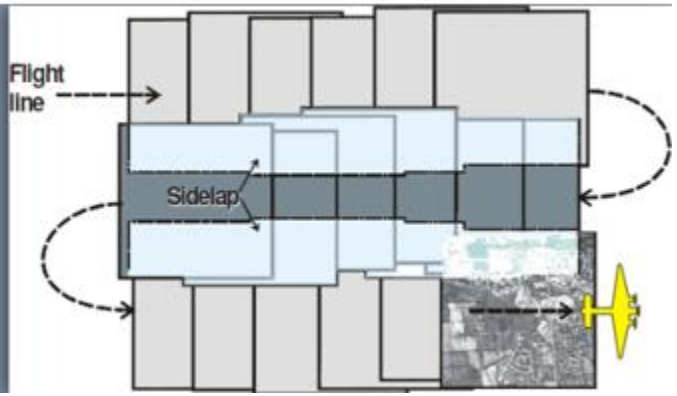
Production process of the orthophoto

Aerial photography







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Cameras used in the aerial photography of the 6th cycle orthophoto

Microsoft Vexcel UltraCam EAGLE -

Z/I Imaging DMC IIe 250

Microsoft Vexcel UltraCamXP

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Technical parameters of the 6th cycle aerial photography

- **Resolution: 0,25m**

- **Types of the scenes: colored (RGBI, RGB), black-and-white (PAN), infrared (CIR)**

- **Camera type: frame camera**

- **Time of scene delivery: 1 month after aerial photography**

- **Time frame of the aerial photography: April to May**

- **Height of the flight - 4000m**

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Production of the orthophoto includes:

- **Digital scenes - RGBI, RGB, CIR, PAN**
- **GPS/IMU data – projection centre geodesy coordinates X0, Y0, Z0 and 3 rotation: angles omega, phi, kappa**
- **The processing of the scenes is done in «Photomod» photogrammetric workstation**
- **For the hight matrix the LiDAR data with 5m resolution are being used**
- **Ortophoto mosaic creation, seam line editing and color adjustment are done with «Orthovista» program**

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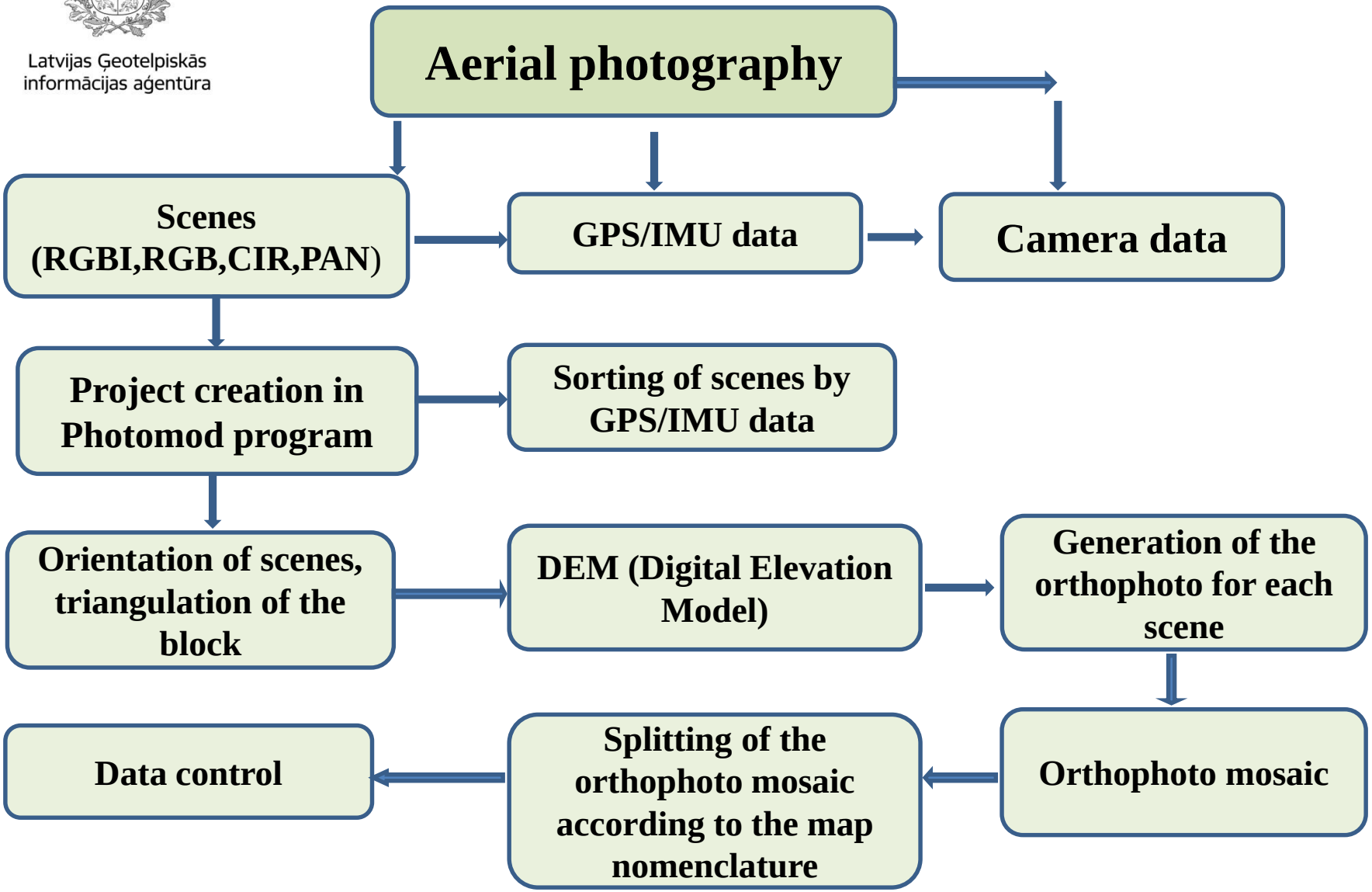
Scheme of the orthophoto production



