Development of Croatian Land Information System

LIFE GIC/HR/001270-LIFE CROLIS

EKONERG CROLIS Team: Marina Kukavica, Vladimir Jelavić, Delfa Radoš

Croatian Land Information System - CROLIS

- To meet the EU's goals for 2030 and 2050 - geographically explicit data are needed
- LIFE CROLIS project - monitoring of Land Cover (LC) and Land Use (LU) changes
- Project co-financing: LIFE program, Fund for environmental protection and energy efficiency, project partners
- Project duration: end of 2026.
- CROLIS partners:

REPUBLIKA HRVATSKA Ministarstvo zaštite okoliša i zelene tranzicije

AGENCIJA ZA PLAĆANJA U POLJOPRIVREDI, RIBARSTVU I RURALNOM RAZVOJU

HRVATSKE ŠUME

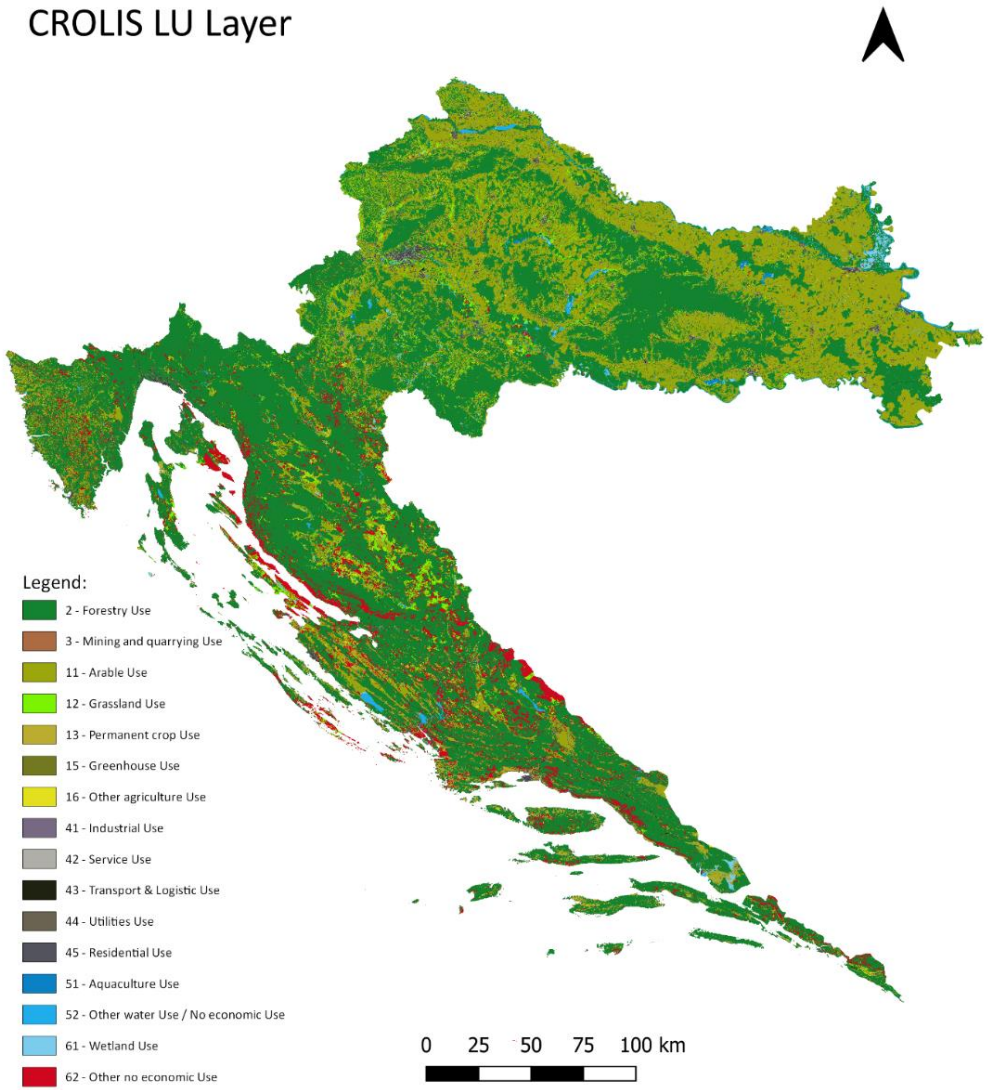
EKONERG

REPUBLIKA HRVATSKA Državna geodetska uprava

- CROLIS main goal:
  - development of a harmonized land monitoring data model - integration and processing of LC, LU and land management data from different data sources and its use for a variety of purposes
- This new model will be designed by integrating the:
  - Existing LC and LU information systems and data in Croatia
  - Freely available products (SPOT, Landsat, Aster and Sentinel-2 satellite imageries)
  - Upcoming multi-temporal observations - to trace back and identify LC and LU changes

