Copernicus Land Monitoring Service (Pan-European and Local) in the Netherlands

Wageningen Environmental Research (WENR) activiteiten

13 Juni 2018, Gerard Hazeu

Copernicus
Europe's eyes on Earth

WAGENINGEN
UNIVERSITY & RESEARCH

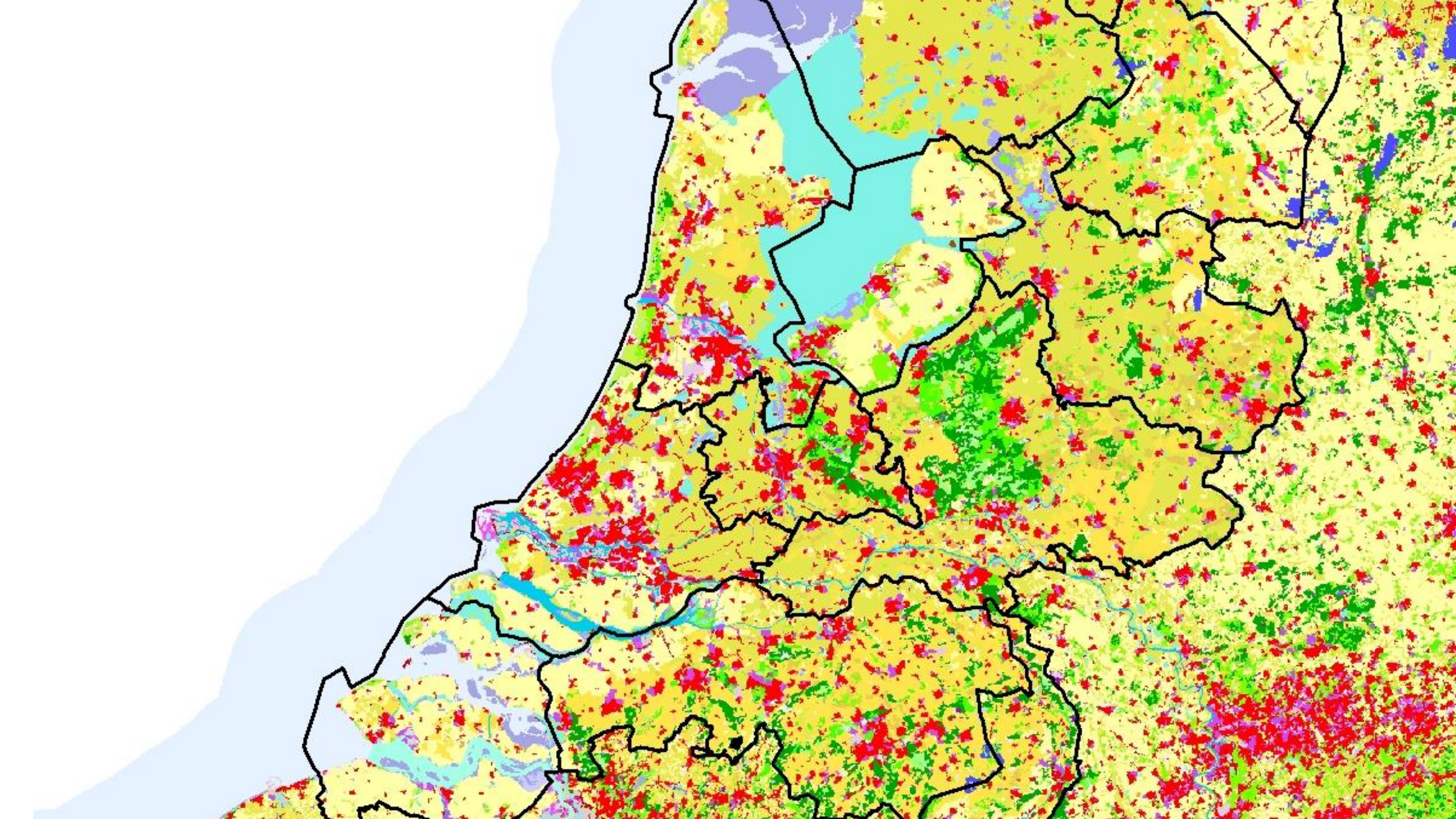
100years
1918 — 2018

Introduction

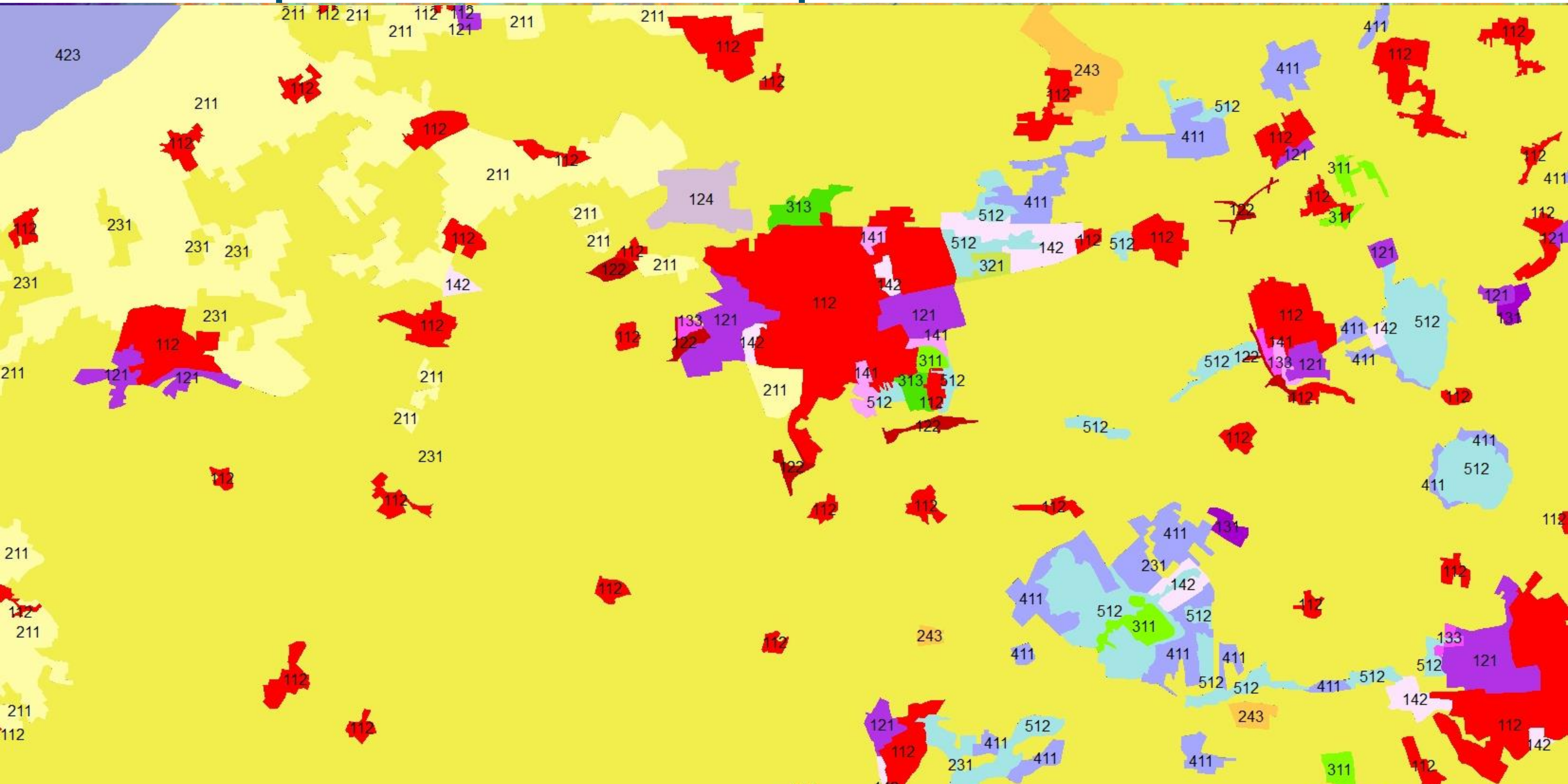
- Personal note and some terminology (EIONET, NRC, EAGLE)
    - WENR
    - EEA, EIONET, NRC-LC, EAGLE
- National activities
    - NL focus: Landelijk Grondgebruik Nederland, Basiskaart Natuur, Groenmonitor......
    - European focus (CLMS)
        - Framework Service contract