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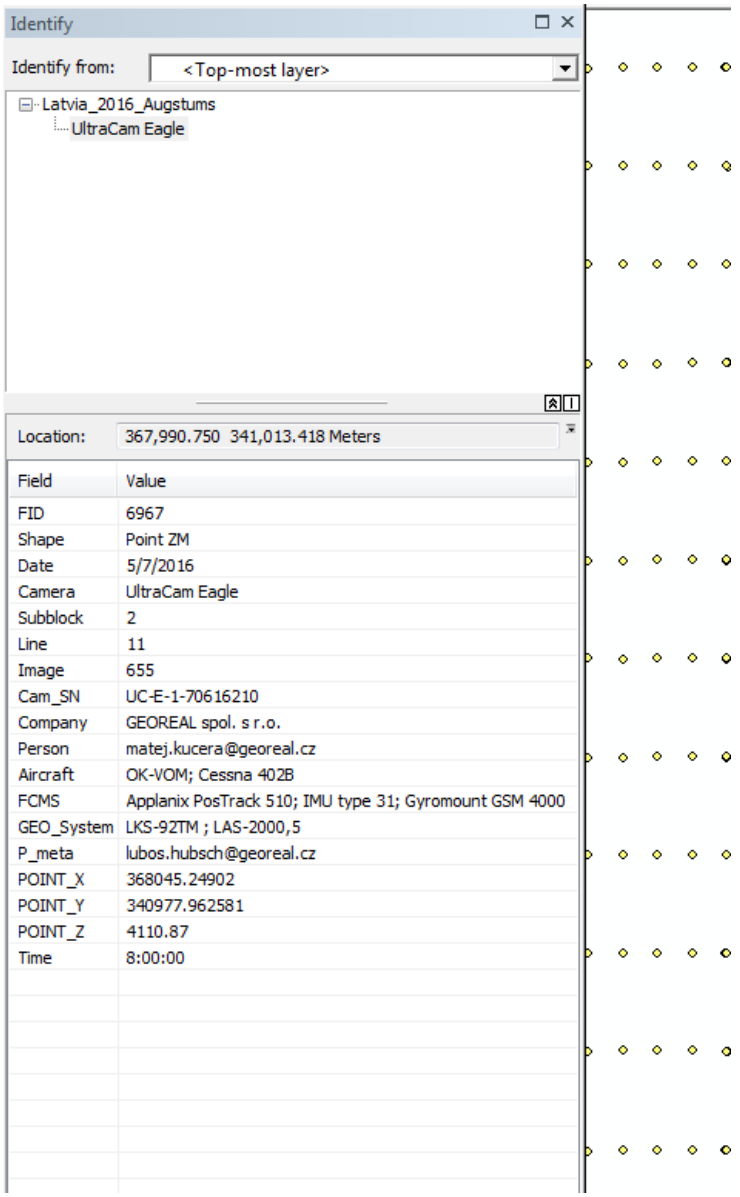
Orthophoto metadata

- **For every orthophoto scene there are metadata available, provided by the aerophography contractor**

- **Metadata include time and coordinates of the aerophotography, height of the flight, reference systems used both horizontally and vertically, image number and camera data**



Field	Value
FID	6967
Shape	Point ZM
Date	5/7/2016
Camera	UltraCam Eagle
Subblock	2
Line	11
Image	655
Cam_SN	UC-E-1-70616210
Company	GEOREAL spol. s r.o.
Person	matej.kucera@georeal.cz
Aircraft	OK-VOM; Cessna 402B
FCMS	Applanix PosTrack 510; IMU type 31; Gyromount GSM 4000
GEO_System	LKS-92TM ; LAS-2000,5
P_meta	lubos.hubsch@georeal.cz
POINT_X	368045.24902
POINT_Y	340977.962581
POINT_Z	4110.87
Time	8:00:00

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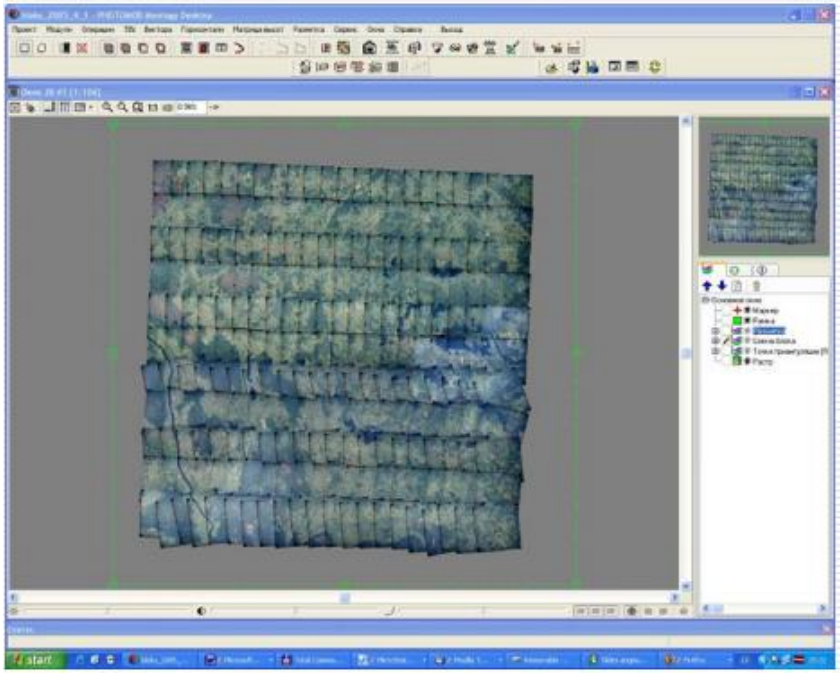
Digital photogrammetric station «Photomod» with a «Planar» stereoscreen



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Orthophoto mosaic in the «Orthovista» program

Orthophoto scenes → Radiometric color smoothing in the orthophoto mosaic → Seam line creation and editing → Radiometric color smoothing, splitting the orthophoto according to the map nomenclature

