This project is funded by the European Union

ENI SEIS II East
Implementation of the Shared Environmental Information System (SEIS) principles and practices in the ENP East region

Regional Conference on the outcome of the CLC-Pilot project, potential benefits and way forward in ENI-East countries

ENI-CLC pilots - Lessons learnt

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ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

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Contents

- Objective of the ENI-CLC pilots
- Workflow
- Comparative statistics
- Land cover flows (example)
- Conclusions (technical, policy, legal compliance)
- Way forward
- Partners

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Objective of the ENI-CLC pilots

Activity 2.3 of the ENI SEIS II East Description of Action "**Pilots on extending CORINE Land Cover (CLC) methodology to areas of the partner countries**":

- A step to facilitate the access to, and use of, some spatial data required for SEIS implementation at national level.
- Allows direct links to related initiatives and programmes at the European level; namely the recently completed production of the 2018 update of the **CLC layers in the EEA39 countries**, and services provided through the **Copernicus Programme**, a joint European Union and European Space Agency initiative for a long-term sustainable capacity building in Earth Observation from space.

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ENI-CLC pilots - the project in numbers

- **Five countries** have participated (Armenia, Azerbaijan, Georgia, Moldova, Ukraine)
- **One country** (Belarus) did not express interest to participate but was kept informed regularly on the process and has full access to all the results
- **Four feasibility** visits organised (AZ, GE, MD, UA)
- **Eight training** missions organised on mapping CLC and CLC Change
- **One on-line training** organised on mapping CLC Change (AM)
- Around **20 technical experts** contributed
- Around **15 governmental experts** involved/ users advise

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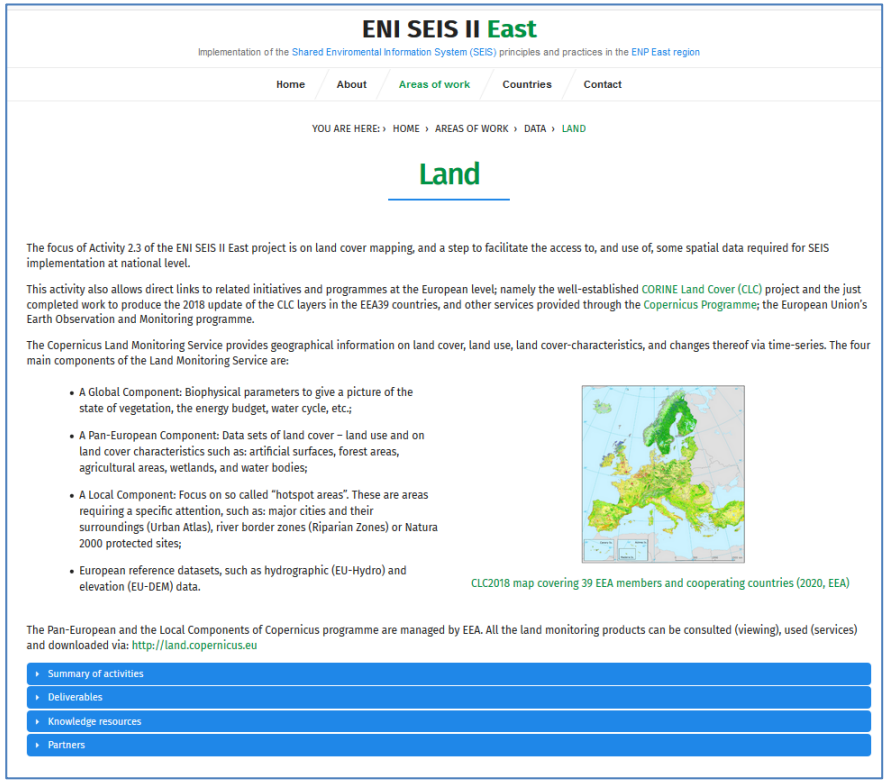
ENI-CLC pilots – visibility and communication (EEA)

- Dedicated page “Land” on the ENI SEIS II website presenting the results
- Data available posted on the Copernicus site for visibility and further use
- Digital package summarising the results available for wide use



https://eni-seis.eionet.europa.eu/east/areas-of-work/data/land

ENI CLC Pilots on CLMS portal, when available

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Workflow

- Selecting pilot area around capital
- Mapping CLC status layer, based on photo-interpretation of satellite images
- Mapping CLC changes based on recent and past satellite images.