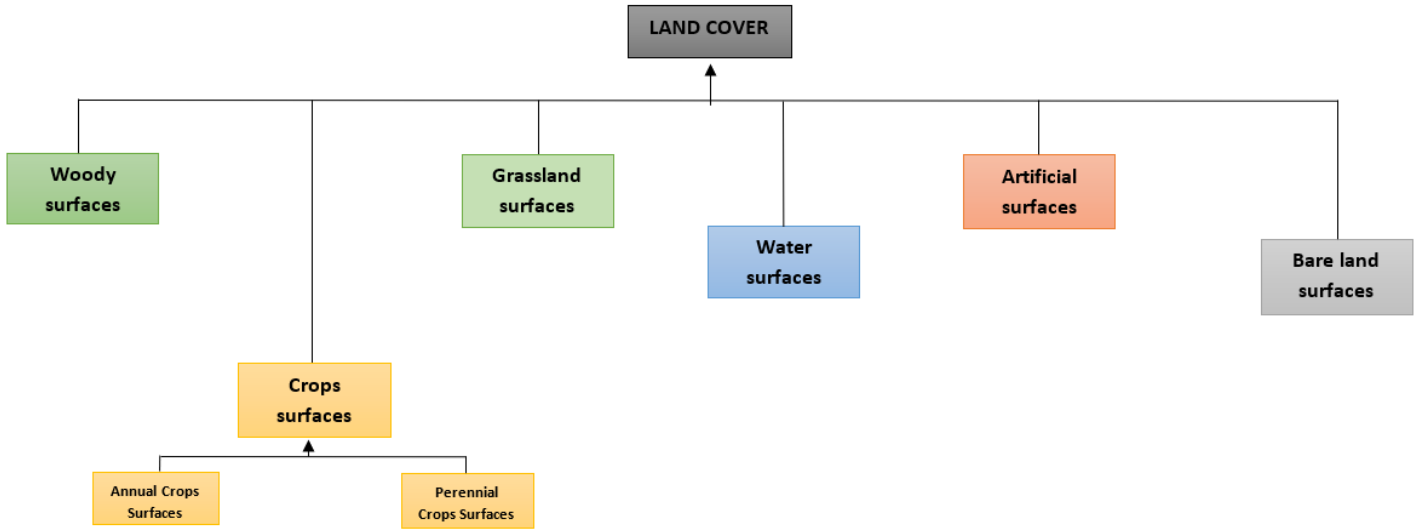
CROLIS Land Use Layer

- Created according to the principles of creating Corine Land Cover + (CLC+) layer
- EEA made recommendations for the creation of the CLC+ layer
- The CROLIS Land Use layer created based on the spatial data of Croatian Forests, the Paying Agency for Agriculture, Fisheries and Rural Development, Croatian Roads, Croatian Waters, Croatian Railways, Croatian Highways, the State Geodetic Administration, the Ministry of Environment and Green Transition
- The CROLIS LU layer consists of 6 Level-1 categories and 16 Level-2 categories
- The hierarchical table proposed by the EEA was used to create the wall-to-wall CROLIS LU layer
- Spatial resolution of the final raster layer is 5m



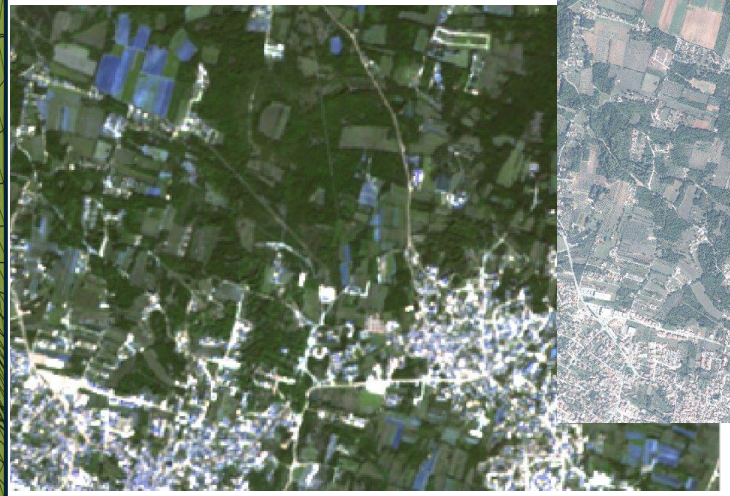
CROLIS Land Cover (LC) status Layer

- At this stage of CROLIS development, the Land Cover status layer includes 6 LC categories:
  - Woody surfaces
  - Crops surfaces divided into
    - Annual Crops Surfaces and
    - Perennial Crops Surfaces
  - Grassland Surfaces
  - Water Surfaces
  - Artificial Surfaces
  - Bare land Surfaces
- Historical land cover layers will be created based on a sample grid system

