

DIGITAL LAND USE MAP FROM ORTHOPHOTOS IN LUXEMBOURG

- Deliverable 1a: Status 2007 -

Technical Report



Reporting:

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1. General overview of the project

This report describes the first deliverable of the Digital Landuse Map for Luxembourg. In the first part, the orthophotos of the year 2007 were automatically classified and mapped with further preprocessing steps.

The final report with detailed technical descriptions of the whole project will be attached to the deliverables 1b and 1c (digital land use maps 2004 and 2001).

For all three status maps, the same interpretation area consisting of 390 km² was mapped. The scale for viewing is 1:5.000.

Project Schedule:

- Completed input datasets (orthophotos, ancillary datasets & final definition of AOI): **July, 6th 2009**
- First interim report: **September, 21st 2009**
- Deliverable 1a and short technical report: **October, 9th 2009**
- Deliverable 1b and 1c, final technical report: **November, 16th 2009**

Interpretation area:

Total area: 390 km²

The interpretation area consist of the urban perimeters (delivered by CEPS)

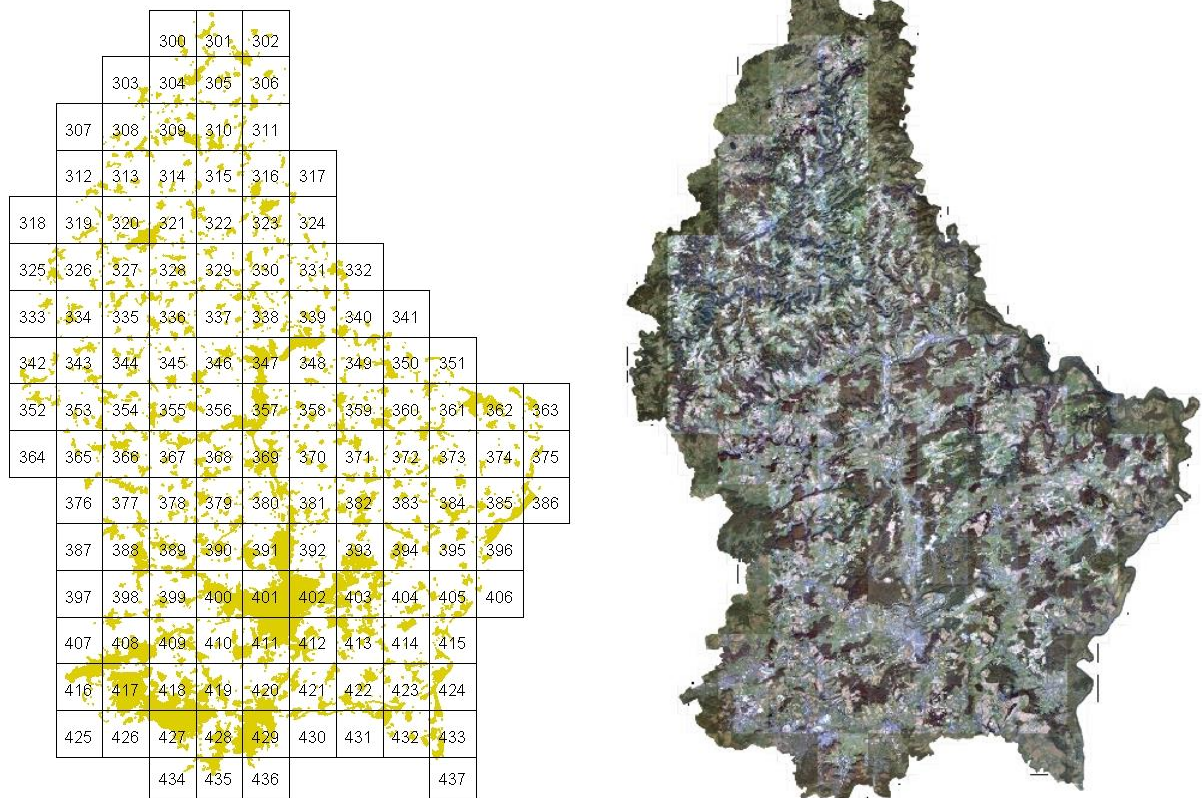


Fig.1: (left) interpretation area of Luxembourg in yellow, the cells define the working units (right) Luxembourg in RGB-orthophoto mosaics of 2007

Input data sets:

- Digital RGB-orthophotos of the years 2007, 2004 and 2001 (resolution 50 cm)
- Digital colour infrared-orthophotos of the year 2007 (resolution 50 cm)
- Settlement outlines („perimetre 2004“ and „perimetre 2007“)
- Ancillary data for validation and assistance
 - Existing building layer from digital cadastre (scale 1:5.000) for buffering and validation
 - OBS 2000 – Layer
 - BD-L-TC (Banque de données topo/cartographique Luxembourg)

Deliverables 1a:

Buildings and other artificial surfaces will be classified according to the following technical specifications:

- Artificial surfaces
 - 1.1. Buildings (>25 m²)
 - 1.2. Other artificial surfaces (>100 m²)
- Non-artificial surfaces (>100 m²)

The minimum mapping width of linear elements (rivers, roads) are mapped, if wider than 3m.