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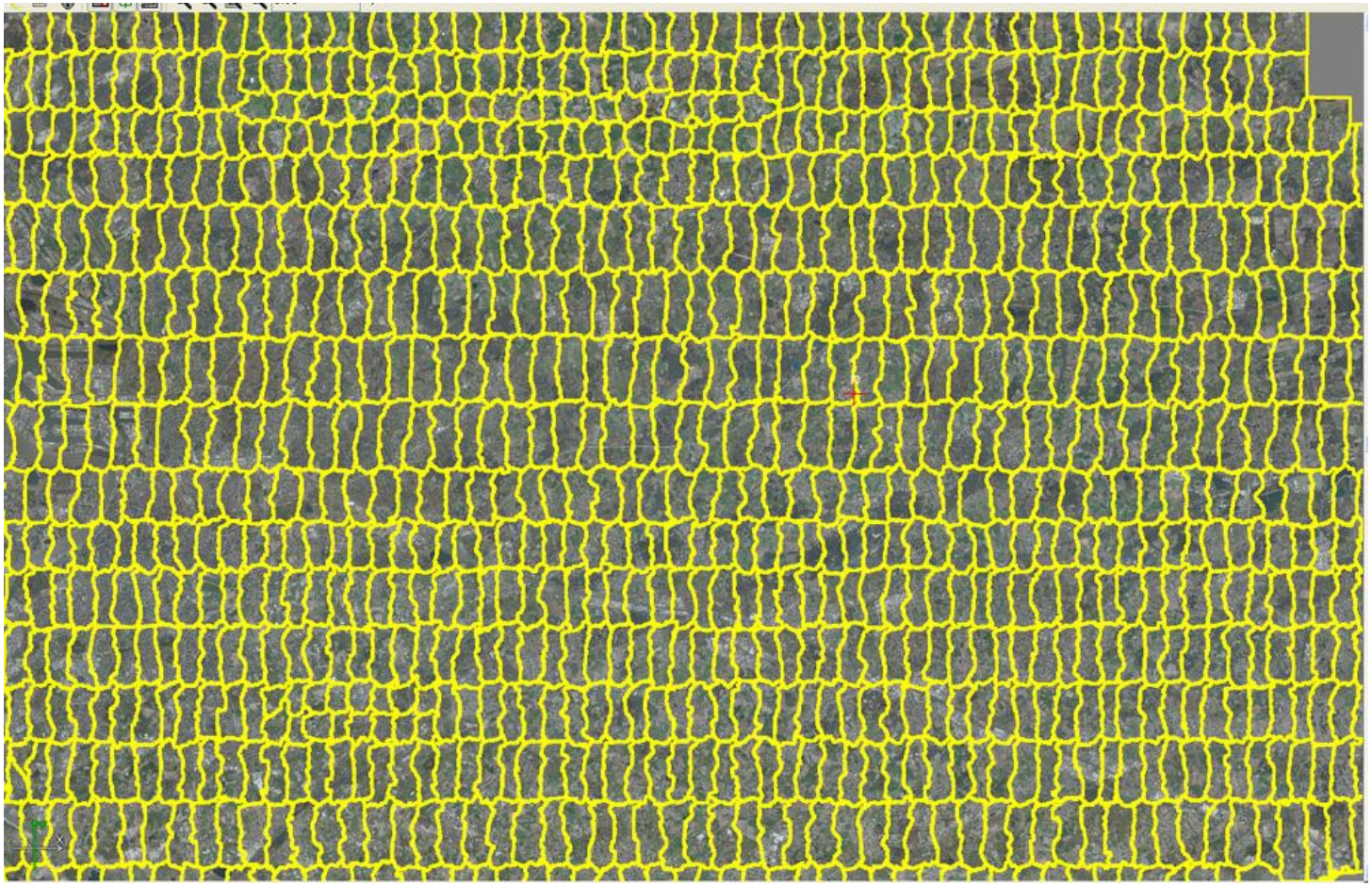
Seam lines of an orthophoto block in the Orthovista program that needs to be controlled and edited in case of error detection

There can be more than 800 scenes in one block



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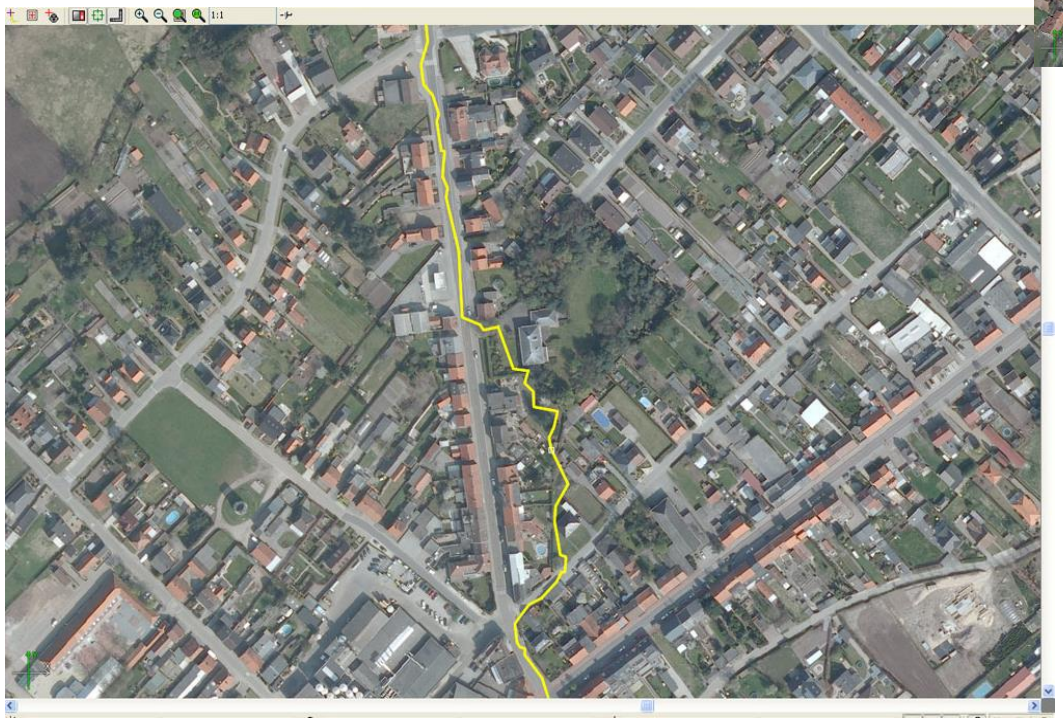
Seam lines



Every seam needs to be visually controlled and, in case of detected errors, edited manually