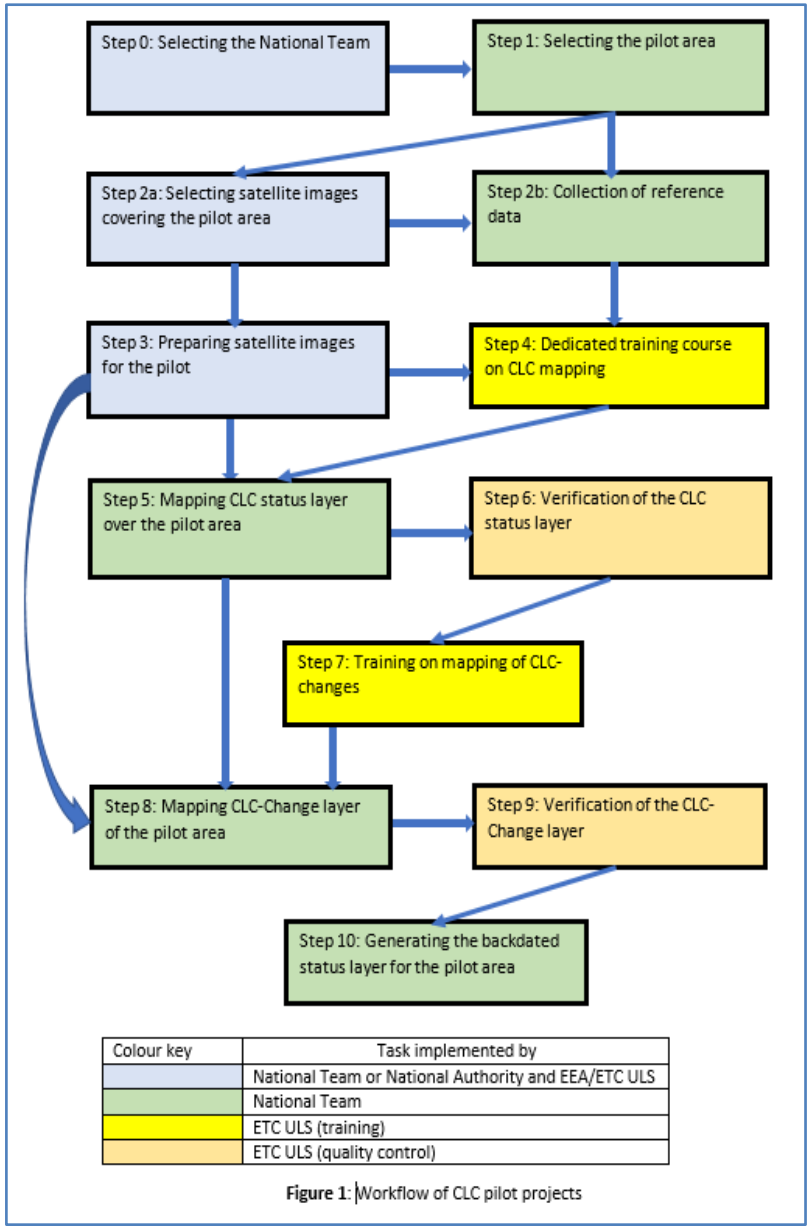

Figure 1: Workflow of CLC pilot projects

Support from ETC/ULS:

- Selecting national technical teams (NTT)
- Training of NTTs
- Selecting and pre-processing of satellite images*
- Verification of results produced by NTTs

*Some countries used their own capacity

Technical specifications for the CORINE Land Cover (CLC) pilot projects implemented in the Eastern Partnership countries (2017-2019)

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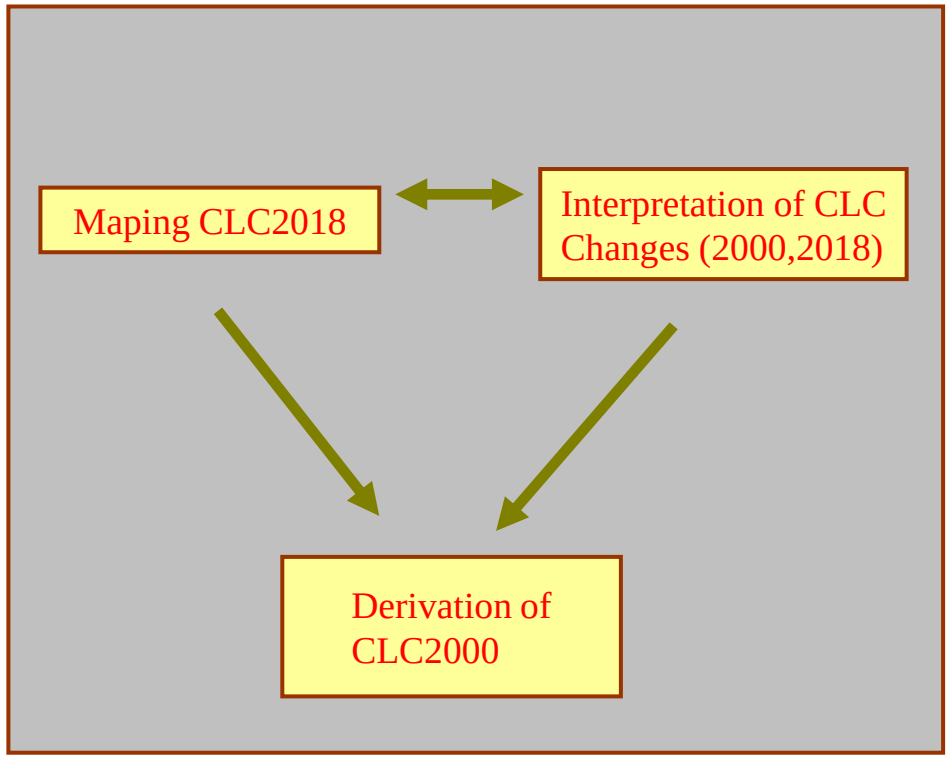
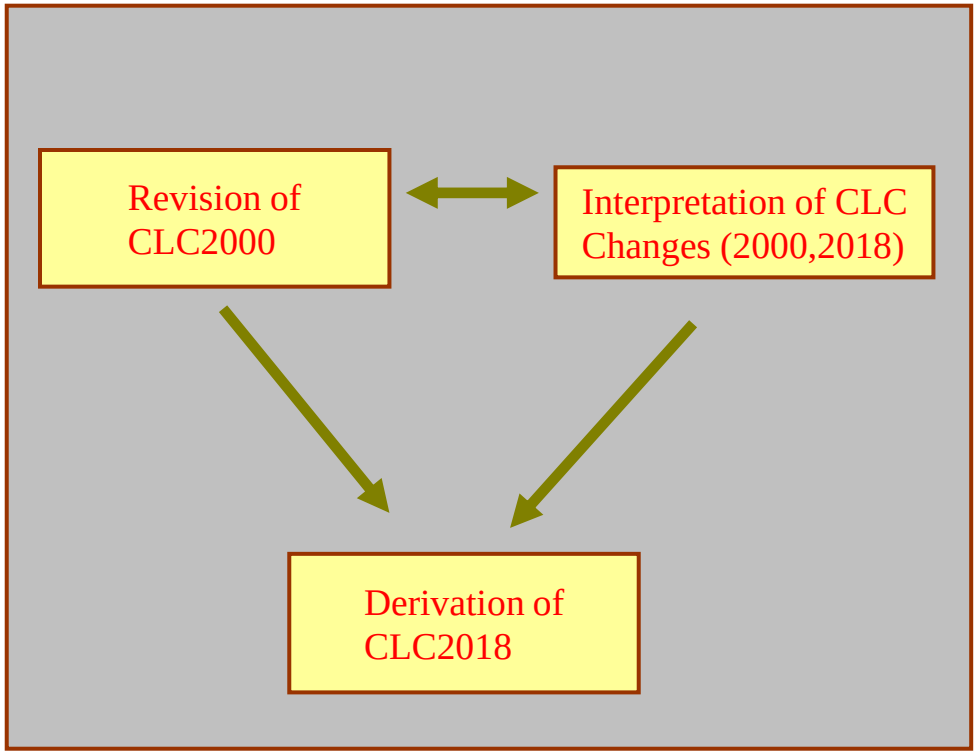
Methodology