        - Other service contracts
        - EAGLE
        - CLC-plus

Framework Service Contract (1)

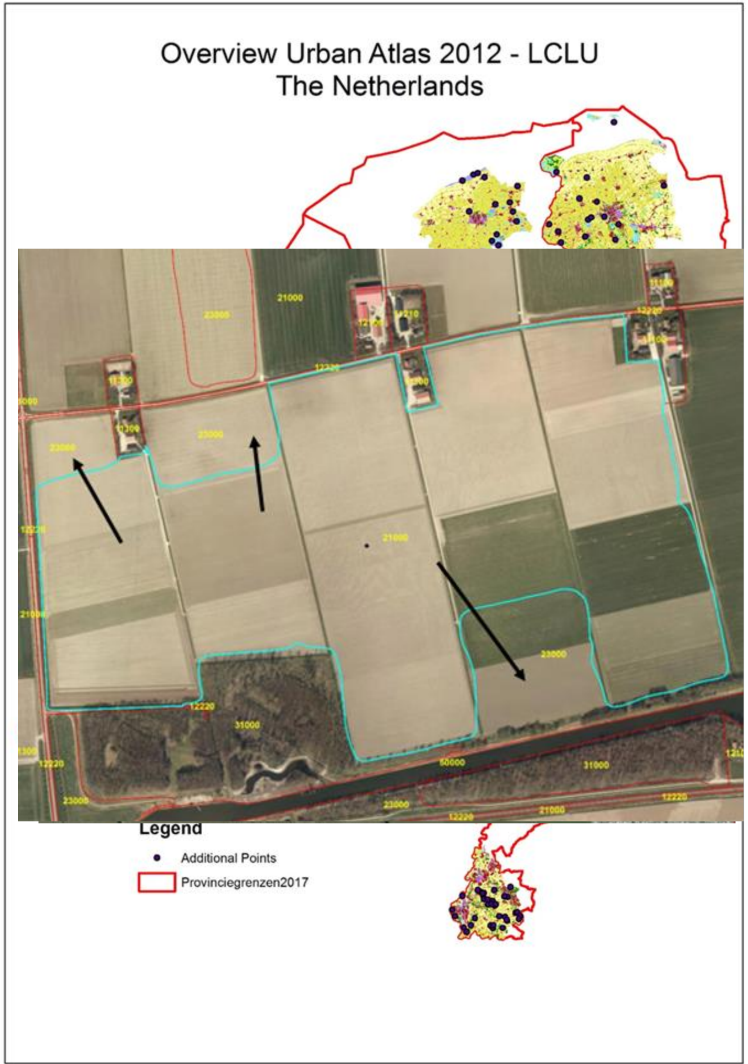
- FSC for the Copernicus Land monitoring services – NRCs LC) Copernicus supporting activities for the period 2017-2021
- CLC2018
  - Production of CLC2018
  - Production of CLC2012revised
  - Production of CLC-change 2012-2018
- Verification Local Components
  - Urban Atlas (UA) 2012 status layer
  - Urban Atlas 2012 Street Tree Layer (STL)
  - Riparian Zones LCLU 2012 status layer (RZ)
  - Riparian Zones Green Linear Elements 2012 status layer (GLE)