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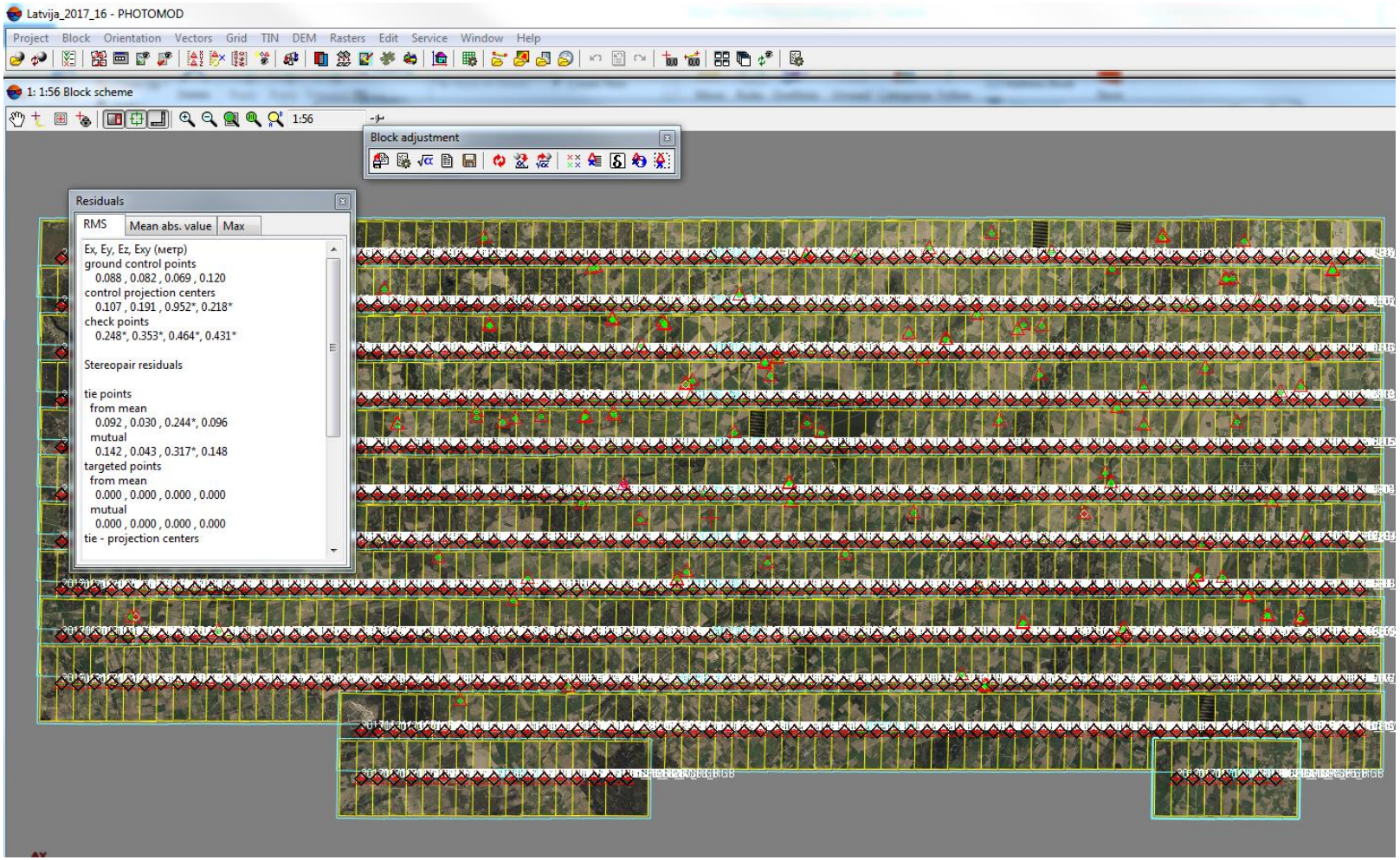
Orthophoto data control - 1

- Precision of the orthophoto depends on several aspects (the software used, aerotriangulation parameters, camera used and precision of the DEM), therefore the total error is 0.8-1m



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Color smoothing in Orthovista

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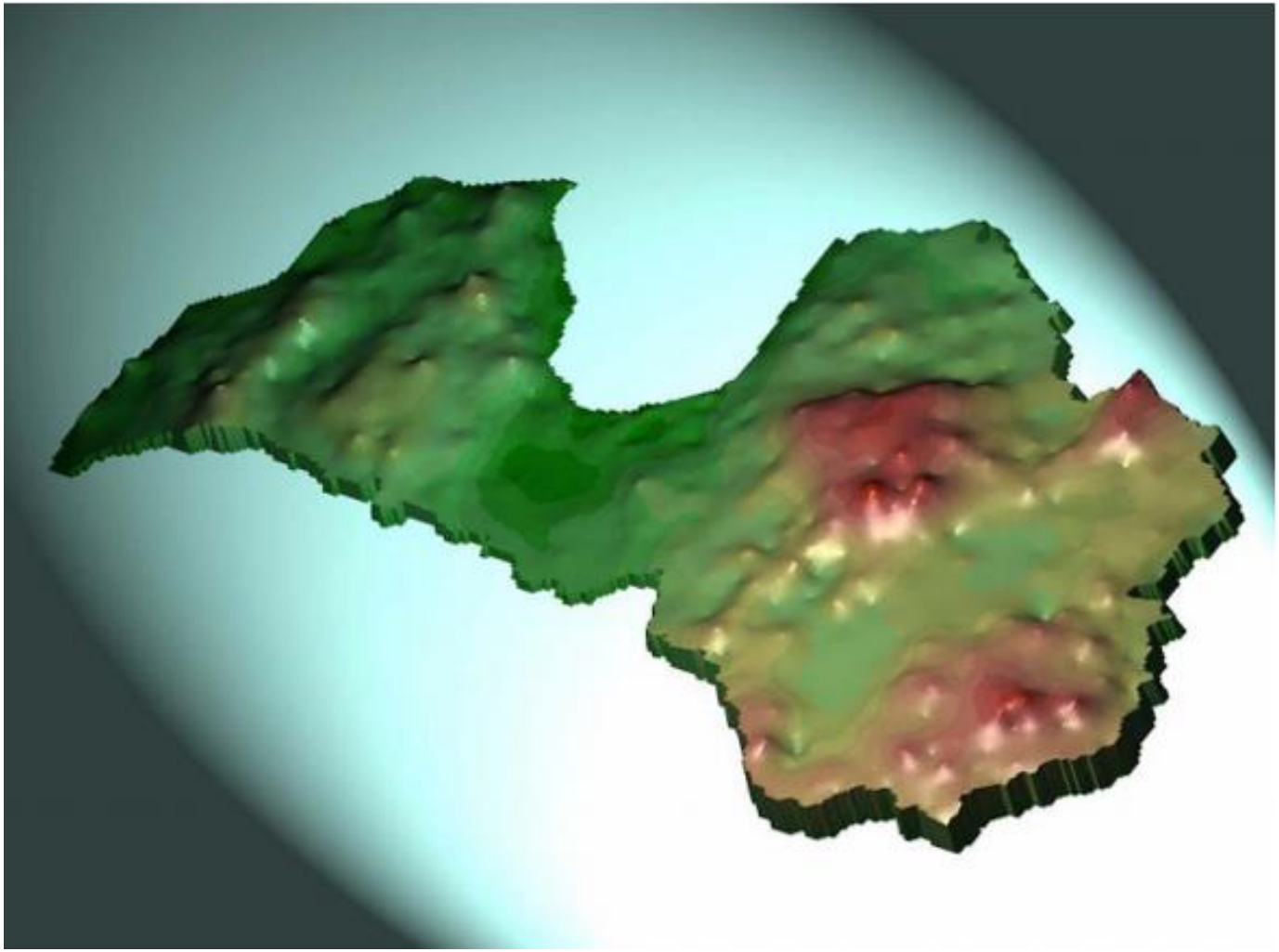
Digital elevation model