Two ways of mapping CLC changes have been applied:



Backdating in AM, AZ, GE and UA: mapping started with creating the CLC2018 status layer and changes mapped backward in time



Updating in MD: mapping started with revision of the existing CLC2000 status layer and changes mapped forward in time

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Satellite images

Recent coverage to map CLC2018

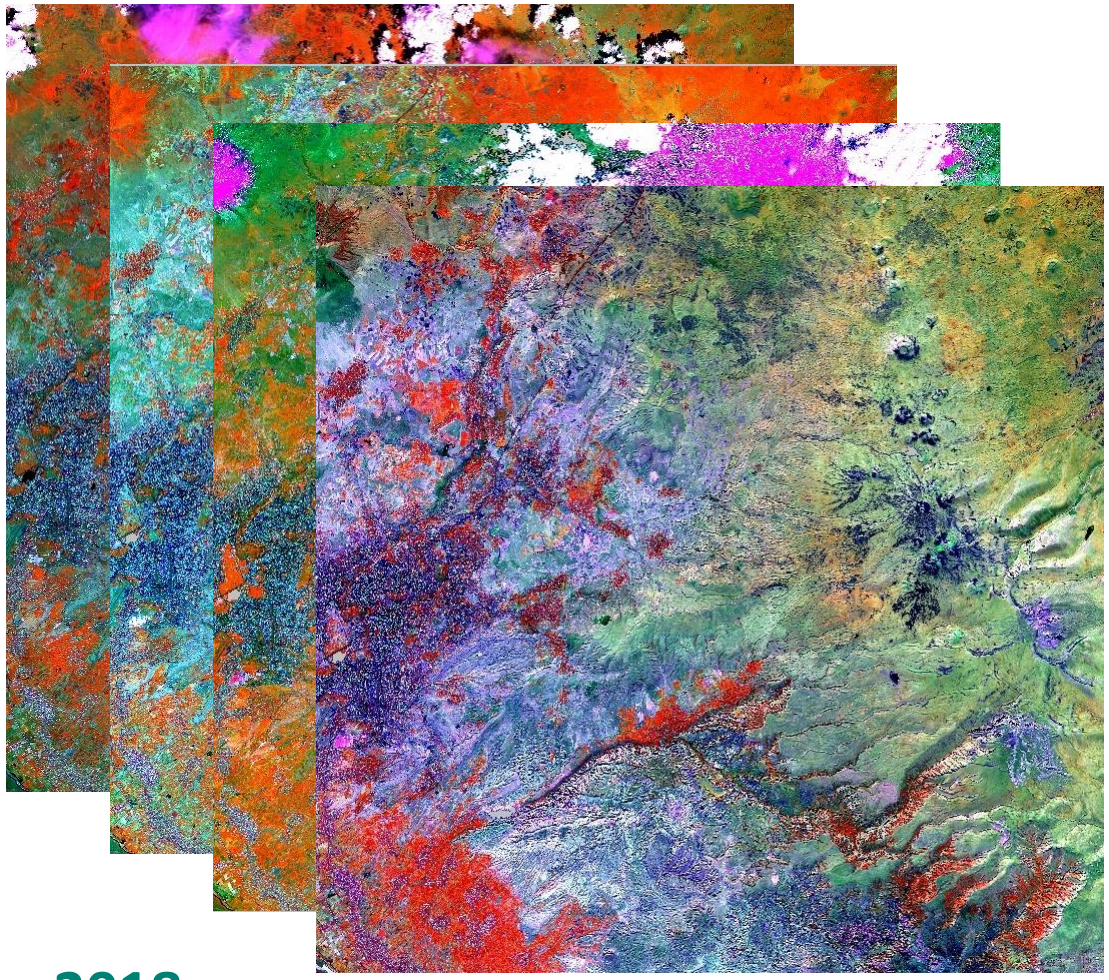
- Freely available ESA Sentinel-2 satellite images (10/20 m pixel size, VIS/NIR/SWIR bands), taken in 2017-2019, downloaded from Copernicus archive were used. For most ENI countries multi-seasonal data were available.
- „Visual product" was generated for photointerpretation (like for EEA39).