Example of CLC2018 production



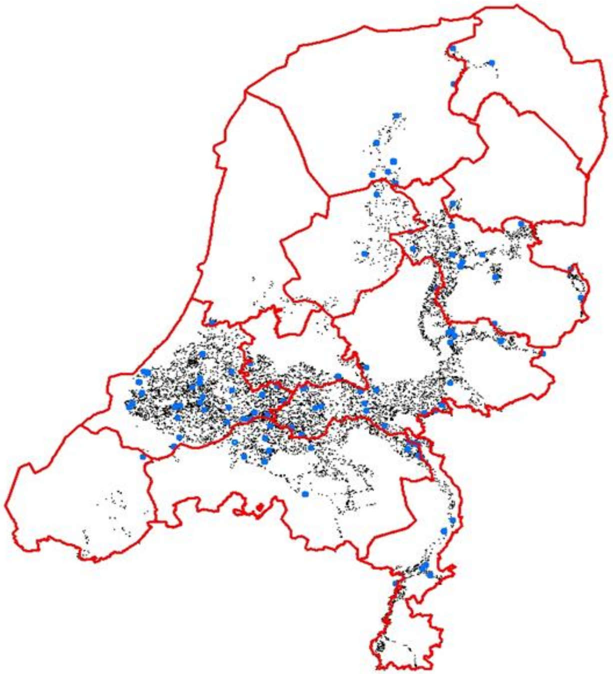
Example of Local Component Verification (1)



DATASET	UA	Urban Atlas LULC 2012
LC/LU CLASS	21000	Arable land (annual crops)
Number of samples selected for the class	10	
CORRECTNESS OF LC/LU CODE		
Number of correctly interpreted samples	7	
Class user's accuracy (weighted)	70.0 %	
Class user's accuracy (CI, weighted)	±29.9%	
Class producer's accuracy (weighted)	63.4%	
Class producer's accuracy (CI, weighted)	±31.5%	
CORRECTNESS OF DELINEATION		
Correctness of delineated area	30.0%	Correct: 3; Unnecessary parts included: 0; Missing parts: 5; Both missing parts and unnecessary parts included: 2
Detail of delineation	60.0%	Correct:6; Too coarse: 4; Too detailed: 0
Positional accuracy	90.0%	Correct: 9; Shifted: 1
CHARACTERIZATION OF THE CLASS		
Typical mistakes (misclassification, wrong delineation, etc.) describe in detail	Main mistakes are the missing of arable land incorrectly classified as pastures next to the arable land polygon and/or unnecessary inclusion of pastures.	
Typical reference information used / minimum required for decision	VHR aerial photographs of the year 2012	
Typical appearance of the class in samples (habitats, cultivation type, land use etc.)	Arable land is encountered throughout The Netherlands. Large scale farming is restricted to some rural provinces like Flevoland, Zeeland and Groningen	
EXAMPLE (typical mistakes / typical appearance):		

Arable Land: Large pasture areas are not included in the arable land polygon. Delineation of polygon does not reflect the field situation and LPIS information of 2012.

Example of Local Component Verification (2)



Black: RZ GLE NL 2012 polygons; Blue: sample points; Red: Province boundaries NL 2018.