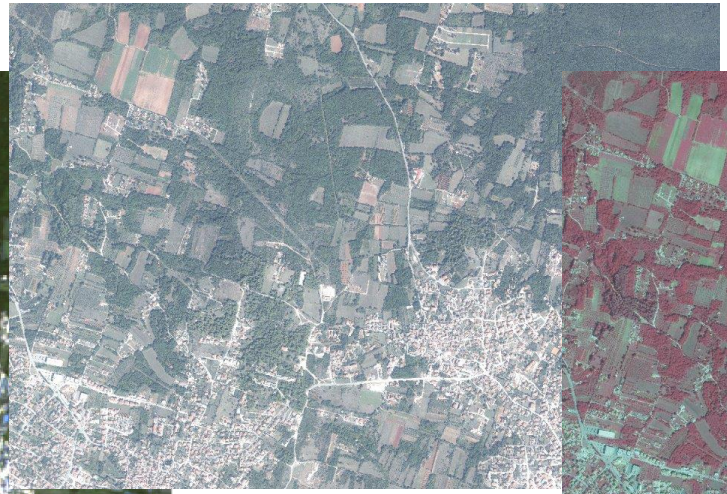


CROLIS LC status Layer

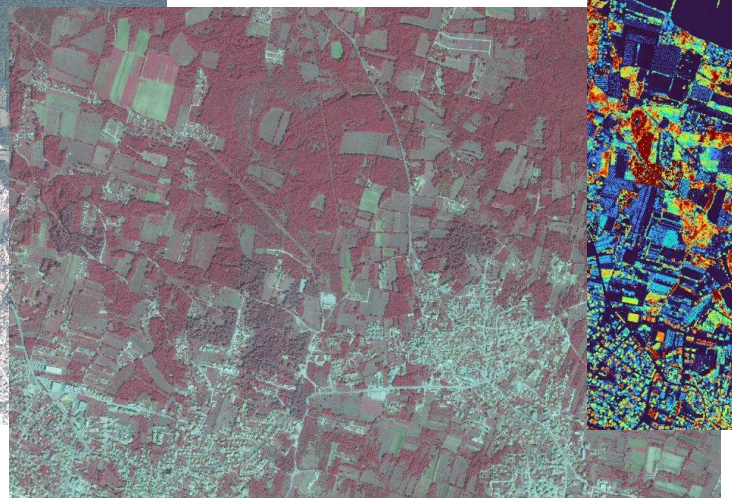
- Object Based Image Analysis
- Input **raster** data for creating the LC status layer:
  - The digital state orthophoto map (DOF) in RGB and CIR production, official state map with the spatial resolution 0.5 m
  - LIDAR nDSM
  - Sentinel-2 satellite imageries with 13 bands in the visible, near infrared, and short-wave infrared part of the spectrum, spatial resolution of 10 m, 20m and 60m with revisit time 5 days
  - National **vector** data from reference national institutions



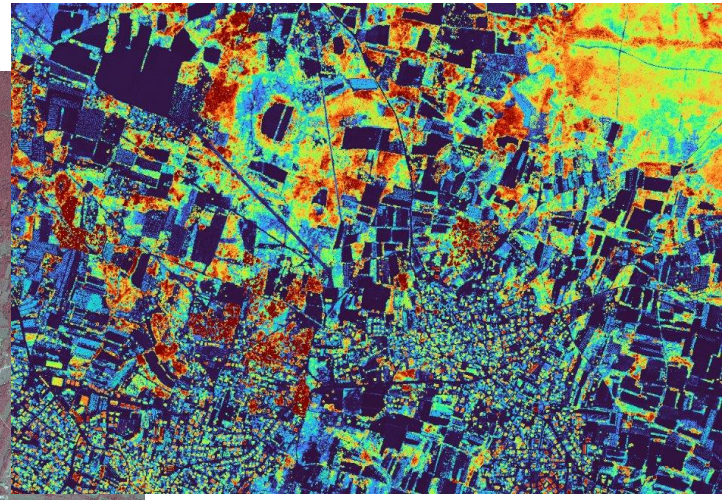
Sentinel-2



State Orthophoto RGB



State Orthophoto CIR



Lidar nDSM

CROLIS LC status Layer

- Corresponding radiometric spectral indices NDVI, NDWI, NDSI, NDBI, SAVI and EVI were made.
- Normalized difference vegetation index (NDVI) is sensitive to vegetation greenness and is useful in understanding vegetation density and assessing changes in plant healt