The precision of the orthophoto depends on the precision of the digital elevation model



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Problems with orthophoto creation

Orthophoto creation is especially difficult in city territories because the geometry of the orthophoto depends on relief therefore areas around the bridges might contain offsets in scenes

There are a couple of solutions for such problems: editing the DEM in stereo mode or using high quality LiDAR data

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Orthophoto data control - 2

- Every scene of the block is visually examined for:
  - Offsets along the seam lines
  - Glints from buildings, greenhouses and other reflective surfaces
  - Errors caused by the in accuracies of the DEM on buildings, bridges, in forests, near the border and in coastal territories
  - Offsets along the scene borders
  - Possible data voids
  - Conformity of background color
  - Other inaccuracies
- Every block of scenes is examined for:
  - Picture size and number
  - Pixel size, number and color mode
  - Coordinate system conformity
  - Precision compared to physically measured support points

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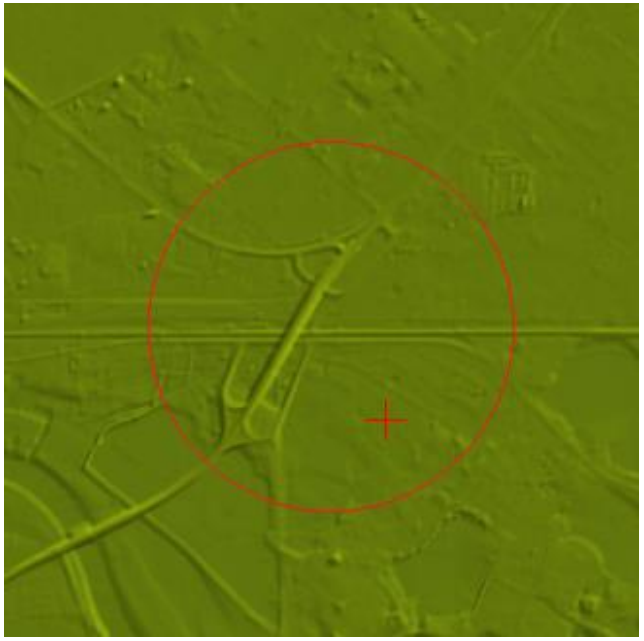
1.Orthophoto offsets on a bridge

2.Edited orthophoto on a bridge

1. Unedited DEM



2.Edited DEM

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RGB orthophoto offset on a bridge

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RGB orthophoto offset on a building

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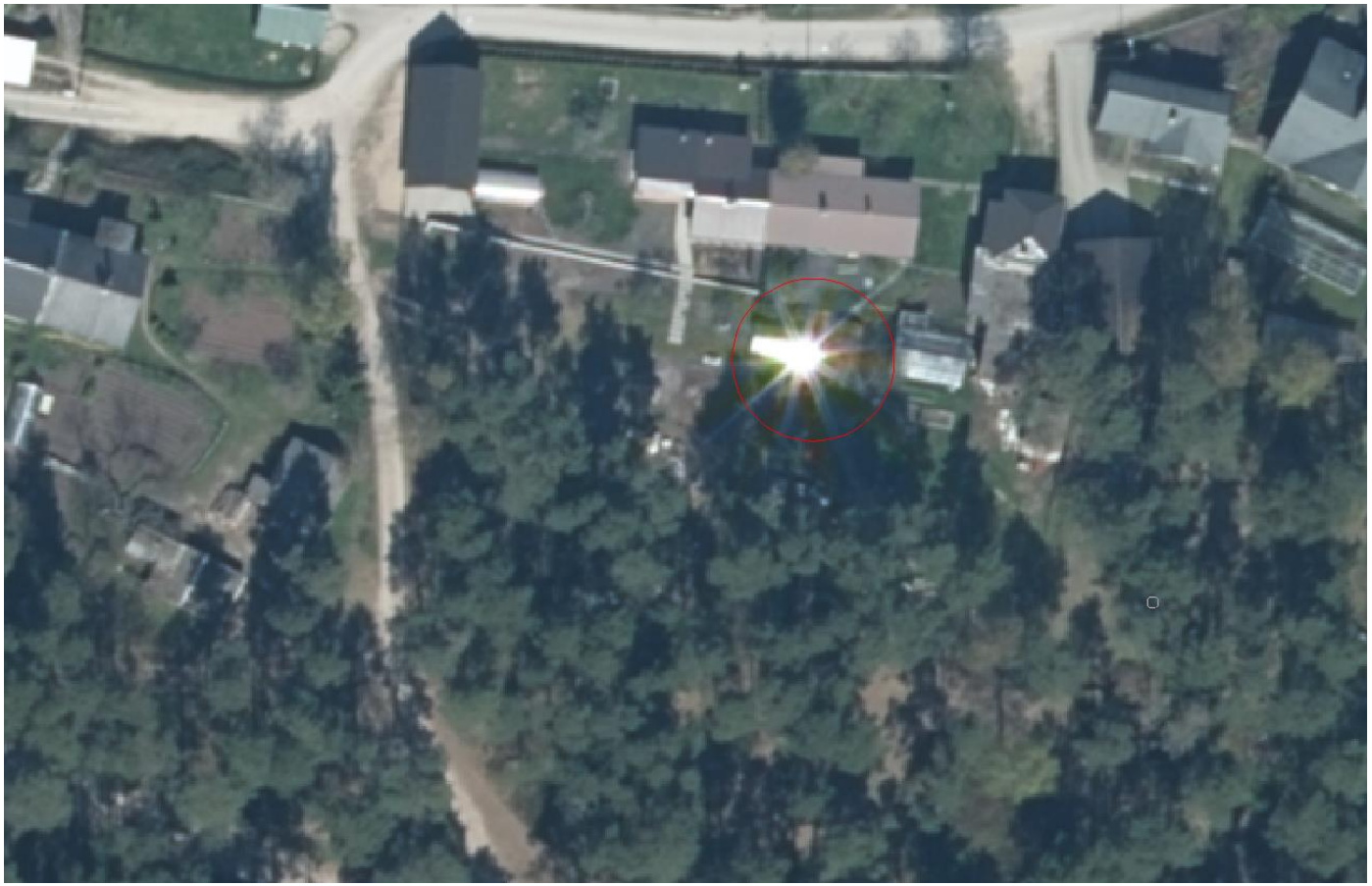
Glint in an RGB orthophoto