Past coverage to map CLC changes

- Freely available Landsat TM data (30 m pixel size, VIS/NIR/SWIR bands) taken in 2000-2005 were downloaded from Landsat data archive. For most of the ENI countries multi-seasonal data were available.

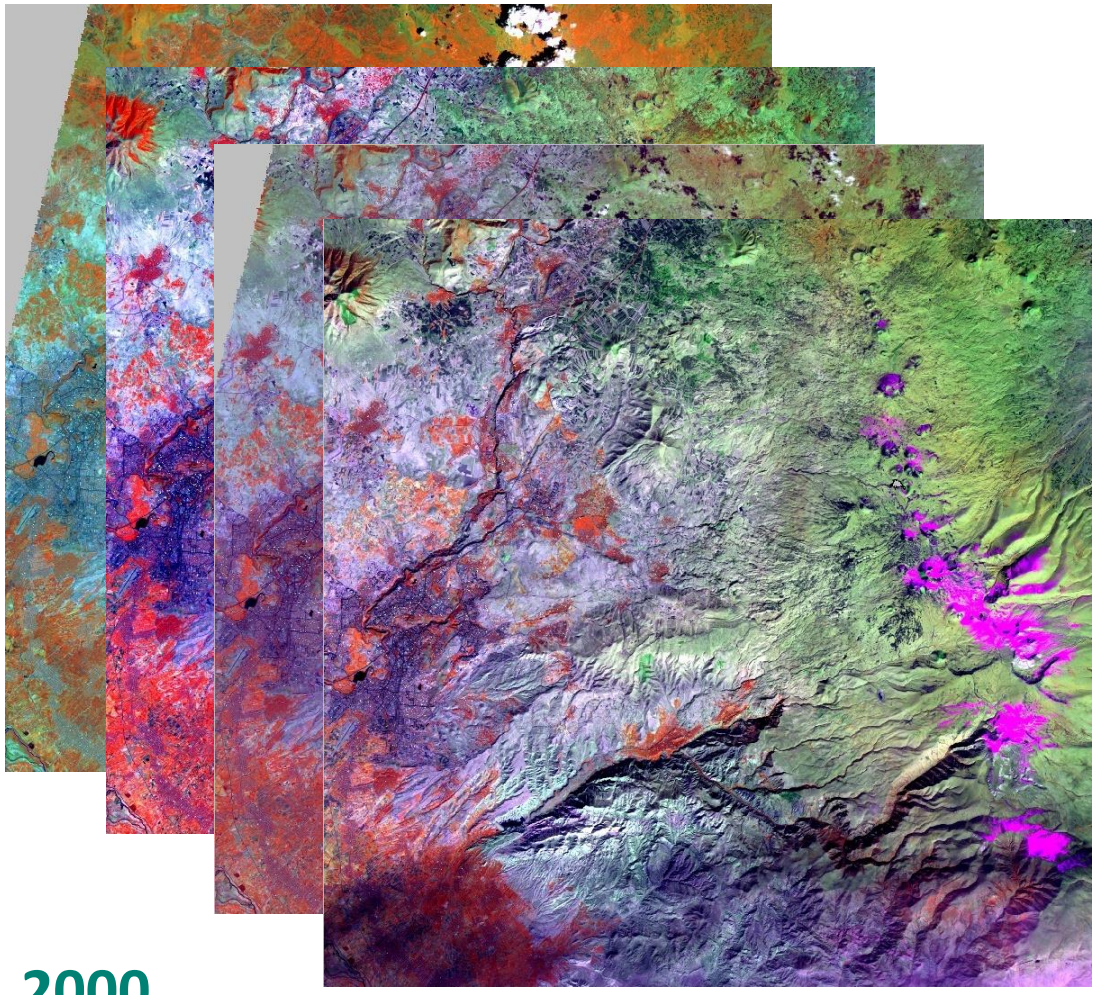
There was no need for geometric rectification only to transform images into national projection.