Definition of thematic classes:

- 1.1. Buildings: buildings of all types of use with a minimum area of 25 m². The minimum length of a building site is 5 m. Building edges smaller 5 m will not be considered. An automated smoothing of building outlines could be offered, but was not part of this contract.
- 1.2. Other artificial surfaces: comprising asphalted roads, railways and other artificial surfaces (e.g. parking lots, construction sites, mining areas) with a minimum area of 100 m² and a minimum width of 3 m
Road areas are classified according to their visibility in the orthophotos. A full connectivity of roads can not be provided when roads are covered or obscured by vegetation or other shadows
- 2. Non-artificial surfaces: those areas include all vegetated areas (e.g. gardens, meadows, pasture, forest) and other non-artificial land without vegetation (e.g. cropland, rocks, water) within the mapped area

Also the following guaranteed quality assessments were met:

- 95% overall thematic accuracy of land use map
- 95% individual accuracy of buildings
- 90% individual accuracy of other artificial surfaces

2. Description of delivery

Deliverable 1a: Digital land use map for 2007

- 135 ESRI-Shapefiles of the mapping results:
<number of working unit>_lux2007.shp

Those datasets are the result of an automated land use classification in un-smoothed form. This means the pixel structure follows the outlines of the orthophotos. All together 390 km² were mapped. The final results are delivered in the projects LUREF.

The attribute tables appear in the following structure:

- Column „ID“: unique identification number for each polygon
- Column „Gridcode“: land use code
 - „1“ = 1.1 Buildings (>25 m²)
 - „2“ = 1.2 Other artificial surfaces (>100 m²)
 - „3“ = 2 Non-artificial surfaces (>100 m²)

Legend files (*.avl, *.lyr) are added to the delivery

Structure of the working units

The squarish 1 km orthofotos were assembled to squarish mosaics of 5 km. This is a suitable size for both automatic classification and post-processing. The working units 364, 387 and 397 had image information, but had no share of the interpretation area. In all, the results for 135 working units are part of this delivery.

- Outline of the interpretation area as ESRI-Shapefile:
(*aoi_luxembourg.shp*)
- Structure of working units (5x5 km mosaics) as a ESRI-Shapefile:
(*mosaics_5x5km.shp*)
- Point samples as ESRI Shapefile, n=3000 points
(*validation2007_sample_3000points.shp*)
 - Column „ID“
 - Column „reference“
 - Column „map“

3. Quality control

Concept of validation:

The quality control is based on point samples consisting of a representative sample of 3000 points. These points are created automatically and are randomly distributed over the whole mapping area. In general, the amount of validation points depends on the number of classes and the area of each class. To emphasize the role of the buildings and the built-up area, those classes are represented much stronger in relation to the total area than the non-artificial areas.

Results of the point-based quality control (3000 points):

Confusion matrix:

| | | Visual reference interpretation | | | |
|--------------|------------|---------------------------------|------------|-------------|-------------|
| | | 1.1 | 1.2 | 2 | sum |
| Land use map | 1.1 | 762 | 23 | 15 | 800 |
| | 1.2 | 27 | 945 | 28 | 1000 |
| | 2 | 37 | 12 | 1151 | 1200 |
| | sum | 801 | 1005 | 1194 | 3000 |

Accuracy statistics:

Producer accuracy, user accuracy, overall accuracy for each class:¹

| | Producer accuracy <i>(with 95%-confidence intervall)</i> | user accuracy <i>(with 95%-confidence intervall)</i> | overall accuracy for each class |
|-------------------------------|---|---|------------------------------------|
| 1.1 Buildings | 95,13 % 93,47 – 96,79 | 95,25 % 94,49 – 96,01 | 95,19 % |
| 1.2 Other artificial surfaces | 94,03 % 92,58 – 95,48 | 94,50 % 93,68 – 95,32 | 94,26 % |
| 2 Non-artificial surfaces | 96,40 % 95,50 – 97,30 | 95,92 % 95,21 – 96,62 | 96,16 % |

| |
|---|
| Overall accuracy of the land use map: 95,27 % |
| Overall accuracy of the class „1.1 Buildings“: 95,19 % |

