LIFE CROLIS

Work on the LIFE CROLIS LULUCF historic period

Zagreb 21 / 11 / 2025

REPUBLIKA HRVATSKA
Ministarstvo gospodarstva i održivog razvoja

AGENCIJA ZA PLAĆANJA U POLJOPRIVREDI, RIBARSTVU I RURALNOM RAZVOJU

HRVATSKE ŠUME

EKONERG

REPUBLIKA HRVATSKA
Državna geodetska uprava

FOND ZA ZAŠTITU OKOLIŠA I ENERGETSKU UČINKOVITOST

CROLIS historic LULUCF model

C.2 SAMPLE BASED SYSTEM FOR HISTORIC LC AND LU

- Sub-Action 1: Derivation of sampling design for statistical significant result
  - Statistical sampling design
  - Synergise between existing grids
  - LUCAS (2x2 km), Forest inventory (4x4 km), others
  - Definition of sampling grid and cluster sampling
  - Area related observations (polygon oriented interpretation of 150*150m area (or larger) and point observation on random samples)
  - Alignment with forest inventory for selected samples
- Sub-Action 2: Preparatory data management and guidelines
  - Preparation of orthophotos and satellite images
  - Interpretation manuals for LC and LU
  - Testing interpretation of LC and LU classes with available historic data
  - Testing the approach in 3 small test areas (main representative landscapes)
  - Guidelines for standardizing the visual interpretation
- Sub-Action 4: Performing the operational interpretation
  - Organisation and roll out of sampling phase based on historic data (1968 - 2014+)
  - Visual interpretation of sampling points
- Sub-Action 6: Results and Analysis
  - Analysing the results
  - Reporting on results according to defined strata
  - Performing LULUCF specific assessment on LC and LU areas for all subcategories and sub-activities

CROLIS historic LULUCF model

2020.

Input data:

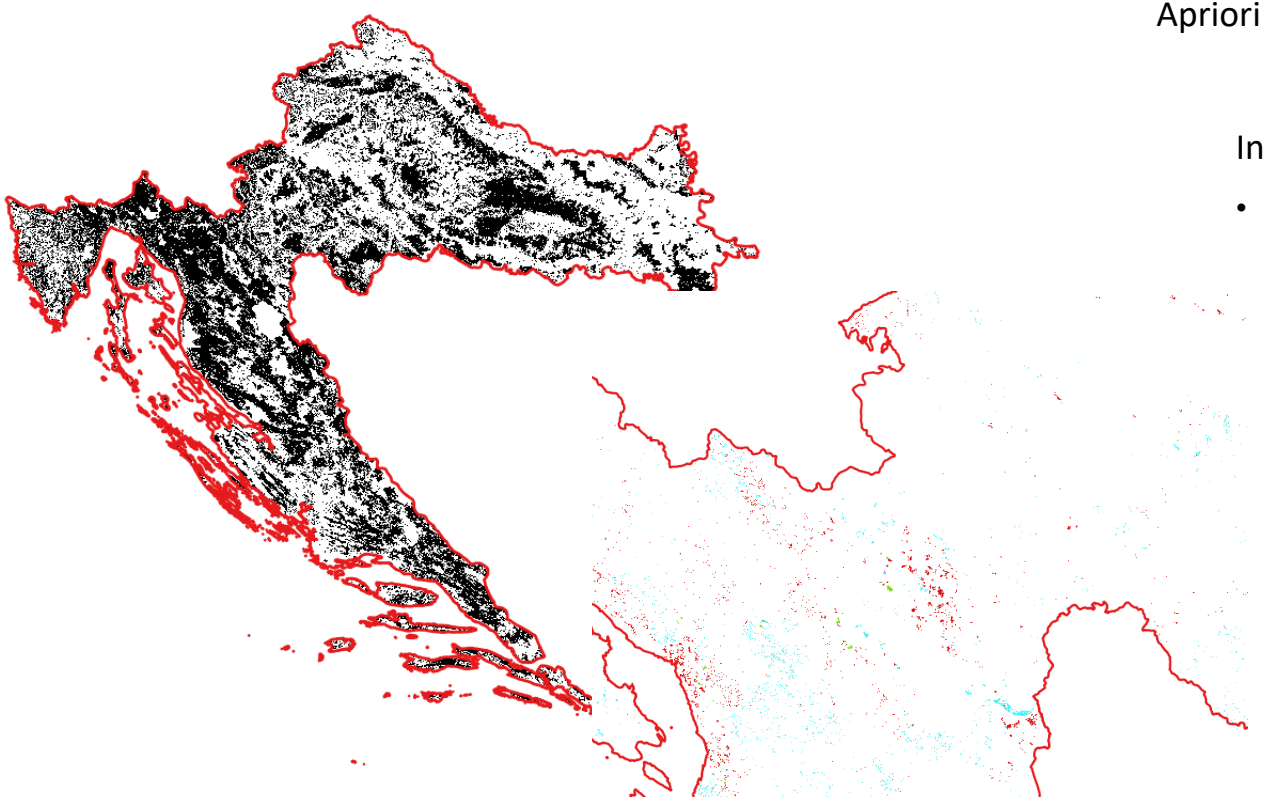
- 1968. – State orthophoto
- 1990. – SPOT satellite images
- 2000. – State orthophoto
- 2010. – State orthophoto
- 2020. – State orthophoto