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Blurred CIR orthophoto

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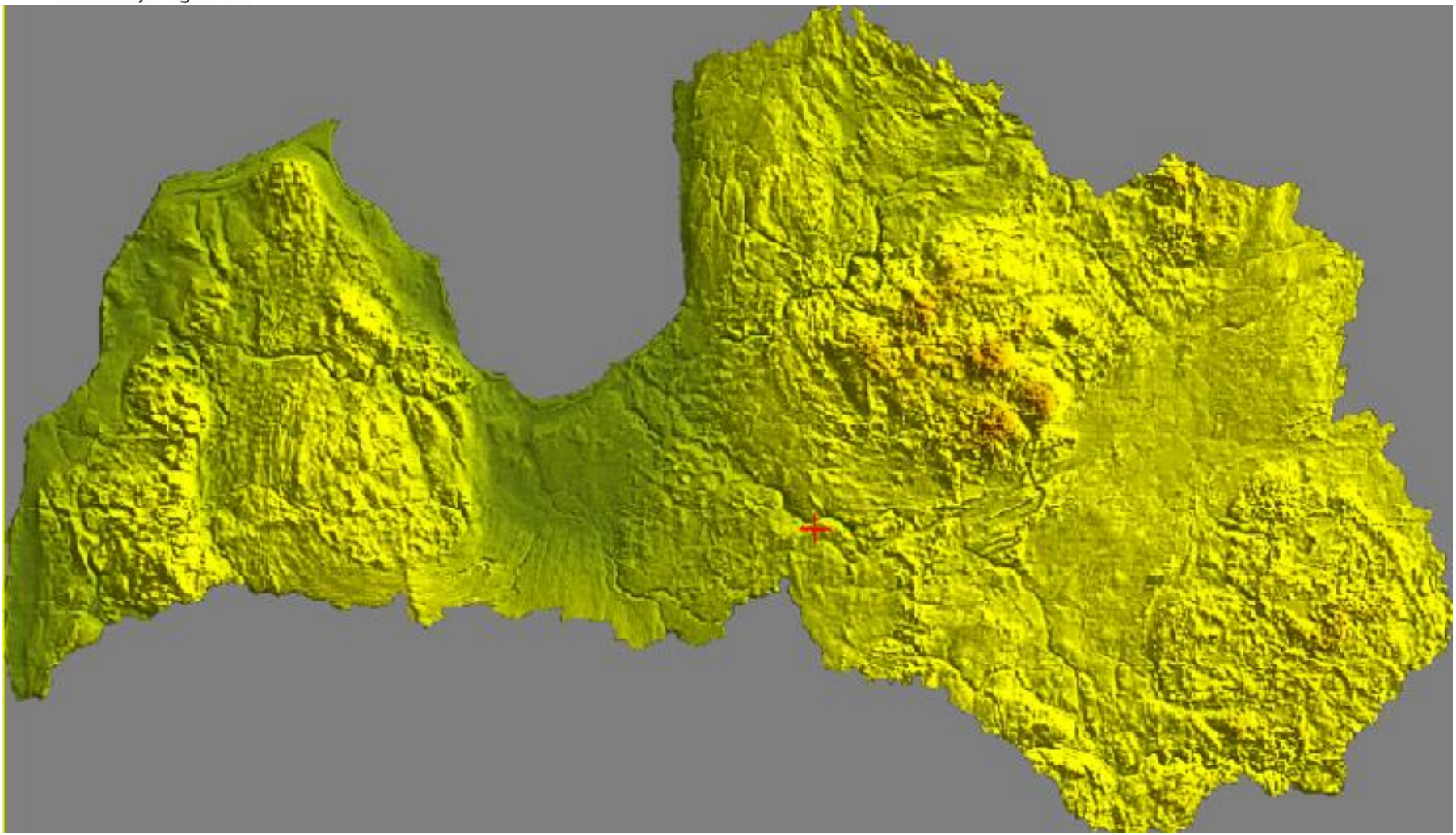
Digital Elevation Model of Latvia with 20m resolution