Satellite image time series - example: Armenia



2018

ESA Sentinel-2 images: 2018-05-17, 2018-07-11, 2019-04-27, 2019-10-14



2000

US Landsat-5 images: 2000-06-03, 2000-08-13, 2000-08-22, 2000-10-16

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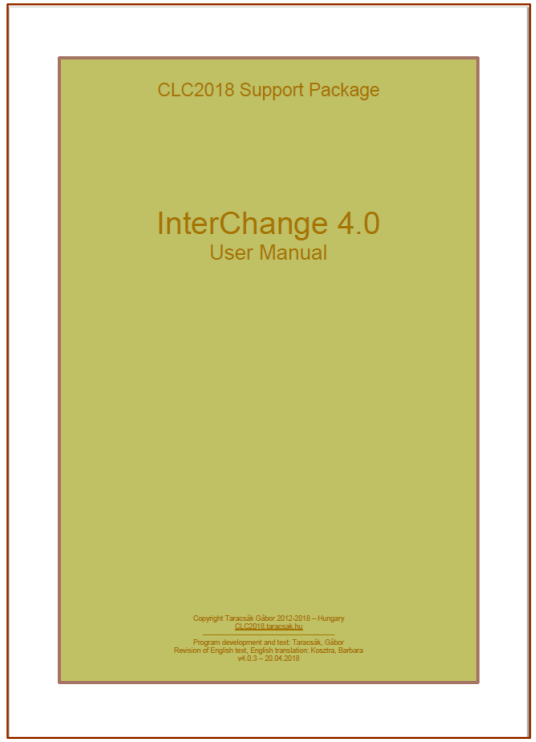
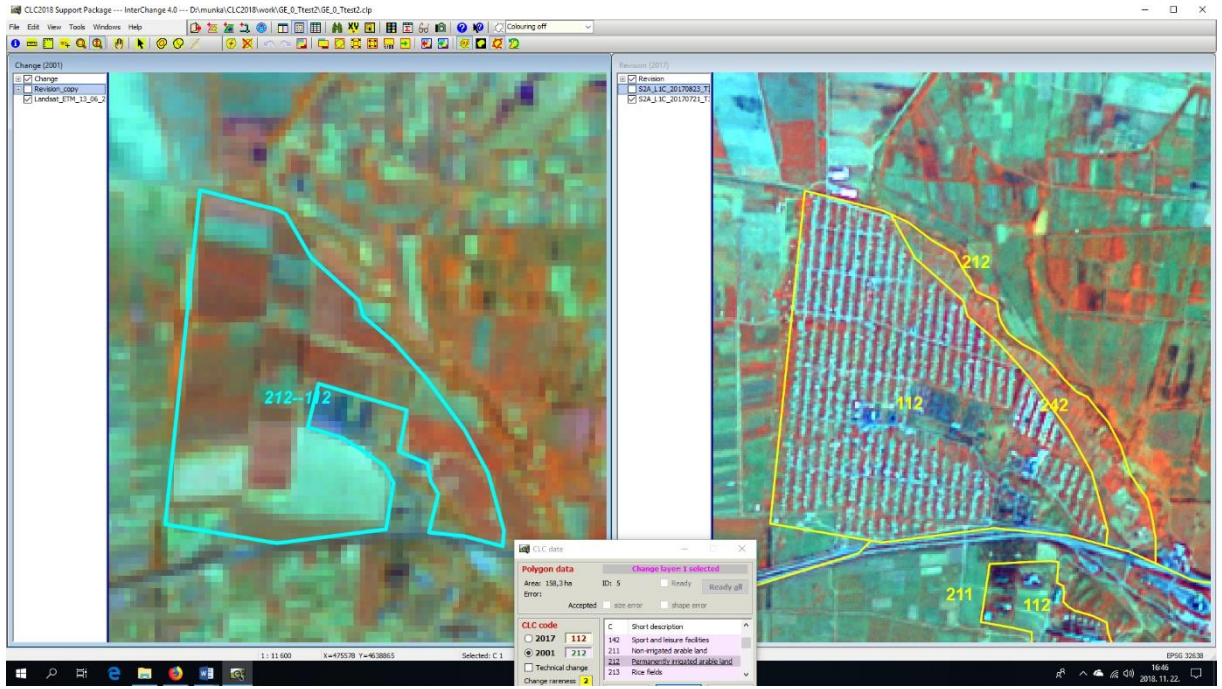
Software used





Computer asisted photo-interpretation (CAPI) software, InterChange was designed to support the CLC2018 project of the EEA. It consisted in the revision of CLC2012 and in mapping CLC-Changes between 2012 and 2018. The software has been adapted to support mapping changes between any two selected years and to provide possibility for backward mapping in time.

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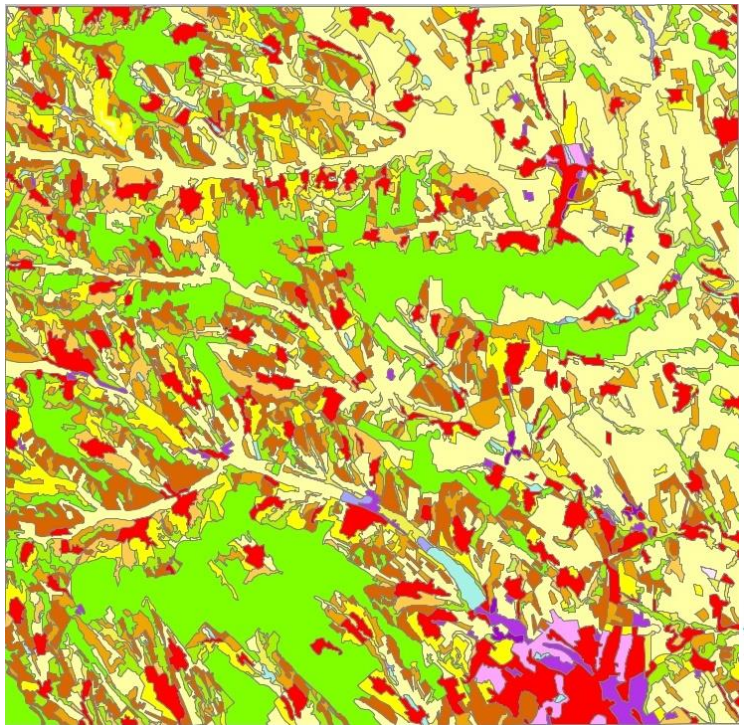
Results – comparison of CLC status layers