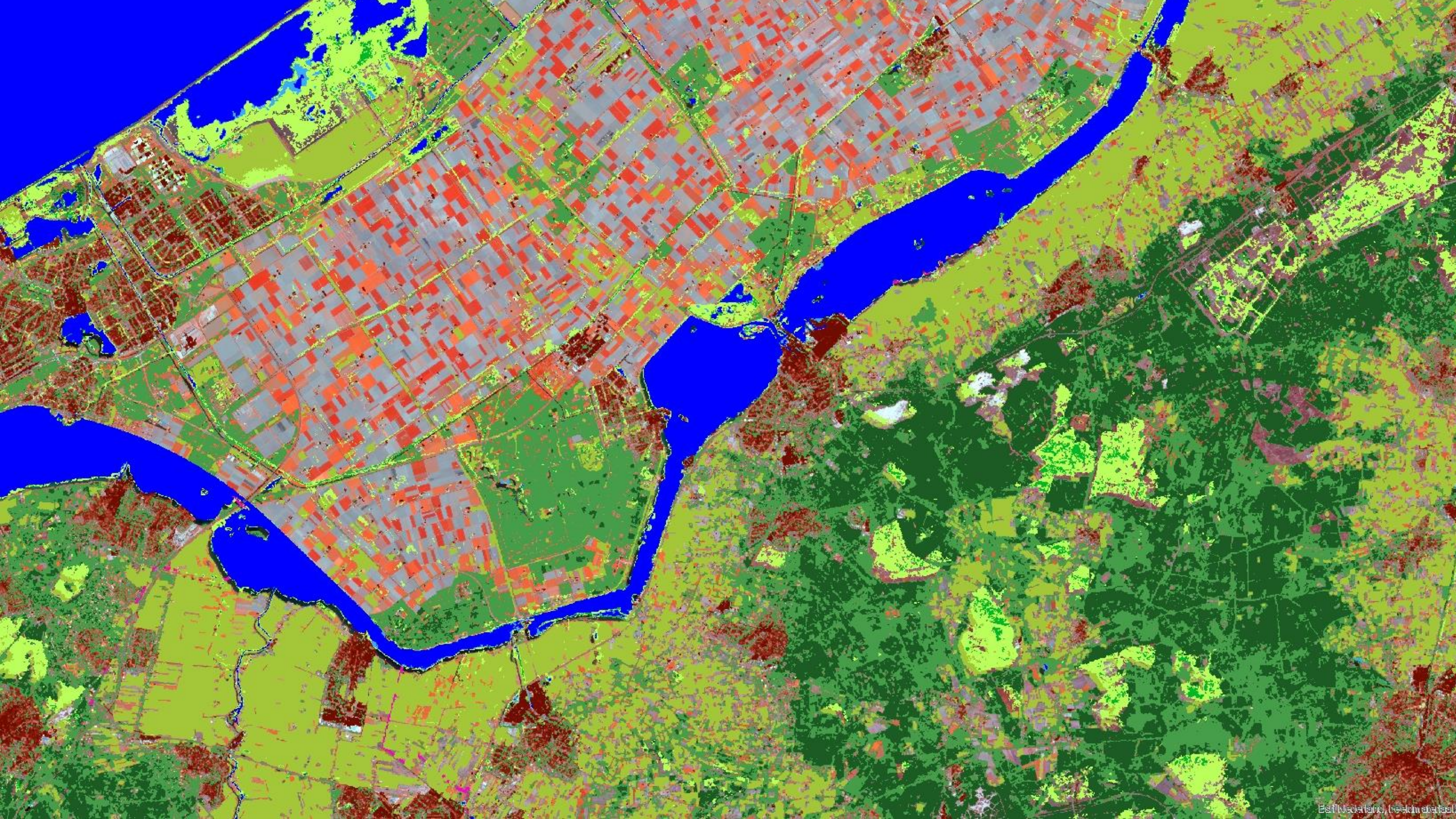
Summary of statistics of Riparian Zones GLE 2012 – The Netherlands:

GLE classes Riparian Zones		Number of polygons	Area (ha)	%
11	Trees – Linear structures	5323	755.6	15.82%
12	Trees – Patches	26793	3761.1	78.74%
21	Hedgerows & scrubs – Linear structures	1258	169.6	3.55%
22	Hedgerows & scrubs - Patches	673	90.5	1.89%

DATASET	GLE	Green linear elements 2012 status layer
Area covered within country	0.01%	4776.8 ha
Number of valid classes appearing in the country	4	
Number of samples selected	100	25 for each of 4 classes
CORRECTNESS OF LC/LU CODE		
Number of correctly interpreted samples	86	
Overall Accuracy (weighted)	89.38%	Non-weighted 86.0%
Overall Accuracy (CI, weighted)	±8.97%	Non-weighted ±6.74%
CORRECTNESS OF DELINEATION		
Correctness of delineated area	35%	Correct: 35; Unnecessary parts included: 5; Missing parts: 44; Both missing parts and unnecessary parts included: 16
Detail of delineation	69%	Correct: 69; Too coarse: 31; Too detailed: 0
Positional accuracy	51%	Correct: 51; Shifted: 49

Framework Service Contract (2)

- Enrichment Urban Atlas (probably class 121 – industrial etc.)
- Post-production verification of the High Resolution Layers (HRLs) for the 2015 reference year.
    - Imperviousness
    - Forest
    - Grassland
    - Wetness & Water
    - Small woody features
- Dissemination national products


Esri Nederland, beeldmateriaal

Framework Service Contract (3)

- Future
  - Verification and enrichment activities related to an upcoming coastal zone product.
  - Post-production verification of the HRLs for the 2018 reference year.
  - Support and testing of future CLC+ (2nd generation CLC methodological improvements and developments), based on CLC2018 products

Other Copernicus contracts

- Specifications for Copernicus land products
  - Specifications HRL (e.g. Water and wetness, Grasslands and Small and Woody Features (SWF))
  - Analyse the possibilities for moving from 3 or 6 yearly snapshots into yearly partial incremental updates of land monitoring products, including the assessment of changes required in workflows
- EAGLE contracts
  - EAGLE data model
  - Towards CLC plus