CROLIS historic LC categories:

- Woodland Surfaces
- Agricultural Surfaces
  - Periodically Agricultural Surfaces
  - Permanent Agricultural Surfaces
- Grassy Surfaces
- Water Bodies Surfaces
- Artificial Surfaces
- Bare Soil Surfaces

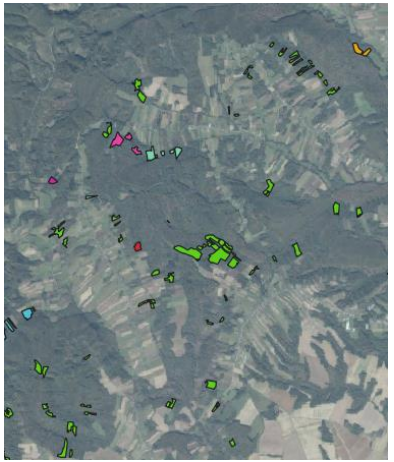
CROLIS historic LULUCF model

Apriori map



Input data:

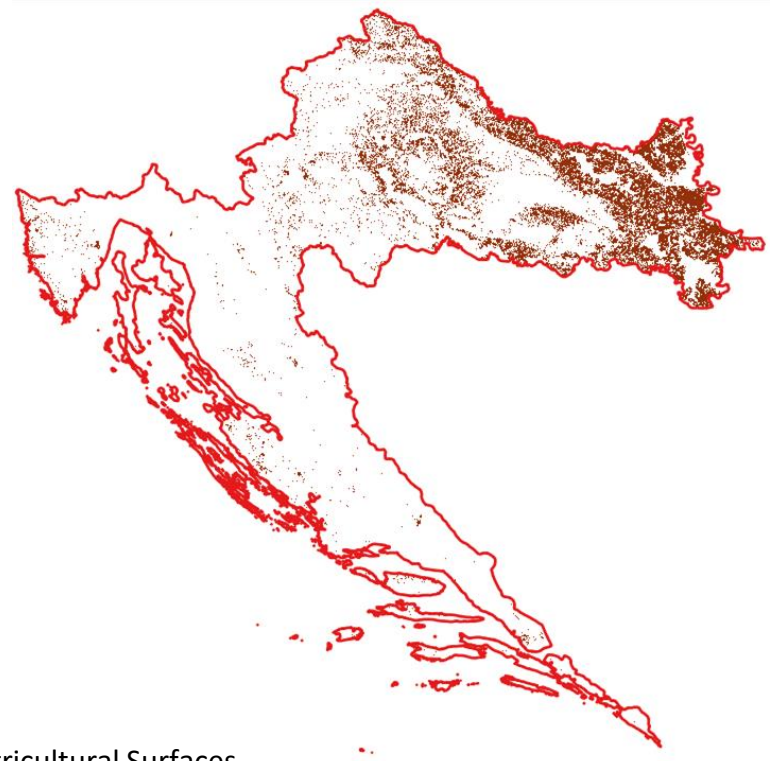
- Official data on forests, afforestation, reforestation and deforestation since 1990.