$$\frac{(\mathrm{NIR}-\mathrm{R})}{(\mathrm{NIR}+\mathrm{R})}$$

- Normalized Difference Water Index (NDWI) is sensitive to liquid water

$$\frac{(\mathrm{Green}-\mathrm{NIR})}{(\mathrm{Green}+\mathrm{NIR})}$$

- Normalized Difference Soil Index (NDSI) is sensitive to soil moisture, organic matter content, and texture

$$\frac{(\mathrm{Red}-\mathrm{Blue})}{(\mathrm{Red}+\mathrm{Blue})}$$

- Normalized Difference Built-up Index (NDBI) is sensitive to artificial objects.

$$\frac{(\mathrm{SWIR}-\mathrm{NIR})}{(\mathrm{SWIR}+\mathrm{NIR})}$$

- The Soil-Adjusted Vegetation Index (SAVI) is sensitive to vegetation

$$\frac{(\mathrm{NIR}-\mathrm{R})}{(\mathrm{NIR}+\mathrm{R}+\mathrm{L})} * (1+L)$$

- Enhanced Vegetation Index (EVI) is sensitive to vegetation, especially in areas with dense vegetation

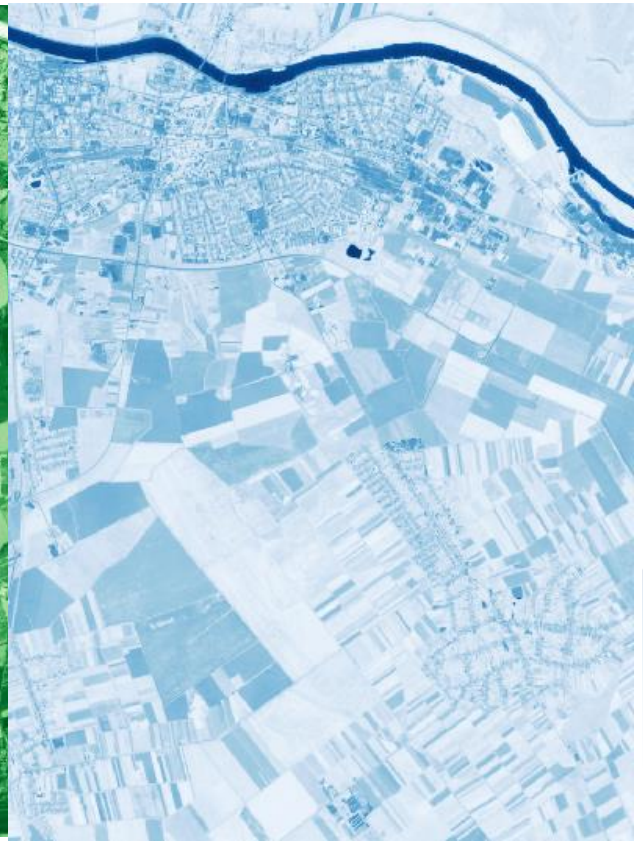
$$2.5 * \frac{(\mathrm{NIR}-\mathrm{R})}{(\mathrm{NIR}+6\mathrm{R}-7.5\mathrm{B}+1)}$$