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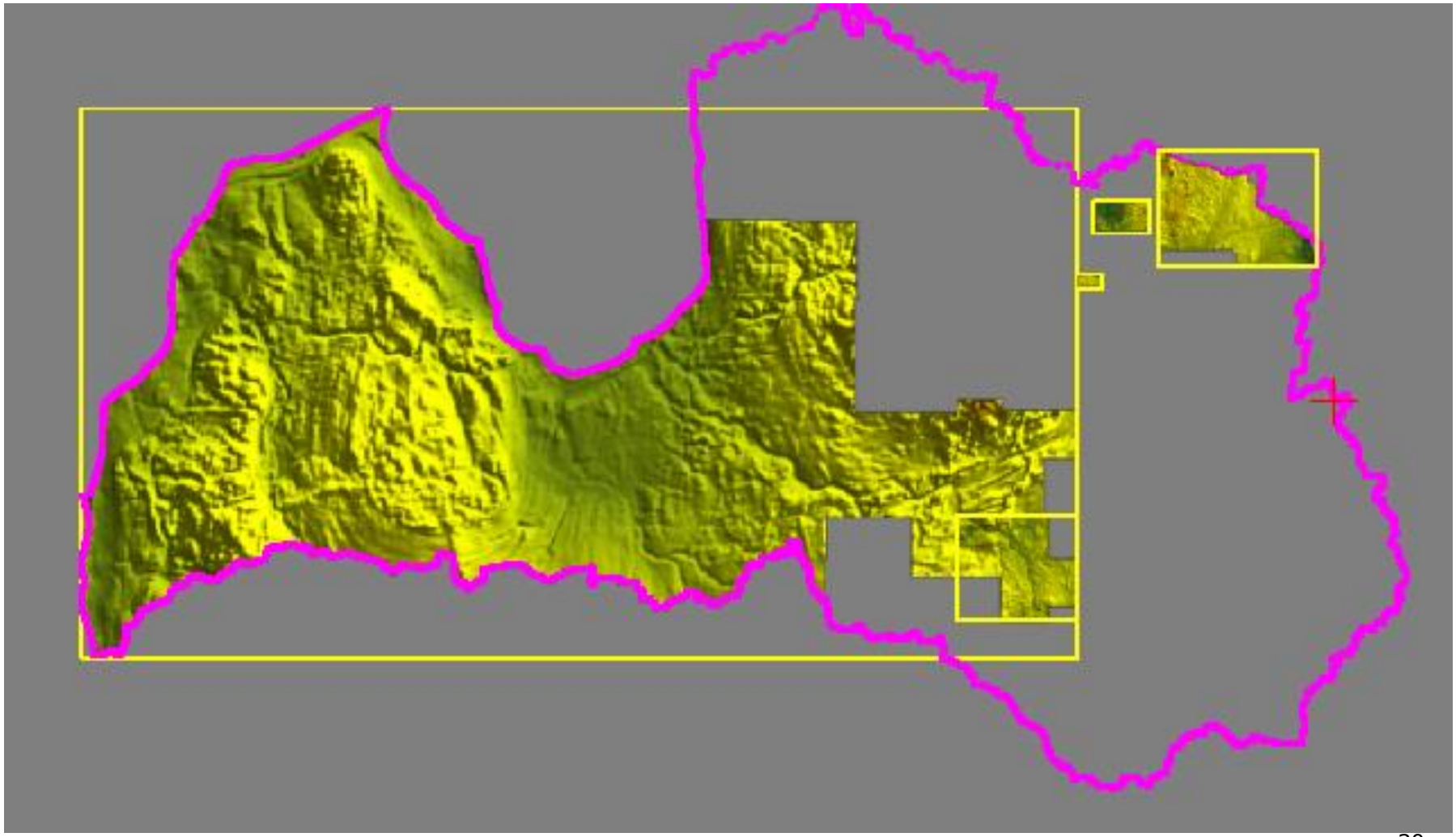
Current coverage of Digital Elevation Model of Latvia with 5m resolution (LiDAR data only)



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Parameters of the complete aerolaserscan of Latvia

- Overall point density at least 4 p/m^2
- Ground point density at least 1.5 p/m^2
- Vertical precision of the data at least 12cm (2 sigmas with 95% confidence level) in relation to Geodesy network of Latvia
- Horizontal precision of the data at least 36cm (2 sigmas with 95% confidence level) in relation to Geodesy network of Latvia

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Point classes obtained by the LiDAR data classification

- Point classes obtained by the automatic data classification:
  - Ground
  - Vegetation:
    - low - less than 30cm,
    - medium - 30 to 180 cm,
    - high - above 180 cm
  - Buildings
  - High and low points
  - Overlap points
- Additional manually classified points:
  - Bridges
  - Water
  - Other objects
- **The main purpose of the manual classification is Ground class point correction**