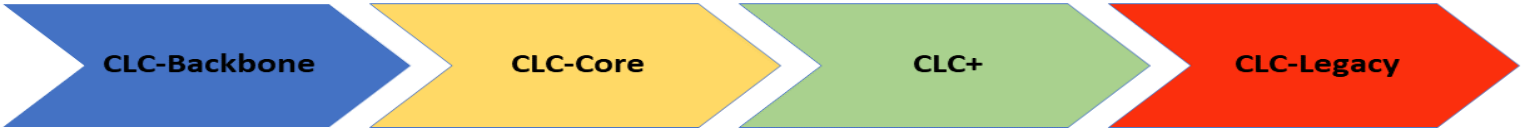
EAGLE

- EAGLE – EIONET Action Group on Land monitoring in Europe
    - EIONET – European Environment Information and Observation Network
    - Group of NRC’s (National Reference Centres) for Land Cover
    - Most active countries: Austria, Finland, Germany, Hungary, Luxembourg, Netherlands, Norway, Portugal, Spain
- Objective – goal:
    - A European land monitoring system fitting with todays needs
    - Streamlining national and European land cover activities (efficiency, bottom-up/top-down)

EAGLE data model

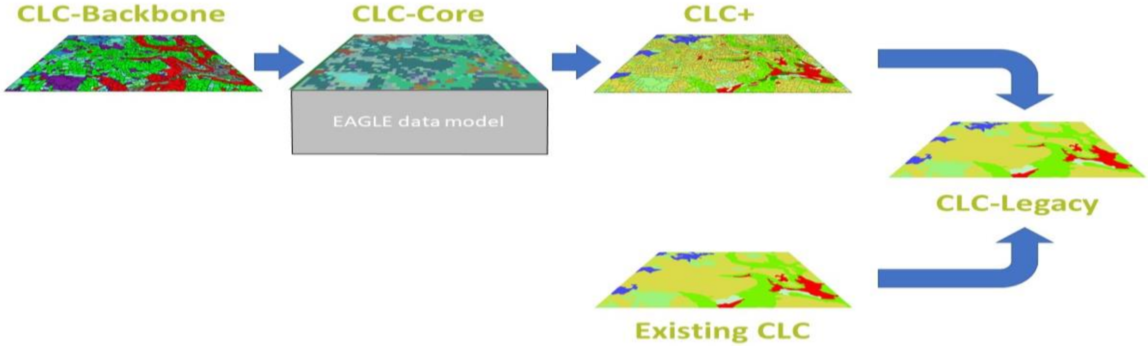
- Criteria: separation LU/LC, object oriented, scale independent, backwards compatible, applicable on national/EU level, temporal phenomena
- Landscape description
  - Land Cover Components (Water, Biotic, Abiotic)
  - Land Use Attributes (agriculture, mining, transportation...)
  - Characteristics (cultivation measures, status/condition....)
- Applicability:
  - Semantic comparison of definitions of classes
  - Guideline of descriptive characterization of landscape

Conceptual design CLC+



These are “working names” and not fixed.

- Multi-stage process
- Multiple products
- Different production philosophies
- Different resource models
- Industrial and Member State involvement



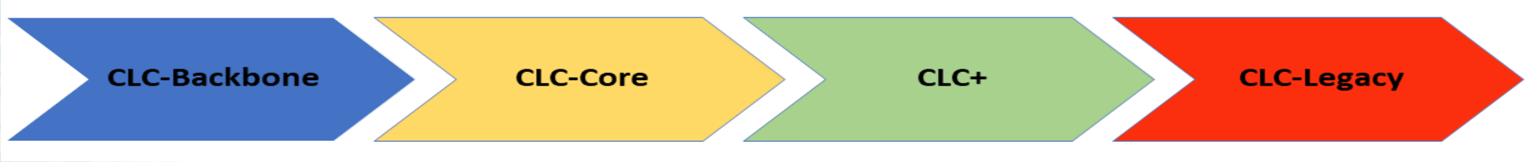
Land Monitoring

Key characteristics for the four elements of 2nd generation CLC

	CLC-Backbone	CLC-Core	CLC+	CLC-Legacy
Description	Detailed wall to wall (EEA-39) geometric vector reference layer with basic thematic content and a raster attribution.	All-in-one data container for environmental land monitoring information according to EAGLE data model.	Thematically and geometrically detailed LULC product.	A more generalised LULC product consistent with the CLC specification.
Role / purpose	Support to CLMS products and services at the pan-European and local levels.	Thematic characterisation of CLMS products and services at the pan-European and local levels.	Support to EU and national reporting and policy requirements.	Maintain the time series (backwards compatibility) and support legacy systems.
Format	Raster and vector.	GRID database.	Raster / grid.	Raster and vector.
Thematic detail	<10 basic land cover classes, few spectral-temporal attributes.	Rich attribution of LC, LU and further characteristics (full EAGLE data model).	High thematic detail including LC and LU with improvements compared to CLC.	CLC-nomenclature with 44 classes + changes between the 44.
Geometric detail (MMU, grid size)	1.0 ha.	1.0 ha, 100 x 100 m grid.	1.0 ha for status and changes.	25 ha for status, 5 ha for changes (raster: 100 x 100 m).
Update cycle	3 - 6 years.	Dynamic update as new information becomes available.	3 - 6 years.	Standard 6 years.
Reference year	2018	2018	2018	2018 / 2024
Production year	2018	2019	TBD	TBD
Method	Geospatial data integration and image segmentation for geometric boundaries and attribution / labelling by pixel-based EO derived land cover	EAGLE-Grid approach: population and attribution of regular GRID	Derived by SQL from CLC-Core	Derived from CLC+ and CLC-Core
Input data	Geospatial data, EO images and ancillary data selected from LoCo (with visual control) and HRL products.	CLC-Backbone, all available HRLs, LoCo, ancillary data, national data provisions (e.g. LU), photointerpretation.	CLC-Core	CLC+ and / or CLC-Core