Country	Area (km2)	Pilot area (km2)	Percent of country area	Number of CLC2018 polygons	Average polygon size (km2)
Republic of Armenia	29 743	2502	8,4	743	3,37
Republic of Azerbaijan	75 142	2509	3,3	532	**4,72**
Georgia	69 700	2500	3,6	712	3,51
Republic of Moldova	33 846	3225	9,5	1838	**1,75**
Ukraine	603 628	1586	0,3	788	2,01

CLC polygon density depends on land use:

- CLC2018 maps are more detailed (having smaller average polygon size) in lowland dominated countries than in the mountainous Caucasus countries. Highest land cover fragmentation was obtained for Moldova.



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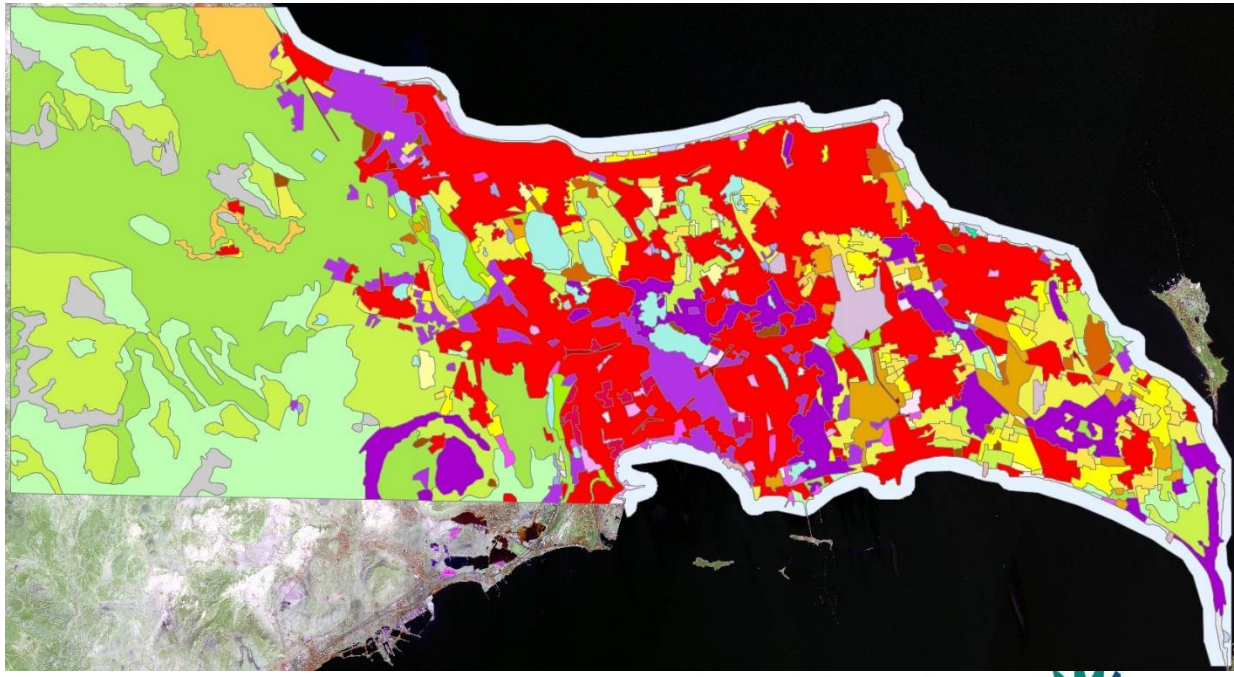
CLC polygon density depends on land use:

- Least detailed CLC2018 map (highest average polygon size) was obtained in Azerbaijan because of the large urban and semi-desert areas around Baku.