¹ Definitions of accuracies:

- *User accuracy (in %):* How many % of the objects in the land use map were mapped correctly?
- *Producer accuracy (in %):* How many % of all real objects were registered correctly in the land use map?
- *Overall accuracy for each class (in %):* Mean of producer and user accuracy

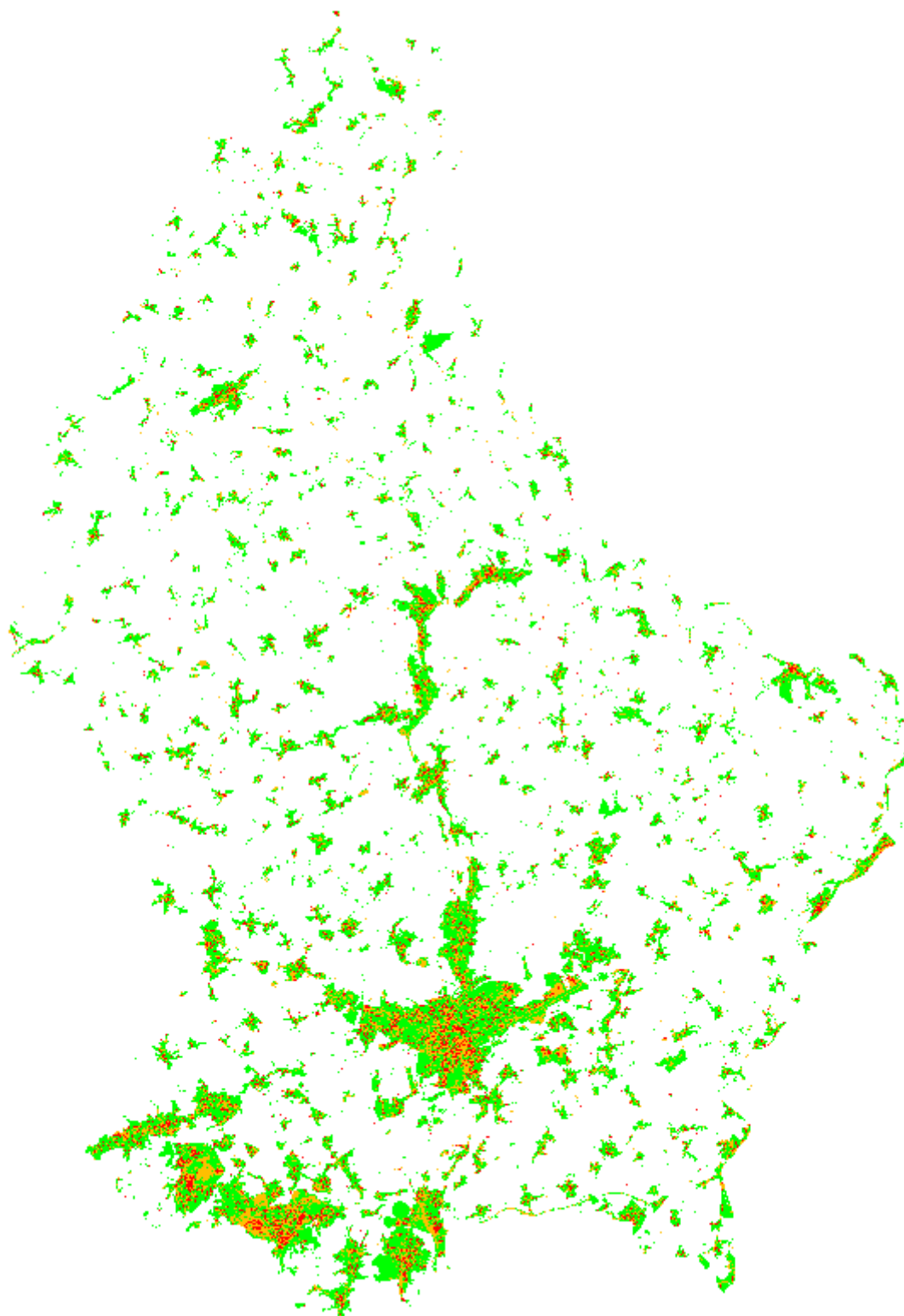


Fig. 2: Land use map Luxembourg 2007 (mapped from orthophotos)