Involvement of Member States

- Input to and review of the conceptual framework and technical specifications.
- Support to population of thematic information in CLC-Core.
- Change mapping.
- Member State benefits
  - CLC-Backbone aligned to national / local mapping requirements
  - Access to information rich CLC-Core
  - CLC+ contributes to national reporting



National considerations CLC+

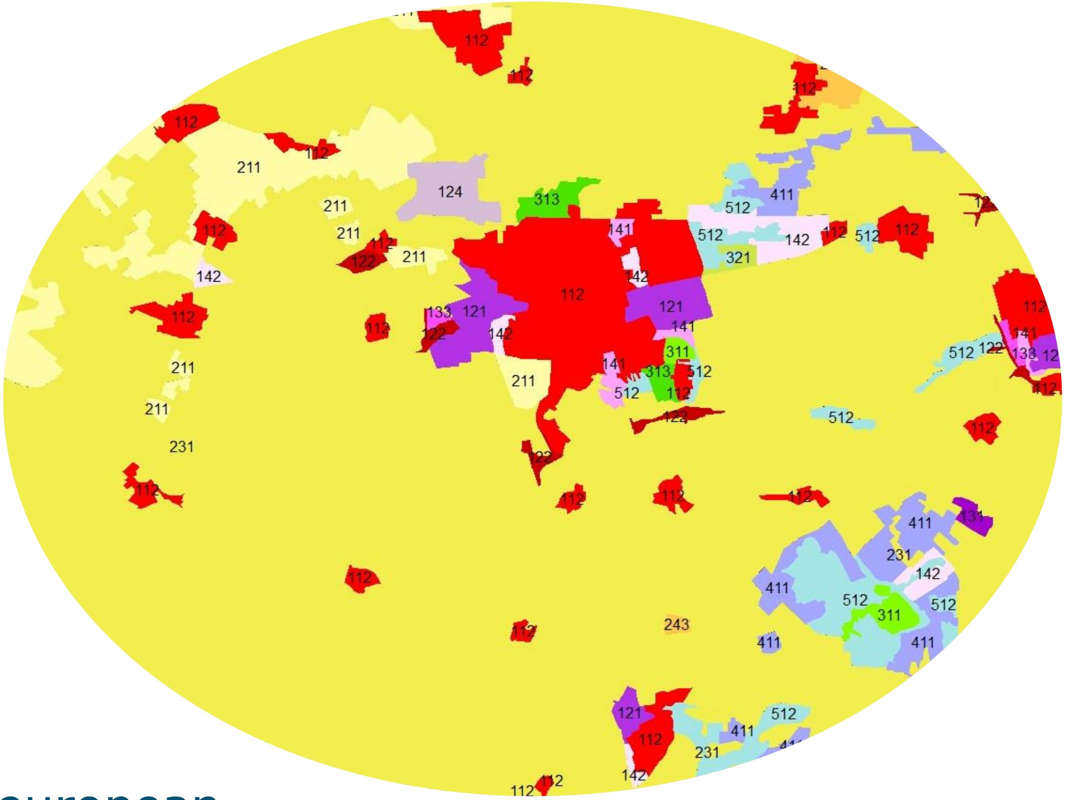
Needs, Plans, Gaps, Expectations

- Derive national LC/LU dataset LGN from CLC+ or derive CLC+ from LGN/national data
- Detailed LC/LU change mapping (type of change) -> monitoring
- Limited number of datasets available regarding EAGLE land cover components
- Increase in temporal frequency and spatial detail
- Complete integration of LPIS data in CLC+
- “algorithms” to derive CLC classes and CLC “traditional” geometry from CLC-core (and/or national data)

Final remarks

- Development land services (products, temporal dimension, spatial detail, time horizon)
- Integration/fine-tuning Dutch and European land activities
    - Support Dutch government to European activities
    - LC/LU data as key dataset – basis registratie
- European and Dutch dissemination
    - Increase awareness of services
    - Insight in use and +/- of services
    - National and/or European products/projections
    - Long term solution needed for (maintenance webservices, metadata etc)

Thanks!