NDVI

1

-0.4

NDWI

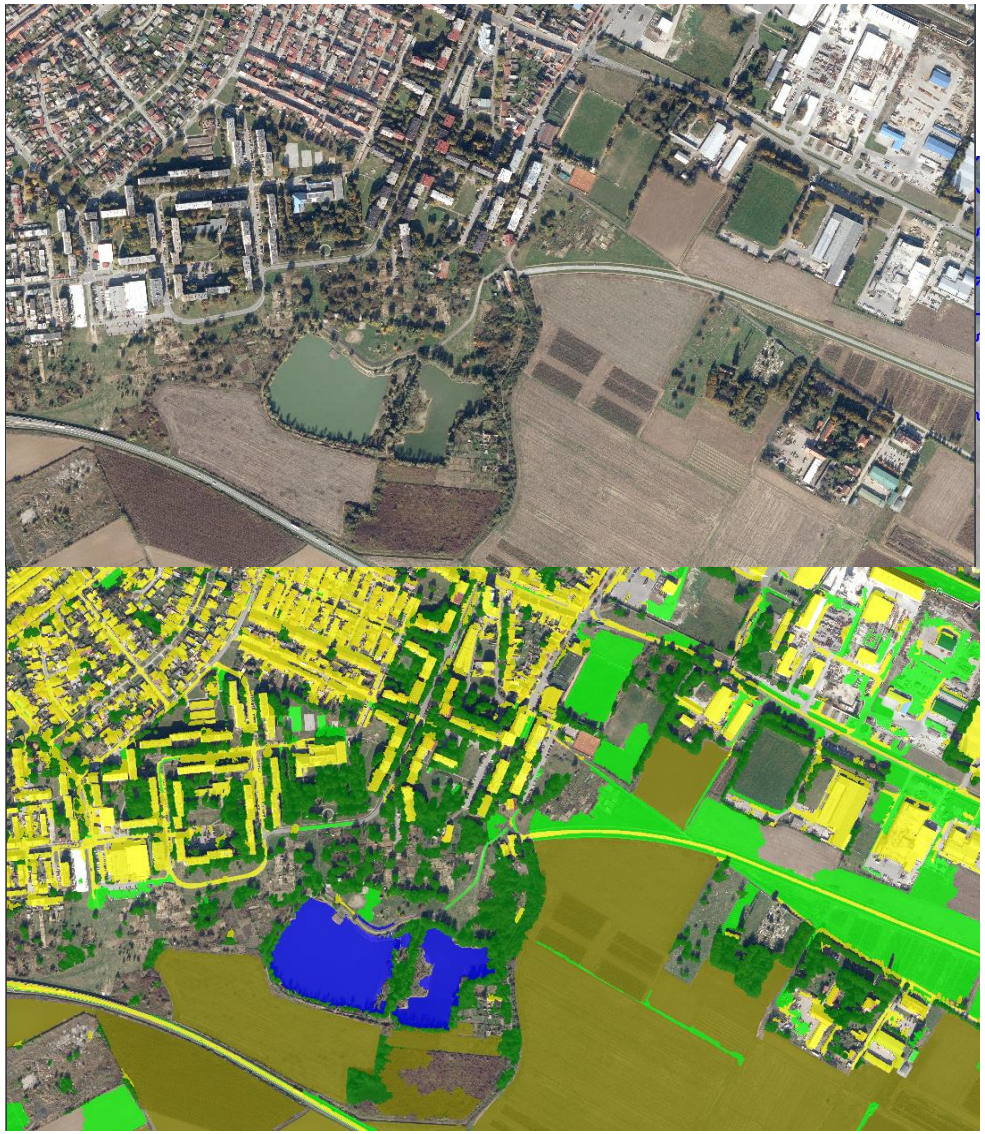


0.5

-0.9

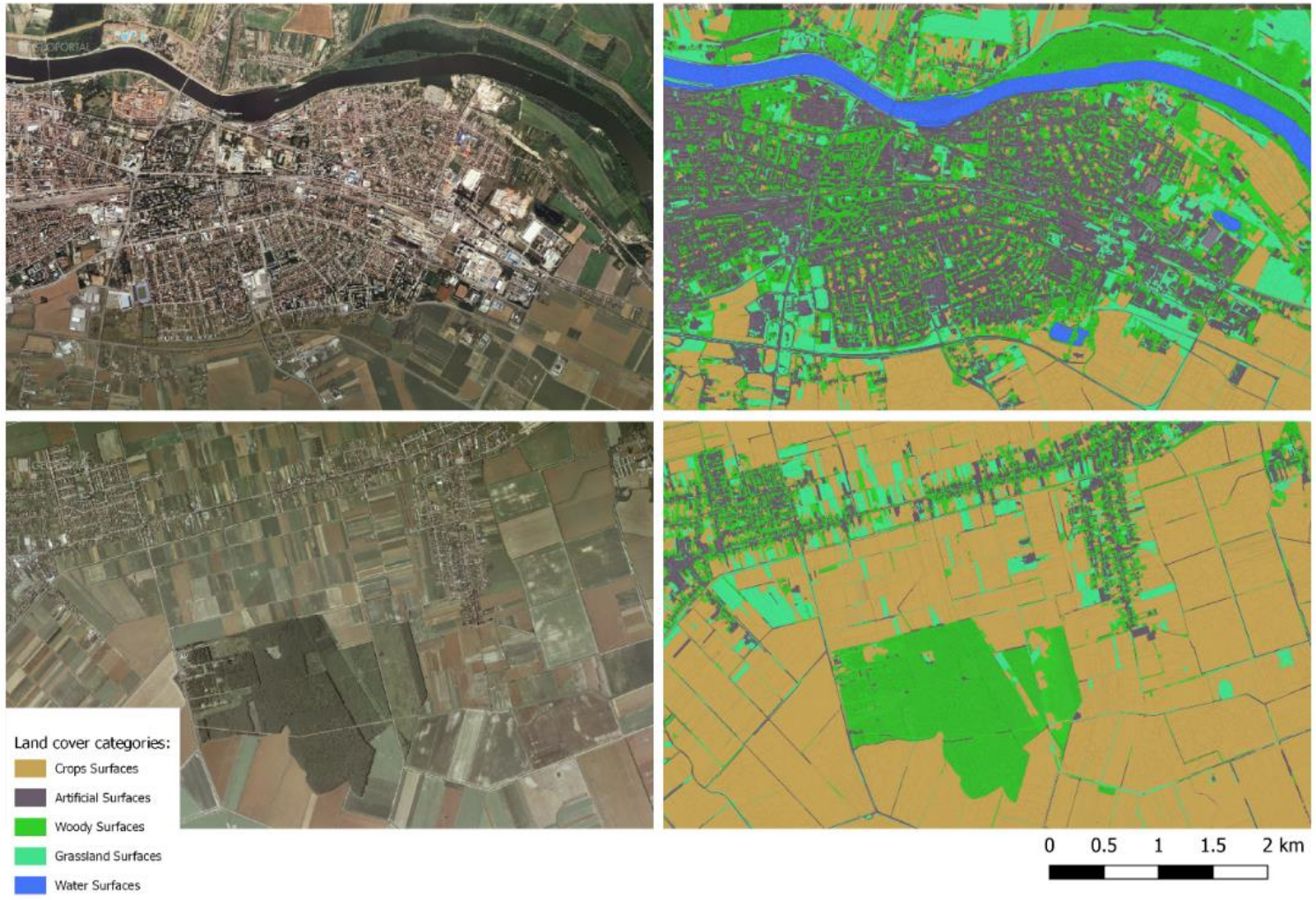
CROLIS LC status Layer

- In order to separate all the mentioned LC categories - newly developed methodology
- eCognition software
- Segmentation is performed in 2 steps with a smaller and larger scale parameter
- Categories are assigned to segments based on threshold values and conditions of input data
- The categories of uncategorized segments will be assigned in the next step using machine learning classification
- All categorized segments - converted into training samples for machine learning models



CROLIS LC status Layer

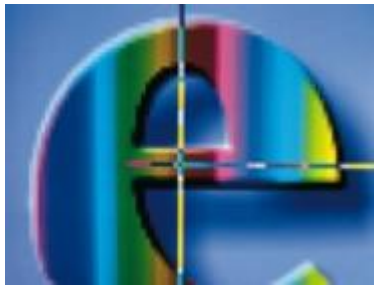
- Machine learning is performed based on raster input data and its statistics, radiometric spectral indices, and geometric characterization of segments, such as relates to other segments.
- The Support Vector Machine (SVM) algorithm with Radial basis function kernel (rbf) has been used to train the model.
- Accuracy assessment



CONCLUSIONS

1. The establishment of a complex land system such as CROLIS requires **the involvement and participation of all national institutions**
2. CROLIS project is the first project of its kind that:
   - Considers the EAGLE system
   - Considers the methods for the creation of CLMS products
   - Final products should contribute to numerous fields and can be used for many purposes
3. The newly developed Land cover classification methodology - improves data quality:
   - National raster and vector data
   - nDSM
   - Improved ARKOD+ layer
4. Enables LULUCF Instances derivation
5. LC / LU area differences – encourages discussion and contributes to decision-making about the purpose of a certain class of land
6. The presented first version of the developed methodology for land cover detection needs to be and will be upgraded according to new input data and future needs

Thank you for attention



EKONERG – Energy Research and Environmental Protection Institute
Koranska 5
10000 Zagreb
www.ekonerg.hr

Marina Kukavica, mag. ing. geod. et geoinf.
Atmospheric Protection and Climate Change Department
mkukavica@ekonerg.hr