- Woodland Surfaces

CROLIS historic LULUCF model

Apriori map



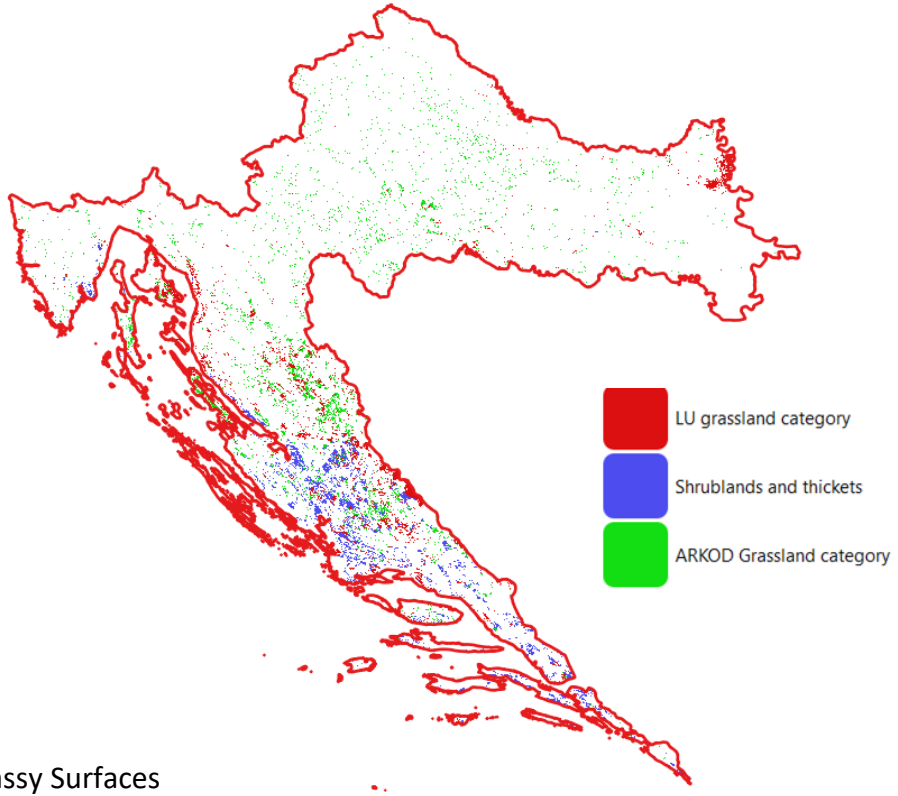
Input data:

- Official data of the Agency for Payments in Agriculture, Fisheries and Rural Development on crops divided into annual and perennial.

- Agricultural Surfaces

CROLIS historic LULUCF model

Apriori map



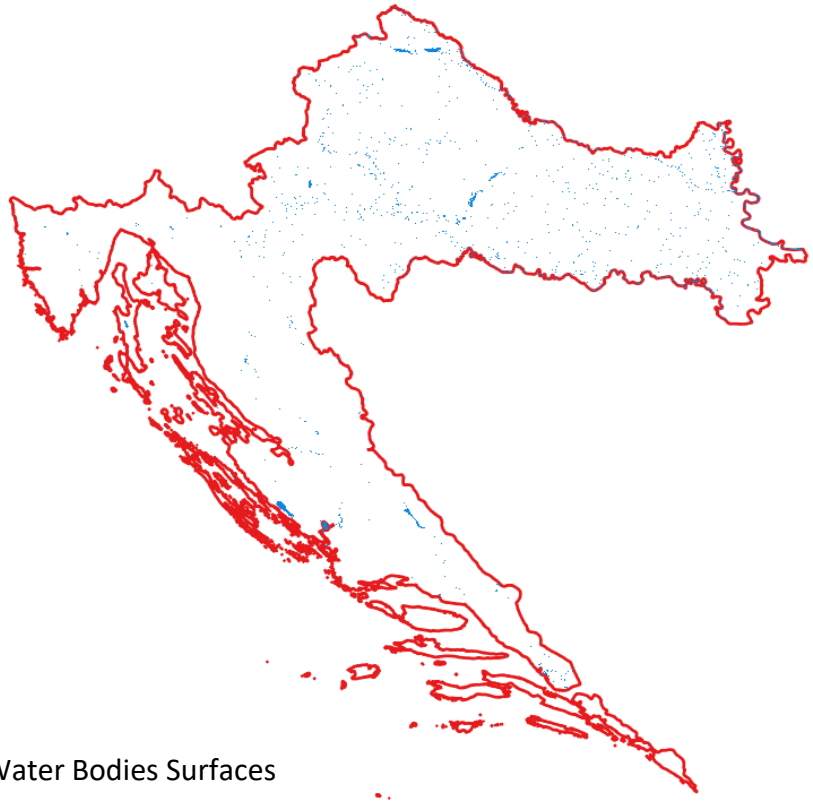
Input data:

- Official data of the Agency for Payments in Agriculture, Fisheries and Rural Development on grassland
- Data on shrublands and thickets
- Data from Croatian Forests Ltd. with the LU grassland category

- Grassy Surfaces

CROLIS historic LULUCF model

Apriori map



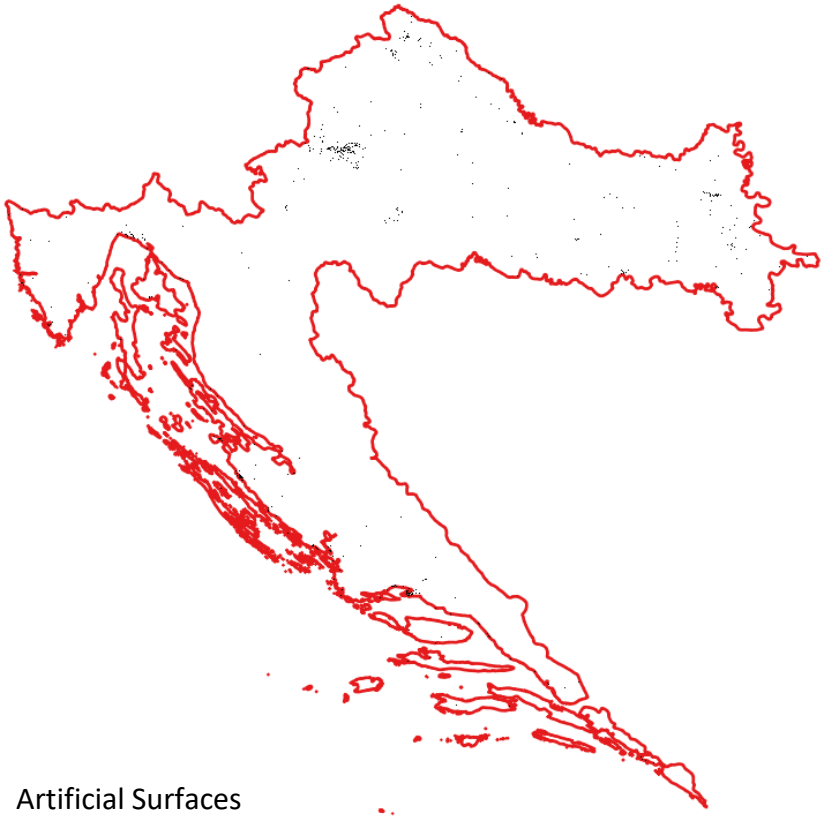
Input data:

- Data from Croatian Waters on water bodies

- Water Bodies Surfaces

CROLIS historic LULUCF model

Apriori map



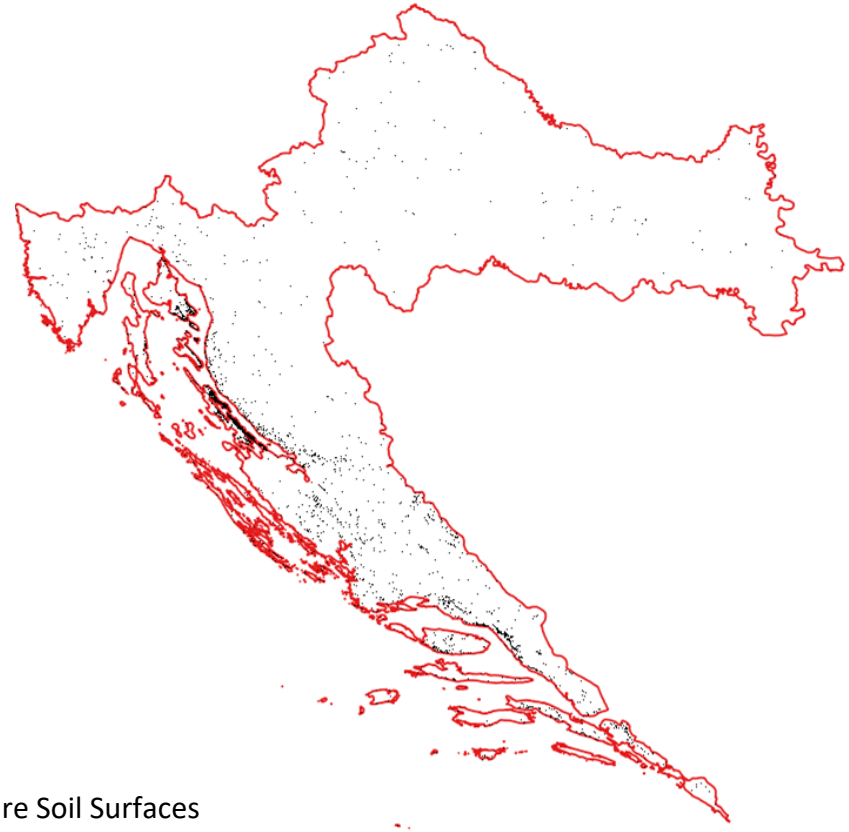
Input data:

- Data from Copernicus CLC backbone

- Artificial Surfaces

CROLIS historic LULUCF model

Apriori map



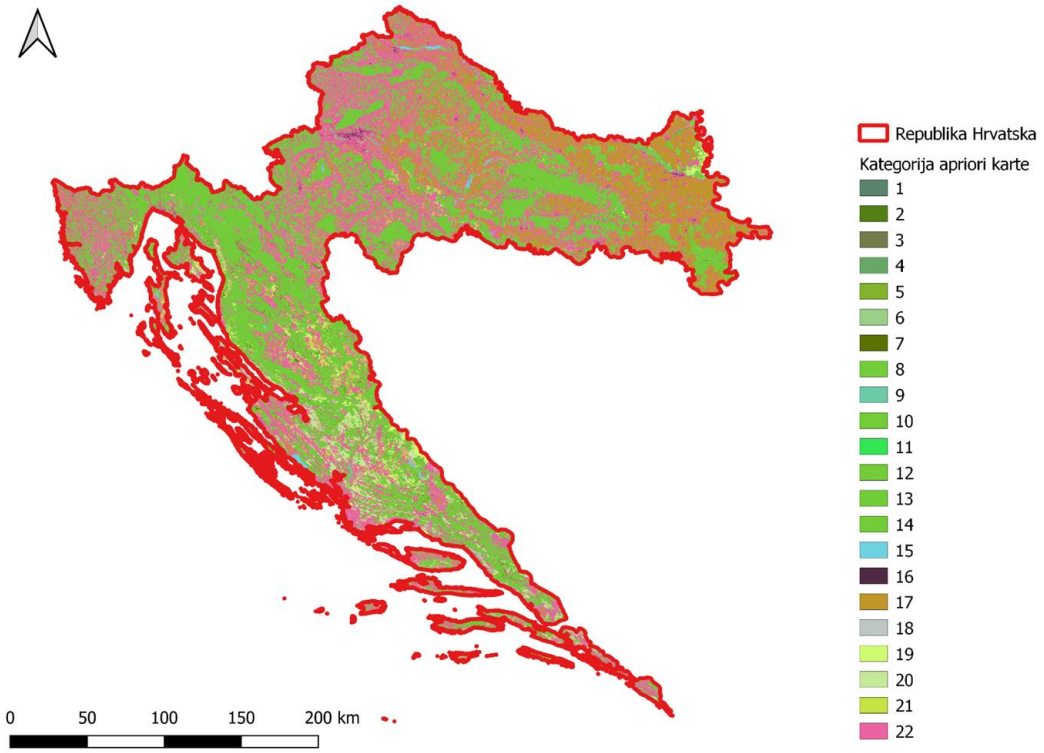
Input data:

- Data from Copernicus CLC+

- Bare Soil Surfaces

CROLIS historic LULUCF model

Apriori map



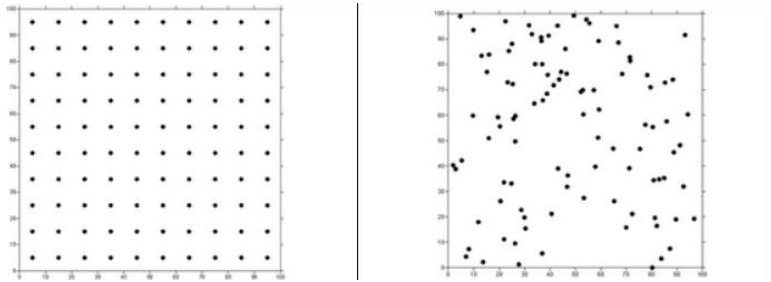
Category	Priority	Area (ha)
Deforestation_2000	1	489.43
2010	2	3,011.48
2020	3	869.31
Afforestation_reforestation_1990	4	203.11
2000	5	2,474.75
2010	6	25,156.64
2020	7	29,041.80
Woodland Surfaces by HŠ	8	2,016,107.33
Private Woodland Surfaces Fond 2010	9	7,944.03
Overlay category 9,8	10	108,807.18
Private Woodland Surfaces Fond 2020	11	7,068.08
Overlay category 11,8	12	224,227.36
Nacionalni parkovi	13	44,835.47
NP S. Velebit	14	9,056.89
Water Bodies Surfaces	15	70,750.52
Artificial Surfaces	16	19,472.46
Agricultural Surfaces	17	762,423.91
Bare Soil Surfaces	18	70,018.33
Grassy Surfaces by Hš	19	106,987.81
Grassy Surfaces	20	117,345.38
Grassy Surfaces ARKOD	21	134,694.02
Other	22	1,905,807.46

CROLIS historic LULUCF model

CROLIS sampling design

CROLIS sampling design:

- Initially - a standard 100x100 m, and later 500x500 m, regular grid sampling design;
- The initial grid sample ~12,600 (by the end of 2024.);
- Project time and resource constraints - initial grid sampling design cannot be implemented;
- An alternative two-phase approach:
  - Construction of an **a priori map** based on credible sources and available data;
  - **Stratified (importance) sampling** based on the a priori map with uniform spatial sampling within layer - **100 m exclusion radius**.



CROLIS historic LULUCF model

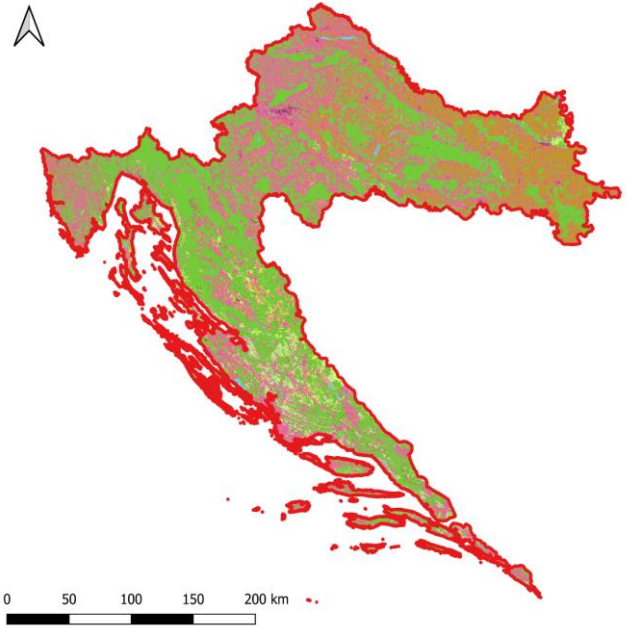
CROLIS sampling design

Stratified sampling - CROLIS a priori map:

- **Goal** : identify *no-change layers* within each LC category - to be omitted from further sampling;

- Initial a priori map was constructed using the available official data;
- Tested on the regular grid initial sample;

- The final a priori map - construction in several iterations, each tested on an additional sample;
- Final version of map: 22 layers.



CROLIS historic LULUCF model

CROLIS sampling design

Iterative construction of CROLIS a priori map:

- Decision: after each iteration - layer is constructed or further refinement needed;
- Based on the results of the **accuracy assessment for multi-class data** (confusion matrix analysis):

  - **Sensitivity (Recall, TPR)** = TP / (TP + FN)
  - **PPV (Precision)** = TP / (TP + FP)

- Sensitivity – how well the a priori map captures points from a given category;
- Positive Predictive Value – the predictive accuracy of the a priori map layer for the specified category.

CROLIS historic LULUCF model

CROLIS sampling design

New LC category via CROLIS a priori map:

Woodland Surfaces – Se=51%, PPV=77%

- Layers A8, A10, A12, A13, and A14 were labeled as ***no-change Woodland Surfaces***;
- Layers constructed using Croatian Forests data - official data on LU Woodland Surfaces;
- These layers do not cover approximately 49% of data observed as unchanged Woodland Surfaces;
- The majority of this data belongs to layer A22 (*Other*);
- Construction of a new category ***Grassland with woody*** – representing forest-like surfaces outside of the domain of Croatian Forests data.

LIFE CROLIS

Thank you for attention!

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