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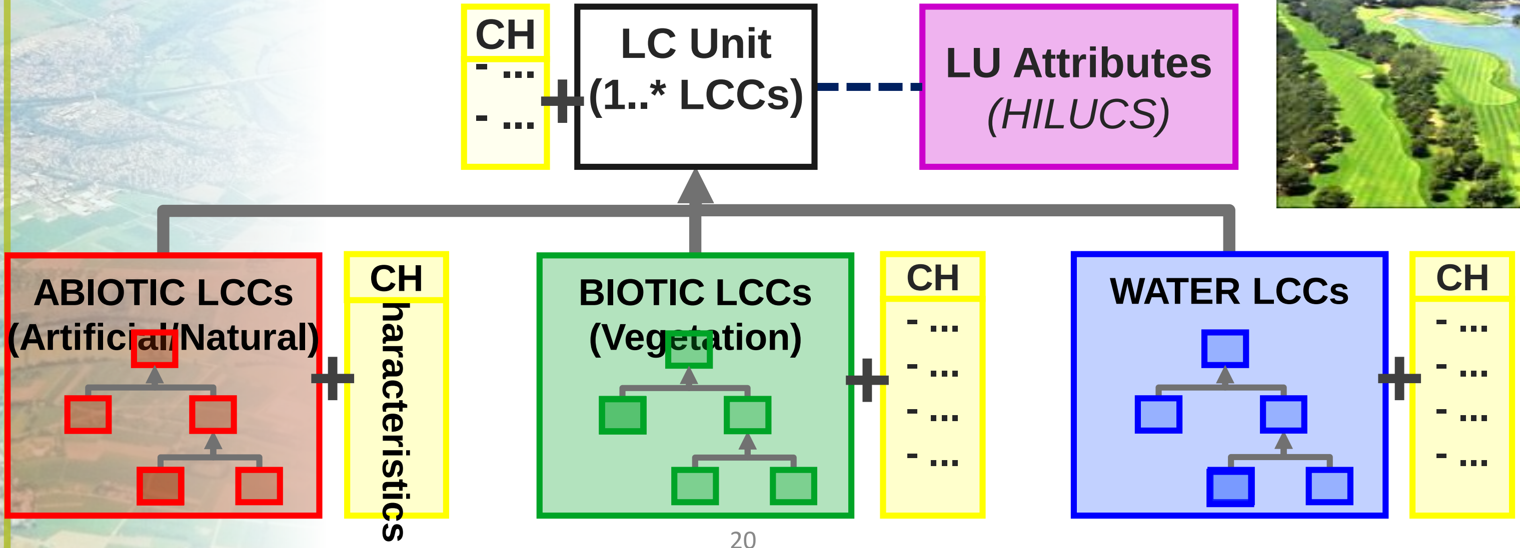
https://land.copernicus.eu/pan-european

Land Monitoring

EAGLE data model



Land Monitoring

Towards CLC+ or second generation CLC

- Driven by DG GROW, EEA & EIONET Member States.
  - Industrial production by service providers
  - Vector product
  - Highly automated
  - Short timeframe
  - Driven by EO (Sentinel-2)
  - Firmly grounded within Copernicus and the Copernicus Land Monitoring Service (local components)

- Land domain represents probably the most diversified area of activity within the Copernicus programme.
- LULC under pins a broad range of uses and applications.
- Stakeholder contributions of requirements and opinions are vital for the success and the long-term development of land monitoring in Europe.

- Multi-stage process, multiple products, industry and MS involved

Issues with CLC

- A number of deficiencies and limitations restrict wider exploitation at the Member State level and below.
  - MMU of CLC (25 ha) is too coarse to capture fine spatial details.
  - Mixed thematic classes with broad definitions difficult to interpret.
  - Not sufficient thematic details or attribution.
  - Many changes smaller 5 ha of the CLC change layer.
  - 6-yearly update too slow for community policy needs.
  - Dynamic landscape features, which are highly relevant to policy, may be missed or underestimated.

Requirements review

Land Monitoring

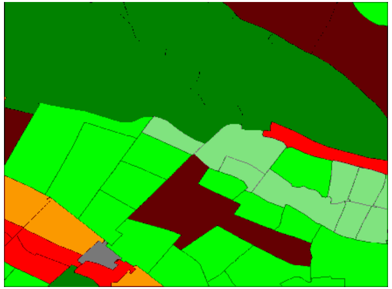
- Review:
  - Key European policy requirements (e.g. Land Use, Land Use Change and Forestry (LULUCF)
  - Additional policy requirements (e.g. EU Biodiversity Strategy to 2020, Mapping and Assessment of Ecosystems and their Services (MAES))
  - EIONET members
- Summary of requirements review
  - MMU 0.5 to 5 ha, 0.5 ha for LULUCF
  - Change layer MMU = status layer MMU
  - Revised thematic content (more classes, increased characterisation)
  - 3 year to yearly update cycle
  - Pan-European coverage (EEA-39)

Land Monitoring

CLC-Backbone (1)