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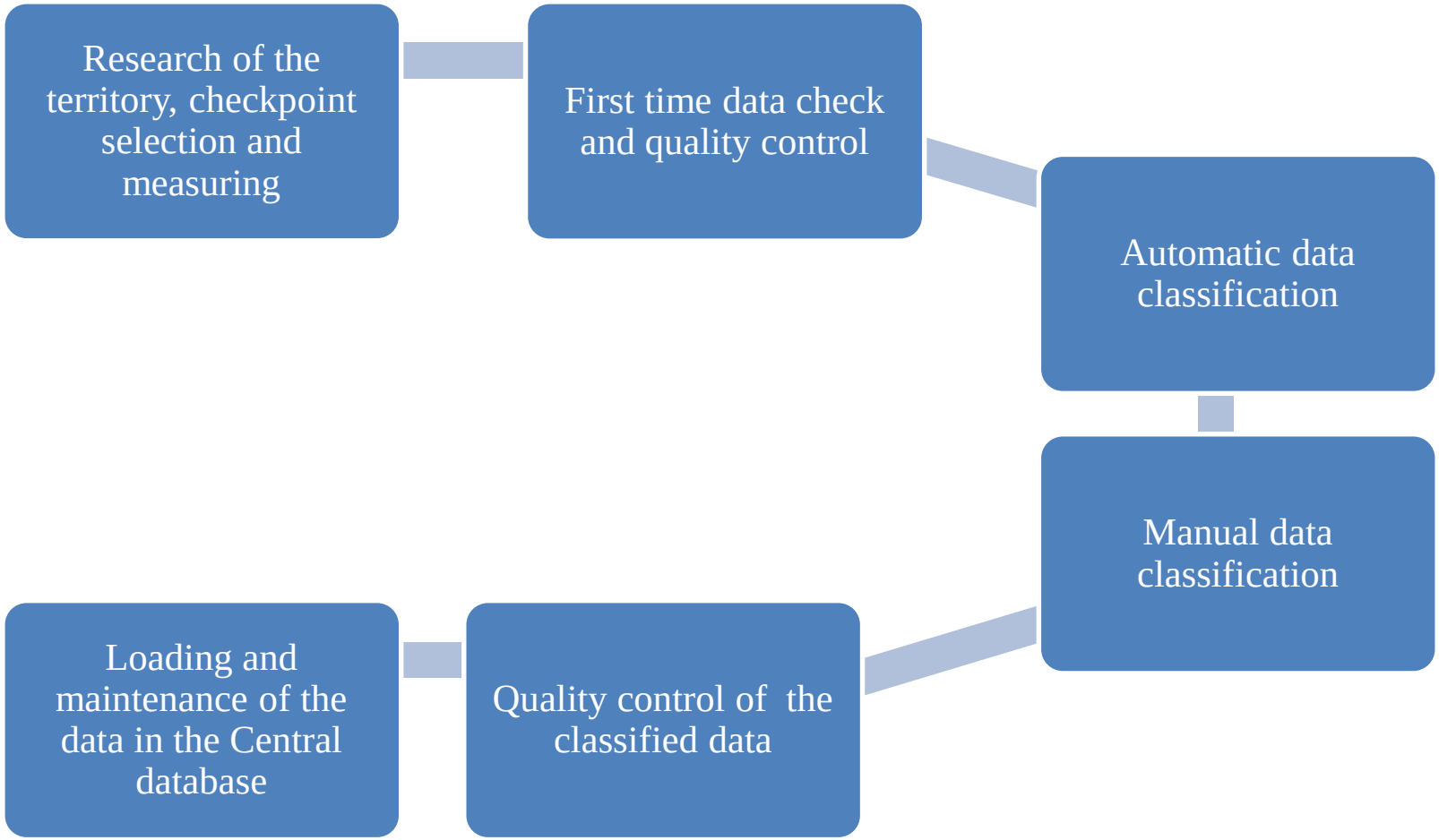
LiDAR data processing in LGIA



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LiDAR LAS data control

- After LGIA receives aerolaserscan data from the contractors, the received data is examined for conformance to the contract and technical specifications, the report is generated
- Both automatic and manual data classifications are performed
- End product of the aerolaserscan data manual classification is a LAS (Log ASCII Standard) file
- Manually classified LAS files are being examined for:
  - Spatial conformance
  - High and low points
- DTM and DSM blocks are generated from the manually classified LAS data blocks by ArcMAP, a Hillshade is also applied
- Every DTM and DSM block is visually examined for:
  - Spatial conformance
  - Holes in the data (usually above water bodies in DTM)
  - Distortions and noise
- If there are errors detected, the accorging LAS files are examined and corrected, surface and terrain models generated anew

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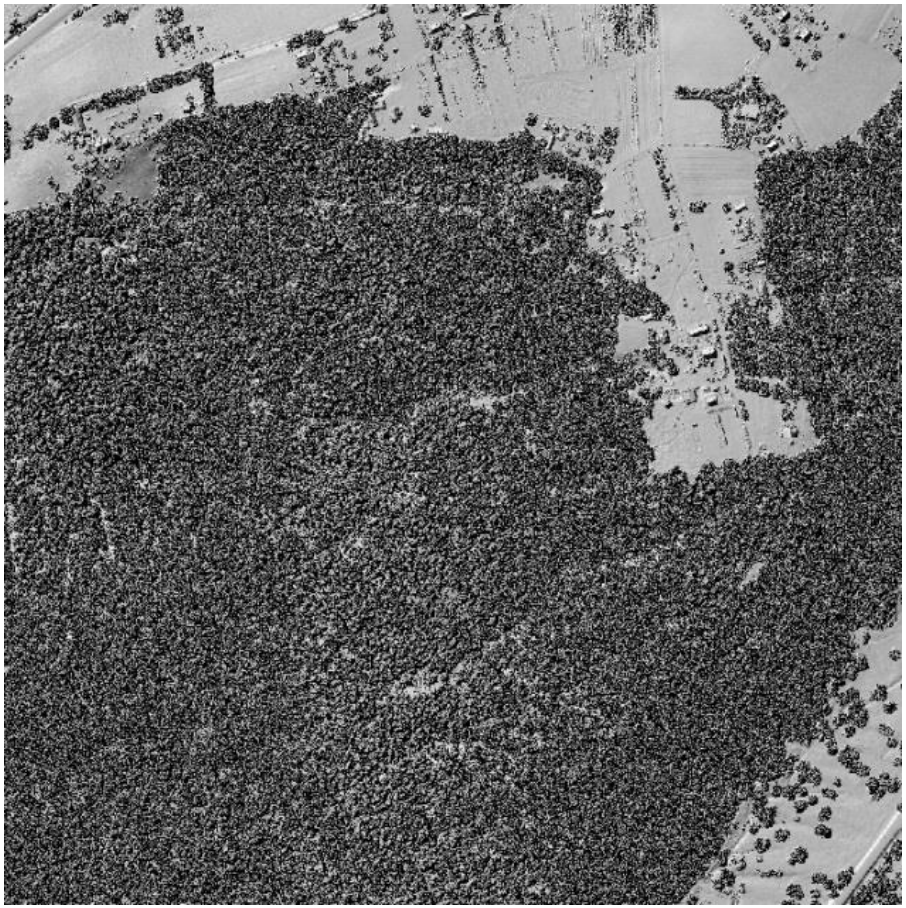
Products created from LiDAR data

Hillshaded Digital Elevation Model



Hillshaded Digital Surface Model

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Future plans

- **Acceleration of the orthophoto creation and improvement of scene quality by using new software methods**
- **Test of True ortho - orthogonal orthophoto creation (important for objects in cities - bridges and buildings)**
- **Test of point cloud acquisition from aerial photography data by the usage of other programs**
- **Laser scan for the whole territory of Latvia to obtain a Digital Terrain Model for all of the country from LiDAR dara**