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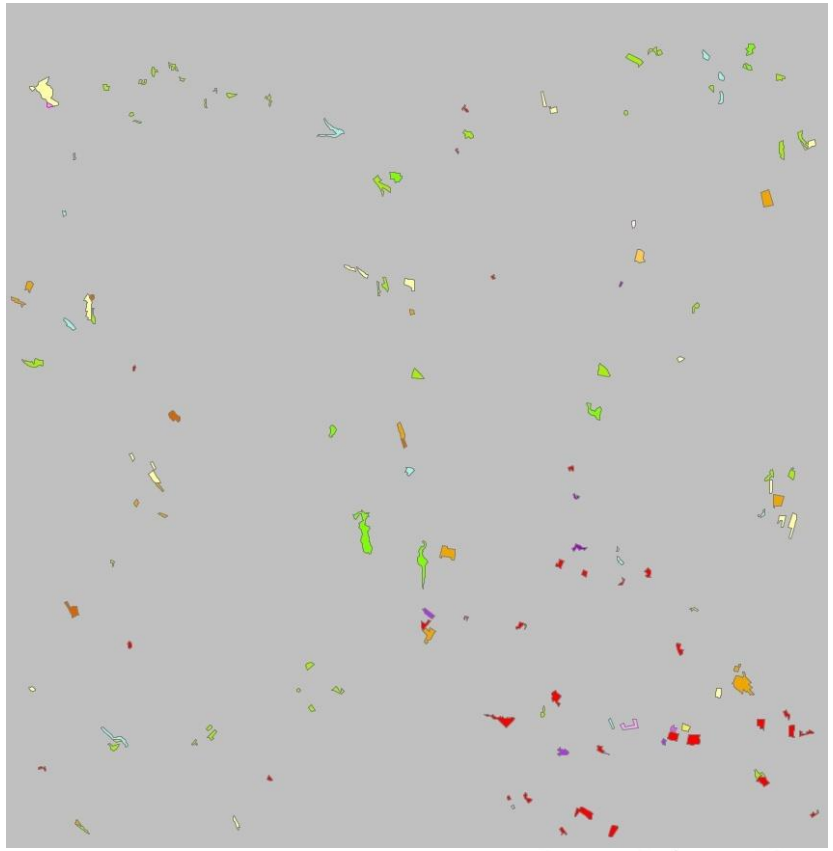
Results – comparison of CLC Change layers

Country	Number of change polygons	Percent change	Year1	Year2	Percent change/years elapsed
Republic of Armenia	437	4,9	2000	2018	0,27
Republic of Azerbaijan	349	10,6	2000	2018	0,59
Georgia	101	2,4	2001	2017	0,15
Republic of Moldova	148	1,1	2000	2018	**0,06**
Ukraine	523	18,8	2005	2018	**1,45**

The speed of CLC Change provides an indication of landscape stability:

- Moldova has shown the most stable land use / land cover (smallest percent change per year).



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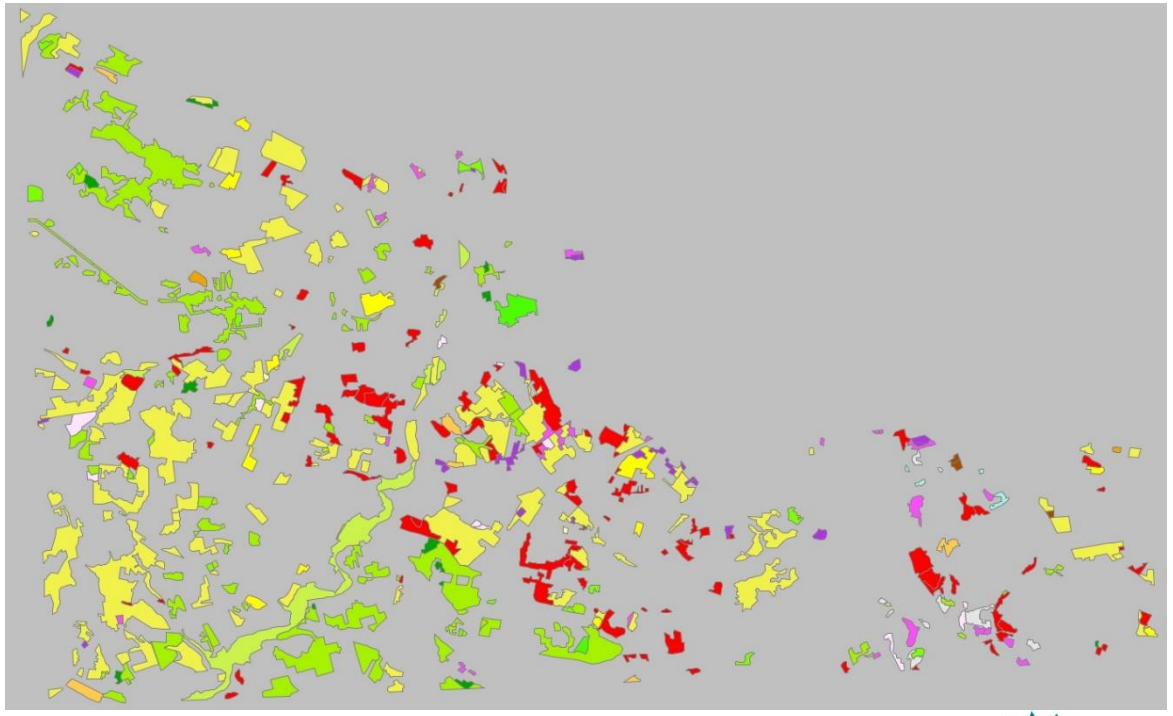
The speed of CLC Change provides an indication of landscape stability:

- Ukraine indicated the highest dynamics in land use / land cover due to strong urban sprawl and changes in agriculture and forestry.