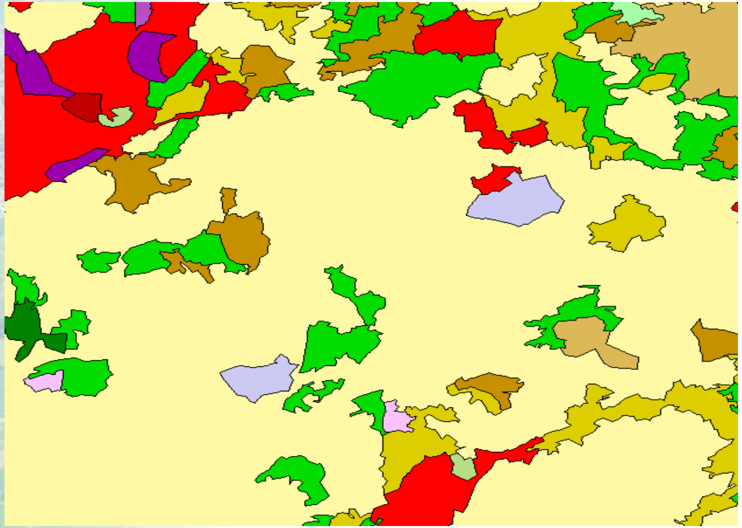
CLC-Backbone | CLC-Core | CLC+ | CLC-Legacy

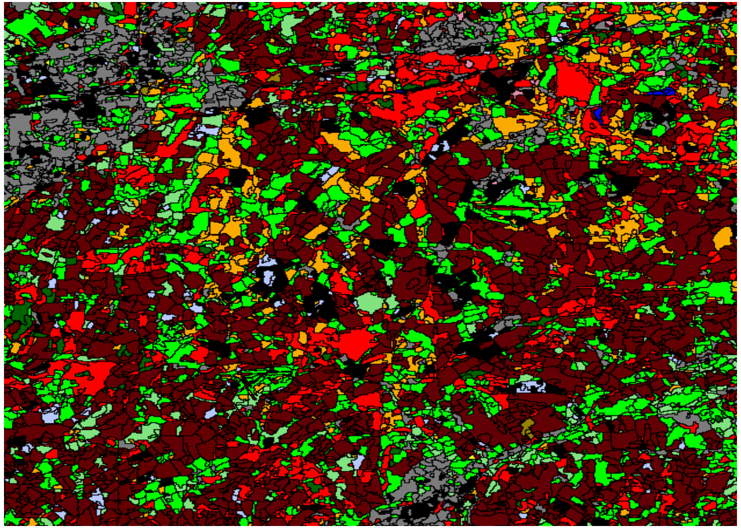
- Outline:
  - Wall-to-wall coverage (EEA-39)
  - Complete the picture started by the LoCo which cover less than one third of EEA-39.
  - Spatially detailed, large scale
  - Vector format
  - Based on digital cartography and EO
  - Limited, but robust thematic detail
  - Geometric backbone/skeleton
  - Basic land cover inventory to support other products



CLC-Backbone (2)

- Example using UK Land Cover Map

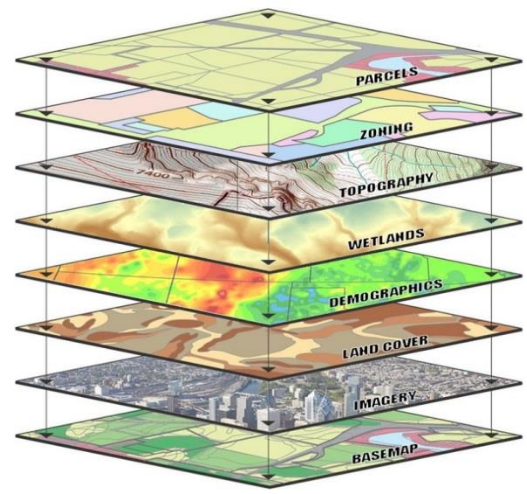




CLC-Core (1)

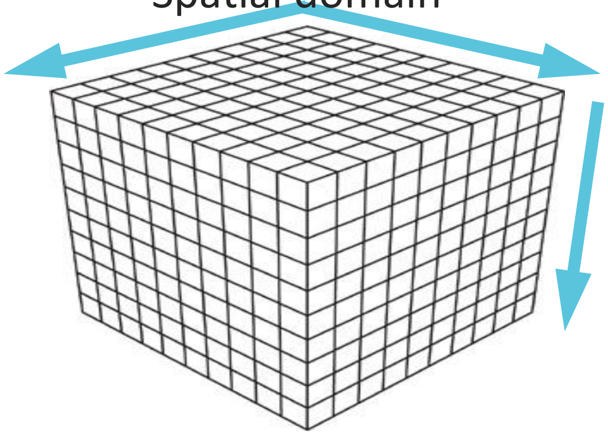
- Outline:
  - Next stage of development after CLC-Backbone
  - A consistent, multi-use repository for environmental information
  - Grid database with EAGLE data model
  - Populated with a broad range of land cover, land use and ancillary data, forming the information
  - CLMS and external sources
  - MS contribution (land use, habitats, etc.)
  - Engine to deliver tailored thematic information.

CLC-Core (2)



Source: CSU,
http://heleneloyan.cikeys.com/update/gis-layers/

Spatial domain



EAGLE
Data
Model

- Outline:
  - End point for this exercise
  - An improved LULC monitoring product
  - Addressing a broad range of requirements
  - Based on CLC-Core, which is built on CLC-Backbone, the local components and HRLs.
  - Improved spatial detail relative to CLC
  - Improved thematic content relative to CLC

CLC-Legacy

- Conventional CLC
- Must be back compatible
- Link into CLC-Core and CLC+
- Potential improvements to attribution