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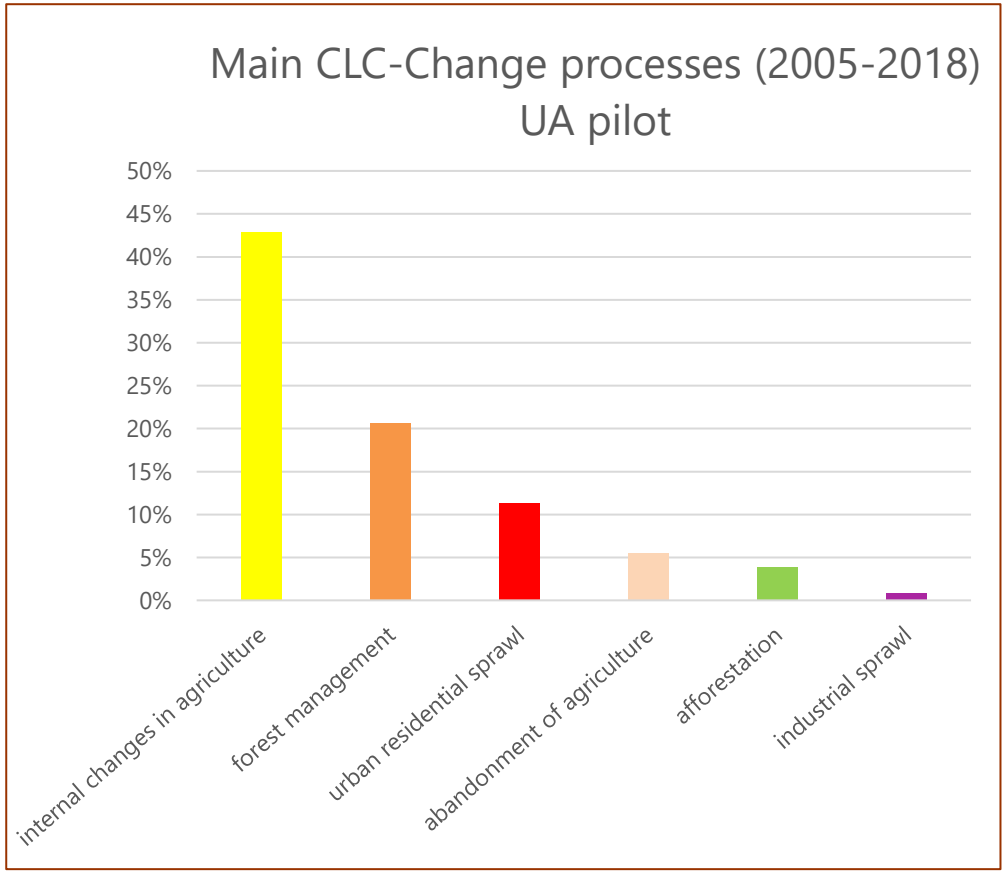
Results – land cover flows, indicators



Based on the analysis of CLC Changes „land cover flows" and furthermore, indicators can be derived.

E.g. main processes were in Ukraine:

- **Internal changes in agriculture** shows mainly converting arable land to pastures or set-aside land around Kyiv (i.e. decrease of crop production).
- **Forest management** is dominated by forest clear-cut.
- **Urban residential sprawl** shows mainly loss of agriculture area due to urban expansion.
- **Abandonment of agriculture** means arable land that has turned to natural grassland.
- **Afforestation** indicates new forest on former agriculture land.

See: Land accounts for Europe 1990-2000, EEA Report No. 11/2006

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Conclusions – technical aspects

- ENI-CLC pilots were successfully implemented in five ENI East countries.
- The methodology of European CLC and CLC Change mapping was applied by the national technical teams for a pilot area around their capital.
- High-resolution satellite images (Sentinel-2, Landsat TM/ETM) were freely available to support CLC mapping and CLC Change mapping.
- InterChange software was easy to use and supported mapping of CLC status layer as well as CLC change layer.
- Expertise was built at national level through training, hands on mapping and photo-interpretation activities and quality control (verification).

Conclusions – policy relevance

- CLC is a standardised, multi-purpose digital map covering 39 EEA member and cooperating countries in Europe (five inventories between 1990 and 2018). It supports various EU environmental policies.
- CLC is widely used at national level in environmental modelling, forestry, hydrology, education, etc.
- CLC Change database serves for land accounting and indicator development.
- CLC can provide a common basis for cross-country activities and projects (e.g. river catchment modelling).
- Producing CLC at national level is a preparatory step towards EU accession.

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Conclusions – support to legal compliance

CLC can contribute to the fulfilment of:

- national reporting obligations
- international reporting obligations, such as
  - Land use, land-use change, and forestry (LULUCF), as defined by the United Nations Climate Change Convention
  - United Nations Convention to Combat Desertification (UNCCD)
  - Others *(based on national commitments)*

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Way forward

- Promote widely the results and the benefits of CLC methodology at national level.
- Broaden the discussions on the potential use of the CLC methodology (ministries, projects, other potential users) with the national technical partner to harvest realistic national needs.
- The Ministry responsible for environment, could consider developing a proposal for a national CLC project. This proposal could be included in the national list of priorities and submitted for consideration to various donors.
- Achieving a national CLC inventory will set up the basis for a national land monitoring programme.

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Partners

Country	National Technical Team
Armenia	“Geoinfo” Limited Liability Company
Azerbaijan	Geodesy and Cartography Limited Liability Company
Georgia	GIS Lab, GIS and RS Analysis Laboratory
Moldova	Agency for Land Relations and Cadastre of Moldova
Ukraine	National University of Life and Environmental Sciences of Ukraine and State research and production centre “Pryroda”.

Interest and active participation of all partners are acknowledged!

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Partners